1st European GREEN Conference

1. Europska GREEN konferencija

23-26 MAY 2023

EU MISSIONS
RESTORE OUR OCEAN AND WATERS

BOOK OF ABSTRACTS

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KNJIGA SAŽETAKA

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Plenary Lecture / *Plenarno predavanje*

Building teams for a sustainable food future

Eva FALCH

Norwegian University of Science and Technology NTNU, Department of Biotechnology and Food Science, Trondheim, Norway

Abstract

Our global food system makes a major impact on the environment and is in desperate need to transformation. An effort to improve the food system needs expertise from multiple disciplines, food actors, policymakers, citizens, and involvement of the young generations such as students to succeed with this ambition. The food system is responsible for 26% of the world's greenhouse gas emissions and since more than 1/3 of all food is wasted 6-10% of the greenhouse gas emissions come from food that is never eaten. Moreover, other major challenges are linked to the global food system, the use of scares food resources, the effect on biodiversity loss, unhealthy diets, and the lack of available food for vulnerable groups. Therefore, joining forces to improve today's food system in necessary. This presentation will include a selection of examples of recent teams that are built to mobilize for sustainable food with a basis from academia. I will present aims, activities, co-creation, methodologies and how these teams' function. Furthermore, the presentation will include aspects around the Code of Conduct instrument from the EUs Farm to Fork Strategy that the university uses as a strategic working plan to ensure working towards a sustainable food future.

Keywords: global food system, sustainable food, EUs Farm to Fork Strategy

Plenary Lecture / *Plenarno predavanje*

Contemporary normals in architecture and liveability

Gabriella MEDVEGY[1], Bálint BACHMANN[2]

[1] University of Pécs, Faculty of Engineering and Information Technology, Boszorkány Street 2, Pécs, Hungary
[2] Budapest Metropolitan University, Nagy Lajos király útja 1-9, Budapest, Hungary

Abstract
Architecture evolves continuously and causes changes around the classical duties of the architect inside. We love to feel how well-detailed and layered this profession is, with the well-known related fields next to architecture, such as 'construction,' 'design', 'urban planner,' 'interior designer,' or 'product designer, etc.' On the other hand, the time of the so-called 'tech- professions' has come. According to the 'Industry 4.0 Strategy', these new professions are smart mobility, smart buildings, smart homes, social web, business web, smart logistics, or smart grid. There is a guess, that these new platforms will be crossed with the classical tools – for sure, they might be merged already. Time makes sure that architecture can't get away without any impact too. And what about the future? It says, 'living,' 'health,' 'food,' and 'mobility' are keywords. All the people will definitely need a place always to live. Human health has context with architecture also since we spend our life inbuilt physical spaces in 75-80 percent of. It matters how these places are. Food? It means not only agriculture but a place for eating and creating. The wish to change locations means mobility in cities. For sure, architecture, urban places, or their design methodologies need to be sensitive to daily phenomena. According to some flagship research at the University of Pécs, Faculty of Engineering and IT (Hungary): urban revitalization and less carbon footprint, the built heritage and intelligent equipment, well-being, and health efficiency are compatible. All these pairs have a common objective: to look for physical spaces for living in a livable environment – with the promise of the future. Some direct contemporary consequences are visible on the horizon, such as the claim to be green, sustainable, or energetically independent – with the support of digitalism, high-tech tools, or alternative design methodologies. And still being human.
Keywords: green architecture, Industry 4.0 Strategy, sustainability

Plenary Lecture / *Plenarno predavanje*

Improving drinking water safety: Addressing new impacts and identifying important toxicity drivers

Susan D. RICHARDSON

University of South Carolina, Department of Chemistry and Biochemistry, Columbia, South Carolina, United States of America

Abstract

While consumers are concerned about pharmaceuticals and per- and polyfluorinated alkyl substances (PFASs) in their drinking water, the largest threat is from disinfection by-products (DBPs), which are an unintended consequence of using chemical disinfectants to make water microbially safe to drink. DBPs are formed by the reaction of disinfectants with naturally occurring organic matter, bromide, and iodide, as well as from anthropogenic pollutants, such as pharmaceuticals. DBPs are present at levels that are orders of magnitude higher than other emerging contaminants, and many have been found to be carcinogenic, genotoxic, mutagenic, cytotoxic, or developmentally toxic. DBPs have also been associated with cancer, miscarriage, and birth defects in human epidemiologic studies. However, until recently, most research focused only on the 11 DBPs regulated by the U.S. EPA, and the complex chemical mixture of DBPs in drinking water was largely unknown. This presentation will cover the state-of-the-science overview of emerging DBPs, including a recent study to identify DBP toxicity drivers in drinking water, a study to assess the impacts of algae on DBP formation, and water reuse. The ultimate goal is to uncover these risks so that new strategies can be applied to improve the safety of drinking water.

Keywords: drinking water, disinfection by-products, toxicity, human health

Plenary Lecture / *Plenarno predavanje*

Importance of education in transition from linear to circular (bio)economy

Marina TIŠMA

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia

Abstract
The linear economy, based on fossil resources and the "take-make-waste" concept, needs to be replaced by the bioeconomy, based on biomass (especially residual biomass) as the main raw material and focused on circularity and sustainability. However, the transition from a linear to a circular (bio)economy brings many challenges and requirements, from changing public awareness to well-trained human resources throughout the value chain. As noted by the BioEast Initiative, the lack of education and skills in the bioeconomy is the main risk for the failure of the European Green Deal objectives and related EU strategies. Therefore, bioeconomy education is urgently needed at all levels of education and in addition to the education of policymakers and entrepreneurs. What the bioeconomy is, what the main drivers for bioeconomy are, how bioeconomy education should be designed, what are the current practices of bioeconomy education and training in the EU and what steps in education are needed to accelerate the transition from a linear to a circular bioeconomy will be discussed.
Keywords: bioremediation, hydrocarbon-degrading bacteria, soil; bioaugmentation

Invited Lectures
Pozvana predavanja

Invited Lecture / *Pozvana predavanje*

Environmental Degradation Induced by Climate Change as a Driver of Human Migration – Linkages and Policy Implications

Michael ALDERSON

Independent Consultant in Education and Development, Alcala la Real, Jaén, Spain

Abstract
Negative impacts on the environment are increasingly a consequence of climate change. Climatic events such as recurrent droughts and floods can cause significant disturbance to human livelihoods, particularly those linked to the environment. These disturbances can have adverse implications for poor and fragile communities that depend heavily on domestic agriculture. Water shortages and floods can lead to the degradation of soils, both of which have the potential to undermine agricultural productivity. When erratic rainfall is persistent, the resilience of farm households may be reduced where traditional coping strategies become less effective. For example, dependence on common property resources (CPRs e.g., tree products, wild vegetables and insects) may increase to supplement diets. More detrimental environmental impacts may occur when households under stress seek to augment incomes through the unsustainable gathering of local CPRs for sale. Collectively, these factors can drive complex and inter-connected processes of environmental degradation and, ultimately trigger the movement of people in search of alternative livelihoods. In recent years, Europe has become a key destination, particularly from Africa. This paper presents the main trends in this migration. With reference to a Case Study from a semi-arid area of Africa, the adaptation of household strategies under drought is examined. It concludes with a review of possible policy responses to support communities in adapting to the local effects of climate change, reducing environmental degradation and stabilizing the movement of people.
Keywords: climate change, environmental degradation, household resilience, migration

Invited Lecture / *Pozvana predavanje*

Higher Education System in the Republic of Croatia and Environmental Awareness – Current State and Perspectives

Boris BAKOTA[1], **Jelena DUJMOVIĆ BOCKA**[1], **Danijela ROMIĆ**[2]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Law Osijek, Stjepana Radića 13, Osijek, Croatia
[2] College of Applied Sciences „Lavoslav Ružička“ in Vukovar, Županijska 50, Vukovar, Croatia

Abstract
European Green Deal motivated authors to analyze how much are ecologically aimed subjects represented at higher education institutions, namely those having legal and public administration study programs (Law Faculties in Osijek, Rijeka, Split and Polytechnics in Gospić, Šibenik, and Vukovar). The main hypothesis: ecologically aimed subjects are insufficiently represented in legal and public administration study programs in the Republic of Croatia. Descriptive statistics will be used to obtain the results. The contribution to administrative science is in: the representation analysis of ecologically aimed subjects in selected higher education institutions, the conduct of empirical research, and obtaining results that aim to show the importance of ecologically aimed subjects at legal and public administration study programs, relevant actors' awareness raising in higher education of significance and importance of ecologically aimed subject's incorporation into higher education system.
Keywords: ecology, higher education system, higher education institutions, subject, ecological awareness

Invited Lecture / *Pozvana predavanje*

Visokoobrazovni sustav u Republici Hrvatskoj i ekološka svijest - stanje i perspektive razvoja

Boris BAKOTA[1], **Jelena DUJMOVIĆ BOCKA**[1], **Danijela ROMIĆ**[2]

[1] Sveučilište Josipa Jurja Strossmayera u Osijeku, Pravni fakultet Osijek, Stjepana Radića 13, Osijek, Hrvatska
[2] Veleučilište "Lavoslav Ružička" u Vukovaru, Županijska 50, Vukovar, Hrvatska

Sažetak

Europski zeleni plan potaknuo je autore članka baviti se analizom zastupljenosti kolegija ekološkog usmjerenja na visokoobrazovnim institucijama koji izvode studijske programe pravnog i upravnog usmjerenja (pravnim fakultetima u Osijeku, Rijeci, Splitu, Zagrebu te veleučilištima u Gospiću, Šibeniku, Vukovaru). Temeljna hipoteza postavljena u radu glasi: kolegiji ekološkog usmjerenja u nedovoljnoj su mjeri zastupljeni u okviru studijskih programa pravnog i upravnog usmjerenja u Republici Hrvatskoj. Za dobivanje rezultata istraživanja korištena je deskriptivna statistika. Doprinos upravnoj znanosti ogleda se u analizi zastupljenosti kolegija ekološkog usmjerenja na odabranim visokoobrazovnim institucijama, provedbi empirijskog istraživanja te dobivanju rezultata koji za cilj imaju ukazati na važnost zastupljenosti ekoloških kolegija u okviru pravnih i upravnih studijskih programa, osvještavanje relevantnih aktera na području visokog obrazovanja u značaj i važnost implementacije kolegija ekološkog usmjerenja u visokoobrazovni sustav.

Ključne riječi: ekologija, visokoobrazovni sustav, visoka učilišta, kolegiji, ekološka svijest

Invited Lecture / *Pozvana predavanje*

Environment & water worldwide – Interaction & connection

Bojan ĐURIN

University North, Department of Civil Engineering, Jurja Križanića 31b, Varaždin, Croatia

Abstract
Two sides are divided by the world - into the environment and money. Environment... soil, air, and water. Money - a simple story. And all together is complex. If we look at water and the environment on the one hand and earnings on the other, there is no love. It is at first sight, but I will show it is not. Science and profession go hand in hand for environmental protection, but also with money. There are many examples on my part, as well as collaborations with dear colleagues and friends from all over the world, excellent scientists, engineers, and experts of different profiles. Mainstream such as combining hydrology and geodesy to predict floods and environmental impact, tax collection, determination of groundwater supplies, then analyzing the water regime of small rivers that are not interesting to anyone, except when the damage or when they want to be used for small hydroelectric power plants… Also, abandoned mines are used to produce electricity on the principle of reversible hydroelectric power plants. Storage of compressed air at high depths in the sea and oceans. Again, the environment and water. Climate change, influence on droughts, determination of the risk of fire and floods ... and again international collaboration, from Japan, Vietnam, India, Saudi Arabia ... through Finland, Italy, Poland, Germany, Austria ... to Brazil (and Croatia).
Keywords: water, environment, collaboration, interdisciplinarity, climate changes

Invited Lecture / *Pozvana predavanje*

Okoliš i vode širom svijeta – interakcija i povezanost

Bojan ĐURIN

Sveučilište Sjever, Odjel za graditeljstvo, Jurja Križanića 31b, Varaždin, Croatia

Sažetak

Na dvije strane dijeli se svijet – na okoliš i na novac. Okoliš… Tlo, zrak i voda. Novac – jednostavna priča. A sve zajedno je složeno. Ako gledamo vodu i okoliš s jedne strane te zaradu s druge strane, nema tu ljubavi. Na prvu je tako, no pokazati ću da ipak i nije. Znanost i struka idu ruku pod ruku i za zaštitom okoliša, ali i sa novcem. Puno je primjera sa moje strane, kao i suradnje sa dragim kolegama i prijateljima iz cijelog svijeta, vrsnim znanstvenicima, inženjerima i stručnjacima različitih profila. Od mainstreama poput kombiniranja hidrologije i geodezije u svrhu predviđanja poplava i utjecaja na okoliš, prikupljanja poreza, određivanja zaliha podzemne vode, zatim analiziranja vodnog režima malih rijeka koje nikome nisu zanimljive, osim kad nastane šteta ili kad ih se želi koristiti za male hidroelektrane… Tu je i korištenje napuštenih rudnika za proizvodnju električne energije na principu reverzibilnih hidroelektrana. Uskladištenje komprimiranog zraka na velikim dubinama u moru i oceanima. Opet okoliš i vode. Klimatske promjene, utjecaj na suše, određivanje rizika od požara i poplava… I opet međunarodna suradnja, od Japana, Vijetnama, Indije, Saudijske Arabije… preko Finske, Italije, Poljske, Njemačke, Austrije… pa sve do Brazila (i Hrvatske).

Ključne riječi: voda, okoliš, suradnja, interdisciplinarnost, klimatske promjene

Invited Lecture / *Pozvana predavanje*

The necessity of smart and inclusive governance in achieving organic and sustainable agro food systems, through the use of technology

Dražen LUŠIĆ[1,2,3]

[1] IFOAM AgriBioMediterraneo, Greece, 73 Aiolou Street, Athens, Greece;
[2] University of Rijeka, Faculty of Medicine, Braće Branchetta 20, Rijeka, Croatia
[3] University of Rijeka, Faculty of Health Studies, Viktora Cara Emina 5, Rijeka, Croatia

Abstract
IFOAM Agribiomediterraneo (IFOAM-ABM) is part of a consortium that currently implements the FARMS4CLIMATE project titled "Smart Governance and Operational Models for Agroecological Carbon Farming". As a part of the PRIMA-MED Programme and supported by the EU, it looks to find out if the provision of Farming Community Based Organizations (CBOs) with higher purposes, such as the urgent need to tackle climate issues (while defending farmers' income), will facilitate stakeholders' alignment and operational activation to achieve the Green and Just Transition required for a Climate Neutral Mediterranean? The main ambition of FARMS4CLIMATE is to make carbon farming operational for smallholders, facilitated by the development of a number of digital breakthroughs technological enablers. However, technologies alone are not sufficient for the effective transformation of agrosystems. Therefore, FARMS4CLIMATE is developing a strategy for transformation that includes four elements: "change element", "change agent", a bottom-up approach, and a multi-actor approach to align visions and interests of diverse interested parties (farmers, farming organizations, research centers, developer and digital data analysts, civil society organizations, international public institutions). This paper presents the key elements of the project with particular attention to IFOAM-ABM's designing the structure for 6 Living Labs. Strategically located in different Mediterranean countries (Italy, Egypt, Tunisia, Spain), each is focused on a specific regenerative practice, aiming at creating 6 Farming CBOs that can drive economic prosperity by flagshipping virtuous carbon management embedded into organic agriculture principles.
Keywords: Carbon Farming, Climate Neutral Mediterranean, Living Labs, IFOAM-ABM

Invited Lecture / *Pozvana predavanje*

Glacial terminus and take inventory using Earth observation data - A case study of Bhutan Himalaya

Bhartendu SAJAN[1], Shruti KANGA[2]*, Suraj Kumar SINGH[3], Praveen Kumar RAI[4], Anisha SINGH[4], Ankita SENGAR[4], Bojan ĐURIN[5], Vlado CETL[6]

[1] Centre for Climate Change and Water Research, Suresh Gyan Vihar University, Jaipur, Rajasthan, India
[2] Department of Geography, School of Environment and Earth Sciences, Central University of Punjab, VPO-Ghudda, Bathinda, Punjab, India
[3] Centre for Sustainable Development, Suresh Gyan Vihar University, Jaipur, Rajasthan, India,
[4] Department of Geography, K.M.C. Language University, Lucknow, Uttar Pradesh, India,
[5] Department of Civil Engineering, University North, Varaždin, Croatia
[6] Department of Geodesy and Geomatics, University North, Varaždin, Croatia

Abstract

The mapping and monitoring of different types of Glacial lakes through Geospatial techniques are vital to show the impact of climate change on the Glaciers. It also serves to alleviate hazards resulting from out bursting of Glacial lakes and catastrophic consequences to human lives. The main goal of the work presented in this paper was to map different types of glacial lakes in Bhutan during the years 1990, 2000, and 2017. During this research, Landsat-TM of 1990, Landsat ETM+ of 2000, and Landsat 8-OLI satellite images of 2017 were used to estimate the changes in the glacial lakes and inventory study. Several glacial lakes i.e., moraine-dammed lake, supra glacial lake, lateral moraine lake, erosional lake, medial moraine lake, and end moraine lake, were mapped within this period. We found a rapid increase in the number of glacial lakes from 1990 to 2017. The number of glacial lakes in 1990 increased from 213 to 436 in 2017. We also observed that the spatial dimensions of some of the glacial lakes were also increased. The study revealed 5 end moraine lakes, 40 lateral moraine lakes, 50 supra-glacial lakes, 239 erosional lakes, and 15 other moraine-dammed lakes in 2017.

Keywords: mapping, monitoring, Earth observation, glacial lakes

Climate change
Klimatske promjene

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Achieving the Green Deal locally: Developing context-induced innovation routines as a process tool for Nature-Based Solutions - Case study Sesvete, Zagreb

Immanuel DARKWA[1], Vesna KOŠČAK MIOČIĆ-STOŠIĆ[2], Damaris FERNANDEZ[3], Ines HRDALO[2], Vesna ŽIDOVEC[2]*

[1] University of Dublin, Trinity College, School of Natural Sciences, Department of Geography, Dublin, Ireland
[2] University of Zagreb, Faculty of Agriculture, Department of Ornamental Plants and Landscape Architecture, Zagreb, Croatia
[3] University of Dublin, Trinity College, School of Chemistry, Dublin, Ireland

Abstract
Climate change and environmental degradation are existential threats requiring urgent transnational action. The European Green Deal, as ambitious as it is, puts an emphasis on innovatively tackling these threats regionally. However, there is no reference blueprint for how potential solutions, particularly nature-based ones, may be developed and implemented through living lab models within distinctive urban settings like Zagreb. To address this gap, this paper proposes a workshop tool for sustainable Nature-Based-Thinking and Nature–Centered-Design based on a methodology developed through literature synthesis, expert interviews, focus group discussions, surveys and synthesized through rigorous research analysis and participatory observation. The collaborative Nature Based Solutions tool was transferred into workshop processes and tested with through-the-process identified stakeholders: academic staff, students, private sector, government, non-governmental institutions, expert association representatives, community members, landscape architects and city planners. The resulting framework proposes a Nature-Based-Centered-Thinking and Design process tool involving 'green' routines in empathy, outreach, collaboration, ideation, conception, and solution - supported by a focal unit and a collaborative network.
Keywords: climate change, European Green Deal, Nature Centered Design, Nature Based Solutions, Innovation Labs

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Fusarium mycotoxins detected in hops

Ivana DODLEK ŠARKANJ[1], Michael SULYOK[2], Rudolf KRSKA[2,3], Božidar SMOLJAN[1], Krunoslav HAJDEK[1], Bojan ŠARKANJ[1]

[1] University North, Trg dr. Žarka Dolinara 1, Koprivnica, Croatia
[2] University of Natural Resources and Life Sciences Vienna (BOKU), Institute of Bioanalytics and Agro-Metabolomics, Department of Agrobiotechnology, IFA-Tulln, Konrad-Lorenz-Str. 20, Tulln, Austria
[3] Queen's University Belfast, Institute for Global Food Security, School of Biological Sciences, University Road, Belfast, Northern Ireland, United Kingdom

Abstract
Hops are one of the main bittering, flavoring, and stability agents in the beer brewing industry. Although used in small quantities in beer brewing, the occurrence of mycotoxins was not carefully monitored, nor requested by worldwide legislation. There is a report of *Fusarium* spp. contamination of hops, and also no reports of the occurring Fusarium mycotoxins. In this paper, we present the first report on the Fusarium mycotoxins in Hops. In total 60 samples from Croatian craft breweries were collected, and analyzed by Dilute and shoot LC-MS/MS multimycotoxin method. The results show the high occurrence of Fumonisins, T-2 & HT-2 toxins as representatives of regulated mycotoxins and Enniatins, Beaouvericine, Culmorine and its hydroxylated derivatives as emerging mycotoxins. In order to understand the mechanics of the occurrence of mycotoxins in hops, further research on the fungal contamination and the effect of weather/climate conditions needs to be conducted. Further, the occurrence of all mycotoxins with proper risk assessment is necessary to evaluate hops as one of the possible mycotoxins sources in our diet and to ensure food safety in the beer brewing industry.
Keywords: hops; mycotoxins; climate change, fungi, LC-MS/MS

Climate change / Klimatske promjene
Poster presentation / *Postersko priopćenje*

Changes in the ichthyofauna of the Mediterranean/Adriatic Sea: are there reasons for concern?

Jakov DULČIĆ

Institute of Oceanography and Fisheries, Šetalište Ivana Meštrovića 63, Split, Croatia

Abstract
The marine biodiversity of the Mediterranean Sea today is faced with significant structural changes in flora and fauna. Similar changes were recorded in the Adriatic Sea. During the last few decades, various factors such as climate change, anthropogenic activities and Lessepsian migrations have changed the composition of the Mediterranean/Adriatic ichthyofauna. Extensive research carried out in the last decades allowed us to recognize species that were not previously recorded or reported from this area. So far, 188 exotic fish species have been recorded in the Mediterranean Sea, a large number of which are Lessespsis migrants of Indo-Pacific origin. Of the 15 Lessepsian fish species recorded in the Adriatic, *Lagocephalus sceleratus, Fistularia commersonii* and *Siganus luridus* were the only species recorded more than once and with geographically scattered records suggesting a successful biological invasion. The firefly Pterois miles shown a rapid geographical expansion in the Mediterranean Sea since 2012, mainly in the eastern part of the Mediterranean. Recent records of finds in the Ionian and Adriatic seas point to the fact that this should be a warning sign and there is an urgent need to undertake and promote control measures. The influence of successful colonizers on the original communities in the Adriatic Sea is not yet fully known, but in the eastern part of the Mediterranean, it is very large. However, the speed of biological invasions suggests that the potential negative effects may become very relevant in the near future.
Keywords: Ichthyofauna, Mediterranean Sea, Adriatic Sea, changes, non-indigenous species

Climate change / Klimatske promjene
Poster presentation / *Postersko priopćenje*

Promjene u ihtiofauni Sredozemnoga/Jadranskoga mora: postoje li razlozi za zabrinutost?

Jakov DULČIĆ

Institut za oceanografiju i ribarstvo, Šetalište Ivana Meštrovića 63, Split, Hrvatska

Sažetak

Morska bioraznolikost Sredozemnog mora danas je suočena sa značajnim strukturnim promjenama flore i faune. Slične promjene zabilježene su i u Jadranskom moru. Tijekom posljednjih nekoliko desetljeća različiti čimbenici kao što su klimatske promjene, antropogene aktivnosti i lesepsijske migracije promijenili su sastav Sredozemne/Jadranske ihtiofaune. Opsežna istraživanja provedena u posljednjim desetljećima omogućila su nam da prepoznamo vrste koje prethodno nisu zabilježene ili prijavljene s ovog područja. U Sredozemnom moru je dosada zabilježno 188 egzotičnih vrsta riba od kojih su veliki broj lesespsijski migranti indo-pacifičkog podrijetla. Od 15 zabilježenih lesepsijskih vrsta riba u Jadranu, *Lagocephalus sceleratus, Fistularia commersonii* i *Siganus luridus* bile su jedine vrste zabilježena više puta i s geografski raštrkanim zapisima sugerirajući uspješnu biološku invaziju. Vatrenjača Pterois miles pokazuje brzo geografsko širenje u Sredozemnom moru od 2012.godine i to uglavnom u istočnom dijelu Sredozemlja. Nedavni zapisi o nalazima u Jonskom i Jadranskom moru ukazuju na činjenicu da bi to trebao biti znak upozorenja te postoji hitna potreba za poduzimanjem i promicanjem mjera kontrole. Utjecaj uspješnih kolonizatora na izvorne zajednice u Jadranskom moru još nije u potpunosti poznat no u istočnom dijelu Sredozemlja je vrlo velik. Međutim, brzina bioloških invazija sugerira da bi potencijalni negativni učinci mogli postati vrlo relevantni u bliskoj budućnosti.

Ključne riječi: Ihtiofauna, Mediteransko more, Jadransko more, promjene, alohtone vrste

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Contribution of Green Infrastructure to Improving Living Conditions in Urban Areas

Nirvana FRANKOVIĆ MIHELJ, Aleksandra ČILIĆ, Ivana JONKE

Environmental Protection and Energy Efficiency Fund, Radnička cesta 80, Zagreb, Croatia

Abstract
As a Member of the European Union, Croatia is committed to the climate-related ambition stated in the European Green Deal, the aim of which is to fulfill the obligation arising from the Paris Agreement. The Green Infrastructure document calls for full integration of green infrastructure concepts in sectoral policies, EU financial instruments and spatial planning, and it is an important factor in the climate change adaptation strategy. Strategic development of the green infrastructures in the Republic of Croatia, as an important element that can have a favorable impact on human health and life, is gaining momentum rapidly, and in the upcoming period, it will significantly contribute to the sustainable development and achieving social, environmental, and economic benefits. The Environmental Protection and Energy Efficiency Fund financially supports projects for implementing the Green Infrastructure concepts with the aim of increasing the resilience of local and regional communities and reducing the vulnerability of natural systems to the adverse impacts of climate change, which will consequently contribute to the development of a green and climate-neutral Croatia. This paper considers the mechanisms of funding green infrastructure projects and presents the best practice examples.
Keywords: green infrastructure; European Green Deal; climate change adaptation.

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Doprinos zelene infrastrukture poboljšanju uvjeta života u urbanim sredinama

Nirvana FRANKOVIĆ MIHELJ, Aleksandra ČILIĆ, Ivana JONKE

Fond za zaštitu okoliša i energetsku učinkovitost, Radnička cesta 80, Zagreb, Hrvatska

Sažetak
Hrvatska kao dio Europske unije dijeli klimatsku ambiciju iskazanu u Europskom zelenom planu kojim se želi ispuniti obveza koja proizlazi iz Pariškog sporazuma. Dokument Zelena infrastruktura zagovara potpunu integraciju zelene infrastrukture u sektorske politike, financijske instrumente EU te u prostorno planiranje, a važan je čimbenik strategije prilagodbe klimatskim promjenama. Strateški razvoj zelenih infrastruktura u Republici Hrvatskoj, kao bitan čimbenik pozitivnog utjecaja na zdravlje i život građana, ubrzano jača te će tek u predstojećem razdoblju značajnije doprinijeti održivom razvoju te postići društvene, okolišne i gospodarske koristi. Fond za zaštitu okoliša i energetsku učinkovitost financijski podržava projekte primjene koncepta zelene infrastrukture sa ciljem povećanja otpornosti lokalne i regionalne zajednice, smanjenja ranjivosti prirodnih sustava na negativne utjecaje klimatskih promjena što će posljedično pridonijeti izgradnji zelene i klimatski neutralne Hrvatske. U radu se razmatra mehanizam financiranja zelene infrastrukture te predstavljaju primjeri dobre prakse.
Ključne riječi: zelena infrastruktura, Europski zeleni plan, prilagodba klimatskim promjenama.

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

The contribution of the LULUCF sector to climate neutrality

Nirvana FRANKOVIĆ MIHELJ[1], Vladimir Jelavić[2], Delfa RADOŠ[2], Stjepan HIMA[2], Vlatka PALČIĆ[3]

[1] Environmental Protection and Energy Efficiency Fund, Radnička cesta 80, Zagreb, Croatia
[2] Ekonerg – Institute for Energy and Environment, Koranska ulica 5, Zagreb, Croatia
[3] Ministry of Economy and Sustainable Development, Radnička cesta 80, Zagreb, Croatia

Abstract
As a European Union (EU) Member State, Croatia is committed to the climate goals of the European Commission laid out in the European Green Deal and the European Climate Law aimed at reaching net zero greenhouse gas emissions (GHG) in the EU by 2050 and reducing GHG by at least 55% by 2030 compared to the baseline (1990) levels. By defining the goals, adopting the relevant amendments to the legislative framework, establishing the mechanism to control compliance with GHG reduction obligations, and monitoring the progress in achieving the goals for renewable energy sources and energy efficiency, the EU wants to become the first climate-neutral continent in the world. To achieve climate neutrality by 2050, (balance between the anthropogenic GHG emissions and removed CO_2), decarbonization measures will have to be implemented throughout all sectors, including for the first time the sector of Land use, land-use change, and forestry (LULUCF). The Ministry of Economy and Sustainable Development and the Environmental Protection and Energy Efficiency Fund initiated various projects aimed at exploring the options for reducing emissions and maintaining/increasing sinks in the LULUCF sector, and defining the measures for individual land categories securing the LULUCF sector in Croatia to contribute to climate neutrality.
Keywords*:* LULUCF sector, European Green Deal, climate neutrality

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Doprinos sektora LULUCF klimatskoj neutralnosti

Nirvana FRANKOVIĆ MIHELJ[1*], Vladimir JELAVIĆ[2], Delfa RADOŠ[3], Stjepan HIMA[4], Vlatka PALČIĆ[5]

[1] Fond za zaštitu okoliša i energetsku učinkovitost, Radnička cesta 80, Zagreb, Hrvatska
[2] Ekonerg-Institut za energetiku i zaštitu okoliša d.o.o., Koranska ulica 5, Zagreb, Hrvatska
[5] Ministarstvo gospodarstva i održivog razvoja, Radnička cesta 80, Zagreb, Hrvatska

Sažetak
Republika Hrvatska kao dio Europske unije (EU) dijeli klimatsku ambiciju Europske komisije iskazanu u Europskom zelenom planu i EU Zakonu o klimi kojima se želi osigurati razvoj EU-a do 2050. s neto-nula emisija stakleničkih plinova, a do 2030. smanjenje emisija stakleničkih plinova na 55 % u odnosu na emisije iz bazne (1990.) godine. Kroz definirane ciljeve, odgovarajuće nadopune i izmijene zakonodavnog okvira, te uspostavom mehanizma kontrole ispunjavanja obaveza o smanjenju emisija stakleničkih plinova, kao i praćenja napretka prema ciljevima u području obnovljivih izvora energije i energetske učinkovitosti, EU želi postati prvi klimatsko neutralni kontinent na svijetu. Kako bi se do 2050. postigla klimatska neutralnost (označava balans između antropogenih emisija i uklonjenog CO_2) bit će potrebno provesti mjere dekarbonizacije u svim sektorima, uključujući po prvi puta i sektor Korištenja zemljišta, prenamjene zemljišta i šumarstva (*eng.* LULUCF). Ministarstvo gospodarstva i održivog razvoja i Fond za zaštitu okoliša i energetsku učinkovitost pokrenuli su različite projekte u svrhu istraživanja mogućnosti za smanjenje emisija i zadržavanje/povećanje uklanjanja CO_2 u sektoru LULUCF-a, kako bi se pravilno definirale mjere koje će se provoditi na pojedinoj kategoriji zemljišta i time osiguralo da sektor LULUCF u Republici Hrvatskoj doprinese klimatskoj neutralnosti.
Ključne riječi*:* sektor LULUCF, Europski zeleni plan, klimatska neutralnost

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Integration of Climate Change Issues into a New Generation of City-level Strategies – Experiences from the City of Ljubljana

Matjaž HARMEL, Sabina CEPUŠ, Klemen STRMŠNIK

ZaVita d.o.o., Tominškova 40, Ljubljana, Slovenia

Abstract
Integration of climate change issues into city-level strategies is proving to be quite challenging, as it requires city authorities to almost simultaneously re-think the majority of local policies and practices. As this is almost impossible, each city authority is put in front of a choice – to develop one overarching strategy or to slowly, but continuously, update all relevant strategies. This article aims to present experiences in these fields gained during the last 10 years of strategy development in the City of Ljubljana and their attempts to use all available mechanisms for the integration of climate change issues into city-level strategies, as well as their actual implementation. From spatial planning policy solutions to substantial changes in city mobility, from improved management of urban and peri-urban forests to introduction of urban farming, from awareness raising to actual involvement of citizens in climate change adaptation measures. Many things have already been done and many lessons can be shared. Yet, we find ourselves with many more unresolved issues, especially when we try to implement EU policies on the local level. This is why this article also addresses upcoming challenges and possible directions for their resolution on the local level, taking into account new EU instruments, including climate proofing and compliance with the "do no significant harm" principle.
Keywords: climate change, mitigation, adaptation, city-level strategy, case example

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

The Traces We leave

Leyla İYILIKÇI[1], Ahmet Ersin YENER[2], Yusuf EROĞLU[2], Burak BAYTAŞ[2], Mehmet Batuhan AKPINAR[2], Elif Öykü ÖZKAN[2], Ferhat Akalan CEREN CAN[2], Abdullah KIZILÇINAR[2], Volkan KARHAN[2], Oğuzhan GÜMÜŞ[2], Ayşegül PALA[3,4]

[1] Dokuz Eylul University, School of Medicine, Department of Anesthesiology, İnciraltı Mh.Mithatpaşa Cd. No: 58/1, İzmir, Turkey
[2] Dokuz Eylul University, School of Medicine (student), Department of Anesthesiology İzmir, , İnciraltı Mh.Mithatpaşa Cd. No: 58/1, Turkey
[3] Dokuz Eylul University, Environment Research and Development Center (CEVMER), Tinaztepe Campus, İzmir, Turkey
[4] Dokuz Eylul University, Faculty of Engineering, Environmental Engineering Department, Tinaztepe Campus, İzmir, Turkey

Abstract
Our project called “The Traces We Leave”, it was planned to investigate the concepts of climate change, carbon footprint, ecological footprint, water footprint and the factors that cause them. We aimed to make people comprehend the importance of these concepts in our lives. Materials and methods: A 16-question survey was planned for DEÜTF 1st year students. In this survey questions, questions about carbon footprint, water footprint, ecological footprint and climate change were asked. Response rates were calculated as %. 18% of the respondents are 18 years old, 36% are 19 years old, 34% are 20 years old, 7% are 21 years old and 5% are 22 years old. 97.8% of the participants have heard of the concept of climate change. It is seen that 80.4% of the participants know the definition of climate change correctly, and 19.6% are wrong or incomplete. 92.4% of the participants have heard of the concept of water footprint. According to obtain data we obtained from the survey, the vast majority of the participants have heard of the concepts of climate change, ecological footprint, carbon footprint and water footprint, and again, the vast majority of them know what these concepts mean.
Keywords: climate change, carbon footprint, ecological footprint, water footprint

Oral presentation / *Usmeno priopćenje*
Climate change / *Klimatske promjene*

The influence of microclimatic growing conditions on the physiological and pomological properties of apples

Miroslav LISJAK[1], Jelena RAVLIĆ[1], Tomislav VINKOVIĆ[1], Andrijana REBEKIĆ[1], Tvrtko JELAČIĆ[2], Tihana TEKLIĆ[1]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia
[2] Croatian Agency for Agriculture and Food, Center for Pomology and Vegetable Crops, Gorice 68b, Zagreb, Croatia

Abstract
Apple crops prefer moderate temperatures along with medium to high humidity. Therefore, the influence of the microclimate and the adaptability of individual varieties to microclimate conditions are very important for preserving the nutritional value of the apple fruit and achieving stable yields. The aim of the scientific project KK.05.1.1.02.0029 "Appleresist" is to increase the adaptability of Croatian agriculture by reducing the harmful impact of climate change on apple production. Based on the above, the experiment with thirty-three apple varieties differing in the ripening period was settled in 2020 in two climatically different localities: Experimental Station Tenja (Faculty of Agrobiotechnical Sciences Osijek) and Experimental Station Donja Zelina (Croatian Agency for Agriculture and Food). During the first and second growing season (2021/2022), the phenophases were monitored and the physiological indicators of drought and temperature stress in apple leaves were analyzed. Pomological traits and nutritive value of fruits, sampled in both locations during the growing season 2022, were also analyzed. Since the results of the research confirm the significant influence of location on the tested properties, producers should consider specific microclimatic conditions when choosing varieties for their orchards with the aim of achieving optimal quality and yield of apple fruits.
Keywords: apple varieties; heat stress; drought stress; fruit quality

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Utjecaj mikroklimatskih uvjeta uzgoja na fiziološka i pomološka svojstva jabuke

Miroslav LISJAK[1], Jelena RAVLIĆ[1], Tomislav VINKOVIĆ[1], Andrijana REBEKIĆ[1], Tvrtko JELAČIĆ[2], Tihana TEKLIĆ[1]

[1] Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti Osijek, Vladimira Preloga 1, Osijek, Hrvatska
2 Centar za voćarstvo i povrćarstvo, Hrvatska agencija za poljoprivredu i hranu, Gorice 68b, Zagreb, Hrvatska

Sažetak
Jabuka preferira umjerene temperature uz srednju do visoku vlažnost zraka. Stoga su utjecaj mikroklime i prilagodljivost pojedine sorte mikroklimatskim uvjetima vrlo značajni za očuvanje hranjive vrijednosti ploda jabuke te postizanja stabilnih prinosa. Cilj znanstvenog projekta KK.05.1.1.02.0029 „Appleresist“ je povećati prilagodljivost hrvatske poljoprivrede kroz smanjenje štetnog utjecaja klimatskih promjena na proizvodnju jabuka. Slijedom navedenog, pokus s trideset i tri sorte jabuka različitih rokova dozrijevanja postavljen je 2020. godine na dva klimatski različita lokaliteta: Pokušalište Tenja (Fakultet agrobiotehničkih znanosti Osijek) i Pokušalište Donja Zelina (Hrvatska agencija za poljoprivredu i hranu). Tijekom prve i druge vegetacijske sezone (2021./2022.) praćene su fenofaze rasta te su analizirani fiziološki pokazatelji sušnog i temperaturnog stresa u listovima jabuka. Analizirana su pomološka svojstva i hranjiva vrijednost plodova uzorkovanih na obje navedene lokacije tijekom vegetacijske sezone 2022. godine. Budući da rezultati istraživanja potvrđuju značajan utjecaj lokaliteta na ispitivana svojstva, proizvođači bi kod odabira sorti pri podizanju nasada trebali voditi računa o specifičnim mikroklimatskim uvjetima s ciljem postizanja optimalne kakvoće i prinosa plodova jabuke.
Ključne riječi: sorte jabuka, toplinski stres, sušni stres, kvaliteta ploda

Climate change / *Klimatske promjene*
Poster presentation / *Postersko priopćenje*

A comparative study of neutral and alkaline salts on germination and growth in industrial hemp (*Cannabis sativa* L.)

Tihana MARČEK, Laura SPAJIĆ, Tihomir MOSLAVAC

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia

Abstract
Salinity is a major abiotic factor that limits the plant's availability of water affecting the plant's growth. Industrial hemp (*Cannabis sativa* L.) is a highly tolerant salt species but the knowledge of the impact of different salt types is limited. In this study, neutral (NaCl, Na_2SO_4) and alkaline ($NaHCO_3$, Na_2CO_3) salts in equal concentrations (100 mM) were applied to explore the effect on seed germination and root growth of two hemp genotypes (Santhica 70 and Futura 83) during 4 days. Each pot contained 30 seeds, and each treatment had three repetitions. In both genotypes, all salt treatments had an inhibitory effect on germination (2. and 4. days) and 4 days-old roots compared to the control. In Santhica 70 (2. days) a significant increase in germination was recorded under NaCl compared to other salts. Futura 83 seeds showed a higher germination percentage under NaCl and $NaHCO_3$ than at Na_2CO_3 and Na_2SO_4 in both time points. In the earliest time point, the most deleterious effect on germination was recorded under Na_2SO_4 in both genotypes. Comparing germination between genotypes, Futura 83 showed better germination properties than Santhica 70 under control and all salt treatments. Both genotypes showed the highest reduction of root growth under Na_2CO_3 treatment while NaCl showed the least damage. In addition, the same genotype had longer roots under NaCl treatment than Santica 70. In conclusion, NaCl treatment had the most beneficial effect on root growth while the inhibitory effect of salt stress on hemp germination depended on the salt type and genotype properties.
Keywords: neutral salts, alkaline salts, germination, root growth

Climate change / *Klimatske promjene*
Poster presentation / *Postersko priopćenje*

Rainfall-Runoff Modeling and Hydrological Responses to the Projected Climate Change for Upper Baro Basin, Ethiopia

Teressa NEGASSA MULETA, Knolmár MARCELL

Budapest University of Technology and Economics, Faculty of Civil Engineering Science, Department of Sanitary and Environmental Engineering, Műegyetem rakpart 3, Budapest Hungary

Abstract
This paper presents the results of Rainfall-Runoff modeling and simulation of hydrological responses under changing climate using HEC-HMS model. The basin spatial data was processed by HEC-GeoHMS and imported to HEC-HMS. The calibration and validation of the HEC-HMS model was done using the observed hydrometeorological data (1989-2018) and HEC-GeoHMS output data. The optimized HEC-HMS model was applied to simulate the hydrological responses of Upper Baro Basin to the projected climate change for mid-term (2040s) and long-term (2090s) A1B emission scenarios. The simulation results have shown a mean annual percent decrease of 3.6 and an increase of 8.1 for Baro River flow in the 2040s and 2090s scenarios, respectively, compared to the baseline period (2000s). A pronounced flow variation is rather observed on a seasonal basis, reaching a reduction of 50% in spring and an increase of 50% in autumn for both mid-term and long-term scenarios with respect to the base period. The study results have an implication that the seasonal and time variation in the hydrologic cycle would likely cause hydrologic extremes. And hence, the developed model and output data are of paramount importance for adaptive strategies and sustainable water resources development in the basin.
Keywords: climate change, flow simulation, HEC-HMS, rainfall-runoff modeling, upper Baro Basin

Climate change / *Klimatske promjene*
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Prevalence of the monogens in wild bouge (*Boops boops* L., 1758.) associated with fish farms

Jana PARADŽIKOVIĆ, Bosiljka MUSTAĆ, Tomislav ŠARIĆ, Bruna PETANI, Slavica ČOLAK

University of Zadar, Department of Ecology, Agronomy and Aquaculture, Ulica Mihovila Pavlinovića bb, Zadar, Croatia

Abstract
Mariculture includes fish farming of marine fish and other species. In Croatia, annual fish production according to the data from 2018., is about 16 782 tons. Good practice in fish farming requires control over fish health status and risk assessment. Disease can be transferred from fish to fish in the cage, but they can also get infected by wild species beyond the cage. The transfer of pathogens between wild and farmed fish is not enough explored. Some parasites are found on both wild and farmed fish, and it was justifiably suspected that various species of wild fish are the primary sources of pathogens for farmed fish. Bogue (*Boops boops*) can often be found near the cages while feeding with leftovers of farmed fish food. This species is also the source of *Ceratothoa oestroides* infestations on farmed sea bass (*Dicentrarchus labrax*) and potential source of monogeneans infestations. In this study, which was conducted from March to June 2020, the prevalence of the monogeneans on wild bogue caught near the cage and biometric parameters as length, mass and index of condition were monitored. During parasitological examination, all fish gill arches were removed and inspected under a light microscope. In that period 87 bouges were examined and 52 *Microcotyle erythrini* were identified based on morphology. Bogue growth depended on temperature; weights and lengths of fish were greater in warmer months than in colder ones. Prevalence and abundance of *M. erythrini* was also higher in worm period. To obtain the best possible results of this research, it is necessary to extend the research throughout the year.
Keywords: bouge (*Boops boops*), *Microcotyle erythrini*, prevalence, mariculture

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Sustainability of the "N" category of natural gas vehicles

Dinko PRIMORAC

University North, Trg dr. Žarka Dolinara 1, Koprivnica, Croatia

Abstract
The transport sector is one of the most important consumers of energy in the European Union and has one of the biggest influences on the economy and the sustainable state of the environment. Efficient transport of goods and services, via N-category vehicles, is one of the prerequisites for the successful economic growth of the Republic of Croatia. Transport is undoubtedly a very important branch of the economy that can make a significant contribution to employment, strengthening competitiveness, and economic growth. However, ineffective management of the transport sector can also have negative impacts, both on the economy and on the general population, such as air pollution, emission of polluting particles, traffic noise, etc. Namely, the transport sector in the European Union relies heavily on propellants that generate a quarter of greenhouse gas emissions. Moreover, the aforementioned emissions of greenhouse gases are continuously increasing, especially from the road transport sector, which accounts for over 70% of emissions. The current trend in the growth of freight transport in the Republic of Croatia initiates an increased growth of transport-caused CO_2 emissions and other polluting particles in the atmosphere. Therefore, without a radical change in transport policy, the Republic of Croatia will not be able to meet the set standards of the European Union on the decarbonization of the transport sector.
Keywords: natural gas, N category vehicles, energy, environment

Climate change / *Klimatske promjene*
Poster presentation / *Postersko priopćenje*

Challenges of adapting the European energy system to climate change

Igor PROVČI

Croatian Transmission System Operator, Vukovarska cesta 217, Osijek, Croatia

Abstract
Climate change is increasingly being felt around the world, and experts expect it will become even more frequent and intense in the coming decades. Extreme weather events caused by climate change are increasingly affecting all parts of the European energy system. The most important changes include an increase in average and extreme air and water temperatures, changes in available water quantities, the risk of floods, and other hazards associated with the consequences of climate change. Such changes will affect the availability of primary energy sources, especially renewable energy sources, as well as conversion, transmission and distribution, energy storage, and energy demand. The paper will present some challenges of the energy system's suitability to climate policies, which imply undertaking a certain set of activities to reduce the energy system's vulnerability to climate change. Increasing the ability of the energy system to recover after the effects of climate change, but also to exploit the potential positive effects that may also be a consequence of climate change. Several studies show that, without appropriate adaptation measures to the consequences of climate change, direct damages to the European energy system from extreme weather events could amount to billions of euros per year by the end of the century, with much higher indirect costs.
Keywords: climate change adaptation, climate policies, European energy system

Climate change / *Klimatske promjene*
Poster presentation / *Postersko priopćenje*

Izazovi prilagodbe Europskog energetskog sustava na klimatske promjene

Igor PROVČI

Hrvatski operator prijenosnog sustava d.d., Vukovarska cesta 217, Osijek, Hrvatska

Sažetak

Utjecaj klimatskih promjena sve se više osjeća diljem svijeta, a predviđa se da će u narednim desetljećima postati još češći i intenzivniji. Ekstremni vremenski događaji uzrokovani klimatskim promjenama sve više utječu na sve dijelove europskog energetskog sustava. Najvažnije promjene uključuju porast srednjih i ekstremnih temperatura zraka i vode, promjene u raspoloživim količinama vode, opasnosti od poplava i ostale opasnosti vezane uz posljedice klimatskih promjena. Takve će promjene utjecati na dostupnost primarnih energenata, posebno obnovljivih izvora energije, kao i na pretvorbu, prijenos i distribuciju, skladištenje energije te na potražnju za energijom. U radu će biti prikazani neki od izazova prilagodbe energetskog sustava klimatskim politikama koji podrazumijevaju poduzimanje određenog skupa aktivnosti s ciljem smanjenja ranjivosti energetskih sustava na klimatske promjene. Povećanje sposobnosti oporavka energetskog sustava nakon učinaka klimatskih promjena, ali i iskorištavanja potencijalnih pozitivnih učinaka koji također mogu biti posljedica klimatskih promjena. Nekoliko studija pokazuju da bi, bez odgovarajućih mjera prilagodbe posljedicama klimatskih promjena, izravne štete na europskom energetskom sustavu od ekstremnih vremenskih događaja mogle iznositi milijarde eura godišnje do kraja stoljeća, uz puno veće neizravne troškove.

Ključne riječi: prilagodba klimatskim promjenama, klimatske politike, Europski energetski sustav

Climate change / *Klimatske promjene*
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The impact of climate change on the lack of water in the soil

Domagoj RASTIJA, Zdenko LONČARIĆ, Vladimir ZEBEC, Mirta RASTIJA

Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, 31000 Osijek, Croatia

Abstract
The aim of this research is to determine the lack of water for vegetable and field crops during the growing season. One of the consequences of climate change is the decrease in the production of organic matter, which leads to the degradation of the physical and chemical soil properties. A low level of organic matter reduces the soil suitability for growing a wider range of crops. On the basis of thirty years of data from the Slavonski Brod climatological station (1989-2018) and the properties of the investigated soils in the area of eastern Croatia, the lack of water in the soil was calculated for the average, dry and wet year. The trend of increasing average monthly temperatures and changes in the distribution of precipitation during the researched period was also determined. The mean annual air temperature is constantly increasing, so in the period from 1989 to 2018, there is an increasing trend of 1.2 °C. The annual amount of precipitation remained at the same level, but due to large oscillations in the distribution of precipitation, the lack of water during the beginning of the growing seasons is increasingly evident. The lack of water to achieve the maximum biological yield of certain crops is pronounced not only in dry and average years but also in years with an above-average amount of precipitation. based on the calculation of the soil water balance, in a dry year for various vegetables in regular sowing and/or planting term, there is a water shortage from 231 mm for kale to 250 mm for onions, tomatoes and eggplant, while sugar beet lacks 260 mm of precipitation. In a year with an average amount of precipitation, the water deficit ranges from 99 mm for kale to 155 mm for melon and watermelon, while the deficit for sugar beet is 160 mm. For the various crops grown as secondary crop, the water deficit is on average 140 mm in a dry year and 70 mm in a year with an average amount of precipitation.
Keywords: climate change, soil water balance, soil degradation, irrigation

Climate change / *Klimatske promjene*
Poster presentation / *Postersko priopćenje*

Utjecaj klimatskih promjena na nedostatak vode u tlu

Domagoj RASTIJA, Zdenko LONČARIĆ, Vladimir ZEBEC, Mirta RASTIJA

Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti Osijek, Vladimira Preloga 1, Osijek, Hrvatska

Sažetak

Cilj ovog istraživanja je utvrditi nedostatak vode za ratarske i povrćarske kulture tijekom vegetacije. Jedna od posljedica klimatskih promjena je smanjenje produkcije organske tvari, što dovodi i do degradacije fizikalnih i kemijskih svojstava tala. Niska razina organske tvari umanjuje pogodnost tala za uzgoj šireg spektra kultura. Na osnovi tridesetogodišnjih podataka s klimatološke postaje Slavonski Brod (1989.-2018.) i svojstava istraživanih tala na području istočne Hrvatske izračunat je nedostatak vode u tlu za prosječnu, sušnu i vlažnu godinu. Također je utvrđen i trend povećanja srednjih mjesečnih temperatura te promjene u distribuciji količina oborina tijekom istraživanog razdoblja. Srednja godišnja temperatura zraka u stalnom je porastu pa je tako u razdoblju od 1989. do 2018. godine trend porasta 1,2 °C. Godišnja količina oborina zadržala se na istoj razini, ali zbog velikih oscilacija u distribuciji oborina sve je izraženiji nedostatak vode tijekom početka vegetacije. Nedostatak vode za postizanje maksimalnog biološkog prinosa pojedinih kultura izražen je, osim u sušnim i prosječnim godinama, čak i u godinama s iznadprosječnom količinom oborina. Iz proračuna bilanci vode u tlu u sušnoj godini raznom povrću u redovnoj sjetvi i/ili sadnji nedostaje od 231 mm za kelj do 250 mm za luk, rajčicu i patlidžan, dok šećernoj repi nedostaje 260 mm oborina. U godini s prosječnom količinom oborina nedostatak vode se kreće od 99 mm za kelj do 155 mm za dinju i lubenicu, dok je nedostatak za šećernu repu 160 mm. Različitim kulturama koje se uzgajaju u postrnoj sjetvi nedostatak vode je u prosjeku 140 mm u sušnoj i 70 mm u godini s prosječnom količinom oborina.

Ključne riječi: klimatske promjene, bilanca vode u tlu, degradacija tala, navodnjavanje

Climate change / *Klimatske promjene*
Poster presentation / *Postersko priopćenje*

Positive role of petroleum engineers in reducing carbon dioxide emissions

Katarina SIMON, Lidia HRNČEVIĆ, Karolina NOVAK MAVAR, Borivoje PAŠIĆ, Petar MIJIĆ, Katarina ŽBULJ, Igor MEDVED

University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Pierittijeva 4, Zagreb, Croatia

Abstract
The fact is that the world today derives most of its primary energy from fossil fuels. Due to the continuous increase of the world population, the demand for energy is also increasing. Some industrialized countries are trying to get this energy from renewable sources, but most of the energy is still derived from fossil sources and will continue to be so in the future. Data shows that most carbon dioxide is released into the atmosphere from transportation, power generation, and industry. If we exclude or reduce transportation-related emissions due to fuel switching, we are still left with two sectors with high emissions. Do we have enough time to wait until most of the world's primary energy is generated from renewable sources, or can we do something immediately, and can the big "polluters" respond positively? Currently, the oil industry knows how to extract, capture and store carbon dioxide, having done so for decades in the extraction of gas fields. In order for carbon dioxide to be safely injected underground, suitable reservoirs must be selected for storage and injection wells must be properly constructed and equipped, which petroleum engineers know and are proficient in. Therefore, this paper describes the process of underground storage of carbon dioxide, focusing on the role of petroleum engineers in this process.

Keywords: carbon dioxide emissions, carbon dioxide capture, well drilling, underground gas storage

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Do we have a recipe for change? - Agenda for Sustainable Food Systems in Europe

Jana ŠIC ŽLABUR, Sanja RADMAN, Nevena OPAČIĆ, Neven VOĆA, Mia DUJMOVIĆ, Sandra VOĆA[1]

University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia

Abstract
It is the final moment to transform existing food systems that are becoming increasingly unsustainable for the planet and humans' health. The food we consume today will change significantly in the not-too-distant future, largely due to rapidly advancing technological achievements and practices that are already significantly influencing the way we produce, process and buy our food. The main goal of all European strategies focuses on building food systems that unite people, climate and environment in a sustainable and resilient chain. To address all current challenges related to food production and consumption through complex social and environmental impacts, increasing urbanization, population growth, demographic change, climate change and resource scarcity, we should focus on four priorities: nutrition, climate, circular economy and innovations. If we are to transform our food systems and find the recipe for more sustainable change, stakeholders from different sectors need to work together to create a safe, high-quality, low environmental footprint food chain capable of feeding the world a healthier and more sustainable way.
Keywords: European policies, improved nutrition patterns, healthy food, food environmental footprint, circular economy

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Imamo li recept za promjenu? - Program za održive prehrambene sustave u Europi

Jana ŠIC ŽLABUR, Sanja RADMAN, Nevena OPAČIĆ, Neven VOĆA, Mia DUJMOVIĆ, Sandra VOĆA

Sveučilište u Zagrebu, Agronomski fakultet, Svetošimunska cesta 25, Zagreb, Hrvatska

Sažetak
Posljednji je trenutak za transformaciju postojećih prehrambenih sustava, a koji postaju sve neodrživiji za planet i zdravlje ljudi. Hrana koju danas konzumiramo značajno će se promijeniti u ne tako dalekoj nam budućnosti, ponajviše zbog brzog napretka tehnoloških dostignuća i praksi koje već značajno utječu na način na koji proizvodimo, prerađujemo i kupujemo hranu. Glavni cilj svih ključnih europskih strategija usmjeren je na uspostavljanje prehrambenih sustava koji ujedinjuju ljude, klimu i okoliš u održiv i otporan lanac. Kako bismo odgovorili na sve trenutne izazove povezane s proizvodnjom i potrošnjom hrane kroz složene društvene i ekološke utjecaje, rastuću urbanizaciju, globalni rast stanovništva, demografske promjene, klimatske promjene i nedostatak resursa, trebali bismo se usredotočiti na četiri prioriteta: prehrana, klima, kružno gospodarstvo i inovacije. Ako želimo transformirati naše prehrambene sustave i pronaći recept za održiviju promjenu, dionici iz različitih sektora moraju raditi zajedno kako bi stvorili siguran, visokokvalitetan prehrambeni lanac s niskim utjecajem na okoliš koji može prehraniti svijet na zdraviji i održiviji način.
Ključne riječi: europske politike, poboljšani obrasci prehrane, zdrava hrana, otisak hrane na okoliš, kružno gospodarstvo

Climate change / *Klimatske promjene*
Oral presentation / *Usmeno priopćenje*

Plant dieback as an indicator of climate change: the case of the cushion plant *Silene acaulis* in the Apennines

Giulio TESEI[1], Giuliano BONANOMI[2], Mohamed IDBELLA[2], Marina ALLEGREZZA[2]

[1] University of Naples Federico II, Department of Agricultural Sciences, Via Università 100, Portici, Italy
[2] Food and Environmental Sciences, Marche Polytechnic University, Department of Agricultural, Via Brecce Bianche, Ancona, Italy

Abstract:
With this research, we want to contribute to the understanding of the ecology of *Silene acaulis*, an alpine cushion plant distributed throughout the Northern Hemisphere, following a severe heat wave in the summer of 2022. As part of our work, we investigated the extensive senescence and dieback of *Silene aculis*, in the Apennines. Our overall goal is to quantify the extent and distribution of Silene dieback to provide a basis for future studies that will focus on causal and mechanistic hypotheses. To this end, we studied *Silene dieback* along a 500 m elevation transect from 1900 to 2400 m a.s.l. in the Sibillini mountain range, part of the Apennines. In addition, we investigated the putative role of the summer 2022 heat wave, which affected the Apennines, in Silene dieback. The results of the research showed that the intensity of the dieback was not uniformly distributed across the elevational gradient, but was widespread at 1900 and 2000 m a.s.l. and decreased with increasing elevation suggesting a change in microclimatic conditions. Detailed analysis of the climatic data clearly shows a combination of several consecutive days of very high temperatures combined with scarce water availability which may have resulted in thermal stress for Silene with consequent damage by excessive temperatures. Our data suggest a shift in climate away from the fundamental niche of the cushion plant Silene, at least during the summer months. The sudden dieback of Silene highlights the vulnerability of high elevation vegetation to climate change.
Keywords: climatic change refugia, alpine vegetation, plant disease, elevation gradient

Climate change / *Klimatske promjene*
Poster presentation / *Postersko priopćenje*

Impact of climate change on water salinisation (Interreg project SeCure)

Damir TOMAS, Stjepan KAMBER, Julija PRPIĆ

Hrvatske vode, Ulica grada Vukovara 220, Zagreb, Croatia

Abstract
Climate change influences integrated water management both from the standpoint of resource availability and from the standpoint of general water use. This situation requires a stricter water management framework, i.e. making an agreement on the new common sustainable water management criteria and objectives imperative. Saltwater intrusion into coastal aquifers poses one of the gravest threats to agricultural land in coastal regions. Italy and Croatia are both affected by saltwater intrusion in their coastal regions, which causes undeniable consequences for agricultural activities that are intensifying due to climate change. The Interreg Programme Italy-Croatia established cooperation between the two countries in their shared efforts to improve the capacities for the preservation of their strategic freshwater resources in the coastal areas and reduction of their vulnerability to contamination by saltwater. The project SeCure (Saltwater intrusion and climate change: monitoring, countermeasures and informed governance) is a continuation of the Italy-Croatia cooperation on their earlier projects. The objective of the project SeCure is to inform the concerned public and raise awareness about the contamination of agricultural land by saltwater, as well as to educate them about new, efficient approaches to minimizing the negative consequences of this phenomenon. This particularly refers to a guidelines update that would be applicable to the entire Adriatic basin, while focusing on the coastal agricultural areas. This project facilitated the extension of the activities to monitor the results achieved through previous projects and the use of a longer timeframe to assess the efficiency of the measures implemented to date to increase the productivity of the agricultural land, improve the status of the ecosystem, as well as the readiness for inevitable climate change.
Keywords: climate change, project SeCure, water salinisation, agriculture

Climate change / *Klimatske promjene*
Poster presentation / *Postersko priopćenje*

Utjecaj klimatskih promjena na zaslanjenje voda (Interreg projekt SeCure)

Damir TOMAS, Stjepan KAMBER, Julija PRPIĆ

Hrvatske vode, Ulica grada Vukovara 220, Zagreb, Hrvatska

Sažetak
Klimatske promjene utječu na integralno upravljanje vodama kako sa stanovišta raspoloživosti resursa tako i sa stanovišta korištenja voda u širem smislu. Ovakva situacija nameće stroži okvir upravljanja vodama, odnosno postavlja kao imperativ dogovor o novim zajedničkim kriterijima i ciljevima održivog upravljanja vodama. Prodiranje slane vode u obalne vodonosnike ubraja se među najozbiljnije prijetnje poljoprivrednim površinama u obalnim regijama. Italija i Hrvatska pogođene su prodorom slane vode u svojim obalnim regijama s nezanemarivim posljedicama na poljoprivredne aktivnosti koje se intenziviraju pod utjecajem klimatskih promjena. Interreg-ovim programom Italy-Croatia ostvarena je suradnja dviju država u zajedničkom nastojanju za poboljšanje kapaciteta za očuvanje strateških resursa slatke vode u obalnim područjima kao i u smanjenju ranjivosti na kontaminaciju slanom vodom. Projekt SeCure (eng. Saltwater intrusion and climate change: monitoring, countermeasures and informed governance) je nastavak suradnje Italije i Hrvatske kroz prethodnu projektnu suradnju. Cilj projekta SeCure je informiranje zainteresirane javnosti i podizanje svijesti o kontaminaciji poljoprivrednih površina slanom vodom te edukacija o novim učinkovitim pristupima u minimiziranju negativnih posljedica tog fenomena. Osobito se to odnosi na nadogradnju smjernica koje bi bile primjenjive na područje čitavog jadranskog bazena s fokusom na obalna poljoprivredna područja. Ovim projektom je omogućeno produljenje aktivnosti u praćenju rezultata ostvarenih kroz prethodne projekte, kao i korištenje duljeg vremenskog okvira za procjenu učinkovitosti do sada provedenih mjera za povećanje produktivnosti poljoprivrednog zemljišta, poboljšanje stanja ekosustava i spremnosti na klimatske promjene koje su neizbježne.
Ključne riječi: klimatske promjene, projekt SeCure, zaslanjenje voda, poljoprivredna aktivnost

Climate change / *Klimatske promjene*
Di Poster presentation / *Postersko priopćenje*

Disease incidence and susceptibility of strawberry cultivars to grey mould (*Botrytis cinerea*) in Bosnia and Herzegovina

Mladen ZOVKO[1], Tihomir MILIČEVIĆ[2], Ivan OSTOJIĆ[1], Jurica PRIMORAC[1]

[1] Faculty of Agriculture and Food Technology, University of Mostar, Biskupa Čule bb, Mostar, Bosnia and Herzegovina
[2] Faculty of Agriculture, University of Zagreb, Svetošimunska cesta 25, Zagreb, Croatia

Abstract
Strawberry is one of the most popular berry crops in Bosnia and Herzegovina with increasing production in recent years. Grey mould caused by the *Botrytis cinerea* Pers., is one of the most important fungal diseases of strawberry in B&H. This pathogen affects fruit in the field, storage, transport and market. Disease incidence were monitored in three years trial (2009, 2010 and 2011) at two locations Veljaci-Ljubuški (West Herzegovina County) and Donja Papratnica-Žepče (Zenica-Doboj County) on ten strawberry cultivars (Antea, Arosa, Camarosa, Clery, Galia, Madeleine, Marmolada, Naiad, Siba and Tethis). Number of plants per cultivar was 200 for each site. The aim of our research was to determine the susceptibility of those cultivars to grey mould under field conditions. Susceptibility to diseases was evaluated on each cultivar by examining all fruits on 20 randomly selected strawberry bushes. The results were presented as the percentage of fruits with a disease symptom in relation to the total number of examined fruits. Considering the three-year average, the highest percentage of fruits with symptoms of grey mould at the Donja Papratnica site was recorded on the cultivars Marmolada 39.3%, Antea 38.5% and Arosa 35.6%. The lowest percentage of fruits with symptoms of grey mould was recorded on the cultivar Camarosa 20.4%. The highest percentage of fruits with symptoms of grey mould at the Veljaci site was recorded on the cultivars Arosa 17.5% and Galia 17.4%, and the lowest on the cultivar Tethis 7.3%.
Keywords: strawberry, *Fragaria* x *ananassa*, *Botrytis cinerea*, diseases incidence, cultivars susceptibility

Computer Science in Environmental Protection
Računalne znanosti u zaštiti okoliša

An Overview of Flood Prediction with Deep Learning Methods

Ingrid HRGA

University of Rijeka, Faculty of Informatics and Digital Technologies, Ul. Radmile Matejčić 2, Rijeka, Croatia

Abstract

A flood represents the occurrence of an unusually large amount of water from a river, lake, ocean, or other body of water on otherwise dry land. Although floods can sometimes bring certain benefits, especially in arid areas, they are still one of the most widespread natural disasters that take human lives, destroy property, and threaten plants and animals every year. Therefore, many research efforts are focused on the development of models and techniques that could timely indicate the danger of flooding. Common approaches to flood prediction are based on hydrological models that use mathematical equations to simulate water behavior. However, such models require a significant level of expertise and specific data that are not always available. Therefore, models based on deep neural networks are increasingly being used as a promising alternative. Such models can find complex patterns and take advantage of satellite imagery or textual data, among other sources. This paper provides an overview of the state-of-the-art deep learning methods used for flood prediction. It discusses the advantages and limitations of each method, compares their performance, and analyses the data sources used. Finally, the paper highlights the challenges and proposes some future directions for research.

Keywords: flood prediction, deep learning, convolutional neural networks (CNN), long short-term neural networks (LSTM), hybrid models

Computer Science in Environmental Protection / *Računalne znanosti u zaštiti okoliša*
Poster presentation / *Postersko priopćenje*

Predviđanje poplava metodama dubokog učenja

Ingrid HRGA

Sveučilište u Rijeci, Fakultet informatike i digitalnih tehnologija, Ul. Radmile Matejčić 2, Rijeka, Hrvatska

Sažetak

Poplava predstavlja pojavu neobično velike količine vode iz rijeke, jezera, oceana ili neke druge vodene površine na inače suhom tlu. Iako poplave ponekad mogu donijeti i poneku dobrobit, posebice u sušnim područjima, ipak predstavljaju jednu od najraširenijih prirodnih katastrofa koje svake godine odnose ljudske živote, uništavaju imovinu te ugrožavaju biljni i životinjski svijet. Stoga su brojni istraživački napori usmjereni na razvoj modela i tehnika koje bi mogle pravovremeno ukazati na opasnost od poplave. Uobičajeni pristupi u predviđanju poplava temelje se na hidrološkim modelima koji koriste matematičke jednadžbe za simulaciju ponašanja vode. Međutim, takvi modeli zahtijevaju značajnu razinu stručnosti te specifične podatke koji nisu uvijek dostupni. Stoga se modeli temeljeni na dubokim neuronskim mrežama sve više koriste kao obećavajuća alternativa. Takvi modeli mogu pronaći složene obrasce u podacima te iskoristiti prednosti satelitskih snimki ili tekstualnih podataka, među ostalim izvorima. U ovom radu daje se pregled najsuvremenijih metoda dubokog učenja koje se koriste u predviđanju poplava. Raspravlja se o prednostima i ograničenjima svake metode, vrši se usporedba njihovih performansi te se analiziraju podaci koji se pri tome koriste. Na kraju se ukazuje na određene izazove te se predlažu neke smjernice za buduća istraživanja.

Ključne riječi: predviđanje poplava, duboko učenje, konvolucijske neuronske mreže (CNN), povratne mreže (LSTM), hibridni modeli

3D simulations in the interdisciplinary design of a nature-like fish ramp

Gorazd NOVAK[1], Polona PENGAL[2], Ana T. SILVA[3], José M. DOMÍNGUEZ[4], Angelo TAFUNI[5], Matjaž ČETINA[1], Dušan ŽAGAR[1]

[1] University of Ljubljana, Faculty of Civil and Geodetic Engineering, Jamova cesta 2, Ljubljana, Slovenia
[2] REVIVO Institute for ichthyological and ecological research, Business unit Ljubljana, Staretova ulica 1, Dob, Slovenia
[3] Norwegian Institute for Nature Research (NINA), Høgskoleringen 9, Trondheim, Norway
[4] EPhysLab (Environmental Physics Laboratory) Edificio Campus da Auga (Campus Sur) Rúa Canella da Costa da Vela 12, As Lagoas. Universidade de Vigo, Ourense, Spain
[5] School of Applied Engineering and Technology, New Jersey Institute of Technology, GITC, Suite 2100, University Heights, Newark, New Jersey, United States of America

Abstract
In our recent study, an interdisciplinary collaboration was used to design a nature-like fish ramp. Focusing on a short section of a small stream with a weir in Slovenia, three-dimensional numerical simulations based on the smoothed particle hydrodynamics (SPH) method were performed to determine the velocity fields for different configurations of the ramp that could replace the weir at the target site. Considering the swimming performances of the target fish species, including *Salmo truta*, *Phoxinus phoxinus*, *Cottus gabio*, and *Eudontomyzon vladykovi*, the possible migration paths along the ramp were mapped. Unpublished details of several optimization stages are presented here, ranging from a straight channel (length 15 m, width 4 m, height 0.5 m) to a complex geometry that can be considered a natural fish passage. Velocity fields were used to examine the effects of the following factors: Slope, bed roughness, flow curvature, and configuration (size, shape, and position) of the elements representing pebbles and stones in the stream. Results are given as plots of velocity fields and turbulent kinetic energy.
Keywords: fish ramp, river restoration, smoothed particle hydrodynamics, flow velocity, TKE

Computer Science in Environmental Protection / *Računalne znanosti u zaštiti okoliša*
Poster presentation / *Postersko priopćenje*

Life Cycle Assessment (LCA) of Microplastics in the Environment

Dunja PROKIĆ[1]*, Mira PUCAREVIĆ[1], Ljiljana ĆURČIĆ[1], Nataša STOJIĆ[1], Maja TURK SEKULIĆ[2], Marcela ŠPERANDA[3]

[1] Educons University, Faculty of Environmental Protection, Vojvode Putnika 87, Sremska Kamenica, Serbia
[2] University of Novi Sad, Faculty of Technical Sciences, Trg Dositeja Obradovića 6, Novi Sad, Serbia
[3] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
Microplastic (MP) pollution is one of the most pressing environmental problems of the 21st century. In the EU, between 75.000 and 300.000 tons of MP are released into the environment every year. MP are ubiquitous, being found in seas, lakes, rivers and estuaries, air, sediments, landfills, and wastewater treatment plants because of improper human disposal of plastics and inadequate waste management. Life cycle assessment (LCA) is frequently promoted as a tool to assess environmental impact. LCA is regulated in accordance with ISO 14040 and implies a process that examines environmental aspects and potential environmental impacts on the product or service life cycle. While LCA is a valuable environmental tool, its application to MP has not been sufficiently developed and investigated. The purpose of this paper is to critically review the LCA modeling of MP. Several leading LCA software were analyzed. Based on the conducted research, it was concluded that there are very few databases used by LCA software, which can be connected to MP. In addition, it was concluded that for these types of analysis, it is best to observe the life cycle of plastic waste, focusing on the concept according to which waste is considered a resource.
Keywords: microplastics, environment, life cycle assessment, plastic waste

Computer Science in Environmental Protection / *Računalne znanosti u zaštiti okoliša*
Poster presentation / *Postersko priopćenje*

Computer-aided molecular design of new environmentally friendly plant protection agents

Vesna RASTIJA, Domagoj ŠUBARIĆ, Maja KARNAŠ

Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract

Resistance to pesticides and their environmental and health hazards indicates an urgent need for the new active ingredients of plant protection products. These compounds must be highly specific and environmentally and toxicologically acceptable. Computer-aided molecular design is a rational approach used for screening, optimizing, and designing highly potent agents for plant protection. *In-silico* techniques like quantitative structure-activity relationships (QSAR), docking and virtual screenings play crucial roles in designing "better" molecules that may later be synthesized and biologically assayed. QSAR techniques provide insight into the relationships between chemical structure and biological activity and present an alternative pathway for the design and development of new molecules with improved activity. Using this relationship, the QSAR model is used to predict the activity of novel compounds. We have used QSAR methodology to estimate toxicity and "pesticide-likeness" properties, as well as effects on phytopathogenic fungi for coumarin derivatives and fluorinated pyrazole aldehydes. To suggest the possible inhibitory mechanism of the tested compounds against plant pathogenic fungi, experimentally obtained results were compared with the results of molecular docking on six enzymes responsible for the fungal growth. Analyzed derivatives are promising candidates for developing plant-protection products that could be safe for the environment, human health, and non-target organisms.

Keywords: environmentally friendly, pesticide-likeness properties, QSAR, molecular docking, toxicity

Computer Science in Environmental Protection / *Računalne znanosti u zaštiti okoliša*
Poster presentation / *Postersko priopćenje*

Računalom potpomognuti dizajn molekula za nova okolišno prihvatljiva sredstava za zaštitu bilja

Vesna RASTIJA, Domagoj ŠUBARIĆ, Maja KARNAŠ

Sbeučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti Osijek, Vladimira Preloga 1, Osijek, Hrvatska

Sažetak

Otpornost na pesticide, njihov utjecaj na okoliš te štetan utjecaj na ljudsko zdravlje ukazuje na žurnu potrebu za novim aktivnim tvarima sredstava za zaštitu bilja. Ovi spojevi moraju biti visoko specifični te ekološki i toksikološki prihvatljivi. Računalom potpomognuti dizajn molekula je racionalan pristup koji se koristi za pretraživanje, optimizaciju i dizajniranje visoko potentnih sredstava za zaštitu bilja. Tehnike *in-silico* kao što su kvantitativni odnosi strukture i aktivnosti (QSAR), molekularno uklapanje i virtualni pregledi igraju ključnu ulogu u dizajniranju "boljih" molekula koje se kasnije mogu sintetizirati i biološki ispitati. QSAR tehnike pružaju uvid u odnose između kemijske strukture i biološke aktivnosti te predstavljaju alternativni put za dizajn i razvoj novih molekula s poboljšanom aktivnošću. Koristeći ovaj odnos, QSAR model se koristi za predviđanje aktivnosti novih spojeva. Mi smo koristili QSAR metodologiju za procjenu toksičnosti i svojstava "sličnosti pesticidima", kao i inhibitorni učinak derivata kumarina te fluoriranih aldehida pirazola na fitopatogene gljive. Kako bi se sugerirao mogući inhibicijski mehanizam ispitivanih spojeva protiv fitopatogenih gljiva, eksperimentalno dobiveni rezultati uspoređeni su s rezultatima molekularnog dockinga na šest enzima odgovornih za rast gljiva. Analizirani derivati obećavajući su kandidati za razvoj proizvoda za zaštitu bilja koji bi mogli biti sigurni za okoliš, zdravlje ljudi i neciljane organizme.

Ključne riječi: okolišno prihvatljivi, svojstva slična-pesticidima, QSAR, molekulsko uklapanje, toksičnost

The possibility of applying remote detection methods in the area of Kopački rit Nature Park

Stela ROTIM[1], Lidija TADIĆ[2]

[1] Ilok Secondary School, Matije Gupca 168, Ilok, Croatia
[2] Josip Juraj Strossmayer University in Osijek, Faculty of Civil Engineering and Architecture, Vladimira Preloga 3, Osijek, Croatia

Abstract
Over the past few decades, climate changes have been observed, which manifest themselves in a series of phenomena, the most important of which are changes in temperature, amount and distribution of precipitation, and an increase in the frequency of extreme hydrological conditions. Ecosystems particularly vulnerable to climate change are wet habitats and wetlands, recognizable as the most productive and the most diverse ecological systems. Kopački rit Nature Park has more than 40 different plant communities and a total of 88 protected plant species. In the future, climate change could cause changes in plants and other species, and it is important to shed light on how these species and communities react to extreme hydrological conditions, in this case, drought. One of the most recent ways of assessing the state of vegetation is remote sensing. Landsat satellites are ideal for meeting this requirement due to their extensive and continuous archive (30+ years), temporal resolution (8-16 days) and 30m spatial resolution. The aim of this work is to research the conservation of the ecology of wetland habitats focusing on two aspects: the interpretation of soil structure and vegetation patterns from a hydrological perspective, and plants based on the understanding of spatial and temporal scales and interactions between soil, water and vegetation. These features can be observed through changes in the vegetation index (Normalized Difference Vegetation Index) and water over time and they can provide insight into the scope, function and frequency of events in the wetland. NDVI values range from -1 to 1. An NDVI of approximately 0.6-0.9 indicates significant vegetation. For areas with sparse vegetation cover, NDVI values are lower but still greater than 0 (approximately 0.2–0.4). NDVI values for water, snow, bare soil and rocks are 0 or close to 0. Data processing and analysis are performed through the Python programming language and geographic information system (QGIS). Satellite images of Kopački rit Nature Park in the period from 2015 to 2021 show the state of the vegetation cover during each August. Thereby, 2020 stands out as a very dry year.
Keywords: climate change, wetland vegetation, NDVI vegetation index, satellite observations

The contribution of computer communications to raising awareness about environmental protection: A case study of the *#Boranka* campaign

Damir TOMIĆ[1], Dan ŠPICER[2], Igor MLADINOVIĆ[3]

[1] Faculty za of Education, Cara Hadrijana 10, Osijek, Hrvatska; Croatian Association of Technical Culture, Dalmatinska 12, Zagreb, Croatia
[2] Scout and Guide Association of Croatia, Koturaška 3a, Zagreb, Croatia
[3] Imago creative agency, Vukovarska 271, Zagreb, Croatio

Abstract
This study focuses on the role of computer-based communications in increasing awareness of environmental protection, using the #Boranka campaign as a case study. By conducting a literature review on the use of computer-based communications for environmental awareness raising, and analyzing social media posts and conducting interviews with campaign organizers, the study evaluates the strategies, messages, and effects of the campaign on the public. The results of the study reveal that the #Boranka campaign successfully raised awareness about environmental protection and attracted volunteers, with computer communications, particularly social networks, playing a significant role in achieving these goals. The use of social networks allowed the campaign to reach a large number of people and emphasize the importance of environmental protection. The campaign's messages were clear, calling for action and citizen engagement in environmental protection. Despite facing challenges such as lack of resources and technical skills, the campaign organizers were able to overcome these obstacles through various strategies. The study concludes that computer communications are an effective tool for raising awareness about environmental protection, particularly when used in combination with other methods. It recommends further research to explore how computer communications can be used to achieve specific environmental goals.
Keywords: environmental protection, computer-based communications, social networks, *#Boranka* campaign

Culture, Art and Sustainability
Umjetnost, kultura i održivost

The impact of digital heritage on sustainability

Maria BAKATSAKI

Technical University of Crete, School of Production Engineering and Management, University Campus, Kounoupidiana, Chania, Greece

Abstract

A debate has developed in recent years on the significance of culture, as the fourth pillar of sustainable development. The starting point of the evolving problem is the role of culture, particularly that of digital heritage, in the other three pillars of sustainability (society, economy, environment), which has become the subject of constant negotiation due to the effects that culture is burdened with by other cognitive areas. Sectors such as the cultural economy, cultural and creative industries, and information and communication technologies comprise the dynamic debate concerning the role of digital cultural applications in sustainable development. However, integrating digital heritage into the dialogue concerning sustainable development is an ongoing and long-term challenge. Using a literature review, this paper examines the threefold role that digital heritage has in cultural sustainability, namely how it mediates the three pillars of sustainability, how it develops and operates alongside the other three pillars, and how sustainability is embedded in the culture. Furthermore, it examines the significant role culture plays in the creation and strengthening of social capital, and its contribution to local and regional development. The core of the work is the perspective that culture, with the contribution of digital technology, exerts a transformative force on existing approaches to development. The paper concludes with some theoretical extensions and administrative implications, as well as an agenda with suggestions for future research.

Keywords: digital heritage, culture, sustainability

Culture, Art and Sustainabilty / *Umjetnost, kultura i održivost*
Oral presentation / *Usmeno priopćenje*

Sustainable fashion: a brief history of change, aspirations, and perspectives

Edit CSANÁK

Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Product Design Institute, Doberdó út 6, Budapest, Hungary

Abstract

The idea of sustainability is now integrated into all creative industries, including textiles. Sustainable fashion is part of an emerging design philosophy and at the same time a trend that aims to reduce the carbon footprint of the world's second-largest economy. The sustainability movement aims to create new systems and mechanisms for the growing textile and fashion industry. Dating back several decades, the movement is reaching out to key players in the fashion world through its organized platforms. As a result, the global industry is paying increasing attention to sustainability in textile and fashion design. The trend towards environmentally conscious textile and apparel production seems to be intensifying as the signs of climate change become more evident, thus the interest of the environmentally-conscious Y and Alpha generations in ecologically produced textile and apparel products is noticeably increasing. This article attempts to present and explore the history and present of eco-friendly concepts as well as current sustainability trends in fashion.

Keywords: textile industry, sustainable fashion, fashion design, eco-friendly concepts

Culture, Art and Sustainabilty / *Umjetnost, kultura i održivost*
Oral presentation / *Usmeno priopćenje*

Greenish-greeny green in mobile gaming

Nikola JOZIĆ, Mario PERIŠA, Lovorka GOTAL DMITROVIĆ

University North, University Center Koprivnica, Trg dr. Žarka Dolinara bb, Koprivnica, Croatia

Abstract
Color in visual art, including in gaming, is one of the most important elements. It has a significant phenomenological influence on the player's psyche. It is used as a mood enhancer, but also for harmonic stability and achieving a complete aesthetic whole. The research that was done for the purposes of this work is based on the use of shades of green in the most popular mobile games today. Statistical methods, i.e., cinematrics, were used for data processing. The obtained results show the important use of shades of green in games, in which the color green is most often associated with nature, plantations, but also with the need for calm and is a common color in card and gambling games. In contrast to the emphasis on nature and calmness, the shades of green used in food (or food preparation) games mostly denote spoiled food and sick people. The interpretation of colors and associations with them (including green) largely depends on the specific shade and its intensity, i.e., more saturated. Color in games is a very unexplored concept, and there is a clear need for an analytical approach to interpret this type of art.
Keywords: cinematrics, color psychology, shades of green color, the most popular mobile games

Eco-Literature: A Literary *New Wave*

Darija KUHARIĆ

Josip Juraj Strossmayer University of Osijek, Academy of Arts and Culture, 1/F Ulica Kralja Petra Svačića, Osijek, Croatia

Abstract

Classical and ancient literature worldwide incorporated ecological themes, whether it be nature writing or romantic poetry, portraying a time when humans and nature coexisted harmoniously and man's impact on the environment was limited. However, modern society's destructive actions towards the environment have led to a new wave of ecological narrative in literature, including fiction, poetry, and criticism. This paper reviews several works of ecological fiction that depict the consequences of environmental degradation on human suffering and displacement, as well as economic and political exploitation's detrimental effects on both humans and the environment. The presence of eco-lit in modern Croatian fiction is also explored. Additionally, the paper discusses climate fiction (cli-fi), a sub-genre of eco-literature that addresses climate change and global warming.

Keywords: fiction, environment, sustainability, ecological literature (eco-lit), climate fiction (cli-fi)

Culture, Art and Sustainabilty / *Umjetnost, kultura i održivost*
Oral presentation / *Usmeno priopćenje*

Carbon footprint in the production of musical instruments as a sales factor

Ana POPOVIĆ, Irella BOGUT, Željko POPOVIĆ

Josip Juraj Strossmayer University of Osijek, Faculty of Education, Cara Hadrijana 10, Osijek, Croatia

Abstract
Although the opinion that traditional materials (various brass alloys) are the best still prevails in the industry of brass instruments, in recent years, especially when talking about school instruments, other materials have started to be used in the production of instruments. The most common alternative are plastic materials, and such instruments are often significantly cheaper than those made of metal. In order to attract customers and position themselves in the elite instrument market, some manufacturers of plastic brass (!) instruments have begun to emphasize their sustainability in terms of their neutral carbon footprint. Such carbon-neutral musical instruments should be the future of instrument manufacturing, provided the quality of the music they produce does not differ from that of musical instruments made from traditional materials. The paper investigates the advantages and disadvantages of those instruments and evaluates their competitiveness in the market using SWOT and PEST analysis.
Keywords: carbon footprint, musical instruments, sustainable music, brass instruments, carbon neutral musical instruments

Culture, Art and Sustainabilty / *Umjetnost, kultura i održivost*
Oral presentation / *Usmeno priopćenje*

Ugljični otisak u proizvodnji glazbenih instrumenata kao faktor prodaje

Ana POPOVIĆ, Irella BOGUT, Željko POPOVIĆ

Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet za odgojne i obrazovne znanosti, Cara Hadrijana 10, Osijek, Hrvatska

Sažetak
Iako u industriji limenih puhačkih instrumenata još uvijek prevladava mišljenje da su tradicionalni materijali (različite legure mesinga) najbolji, posljednjih se godina, naročito kada govorimo o školskim instrumentima, u proizvodnji instrumenata počinju upotrebljavati i drugi materijali. Najčešća alternativa su plastični materijali te su takvi instrumenti često značajno jeftiniji od onih napravljenih od metala. Kako bi privukli kupce, a i pozicionirali se na elitnom tržištu instrumenata, neki proizvođači plastičnih limenih (!) puhačkih instrumenata počeli su isticati njihovu održivost u smislu njihovog neutralnog ugljičnog otiska. Takvi ugljično neutralni glazbeni instrumenti trebali bi biti budućnost proizvodnje instrumenata, pod uvjetom da se kvaliteta glazbe koju proizvode ne razlikuje od one glazbenih instrumenata napravljenih od tradicionalnih materijala. U radu se istražuje koje su prednosti i mane takvih instrumenata te procjenjuje njihova konkurentnost na tržištu pomoću SWOT i PEST analize.
Ključne riječi: ugljični otisak, glazbeni instrumenti, održiva glazba, limeni puhački instrumenti, ugljično neutralni glazbeni instrumenti

Culture, Art and Sustainabilty / *Umjetnost, kultura i održivost*

Poster presentation / *Postersko priopćenje*

The place of ecomusicology within the framework of a multidisciplinary approach in the field of environmental protection and sustainable development

Ana POPOVIĆ, Željko POPOVIĆ, Irena KIŠMARTIN

Josip Juraj Strossmayer University of Osijek, Faculty of Education, Cara Hadrijana 10, Osijek, Croatia

Abstract

Ecomusicology, that is, ecomusicologies, deals with different studies of man and music, traditions, perceptions and compositions from the aspect of influence or imitation of nature and similar references to the natural environment. Such studies may consider musical and sonic issues, both textual and performative, related to ecology and the natural environment. This paper provides an overview of reference works that inaugurate ecomusicology as a sub-discipline of musicology, and an overview of works published in the Republic of Croatia that would belong to the field, with a particular focus on the possibilities of such research in the future. Also, the paper explores the possibilities of project linking of ecomusicological research with other topics in the field of environmental protection and sustainable development.

Keywords: ecomusicology, musicology, methodology, ecology, multidisciplinary approach

Culture, Art and Sustainabilty / *Umjetnost, kultura i održivost*
Poster presentation / *Postersko priopćenje*

Mjesto ekomuzikologije u okvirima višedisciplinarnog pristupa u području zaštite okoliša i održivog razvoja

Ana POPOVIĆ, Željko POPOVIĆ, Irena KIŠMARTIN

Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet za odgojne I obrazovne znanosti, Cara Hadrijana 10, Osijek, Hrvatska

Sažetak

Ekomuzikologija, odnosno, ekomuzikologije, bave se različitim studijama čovjeka i glazbe, tradicija, percepcija i skladbi s aspekta utjecaja ili oponašanja prirode i sličnih referiranja na prirodni okoliš. Takve studije mogu razmatrati glazbena i zvučna pitanja, kako tekstualna tako i izvedbena, povezana s ekologijom i prirodnim okolišem. Ovaj rad bavi se pregledom referentnih radova koji inauguriraju ekomuzikologiju kao poddisciplinu muzikologije te donosi osvrt na radove objavljene u Republici Hrvatskoj koji bi po tematici pripadali u to područje, s naročitim osvrtom na mogućnosti takvih istraživanja u budućnosti. Također, u radu se istražuju mogućnosti projektnog povezivanja ekomuzikoloških istraživanja s drugim temama u području zaštite okoliša i održivog razvoja.

Ključne riječi: ekomuzikologija, muzikologija, metodologija, ekologija, višedisciplinarni pristup

Ecological Agriculture
Ekološka poljoprivreda

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Common flax (*Linum usitatissimum* L.) seed priming with coumarin derivatives: An eco-friendly plant protection approach

Dejan AGIĆ[1], Manda ANTUNOVIĆ[1], Drago BEŠLO[1], Ivana VARGA[1], Goran HERMAN[1], Dino KARAVIDOVIĆ[1], Maja MOLNAR[2]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia

Abstract
Most of the causative agents of common flax (*Linum usitatissimum* L.) fungal diseases are seed-borne and soil-borne. Seed-borne fungi of flax causing seedling blight, wilt, and seedling spotting are severe problems for common flax agricultural production. To control seed-borne fungi efficiently and environmentally friendly six coumarin derivatives synthesized by green chemistry methods with antifungal activity were screened as potential seed priming agents. Pretreatment of common flax seeds was performed by soaking the seeds in 1.0 mM solutions of 3-acetyl and 3-cyano coumarins for 15 minutes. The seeds were then germinated for 7 days after which germination, weight, root length, stem, and total seedling length were measured. The study showed that the seed priming method with the tested coumarin derivatives did not significantly affect the examined parameters. Among them, seeds primed with 1.0 mM 3-acetyl-8-hydroxy-2H-chromen-2-one had the highest average values for root length, seedling weight, and seed germination. From the obtained results it can be concluded that all tested coumarin derivatives could be used as potential priming agents in common flax seeds protection from pathogen fungi since they did not show a significant adverse effect on the early growth and development of seedlings.
Keywords: common flax, coumarin derivatives, seed priming, plant protection

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Potentials for the development of organic animal farming in the Republic of Croatia

Zvonko ANTUNOVIĆ, Željka KLIR ŠALAVARDIĆ, Danijela SAMAC, Josip NOVOSELEC

Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
In the Republic of Croatia, organic animal production is constantly increasing. The aim of this paper is to present the state of organic animal production in the Republic of Croatia during the last decade and the potential for its development. During the last decade, numerous activities/measures led to an increase of used agricultural land under organic production, and now it constitutes 8.25% of the total used agricultural land. The aforementioned had contributed to a significant increase in the number of domestic animals in organic farming in the last decade, mostly poultry, cattle, ungulates, sheep and goats, while a decrease in the number of pigs and bee colonies was recorded. The situation is similar to the obtained organic products of animal origin. For an even more significant interest in organic animal production in the Republic of Croatia, it is necessary to consolidate fragmented land areas and improve the fertility of such soils, arrange land registers, organize marketing and markets much better. Besides, more significant work should be done on the education of farmers and consumers of organic animal products. The potential for the development of organic animal production in Croatia is very good, not only because of the wealth of natural resources; various incentive measures; the preservation of numerous protected and GMO-free landscapes, suitable for the aforementioned production; the abundance of neglected land areas, which could be quickly reassigned to another purpose, regulated by law; but also due to the emphasis on tourist destinations and friendly farming.
Keywords: organic animal farming, Republic of Croatia, state, development, potentials

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Potencijali razvoja ekološkog stočarstva u Republici Hrvatskoj

Zvonko ANTUNOVIĆ, Željka KLIR ŠALAVARDIĆ, Danijela SAMAC, Josip NOVOSELEC

Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti Osijek, Vladimira Preloga 1, Osijek, Hrvatska

Sažetak
U Republici Hrvatskoj je ekološka stočarska proizvodnja u stalnom porastu. Cilj ovoga rada je prikazati stanje ekološke stočarske proizvodnje u Republici Hrvatskoj tijekom zadnjeg desetljeća te potencijale njenoga razvoja. Tijekom zadnjeg desetljeća poduzete su brojne aktivnosti/mjere koje su dovele do povećanja površina korištenog poljoprivrednog zemljišta pod ekološkom proizvodnjom te je sada to 8,25% udjela u ukupnim korištenim poljoprivrednim površinama. Navedeno je pogodovalo i značajnom povećanju broja domaćih životinja u ekološkom uzgoju u zadnjem desetljeću i to najviše peradi, goveda, kopitara te ovaca i koza, dok je zabilježeno smanjenje broja svinja i pčelinjih zajednica. Slična je situacija i s dobivenim ekološkim proizvodima životinjskoga podrijetla. Za još značajnije povećanje interesa za ekološkom stočarskom proizvodnjom u Republici Hrvatskoj trebalo bi poraditi na okrupnjavanju rascjepkanih zemljišnih površina i poboljšanju plodnosti takvih tala, sređivanju zemljišnih knjiga, te kvalitetnijem marketinško-tržišnom organiziranju, ali i značajnije poraditi na edukaciji uzgajivača i konzumenata takvih ekoloških animalnih proizvoda. Potencijali za razvoj ekološke stočarske proizvodnje u Hrvatskoj su vrlo dobri ne samo zbog bogatstva prirodnim resursima, različitih poticajnih mjera, očuvanosti brojnih zaštićenih i GMO-slobodnih krajolika pogodnih za navedenu proizvodnju, obilja zapuštenih zemljišnih površina koje bi se brzo mogle staviti u funkciju, uređenoj zakonskoj regulativi, nego i zbog naglašenosti turističke destinacije i *friendly* uzgoja.
Ključne riječi: ekološko stočarstvo, Republika Hrvatska, stanje, razvoj, potencijali

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Regenerative agriculture and fruit species

Kristina BATELJA LODETA[1], Tina ZRINSKI[1], Aleš VOKURKA[1], Ines POHAJDA[2], Jelena GADŽE[1]

[1] University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia
[2] Ministry of Agriculture, Ulica grada Vukovara 78, Zagreb, Croatia

Abstract
The increasing influence of globalization and the progress of industry in all spheres of life has led to a drastic decline in biodiversity, soil health, water pollution and changes in the concentration of gases in the atmosphere in recent decades. Due to pervasive climate change and inadequate agricultural practices around the world, regenerative agriculture has attracted the attention of farmers and the public in recent decades. The roots of regenerative agriculture lie largely in local food production and traditional ecological knowledge that ensures biodiversity. The principles of regenerative agriculture emphasize the advantages of perennial plantings over annual crops. Perennial plantings are an ideal system for increasing biodiversity because they incorporate different plant species, each of which can contribute in unique ways to the overall microsite. Orchards are also a form of perennial planting. The research conducted confirms that regenerative agriculture, as a system of specific agricultural principles and practices, increases biodiversity, enriches the soil, improves water balance and strengthens the ecosystem, one of the goals being carbon sequestration.
Keywords: biodiversity, carbon sequestration, sustainability, restoring soil

Ecological Agriculture / *Ekološka poljoprivreda*
Oral presentation / *Usmeno priopćenje*

Adaptation to Climate Change Using Available Clones of cv. Graševina (*Vitis vinifera* L.)

Darko CENBAUER, Ivan PRŠA

Croatian Agency for Agriculture and Food, Vinkovačka cesta 63c, Osijek, Croatia

Abstract
Climate change poses a significant challenge to vineyard owners worldwide, impacting phenological characteristics and grape yield. This study aims to assess the adaptability of different Graševina clones (*Vitis vinifera* L.) to climate change. Within the interdisciplinary project VITCLIC (Viticulture and Climate Change in Croatia), it has been established that Croatian wine regions have shifted from one zone/class to another due to increasing agroclimatic indices. If the positive trend of agroclimatic indices and air temperature continues, the cultivation of our most widespread cultivar Graševina and the production of its quality wine will become uncertain in the future. Through the clonal selection of Graševina, clones with the potential as a biological adaptation measure to climate change have been identified. These clones not only allow vineyards to adapt to changing climate conditions but also play a crucial role in preserving the existing assortment, representing the foundation of the Croatian terroir. Studying and selecting these clones enable vineyard owners to maintain the characteristic attributes of Croatian viticulture while ensuring the sustainability of their production in future climate conditions. This study provides a comprehensive perspective on selecting a variety or clone as an effective adaptation strategy to climate change, highlighting the importance of identifying and cultivating more resilient varieties and clones to ensure the sustainability of viticulture in the future.
Keywords: climate change, Graševina, cultivar, clone

Ecological Agriculture / *Ekološka poljoprivreda*
Oral presentation / *Usmeno priopćenje*

Adaptacija na klimatske promjene dostupnim klonovima cv. Graševina (*Vitis vinifera* L.)

Darko CENBAUER, Ivan PRŠA

Hrvatski agencija za poljoprivredu i hranu, Vinkovačka cesta 63c, Osijek, Hrvatska

Sažetak
Klimatske promjene predstavljaju značajan izazov za vinogradare diljem svijeta, utječući na fenološke karakteristike i prinos grožđa. Cilj ovog rada je procijeniti sposobnost prilagodbe različitih klonova Graševine (*Vitis vinifera* L.) na klimatske promjene. U okviru interdisciplinarnog projekta VITCLIC (Vinogradarstvo i klimatske promjene na području Hrvatske), ustanovljeno je da su vinogradarske regije Hrvatske zbog povećanja agroklimatskih indeksa prešle iz jedne zone/klase u drugu. Nastavi li se takav pozitivan trend agroklimatskih indeksa odnosno temperature zraka postaje upitan uzgoj našeg najrasprostiranijeg kultivara Graševine i proizvodnja njezina kvalitetnog vina u budućnosti. Klonskom selekcijom Graševine, identificirani su klonovi koji predstavljaju potencijal kao biološka mjera prilagodbe klimatskim promjenama. Ovi klonovi ne samo da omogućuju prilagodbu vinogradarstva na promjenjive klimatske uvjete, već također igraju ključnu ulogu u očuvanju postojećeg sortimenta, koji predstavlja osnovu hrvatskog terroira. Proučavanje i selekcija ovih klonova omogućuje vinogradarima da zadrže karakteristične atribute hrvatskog vinarstva, istovremeno osiguravajući održivost njihove proizvodnje u budućim klimatskim uvjetima. Ovaj rad pruža sveobuhvatnu perspektivu izbora sorte ili klona kao učinkovite strategije prilagodbe klimatskim promjenama, ističući važnost identifikacije i uzgoja otpornijih sorti i klonova za osiguravanje održivosti vinogradarstva u budućnosti.
Ključne riječi: klimatske promjene, Graševina, kultivar, klon

Ecological Agriculture / *Ekološka poljoprivreda*
Oral presentation / *Usmeno priopćenje*

Possibilities of using Earth observation data in sustainable organic agriculture

Marin ČAGALJ[1], Ana MUCALO[1], Antonio MORIĆ-ŠPANIĆ[2]

[1] Institute for Adriatic Crops and Karst Reclamation, Put Duilova 11, Split, Croatia
[2] PINUS NIGRA, Ulica svetog Spasa 7J, Split, Croatia

Abstract
Since the 1920s, the expansion of organic agriculture has become a worldwide movement, has reached a peak of scientific interest, and is now combined with multidisciplinary approaches such as remote sensing data and supplemented with in situ data. To differentiate from conventional products and gain consumer confidence, organic food needs to be certified, and the digitalization of agriculture is an effective way to achieve sustainable and cost-effective farming. Earth observation (EO) in viticulture refers to the use of remote sensing technologies to monitor and analyze various aspects of viticulture, such as crop health, yield forecasting, and water management. By using Earth observation data in vineyards, growers can reduce costs, increase productivity, and improve the quality of their grapes, ultimately leading to better wine production. As part of the scientific research, a special focus will be placed on the possibilities for introducing an innovative certification model of organic agriculture crops in the Republic of Croatia.
Keywords: sustainable organic agriculture; Earth observation; precision agriculture, precision grape growing, Croatia

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

The effect of plasma-activated water on germination and plant growth under abiotic stresses

Viktoria ČURILA[1], Mirna HABUDA–STANIĆ[2], Tihana MARČEK[2]

[1] Josip Juraj Strossmayer University of Osijek (PhD student), Trg Svetog Trojstva 3, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia

Abstract
Cereals face numerous biotic and abiotic stresses in their environment, which can lead to a decrease in yield. Traditional methods of improving yields, such as use of artificial fertilizers and pesticides, have a negative effect on the environment and human health. Therefore, it is necessary to find environmentally acceptable and sustainable methods of improving germination, growth and development of plants with an emphasis on the production of genotypes that successfully tolerate negative environmental conditions. One method is plasma-activated water (PAW), which is obtained by electric discharge and is a source of various reactive oxygen (ROS) and nitrogen particles (RNS) that change the physical and chemical composition of water. The aim of this review is to present previous researches of the effect of PAW on the germination and growth of different plant species with a priority on abiotic stresses that cause osmotic stress such as drought and salinity. According to literature data, the effect of PAW on germination and growth depends on the nature of the treatment, type of seed, genotypic characteristics and type of stress. In addition, one of the frequent environmental stresses is the stress caused by the accumulation of heavy metals in the soil, especially arsenic, which adversely affects plant growth and human health. Elevated levels of arsenic (As) have been recorded in the underground waters of Eastern Croatia. Therefore, the possibility of using PAW in researches related to arsenic-induced stress will be presented in this review.
Keywords: plasma-activated water (PAW), germination, growth, abiotic stress, arsenic

Učinak plazma aktivirane vode na klijanje i rast biljaka u uvjetima abiotičkih stresnih čimbenika

Viktoria ČURILA[1], Mirna HABUDA–STANIĆ[2], Tihana MARČEK[2]

[1] Sveučilište J. J. Strossmayera u Osijeku (doktorant), Trg Svetog Trojstva 3, Osijek, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek, Franje Kuhača 18, Osijek, Hrvatska

Sažetak
Žitarice se u svome okolišu suočavaju s brojnim biotičkim i abiotičkim stresovima koji mogu dovesti do smanjenja prinosa. Tradicionalne metode poboljšavanja prinosa, kao što su korištenje umjetnih gnojiva i pesticida, imaju negativan učinak na okoliš i zdravlje ljudi. Stoga, nužno je pronaći ekološki prihvatljive i održive metode poboljšanja klijavosti, rasta i razvoja biljaka s naglaskom na proizvodnju genotipova koji uspješno toleriraju negativne okolišne uvjete. Jedna takva metoda je plazmom aktivirana voda (engl. *Plasma activated water* – PAW), a dobivena je električnim pražnjenjem i izvor je različitih reaktivnih kisikovih (ROS) i dušikovih čestica (RNS) koje mijenjaju fizikalno – kemijski sastav vode. Cilj ovog preglednog rada je prezentirati dosadašnja istraživanja o učinku PAW na klijavost i rast različitih biljnih vrsta uz naglasak na abiotičke stresove koje izazivaju osmotski stres kao što su suša i salinitet. Prema literaturnim podatcima, učinak PAW na klijavost i rast ovisi o prirodi tretmana, vrsti sjemena, genotipskim karakteristikama i tipu stresa. Osim toga, jedan od čestih okolišnih stresova je i stres izazvan akumulacijom teških metala u tlu, posebice arsena, koji štetno utječe na rast biljaka i zdravlje ljudi. U podzemnim vodama istočne Hrvatske zabilježene su povišene razine arsena (As). Stoga će u ovom radu biti prikazana i mogućnost primjene PAW u istraživanjima vezanim za stres izazvan arsenom.
Ključne riječi: plazmom aktivirana voda (PAW), klijanje, rast, abiotički stres, arsen

Ecological Agriculture / *Ekološka poljoprivreda*
Oral presentation / *Usmeno priopćenje*

Development of an autonomous fleet robotic system for ecological weed control

Vladimir DAM[1], Vladimir POLJANČIĆ[1], Dubravko FILIPOVIĆ[2], Stjepan PLIESTIĆ[2]

[1] Purić d.o.o., Development department Damko, Hrvatskih branitelja 7, Samobor, Croatia
[2] University of Zagreb Faculty of Agriculture, Svetošimunska 25, Zagreb, Croatia

Abstract
Weed control in agriculture was carried out for years almost exclusively by chemical methods, but the intensive use of chemical agents resulted in significant negative effects on the environment and human health. Great progress in electronics and computer technologies and the development of vehicle guidance systems together with the introduction of precision agriculture have opened up the possibility of using robots in weed control, and many robotic systems with different methods of weed control have been developed, but due to the high-cost none of these robotic systems have yet did not find wider application. The goal of our project was to develop a robotic weed control system that will be efficient, affordable and widely applicable in agricultural production. The operation of this robotic system is planned in fleets using several smaller robots with navigation control units and dimensions that will allow movement between crop rows, taking into account soil configuration and potential obstacles. For weed detection robot use a machine vision system and image recognition software that compares the contours of each individual plant, and those identified as weeds are destroyed using laser beams. The laser beam that destroys weeds is directed directly at the growth center of a plant that is not the desired crop, and the intensity of the laser beam is determined with regard to the type and height of the weeds.
Keywords: ecology, weeds, robot, machine vision, laser

Ecological Agriculture / *Ekološka poljoprivreda*
Oral presentation / *Usmeno priopćenje*

Razvoj autonomnog flotnog robotskog sustava za ekološko suzbijanje korova

Vladimir DAM[1], Vladimir POLJANČIĆ[1], Dubravko FILIPOVIĆ[2], Stjepan PLIESTIĆ[2]

[1] Purić d.o.o., Razvojni odjel Damko, Hrvatskih branitelja 7, Samobor, Hrvatska
[2] Sveučilište u Zagrebu Agronomski fakultet, Svetošimunska 25, Zagreb, Hrvatska

Sažetak
Suzbijanje korova u poljoprivredi godinama se provodilo gotovo isključivo kemijskim metodama, ali intenzivna uporaba kemijskih sredstava je rezultirala značajnim negativnim učincima na okoliš i ljudsko zdravlje. Veliki napredak u elektronici i računalnim tehnologijama te razvoj sustava za navođenje vozila zajedno s uvođenjem precizne poljoprivrede su otvorili mogućnost korištenja robota u suzbijanju korova, te su razvijeni mnogi robotski sustavi s različitim metodama suzbijanja korova, ali zbog visokih cijena niti jedan od ovih robotskih sustava još nije našao širu primjenu. Cilj našeg projekta bio je razviti robotski sustav za kontrolu korova koji će biti učinkovit, prihvatljive cijene i široko primjenjiv u ratarskoj proizvodnji. Rad ovog robotskog sustava planiran je u flotama uz korištenje nekoliko manjih robota s navigacijskim upravljačkim jedinicama i dimenzijama koje će omogućiti kretanje između redova usjeva, uzimajući u obzir konfiguraciju tla i potencijalne prepreke. Za otkrivanje korova koristi se sustav strojnog vida i softver za prepoznavanje slika koji uspoređuje konture svake pojedine biljke, a one koje se prepoznaju kao korov uništavaju se pomoću laserskih zraka. Laserska zraka koja uništava korov se usmjerava direktno na središte rasta biljke koja nije željeni usjev, a intenzitet laserske zrake se određuje s obzirom na vrstu i visinu korova.
Ključne riječi: ekologija, korovi, robot, strojni vid, laser

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Arbuscular mycorrhizal fungi and viral infection induced changes of the gas-exchange parameters of the grapevine (*Vitis vinifera* L.)

Emanuel GAŠI, Mate ČARIJA, Katarina HANČEVIĆ, Tomislav RADIĆ

Institute for Adriatic Crops and Karst Reclamation, Put Duilova 11, Split, Croatia

Abstract
Grapevine (*Vitis vinifera* L.) is one of the most virus prone crop with more than 80 viruses described for this host (Fuchs, 2020). Arbuscular mycorrhizal fungi (AMF), on the other hand, tends to form a stable association with the grapevine and contribute to its stress alleviation (Trouvelot *et al.*, 2015). However, the influence of AMF on the ability of the grapevine host to cope with virus-induced stress is under-investigated. Therefore, in order to get the first look into the grapevine – AMF – virus interplay, we explored the physiological changes in the grapevine connected to the photosynthesis processes. A mixture of different virus combinations (GRSPaV - grapevine rupestris stem pitting virus, GLRaV-3 - grapevine leafroll associated virus 3, GPGV - grapevine pinot gris virus), and two different AMF inoculum ("mono" - *Rhizophagus irregularis* and "multi" - *Rhizophagus irregularis*, *Funneliformis mosseae* and *Funneliformis caledonium*) was used. The parameters used were net photosynthesis rate, conductance to H2O, transpiration and intercellular CO_2 concentration of leaves during three measuring points of one growing season. The effect of AMF resulted in the induction of net photosynthesis rate, transpiration and conductance to H2O. The beneficial role of AMF was especially seen in treatments with GRSPaV or GRSPaV coinfection with GLRaV-3. The presented results on photosynthesis point out that AMF can be beneficial for grapevine facing viral infection.
Keywords: arbuscular mycorrhizal fungi, grapevine, viral infection, photosynthesis

Ecological Agriculture / *Ekološka poljoprivreda*
Oral presentation / *Usmeno priopćenje*

The impact of fly ash application on pH in acidic agricultural and forest soils: a meta-analysis approach

Jelena HORVATINEC, Gabrijel ONDRASEK

University of Zagreb, Faculty of Agriculture, Svetosimunska c. 25, Zagreb, Croatia

Abstract
Fly ash (FA) is a fine-powdered co-product from different power plant facilities, usually very alkaline (pH>10), which makes FA a potential amendment for pH-constrained acidic soils in agro-/forest-ecosystems. The main objective was to determine and quantify the effects of the application of FA on pH in acidic agricultural and forest soils based on 456 samples from 28 studies using a random effect meta-analysis. The effect size of 26 studies was medium to strong and positively correlated with the results from particular studies, while only two studies had a negative value but a small effect size and seemed to be in contradiction with other studies. However, it was confirmed that FA application significantly increased soil pH by 13.35% ($p<0.001$), confirming its acid-neutralizing properties. Thus, it can be concluded that FA can be used as a soil amendment in the conditioning of acidic soils in agriculture and forestry. In the next, we will test the same multiple meta-analysis approach in studying the impact of FA application on some other soil physicochemical constraints.
Keywords: fly ash, meta-analysis, pH, waste, amendment, agricultural and forestry soils

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Stability of some bioregulators and their effect on sweet cherry fruits

Jelena KALAJDŽIĆ[1], Biserka MILIĆ[1], Sanja ARMAKOVIĆ[2], Stevan ARMAKOVIĆ[2], Mladen KALAJDŽIĆ[1], Maria SAVANOVIĆ[2]

[1] University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Novi Sad, Serbia
[2] University of Novi Sad, Faculty of Sciences, Trg Dositeja Obradovića 3, Novi Sad, Serbia

Abstract
Sweet cherry fruits are highly valuable in the local and world markets. the most important attributes are fruit size, fruit firmness and skin color. The use of bioregulators is a regular agrotechnical strategy for improving the fruit size and quality of some fruits. These chemicals increase yields even in small quantities but it depends on the fruit species and cultivars. Moreover, the data related to the stability of these compounds are scarce. Thus, the aim of this study was to investigate the effect of the bioregulators on the physical and chemical fruit properties of four sweet cherry cultivars (Summit, Kordia, Lapins and Regina), grafted on rootstock Gisela 5 during two consecutive years. The following bioregulator treatments were applied after full bloom: 100 mg L^{-1} BA (6-benzyladenine), 20 mg L^{-1} NAA (α-naphthaleneacetic acid) and untreated control. Hydrolysis of these molecules was conducted in the dark while direct photolysis was carried using the Sun simulator. A computational quantum modeling method known as DFT was also applied to investigate the reactive properties of these compounds. Effects of 6-benzyladenine and α-naphthylacetic acid on physical and chemical properties were variable depending on the experimental year and cultivar. BA increased the fruit diameter of cultivars Kordia and Lapins while other cultivars were not affected. The fruit weight of cultivars Kordia and Regina was increased. Treatments did not affect fruit firmness while both treatments decreased soluble solid content in the fruits of Lapins and Regina. Results obtained by degradation procedures as well as DFT calculations suggest that NAA is less stable than BA during direct photolysis. The degradation pathway is important because these substances are present in nature after their application in the field.
Keywords: 6-benzyladenine, α-naphthylacetic acid, sweet cherry, stability

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

The influence of biopreparations on yield and quality parameters of wheat

Suzana KRISTEK, Jurica JOVIĆ, Josipa JANTOŠ, Marina MARTINOVIĆ, Zdenko LONČARIĆ

Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
Two-year experiments were conducted on two different types of soil during 2021 and 2022. The influence of microbiological preparations Mycor-FAZOS, Vitality-FAZOS and Super Green-FAZOS on yield and quality parameters of wheat "Mura" variety (Agrigenetics) was investigated. The experiment was set up according to the split-block scheme in 4 repetitions on 2 types of soil, each in 12 different variants. The area of the basic plot was 40 m^2, while the calculated plot was 24 m^2. The elements of the research were: A (soil type) – A1 - humogly, A2 - eutric brown soil; B (seed treatment) – B1 – control, B2 – seed treated with biopreparation; C (protection against diseases) – C1 – control, C2 – treatment with chemical fungicides, C3 – treatment with biopreparations. The research parameters were grain yield (t/ha), protein content in grain (%), mass of 1000 grains (g), hectoliter mass (kg) and plant height (cm). The highest average grain yield was obtained by the B2C3 variant, where the yield was 14.25% higher than the yield obtained by the B1C2 variant. In terms of protein content, the difference between the mentioned varieties was 4.85%, in the weight of 1000 grains 4.98%, in hectoliter weight 3.10%, and in the height of the plant 5.26%. We can conclude that seed treatment with the biopreparation Mycor-FAZOS improved root development and the plants were healthier, taller and more robust, but also of uniform growth and darker than untreated seed variants (increased photosynthesis index). The protection performed with Vitality-FAZOS and Super Green-FAZOS biopreparations (microorganisms that have an extremely fungicidal effect, but also synthesize growth hormones) ensured that the wheat remained healthy, while achieving a higher seed yield and obtained better quality of the researched parameters.
Keywords: benefit microorganisms, wheat, yield, quality elements

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

The effect of high voltage electrical discharge (HVED) treatment on small seed plants

Lea LOJKOVÁ[1], Sanja ZEC ZRNUŠIĆ[2], Helena PLUHÁČKOVÁ[1], Radim CERKAL[1], Tihana MARČEK[2]

[1] Mendel University in Brno, Faculty of AgriSciences, Zemědělská 1665/1, Brno, Czech Republic
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology, Franje Kuhača 18, Osijek, Croatia

Abstract
High voltage electrical discharge (HVED), is a method that modifies the physiochemical water structure creating plasma-activated water. Recent studies showed a beneficial HVED effect on germination and plant growth under both optimal and stress conditions. In this study, three types of seeds with low germination rates were used. The aim of the study was to find out whether seeds of carrot (*Daucus carota* L.), melitot (*Melilotus officinalis* L.), and mallow (*Malva verticillata* L.) can undertake the HVED treatment to increase germination ability and vitality in the early developmental stage. Seeds were treated at 30Hz for the 30s (carrot, mallow) while melilot seeds were exposed to HVED treatment for 10s under the same frequency. In carrot and mallow, HVED promoted germination percentage during the time. HVED improved the growth of shoots and roots in all tested plant species on the 10th day. The shoot length in carrot, melitot, and mallow increased by 33%, 27%, and 83% in the HVED group compared to untreated plants. Similarly, root length was 26% (carrot), 24.7% (melitot), and 38% (mallow) higher in HVED-treated plants. Obtained results showed promising usage of the HVED method in improving the germination properties of seed material with low germination ability.
Keywords: high voltage electrical discharge, small seeds, germination, growth

Ecological Agriculture / *Ekološka poljoprivreda*
Oral presentation / *Usmeno priopćenje*

Soil and Millet (*Panicum miliaceum*) response to fly bioash application in acidic luvisol

Gabrijel ONDRASEK, Jelena HORVATINEC, Filip KRANJČEC

University of Zagreb, Faculty of Agriculture, Svetosimunska cesta 25, Zagreb, Croatia

Abstract
Fly bioash (FBA) is an alkaline (pH>13) complex solid by-product from biomass-fuelled plant facilities, enriched in numerous minerals and nutrients. A field experiment was conducted to investigate the influence of FBA addition at increasing rates (0-17.2 t/ha) on certain chemical pedovariables and millet (*Panicum miliaceum*) vegetative performances, during one vegetation season in acidic (pH 4.0) agricultural luvisol. The results showed that FBA addition had a significant positive effect on the rhizosphere soil, including an increase in soil pH (up to 7.8), electrical conductivity (up to 0.288 mS/cm), and the content of bioavailable P (up to 3.5-fold) and K (up to 3.9-fold). Furthermore, FBA significantly improved the grain yield (by 52%) and vegetative growth parameters (fresh biomass of root by 53% and shoot by 45%, shoot length by 35%) in comparison to the control soil without FBA addition. These findings suggest that FBA has the potential to ameliorate soil acidity and provide cultivated plants with more available essential nutrients, resulting in improved plant growth and yield. However, further long-term open-field and controlled studies are needed to investigate other soil pedovariables (e.g. microbiomes, trace metal bioavailability) to avoid any potential adverse environmental consequences (salinization, metal contamination, reduced microbial diversity), prior to widespread use of FBA.
Keywords: biomass fly ash, acidic soil, millet, open-field experiment, plant growth, nutrients

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Possibilities of ecological equidae products production

Mihaela OROZ[1], Jelena RAMLJAK[2], Mirjana BABAN[1]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia
[2] University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia

Summary
In Croatia, in ecological conditions, indigenous breeds of horses (Croatian cold-blooded horse, Croatian Posavac, Međimurje horse), and donkeys (Littoral Donkey, Istrian Donkey, North Adriatic Donkey) are extensively bred, and by staying on pastures they turn the voluminous plant mass into valuable animal products, milk and meat. There is no organized production or processing of mare's and donkey's milk or horse's and donkey's meat in our country, unlike other domestic animal products. However, the production and processing of mare's and donkey's milk is increasing due to the knowledge of the positive effects on human health and vitality. Although it is not often emphasized that horse or donkey meat is produced or consumed at all, it is certainly a fact that cannot be denied. The emotional relationship of a man towards a horse or a donkey represents a barrier for many consumers to include Equidae meat in their own diets. However, through proper marketing of horse and donkey milk and meat as indigenous and ecological products, these products are gradually being presented as part of the exclusive tourist offer. The perspective of Equidae breeding in Croatia must be based on the indigenous ecological products branding, as a competitive product for the European market.
Keywords: ecological products, autochthonous breeds, ungulate milk, ungulate meat

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Mogućnosti proizvodnje ekoloških proizvoda kopitara

Mihaela OROZ[1], Jelena RAMLJAK[2], Mirjana BABAN[1]

[1] Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti Osijek, V. Preloga 1, Osijek, Hrvatska
[2] Sveučilište u Zagrebu, Agronomski fakultet Zagreb, Svetošimunska cesta 25, Zagreb, Hrvatska

Sažetak
U Republici Hrvatskoj se u ekološkim uvjetima ekstenzivno uzgajaju autohtone pasmine konja (hrvatski hladnokrvnjak, hrvatski posavac, međimurski konj) i magaraca (primorsko-dinarski, istarski i sjeverno-jadranski) koji boravkom na pašnjacima pretvaraju voluminoznu biljnu masu u vrijedne animalne proizvode, mlijeko i meso. U Hrvatskoj nema organizirane proizvodnje i prerade kobiljeg i magaričinog mlijeka te konjskog i magarećeg mesa kao u slučaju drugih vrsta domaćih životinja. Međutim, proizvodnja i prerada mlijeka kobila i magarica se povećava zbog spoznaja o pozitivnim učincima na zdravlje i vitalnost ljudi. Premda se često ne naglašava da se uopće proizvodi ili konzumira meso konja ili magaraca, to je svakako činjenica koja se ne može zaobići. Emotivni odnos čovjeka prema konju ili magarcu brojnim potrošačima predstavlja barijeru u uvođenju mesa kopitara u vlastiti jelovnik. Međutim, uz primjeren marketing mlijeka i mesa konja i magaraca kao autohtonog i ekološkog proizvoda, ono polako postaje dio ekskluzivne turističke ponude. Bilježe se primjeri organiziranog korištenja mesa magaraca i konja u elitnoj gastronomskoj ponudi. Perspektiva uzgoja kopitara u Hrvatskoj se mora temeljiti na brendiranju autohtonih ekoloških proizvoda kao konkurentnog proizvoda za europsko tržište.
Ključne riječi: ekološki proizvodi, autohtone pasmine, mlijeko kopitara, meso kopitara

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Post-harvest cover crops as a stimulative pasture for increased honey bee (*Apis mellifera L.*) nutrition

Zlatko PUŠKADIJA, Marin KOVAČIĆ, Filip JAMAN, Bojan STIPEŠEVIĆ

Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
The importance of pollination service of insects, especially honey bees, has been a very important topic recently, due to the disturbance of pollinators via global climate changes and human impact through environmentally unfavorable agriculture practices, deforestation and nature meadows transformation into arable land. In order to mitigate enlisted negative impacts, the honey bee has to have supplementary feed for the prolonged active period, which can be arranged with seeding "floral islands" - arable land seeded by cover crop after winter crop being harvested. An experiment has been established near Vukovar, Croatia, where "floral islands" of cover crops (a mixture of buckwheat, mustard, phacelia, camelina and nyger) were established at two sites during the summers 2021 and 2022. The test group (5 apiaries with 10 bee colonies) was moved next to the fallow crop, while the control group was located away from it, and the strength of the bee colonies was measured. The test group showed slightly more brood and bees than the control group before winter, while in March of the following year the test group had significantly more brood and there were no differences in the number of frames occupied with bees. The research showed the importance of summer feeding of bee colonies, either through flower strips in the form of a cover crop or feeding with sugar syrup. For further research, we recommend examining the earlier sowing of the post-harvest cover crops so that flowering coincides with the intensive preparation of the honey bee colony for the winter.
Keywords: honeybee, summer cover crops, stimulative pasture

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

The state of organic milk production in the EU and the Republic of Croatia

Dragan SOLIĆ[1], Marija ŠPEHAR[1], Lidija MAUROVIĆ-KOŠĆAK[1], Vesna GANTNER[2]

[1] Croatian Agency for Agriculture and Food, Usorska 19, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotehnical Science Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
Organic agricultural production is not only a highly specialized part of food production, but it is becoming a way of life as well as one of the most dynamic sectors of agriculture. The number of hectares under ecological agricultural production is constantly increasing at the World and European level. European organic production represents around 20% of all organic agricultural areas on a global level. Organic milk production is based on approved rules that include animals' origin, breeding and housing procedures, feeding and health care. Although the proportion of organic milk in total milk production is low (3.7%), in several countries organic milk production has a respectable proportion in total produced milk as follows: Sweden (20%), Austria (17%) and Denmark (13%). Half of all organic milk in the EU is used as drinking milk, while 26% is used for cheese production. The prices of organic milk in countries with organized purchases during 2021 were on average 12% higher than the prices of conventionally produced milk. Milk production per cow is lower on organic farms (from 8 to 33%) than production on conventional farms
Keywords: organic milk production, share of organic milk, prices of organic milk

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Stanje ekološke proizvodnje mlijeka u Europskoj uniji i Republici Hrvatskoj

Dragan SOLIĆ[1], Marija ŠPEHAR[1], Lidija MAUROVIĆ-KOŠĆAK[1], Vesna GANTNER[2]

[1] Hrvatska agencija za poljoprivredu i hranu, Usorska 19, Osijek, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti, Vladimira Preloga 1, Osijek, Hrvatska

Sažetak
Ekološka poljoprivredna proizvodnja nije samo visoko specijalizirani dio proizvodnje hrane, već postaje način života, ali i jedan od najdinamičnijih sektora poljoprivrede. Broj hektara pod ekološkom poljoprivrednom proizvodnjom u stalnom je porastu na svjetskoj i europskoj razini. Europska ekološka proizvodnja predstavlja oko 20% svih ekoloških poljoprivrednih površina na globalnoj razini. Ekološka proizvodnja mlijeka temelji se na odobrenim pravilima koja uključuju podrijetlo životinja, postupke uzgoja i držanja, hranidbu i zdravstvenu njegu. Iako je udio ekološki proizvedenog mlijeka u ukupnoj proizvodnji mlijeka nizak (3,7 %), u nekoliko zemalja ima respektabilan udio u ukupno proizvedenom mlijeku: Švedska (20 %), Austrija (17 %) i Danska (13 %). Polovica cjelokupnog ekološki proizvedenog mlijeka u EU koristi se kao mlijeko za piće, dok se 26% koristi za proizvodnju sira. Cijene ekološkog mlijeka u zemljama s organiziranim otkupom tijekom 2021. bile su u prosjeku 12 % više od cijena konvencionalno proizvedenog mlijeka. Proizvodnja mlijeka po kravi manja je na ekološkim farmama (od 8 do 33 %) od proizvodnje na konvencionalnim farmama.
Ključne riječi: ekološka proizvodnja mlijeka, udio ekološkog mlijeka, cijena ekološkog mlijeka

Ecological Agriculture / *Ekološka poljoprivreda*
Poster presentation / *Postersko priopćenje*

Conventional and ecological production of vegetables in the Republic of Croatia

Snježana TOLIĆ[1], Lidija MAUROVIĆ KOŠĆAK[2], Ljubica RANOGAJEC[1]

[1] Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti Osijek, Vladimira Preloga 1, Osijek, Croatia
[2] Croatian Agency for Agriculture and Food, Vinkovačka cesta 63c, Osijek, Croatia

Abstract
The purpose of the work is to determine the state of vegetable production in the Republic of Croatia with an emphasis on organic production. Despite the good growing conditions, domestic production meets about 65% of the need for vegetables with annual fluctuations. During the analyzed period, there were noticeable changes in the share of certain vegetable crops in the structure of areas under vegetables, but also a very low share of organic vegetable production despite the increasing demand. The paper includes 1) an overview of the areas under vegetable crops in Croatia, including areas under organic production, 2) an analysis of changes in the structure of production from 2015 to 2021 in the coverage of used areas for which subsidies are requested, and 3) an insight into the reasons of insufficient vegetable production and weak interest of producers in organic vegetable production. The paper used data from the Agency for Payments in Agriculture, the Ministry of Agriculture, and the results of previous research. The aim of the work is to evaluate the current situation in the vegetable sector and to point out the possibilities of production development within the framework of new development policies.
Keywords: vegetable production, structure of vegetable production, organic vegetable production, Croatia

Ecological Food Production
Ekološka proizvodnja hrane

Ecological Food Production / *Ekološka proizvodnja hrane*
Oral presentation / *Usmeno priopćenje*

Possible factors affecting high mortality rate of locusts, *Locusta migratoria* (Linn, 1758) reared for manure and food

Melita ZEC-VOJINOVIĆ, Slavica DUDAŠ, Martina PERŠIĆ, Marin TOMIČIĆ

Polytechnic of Rijeka, Vukovarska 58, Rijeka, Croatia

Abstract
Insects are suggested as a sustainable replacement feed for animals, a protein source for humans and as manure. Since the availability and sustainability of protein production is becoming insufficient and expensive, alternatives are required. One of the alternatives is also mass rearing of *Locusta migratoria*, insects that has been approved for human consumption by the European Commission. The locusts are alternative protein sources for humans and animals, rich in nitrogen and other macro-nutrients that enrich soil, and various minerals and vitamins. According to the benefits of edible insects, the number of insect farms is increasing. One of the farms is also established in Croatia to produce insect manure and proteins as food for humans. One of the challenges that the farm faces are periodical high locust mortality rate. Thus, the overall goal is to investigate the possible factors affecting the locust mortality. The aim of this study was to test the presence of entomopathogens as factors causing mortality. According to the preliminary results, there was no evidence of tested entomopathogen infection. The behavior of ill insects was recorded and possible mortality factors were identified. Future studies will identify abiotic factors and raring conditions that impact the high locust mortality rate.
Keywords: locust, mortality, manure, food, insect farm

Ecological Food Production / *Ekološka proizvodnja hrane*
Oral presentation / *Usmeno priopćenje*

Mogući uzročnici visoke stope smrtnosti skakavaca *Locusta migratoria* (Linn, 1758) uzgajanih za gnojivo i hranu

Melita ZEC-VOJINOVIĆ, Slavica DUDAŠ, Martina PERŠIĆ, Marin TOMIČIĆ

Veleučilište u Rijeci, Vukovarska 58, Rijeka, Hrvatska

Sažetak
Kukci se predlažu kao održiva alternativa za prehranu životinja, izvor proteina za ljude i kao gnoj. Budući da dostupnost i održivost proizvodnje proteina postaje nedostatna i skupa, potrebne su alternative. Jedna od alternativa je i masovni uzgoj vrste *Locusta migratoria*, jednog od kukaca koje je Europska komisija odobrila za prehranu ljudi. Skakavci su alternativni izvori proteina za ljude i životinje, uključujući kućne ljubimce i ribe, bogati su dušikom i drugim makronutrijentima koji obogaćuju tlo, te raznim mineralima i vitaminima. S obzirom na dobrobiti jestivih kukaca, povećava se broj farmi za uzgoj kukaca. Jedna od farmi za proizvodnju gnoja za uzgoj biljaka i proteina kao hrane za ljude je osnovana i u Hrvatskoj. Jedan od izazova s kojima se farma suočava je povremena visoka stopa smrtnosti skakavaca. Stoga je opći cilj bio istražiti moguće čimbenike koji utječu na smrtnost skakavaca. Cilj ovog rada bio je ispitati prisutnost entomopatogena kao čimbenika smrtnosti. Prema preliminarnim rezultatima nije bilo dokaza o zaraženosti skakavaca sa testiranim entomopatogenima. Zabilježeno je ponašanje bolesnih kukaca te su identificirani mogući čimbenici smrtnosti. Buduće studije identificirat će abiotske čimbenike i uvjete koji bi mogli utjecati na visoku stopu smrtnosti skakavaca.
Ključne riječi: skakavac, mortalitet, gnojivo, hrana, farma kukaca

Ecological Food Production / *Ekološka proizvodnja hrane*
Poster presentation / *Postersko priopćenje*

Effects of drought on total phenolic content and phenolic secoiridoids profile in organically produced extra virgin olive oil from the island of Korčula

Tea BILUŠIĆ[1], Sunčica ROCA[2], Vilko SMREČKI[2], Prokopios MAGIATIS[3], Elleni MELIOU[3], Petra BRZOVIĆ[1]

[1] University of Split, Faculty of Chemistry and Technology, R. Boškovića 35, Split, Croatia
[2] Ruđer Bošković Institute, NMR Centre, Bijenička cesta 54, Zagreb, Croatia
[3] National and Kapodistrian University of Athens, Department of Pharmacognosy and Chemistry of Natural Products, 30 Panepistimiou, Athens, Greece

Abstract
Environmental factors are known to affect the phenolic content in olive fruit and lead to changes in phenolic profile. This study compares the total phenolic content and the profile of phenolic secoiridoids (oleocanthal, oleacein, ligstroside, oleuropein) in relation to water deficit stress in organically produced extra virgin olive oil from Korčula island. The accumulation of phenolic compounds is one of the adaption mechanisms of the olive tree against water deficit[1]. Due to the numerous health benefits of phenolic compounds in extra virgin olive oil (especially oleocanthal, oleacein, oleuropein), their content is associated with a positive health profile and consequently with the market value of olive oil. The percentage of free fatty acids (FFA) and the peroxide value (PV) are very similar in organically produced extra virgin olive oil after a drought and after a rainy period. The total phenolic content in olive oil after a drought period is much higher (1236.23 mg/kg) than in olive oil after a rainy period (668.10 mg/kg) which was confirmed by Folin-Ciocalteu colorimetric assay and NMR spectroscopy. The content of oleocanthal, oleacein, ligstroside and oleuropein aglycones (mono- and dialdehyde forms), total tyrosol and hydroxytyrosol derivatives is much higher (ca. 53%) in olive oil after drought stress.
Keywords: organic production, extra virgin olive oil, drought, phenolic content, phenolic secoiridoids

Ecological Food Production / *Ekološka proizvodnja hrane*
Poster presentation / *Postersko priopćenje*

Impact of native *Pichia kluyveri* and *Metschnikowia pulcherrima* on Maraština wines

Ana BOBAN[1], Vesna MILANOVIĆ[2], Zvonimir JURUN[1], Ana MUCALO[1], Irena BUDIĆ-LETO[1]

[1] Institute for Adriatic Crops and Karst Reclamation, Put Duilova 11, Split, Croatia
[2] Polytechnic University of Marche, Department of Agricultural, Food and Environmental Sciences, Ancona, Italy, via Brecce Bianche, Ancona, Italy

Abstract
Wines made from the same grape variety but from different grape microbiota are appreciated for their diversity. Grape microbiota varies among the same variety, and depends on the vineyard condition status, soil type, temperature, and rainfall, thus influencing the diversity of wines produced from the same grape but from different vineyards or winegrowing regions. Even if *Saccharomyces cerevisiae* is the main species able to complete fermentation, nowadays there is growing interest in native non-*Saccharomyces* yeasts due to their possible contribution to wine organoleptic properties. The aim of this study was to investigate the fermentative potential of native non-*Saccharomyces* yeast strains in sequential fermentation with commercial *S. cerevisiae* yeast with the purpose of selecting the potential starter culture. Indigenous *Pichia kluyveri* and *Metschnikowia pulcherrima* yeasts were selected from a collection of native yeasts established at the Institute for Adriatic Crops and Karst Reclamation in 2021, previously isolated from Maraština grapes. Control fermentation was set up with commercial *M. pulcherrima* FLAVIA strain. Both native yeasts in sequential fermentation with *S.cerevisiae* finished alcoholic fermentation. Physico-chemical parameters like ethanol (% vol.), volatile acids (g/L), pH, and extract content (g/L) in experimental wines revealed good fermentation performance of native yeast strains in comparison with commercial *M. pulcherrima/S.cerevisiae*.
Keywords: native yeast, *Pichia kluyveri, Metschnikowia pulcherrima*, Maraština, FTIR analysis

Ecological Food Production / *Ekološka proizvodnja hrane*
Poster presentation / *Postersko priopćenje*

Perception of Faculty of tourism and rural development students on slow food concept

Maja ERGOVIĆ RAVANČIĆ, Valentina OBRADOVIĆ, Helena MARČETIĆ, Svjetlana ŠKRABAL

Josip Juraj Strossmayer University of Osijek, Faculty of tourism and rural development in Požega, Vukovarska 17, Požega, Croatia

Abstract
The slow food movement, which originated in Italy in 1989, is a movement that defines a respectful attitude towards food. It includes the protection of local food, food culture and traditions. The movement advocates the cultivation of food that is carefully prepared and consumed with pleasure. It encourages the improvement of relations between producers of ecologically produced food, cooks and consumers. Slow food represents resistance to fast food and modern fast consumption, which has led to the abandonment of local gastronomic traditions and a decrease in people's interest in authentic food. The aim of this paper was to investigate the attitudes of students of the Faculty of Tourism and Rural Development in Požega about slow food. Using the online survey method, the research has been conducted on a sample of 38 students of Enogastronomy and Tourism. The results of the research showed that students are aware of the concept of slow food. Enjoying the food, they consume is extremely important for almost all students. Half of the respondents had heard of slow food, while only a quarter declared that they had consumed food presented as slow food. According to the respondents, slow food is best described by the attributes "natural", "ecological", "healthy", "conscious food consumption" and "enjoying eating".
Keywords: slow food, student, organic food, perception, consumption

Ecological Food Production / *Ekološka proizvodnja hrane*
Poster presentation / *Postersko priopćenje*

What is behind the GM(O)-free label and consumer's right to an informed choice

Renata HANZER, Ksenija DUKA

Croatian Agency for Agriculture and Food, Usorska 19 Brijest, Osijek, Croatia

Abstract
According to European Union legislation, products containing or consisting of genetically modified organisms that have been authorized for marketing must be clearly labeled. The obligation to label excludes products in which an adventitious or technically unavoidable content of an approved genetically modified organism was found below 0.9%. We call labeling like this positive labeling and its purpose is to enable consumers to make an informed choice. In addition to positive labeling on the market, we also recognize negative labeling such as GM(O)-free labeling, which, in addition to the existing obligation of positive labeling, additionally emphasizes the exemption of the presence of a food ingredient. At the Union level, there is no unique legislation that prescribes the conditions and use of GM(O)-free labels, but they are applied on a voluntary basis through the adoption of national regulations of individual member states respecting the existing laws. There are a large number of such national labels on the European Union market, but the lack of a harmonized approach also brings different requirements for certification, such as the threshold of technically unavoidable presence for food of non-animal origin or animal feeding requirements for products of animal origin. The average European consumer is aware of the importance of food quality and their right to make an informed choice, and at the same time, the European market is flooded with different labels which can lead to confusing information as well as mistrust of the system.
Keywords: genetically modified organisms, GMO-free labeling, legislation

Ecological Food Production / *Ekološka proizvodnja hrane*
Poster presentation / *Postersko priopćenje*

Što se krije iza GM(O)-free oznake i pravo potrošača na informirani odabir

Renata HANZER, Ksenija DUKA

Hrvatska agencija za poljoprivredu i hranu, Usorska 19, Brijest, Osijek, Hrvatska

Sažetak

Prema zakonodavstvu Europske unije proizvodi koji sadrže ili se sastoje od genetski modificiranih organizama koji su prošli postupak odobravanja moraju biti jasno označeni. Obveza označavanja izuzima proizvode kod kojih je utvrđen slučajan ili tehnološki neizbježan sadržaj odobrenog genetski modificiranog organizma u količini manjoj od 0,9 %. Ovako označavanje nazivamo pozitivnim označavanjem i ima za svrhu omogućiti potrošačima informirani odabir. Osim pozitivnog označavanja na tržištu prepoznajemo i negativno označavanje poput GM(O)-free označavanja kojim se uz postojeću obvezu pozitivnog označavanja dodatno naglašava izuzeće prisustva nekog sastojka hrane. Na razini unije ne postoji jedinstveno zakonodavstvo koje propisuje uvjete i korištenje GM(O)-free oznaka već se one primjenjuju na dobrovoljnoj osnovi donošenjem nacionalnih propisa pojedinih članica uvažavajući postojeće zakone. Na tržištu Europske unije prisutan je veliki broj takvih nacionalnih oznaka, no ne postojanje harmoniziranog pristupa donosi i različite zahtjeve za certificiranje poput praga tehnološki neizbježnog sadržaja kod hrane neživotinjskog porijekla ili uvjeta hranjenja životinja kod proizvoda životinjskog porijekla. Prosječan europski potrošač svjestan je važnosti kvalitete hrane i svog prava na informirani odabir, a istovremeno je europsko tržište preplavljeno posebnim oznakama na proizvodu što može dovesti do zbunjujućih informacija kao i nepovjerenja u sustav.

Ključne riječi: genetski modificirani organizmi, GM(O)-free označavanje, zakonodavstvo

Ecological Food Production / *Ekološka proizvodnja hrane*
Poster presentation / *Postersko priopćenje*

Phenolic content and mass loss during storage of three types of microgreens

Marin TOMIČIĆ, Slavica DUDAŠ, Melita ZEC VOJINOVIĆ, Martina PERŠIĆ

Polytechnic of Rijeka, Vukovarska 58, Rijeka, Croatia

Abstract
Microgreens, in addition to being used in fine dining in recent years, are considered to be functional food due to their high content of vitamins, minerals, and antioxidants. Due to the simple growing system, microgreens can be a source of fresh vegetables in places where vegetable cultivation is difficult or impractical. The aim of this research was to determine the differences in the phenolic content, the change in the phenolic content and the loss of mass during storage of three different types of microgreens. After seven days of uncovered storage at 6 °C, the mass loss of radish was 74.5%, of wheat 66.3%, and of peas 49.5%. During storage in plastic bags at 6 °C, the mass loss of wheat was 6.5%, of radish 4.8%, and of peas 3.6%. At the harvest, radish microgreens had the highest content of phenolic compounds in comparison to weat and pea microgreens. When comparing the phenolic content before and after storage in plastic bags, results showed that there was no significant change in the phenolic content in peas during storage, while the content decreased in wheat and increased in radishes.
Keywords: microgreens, phenolic compounds, wheat, pea, radish

Ecological Food Production / *Ekološka proizvodnja hrane*
Poster presentation / *Postersko priopćenje*

Sadržaj fenola i gubitak mase tijekom skladištenja tri vrste mikrozelenja

Marin TOMIČIĆ, Slavica DUDAŠ, Melita ZEC VOJINOVIĆ, Martina PERŠIĆ

Veleučilište u Rijeci, Vukovarska 58, Rijeka, Hrvatska

Sažetak
Uz to što se posljednjih godina koristi u visokoj gastronomiji, mikrolozenje se zbog visokog udjela vitamina, minerala i antioksidansa smatra funkcionalnom hranom. Zbog jednostavnog načina uzgoja može predstavljati izvor svježeg povrća u mjestima gdje je otežan ili nepraktičan njegov uzgoj. Cilj istraživanja bio je utvrditi razlike u sadržaju fenolnih tvari, promjeni sadržaja fenolnih tvari i gubitku mase tijekom skladištenja tri različite vrste mikrozelenja. Gubitak mase nakon sedam dana skladištenja na otvorenom pri 6 °C iznosio je 74,5 % kod rotkvice, 66,3 % kod pšenice te 49,5 % kod graška. Prilikom skladištenja u plastičnim vrećicama pri 6 °C gubitak mase iznosio je 6,5 % kod pšenice, 4,8 % kod rotkvice i 3.6 % kod graška. Sadržaj fenolnih tvari nakon berbe bio je veći kod rotkvice u usporedbi sa pšenicom i graškom. Usporedbom sadržaja fenolnih tvari prije i nakon sedam dana skladištenja u plastičnim vrećicama utvrđeno je da kod graška nije bilo značajne promjene u sadržaju fenolnih tvari tijekom skladištenja, dok se kod pšenice sadržaj smanjio, a kod rotkvice povećao.
Ključne riječi: mikrozelenje, fenoli, pšenica, grašak, rotkvica

Ecological Medicine and Biomedicine
Ekološka medicina i biomedicina

The circulation of iodine in nature and its impact on human health

Marija DUNDOVIĆ[1], Ines BANJARI[2], Marina FERENAC KIŠ[1,3]

[1] Clinical Hospital Centre Osijek, Josip Huttler Street 4, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[3] Josip Juraj Strossmayer University of Osijek, Faculty of Medicine, Josip Huttler Street 4, Osijek, Croatia

Abstract
Iodine is a halogen element that varies greatly in concentration among sources in the environment. It is abundant in the marine environment and organic sedimentary rocks. In the environment, iodine circles in the biogeochemical circle, which includes the atmosphere, hydrosphere, geosphere and biosphere. Before the last ice age, iodine was uniformly distributed in the environment, but afterward, regions rich and poor in iodine were created. Iodine is omnipresent in the human body and is crucial for the thyroid gland's functioning. Food and water are the main sources of iodine for the body. The main food sources of iodine are seaweed and saltwater fish, as well as dairy and eggs. Considering the lack of iodine in certain regions and the occurrence of diseases caused by the insufficient intake of iodine, a number of countries put in the effect mandatory iodine food fortification, mostly salt. Population groups at a particularly high risk of iodine deficiency are pregnant women, nursing mothers and children. The aim of this paper is to provide a literature review of the current understanding of how climate change affects iodine's circulation in nature and human health.
Keywords: iodine, iodine circulation, human health

Kruženje joda u prirodi i utjecaj na zdravlje čovjeka

Marija DUNDOVIĆ[1], Ines BANJARI[2], Marina FERENAC KIŠ[1,3]

[1] Klinički bolnički centar Osijek, Ulica Josipa Huttlera 4, Osijek, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek, Franje Kuhača 18, Osijek, Hrvatska
[3] Sveučilište Josipa Jurja Strossmayera u Osijeku,Medicinski fakultet Osijek, Ulica Josipa Huttlera 4, Osijek, Hrvatska

Sažetak

Jod je halogeni element čija koncentracija značajno varira među izvorima u okolišu, a najviše je prisutan u morskom okolišu i organskim sedimentnim stijenama. U okolišu kruži u biogeokemijskom ciklusu koji uključuje atmosferu, hidrosferu, geosferu i biosferu. Prije pojave posljednjeg ledenog doba jod je bio jednolično raspoređen u sastavnicama okoliša, a nakon ledenog doba dolazi do stvaranja regija koje su bogate i siromašne jodom. Jod je sve prisutan element u ljudskom organizmu i ključan za rad štitnjače koja ga koristi za stvaranje hormona nužnih za regulaciju staničnog metabolizma i vitalnih tjelesnih funkcija. Jod u ljudski organizam ulazi putem hrane i vode. Glavni prehrambeni izvori joda su morske alge i morska riba, ali su dobar izvor joda i mliječni proizvodi te jaja. S obzirom na nedostatak joda u pojedinim regijama i pojavnost bolesti koje su uzrokovane nedovoljnim unosom joda, brojne zemlje uvode obvezno obogaćivanje hrane jodom, najčešće soli. Populacijske skupine u riziku od nedovoljnog unosa joda i posljedično povećanog rizika za brojne bolesti su trudnice, dojilje i djeca predškolske i školske dobi. Cilj ovog rada je kroz pregled literature prikazati trenutne spoznaje o utjecaju klimatskih promjena na ciklus kruženja joda u prirodi i posljedični utjecaj na zdravlje čovjeka.

Ključne riječi: jod, kruženje joda u prirodi, ljudsko zdravlje

Ecological Medicine and Biomedicine / Ekološka medicina i biomedicina
Oral presentation / *Usmeno priopćenje*

Antiinflammatory effect of extracellular vesicles from blood plasma on HUVEC culture

Zala JAN[1], Anna ROMOLO[1,2], Aleš IGLIČ[2], Damjana DROBNE[3], Veronika KRALJ-IGLIČ[2]

[1] University of Ljubljana, Faculty of Health Sciences, Laboratory of Clinical Biophysics, Zdravstvena 5, Ljubljana, Slovenia
[2] University of Ljubljana, Faculty of Electrical Engineering, Laboratory of Physics, Tržaška 5, Ljubljana, Slovenia
[3] University of Ljubljana, Biotechnical Faculty, Research Group for Nanobiology and Nanotoxicology, Jamnikarjeva 101, Ljubljana, Slovenia

Abstract
Clinical evidence indicates beneficial effects of blood plasma in different fields of medicine (e.g. in wound healing and regeneration), however, the underlying mechanisms are not yet completely understood. It was indicated that extracellular vesicles (EVs) that are shed by blood cells may be the vectors of the healing processes. It was the aim of this study to provide evidence in regard to this hypothesis. We isolated EVs from human blood plasma and characterized them by cryogenic transmission electron microscopy and by interferometric light microscopy. EVs were added to the Human Umbilical Vein Endothelial Cells (HUVEC) culture. We assessed inflammation markers (CholinEsterase, Glutathione S Transferase and Tumour Necrosis Factor Alpha) by ELISA tests before exposure to EVs and after 24 hours of exposure. The size of the EVs that appeared as bilayer membrane-enclosed particles was on average 115 nm and their number density was 1.8×10^{10} /mL. We found that 24 hours after the addition of EVs to the cells the inflammation markers considerably and statistically significantly decreased. These results indicate that the beneficial effect of plasma in healing and regeneration includes suppression of inflammation mediated by EVs.
Keywords: platelet-rich plasma, extracellular vesicles, interferometric light microscopy

The influence of Tae Bo exercises on phosphorus and calcium levels in women with osteoporosis

Slavica JANKOVIĆ, Tea DODLEK

University of Applied Sciences "Lavoslav Ružička" in Vukovar, Županijska ulica 50, Vukovar, Croatia

Abstract

Calcium and phosphorus are the most abundant minerals necessary for building bones. Their levels in the body are influenced by many factors, one of which is physical activity. Insufficient levels of the mentioned minerals can lead to the manifestation of osteopenia and osteoporosis. This paper aimed to show the impact of Tae Bo exercise and walking on the levels of calcium and phosphorus in women suffering from osteoporosis. Tae Bo is a high-intensity aerobic activity that combines martial arts with dance movements, with the aim of increasing strength, muscular endurance and flexibility. The research was conducted as a prospective randomized controlled trial on 92 women aged 55 to 65 in Vukovar-Srijem County. Blood calcium and phosphorus levels were measured at the beginning and at the end of the trial. The results of this paper showed that Tae Bo exercises and walking do not have a statistically significant effect on the blood calcium and phosphorus levels.

Keywords: phosphorus, calcium, osteoporosis, Tae Bo

Ecological Medicine and Biomedicine / Ekološka medicina i biomedicina
Oral presentation / *Usmeno priopćenje*

Utjecaj Tae Bo vježbi na vrijednost fosfora i kalcija kod žena s osteoporozom

Slavica JANKOVIĆ, Tea DODLEK

Veleučilište „Lavoslav Ružička“ u Vukovaru, Županijska ul. 50, 32000, Vukovar, Hrvatska

ažetak
Kalcij i fosfor najzastupljeniji su minerali neophodni za izgradnju kosti. Na njihovu vrijednost u organizmu utječu mnogi čimbenici, a jedan od njih je tjelesna aktivnost. Nedostatne razine navedenih minerala mogu utjecati na pojavu osteopenije i osteoporoze. Cilj ovog istraživanja bio je prikazati utjecaj Tae Bo vježbi i šetanja na vrijednosti kalcija i fosfora kod žena oboljelih od osteoporoze. Tae Bo je visoko intenzivna aerobna aktivnost koja kombinira pokrete borilačkih vještina s plesnim pokretima, a s ciljem povećanja snage, mišićne izdržljivosti i fleksibilnosti. Istraživanje je provedeno kao prospektivna randomizirana kontrolirana studija na 92 žene u dobi od 55 do 65 godina u Vukovarsko–srijemskoj županiji. Vrijednosti kalcija i fosfora iz krvi izmjerene su na početku i na kraju istraživanja. Rezultati ovog istraživanja su pokazali da Tae Bo vježbe i šetanje nemaju statistički značajan utjecaj na vrijednosti kalcija i fosfora u krvi.
Ključne riječi: fosfor, kalcij, osteoporoza, Tae Bo

Ecological Medicine and Biomedicine / Ekološka medicina i biomedicina
Oral presentation / *Usmeno priopćenje*

Oncogenic potential and pathways of the most common drinking water contaminants

Tomislav KUREVIJA[1,3], Valentina KUREVIJA[2], Matea LUKIĆ[1], Ivan ŠTEFANAC[3,4]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Medicine, Josip Huttler Street 4, Osijek, Croatia
[2] Clinical Hospital Centre Osijek, Josip Huttler Street 4, Osijek, Croatia
[3] Health Center of Osijek-Baranja County, Park kralja Petra Krešimira IV 6, Osijek, Croatia
[4] Josip Juraj Strossmayer University of Osijek, Faculty of Dental Medicine and Health, Crkvena 21, Osijek, Croatia

Abstract
In the last two centuries since the beginning of industrialization, the world has developed rapidly, which has contributed to the development of water supply networks and the improvement of the quality of drinking water. At the same time, as a result of the increasing development of industry, air and water pollution is also increased. The drinking water that we daily enter into our organisms, although thoroughly processed and purified by water services, still contains traces of various contaminants. Despite regular testing of water quality and limited maximum permitted levels for each contaminant, the question arises whether and to what extent the mentioned substances have a negative effect on human health. The most common contaminants detected in drinking water that according to relevant worldwide research contribute to a higher risk of cancer are arsenic and other heavy metals, nitrates, byproducts of chemicals and radioactive materials. The most common malignancies associated with this etiology are cancers of the bladder, kidneys, liver, colon and lungs. The goal of this research is to determine the current scientific knowledge of their oncogenic potential and their mechanisms of oncogenesis.
Keywords: drinking water contaminants, pollution, oncogenesis

Ecological Medicine and Biomedicine / Ekološka medicina i biomedicina
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Indoor air pollution and climate conditions in Sarajevo Kindergartens – Facing up with Growing Public Health Challenge

Daniel MAESTRO[1,2], Sabina ŠEGALO[2], Arzija PAŠALIĆ[2], Nerma MAESTRO[3]

[1] Institute of Public Health of the Federation of Bosnia and Herzegovina, Maršala Tita 9, Sarajevo, Bosnia and Herzegovina
[2] Univerity of Sarajevo, Faculty of Health Studies, Stjepana Tomića 1, Sarajevo, Bosnia and Herzegovina
[3] Institute of Public Health of the Sarajevo Canton, Mustafe Pintola 1, Sarajevo, Bosnia and Herzegovina

Abstract
After the parental home, kindergarten is the most important place of residence for children of preschool age. It is estimated that children spend an average of 5 to 7 years of their lives in kindergartens, 5 to 10 hours a day. It is known that this is a time of children's intense psychological and physical growth and development. Poor indoor air quality (IAQ) has numerous negative effects on health in general, affecting the respiratory system due to the presence of certain air pollutants from various sources. Considering the magnitude of the problem and characteristics of the geographic area of Sarajevo Canton, the study aimed to obtain results on IAQ in preschool institutions. Five kindergartens in different municipalities, environments, and distances from main roads were included. The levels of air pollutants and formaldehyde were measured. Daily particulate matter (PM) concentrations and noise levels were found to be above recommended levels in all kindergartens. Higher CO_2 concentrations were found in four facilities and elevated formaldehyde concentrations in one facility. Our results suggest that the health and general well-being of preschool-aged children are at risk from poor IAQ. There is an urgent need for the adoption of realistic strategies and action plans to improve the living conditions of preschool-aged children to reduce the risk of adverse health effects.
Keywords: indoor air quality, air pollutant, preschool institutions, health

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Environmental changes and vector-borne diseases

Zarema OBRADOVIĆ, Arzija PAŠALIĆ , Eldina SMJEČANIN, Ema PINDŽO, Enisa ŠLJIVO, Amar ŽILIĆ

University of Sarajevo, Faculty of Health Studies, Stjepana Tomića 1, Sarajevo, Bosnia and Herzegovina

Abstract
All over the world, an increase in diseases transmitted by vectors is evident and they account for 17% of all infectious diseases. These diseases arise in the pathogen-vector-host interaction, where the role of the vector is the most significant. Transmission of pathogens by vectors occurs from human to human, or more often from animals to humans, so a large number of vector-borne diseases are zoonoses. The most important vectors are mosquitoes and ticks, and the most important diseases they transmit are malaria, dengue fever, West Nile virus fever, yellow fever, Zika virus infection, Lyme disease, tick-borne encephalitis, Crime-Congo hemorrhagic fever and rickettsiosis. The life and maintenance of vectors are influenced by different environmental factors: climate, urbanization, deforestation, and waste disposal. In recent years, these factors have favored the increase in the number of vectors and their spread. As a result, there has been an increase in the number of people suffering from the diseases they transmit and their occurrence in the form of emergent or re-emergent diseases. The increase in the number of people suffering from vector-borne diseases was also contributed by reduced investment and limited resources for the control of these "One Health", integrated monitoring of the environment, animal health and human health. The segments of prevention of vector-borne diseases are raising the population's awareness of the importance of vectors, education of professionals who deal with vectors and vector-borne diseases, and planning and implementation of vector control measures.
Keywords: vectors, environment, prevention

Biodiversity innovations

Nika PAVLOVIĆ, Ivan MIŠKULIN, Maja MIŠKULIN

Josip Juraj Strossmayer University of Osijek, Faculty of Medicine Osijek, Josipa Huttlera 4, Osijek, Croatia

Abstract
Nature protection has become crucial for the preservation of humanity. Protected areas are not enough to preserve biodiversity and it is necessary to act on a global scale. For nature to recover, losses must be turned into gains. The EU Biodiversity Strategy in line with the UN Sustainable Development Goals, aims to reduce pressure on habitats and species and make ecosystem use sustainable. Tree planting campaigns, real-time monitoring of vegetation changes, and the use of satellites to detect thermal anomalies to curb deforestation and thus climate change, as well as sustainable architecture, are a good start to conserving natural wealth. DNA biobanking of endangered species, bioacoustic monitoring of wildlife, biocarbon engineering, and the reduction of invasive species from ballast water through the use of inflatable bladders called biomimicry are just a few of the innovations helping to save biodiversity. To stop the degradation of biodiversity, which is mainly a result of human activities, and to maintain a healthy environment and thus a better quality of life, joint efforts are needed. Otherwise, the world population will not be able to cope with the inevitable consequences.
Keywords: biodiversity, innovation, ecology, sustainable development, environment

Climate-friendly eating habits

Nika PAVLOVIĆ, Ivan MIŠKULIN, Maja MIŠKULIN

Josip Juraj Strossmayer University of Osijek, Faculty of Medicine Osijek, Josipa Huttlera 4, Osijek, Croatia

Abstract

Certain food chains contribute to an increase in greenhouse gas emissions and consequently have a negative impact on climate change. Food choices, ingredients and eating habits largely determine the health of our planet. In addition to environmental protection, a change in our consumption behavior in the sense of a sustainable diet would also have a major impact on our health. Such consumption patterns would include smaller portions, fresh seasonal and regional foods, a lower proportion of meat and processed foods and a higher proportion of fruits and vegetables thus supporting environmentally sustainable production. A more sustainable food system would also include reducing food waste, which is a major problem today. In most cases, people are unaware of the ways and extent to which their food choices can affect the environment. In order to eat healthier, it is necessary to educate people about the different ways they can make food choices, prepare food, and store food, which is an essential part of reducing waste. It can be a difficult and complicated process to change food choices and turn them into habitual behaviors. Increased awareness of choices and a shift in consciousness could change global food systems in favor of a sustainable environment.

Keywords: climate-friendly, eating habits, food chains, sustainable diet, waste reduction

Ecological Medicine and Biomedicine / Ekološka medicina i biomedicina
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The concentrations of polycyclic aromatic hydrocarbons in traditional dray cured meat product "*Buđola"* produced in industrial and traditional conditions

Leona PULJIĆ [1], Dragan KOVAČEVIĆ[2], Brankica KARTALOVIĆ[3], Kristina MASTANJEVIĆ [2], Nikolina KAJIĆ[1], Krešimir MASTANJEVIĆ[2]

[1] University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule bb, Mostar, Bosnia and Herzegovina
[2] University of Josip Juraj Strossmayer in Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[3] Scientific Veterinary Institute Novi Sad, Rumenački put 20, Novi Sad, Serbia

Abstract
When smoking, traditional meat products may be associated with some health safety concerns, such as the presence of polycyclic aromatic hydrocarbons (PAHs). Recently, there has been growing concern about the health aspects of meat products smoked in traditional (uncontrolled) conditions. Accordingly, this study aims to evaluate the difference in PAH content in the samples of the traditional dry-cured meat product "*Buđola*" produced in traditional smokehouses and in industrial chambers. PAHs were determined at the end of the smoking phase and at the end of the production. The comparison has shown that traditional smoking methods result in higher contamination with PAH than industrial ones. Out of 16 analyzed PAHs, 10 (Nap, Anl, Fln, Ant, Phen, Flt, BaA, Pyr, BbF, BkF) were found in the traditionally smoked "Buđola" samples, while 2 (Nap, Anl) were present in the industrially smoked samples. The content of BaP was below the limit of quantification for all samples (traditional and industrial). PAH4 levels in "*Buđola*" ranged from below the limit of quantification – 17.23 $\mu g kg^{-1}$ and did not exceed legislation levels. Obtained PAH16 content ranged from 27.07 $\mu g kg^{-1}$- 2168.99 $\mu g kg^{-1}$. The internal parts retained a lower concentration of total PAHs and individual PAHs than the surface layer. The results indicate that, from a health point of view, industrially produced *"Buđola"* are safer for consumption than those smoked in uncontrolled production conditions.
Keywords: *Buđola*, PAH, BaP, traditional and industrial smoking

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Sulfur supply impacts imidacloprid phytotoxicity in tomato seedlings

Martina VARGA[1], Tihana MILOLOŽA[1], Fabijan ILJKIĆ[1]

Josip Juraj Strossmayer University of Osijek, Department of Biology, Cara Hadrijana 8/A, Osijek, Croatia

Abstract

Imidacloprid is a systemic neonicotinoid pesticide extensively used on more than 140 different crops in over 120 countries. Sulfur is an essential macronutrient, and its availability may affect plant stress responses. Over the past years, studies have shown that sufficient sulfur supply improves plant tolerance to various toxicants. Therefore, this study investigated the effect of sulfur concentration on the phytotoxicity of imidacloprid on hydroponically grown tomato plants. When plants were exposed to imidacloprid under a low sulfur supply, higher levels of oxidative stress were observed, evident from significantly higher hydrogen peroxide concentrations and exaggerated lipid peroxidation compared to the effects of imidacloprid under optimal or increased sulfur supply. Accumulation of reactive oxygen species caused damage to proteins and photosynthetic pigments, which resulted in decreased growth. Although antioxidative enzymes were induced in tomato plants under low sulfur conditions and phenol concentration was increased, this antioxidative response could not prevent oxidative damage. The results reveal that sulfur deficiency, a common problem in agricultural soils, significantly affected tomato plants under imidacloprid exposure. Therefore, a moderate sulfur supply may be an effective strategy to reduce imidacloprid phytotoxicity to tomato plants and potential risk to human health in regions where neonicotinoid insecticides are intensively used.

Keywords: sulfur supply, imidacloprid, tomato plants, environmental risk, oxidative stress

Ecological Medicine and Biomedicine / Ekološka medicina i biomedicina
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Utjecaj dostupnosti sumpora na fitotoksičnost imidakloprida kod klijanaca rajčice

Martina VARGA, Tihana MILOLOŽA, Fabijan ILJKIĆ

Sveučilište Josipa Jurja Strossmayera u Osijeku, Odjel za biologiju, Cara Hadrijana 8/A, Osijek, Hrvatska

Sažetak

Imidakloprid je sustavni neonikotinski pesticid koji se intenzivno upotrebljava za više od 140 različitih poljoprivrednih kultura u 120 država. Sumpor je esencijalni makroelement i njegova dostupnost može utjecati na odgovor biljaka na stres. Posljednjih godina brojna su istraživanja pokazala da optimalna dostupnost sumpora povećava otpornost biljaka na različite toksikante. Stoga, u ovom istraživanju ispitan je utjecaj koncentracije sumpora na fitotoksičnost imidakloprida kod hidroponski uzgajanih klijanaca rajčice. Kada su biljke imidaklopridu izložene u uvjetima smanjene koncentracije sumpora, uočene su više razine oksidativnog stresa, koji se očitovao u značajno povišenoj koncentraciji vodikovog peroksida i višoj razini lipidne peroksidacije u usporedbi s učincima imidakloprida pri optimalnim ili višim koncentracijama sumpora. Akumulacija reaktivnih kisikovih jedinki uzrokovala je oštećenje proteina i fotosintetskih pigmenata što je rezultiralo inhibicijom rasta. Iako su aktivnosti antioksidativnih enzima i koncentracija fenola bile povišene kod biljaka u uvjetima niske koncentracije sumpora, ovaj antioksidativni odgovor nije mogao spriječiti oksidativna oštećenja. Rezultati ovog istraživanja pokazali su da deficit sumpora, čest problem na poljoprivrednim površinama, ima značajan utjecaj na klijance rajčice tretirane imidaklopridom. Prema tome, umjerena opskrba sumporom u regijama gdje se intenzivno koriste neonikotinoidni insekticidi mogla bi biti učinkovita strategija za smanjenje fitotoksičnosti imidakloprida na poljoprivredne kulture i potencijalni rizik za zdravlje ljudi.

Ključne riječi: dostupnost sumpora, imidakloprid, klijanci rajčice, rizik za okoliš, oksidativni stres

Ecological Medicine and Biomedicine / Ekološka medicina i biomedicina
Oral presentation / *Usmeno priopćenje*

Therapeutic factors of the sea – local or global resource?

Nikolina ZAPLATIĆ DEGAČ[1], Anica KUZMIĆ[1], Siniša BOSAK[2]

[1] University North, University Center Varaždin, Ulica 104. brigade 3, Varaždin, Crotia
[2] Center for Spine Health Varaždin, Ulica Vinka Međerala 15, Varaždin, Croatia

Summary
Of the Earth's total surface, which is 510 million km², 70.8% is occupied by sea spaces, so the ancient Greeks and Romans already studied the effectiveness of the sea on human health and used it as a method of treatment, especially for the treatment of wounds and problems with the respiratory system. By using the benefits of seawater and its environment, a treatment method has been developed that uses the healing factors of the sea for preventive and therapeutic purposes. Sea water contains an abundance of vital elements and medicinal compounds that revitalize the human body. With a composition similar to human blood plasma, it is easily absorbed into the body, expelling harmful substances from the body. The positive effects of the sea on human health have been recognized all over the world and thus have become a component of health tourism. However, climate change, air pollution and changes in water quality and quantity directly affect the environment and are associated with a range of adverse health outcomes. Since many large bodies of water are connected, a local problem can be one of many factors that inevitably lead to the emergence of a larger problem. Water as a whole is also a common global good shared by all people and all living organisms on our planet. Rapid economic and technological development as well as population growth result in an increase in the use of sea water and its factors, and at the same time in the continuous devastation of all existing natural resources.
Keywords: sea, natural resources, therapeutic factors

Ecological Medicine and Biomedicine / Ekološka medicina i biomedicina
Oral presentation / *Usmeno priopćenje*

Ljekoviti čimbenici mora – lokalni ili globalni resurs?

Nikolina ZAPLATIĆ DEGAČ[1], Anica KUZMIĆ[2], Siniša BOSAK[3]

[1] Sveučilište Sjever – Sveučilišni centar Varaždin, Ulica 104. brigade 3, Varaždin, Hrvatska
[2] Centar za kralježnicu Varaždin, Ulica Vinka Međerala 15, Varaždin, Hrvatska

Sažetak
Od sveukupne Zemljine površine, koja iznosi 510 milijuna km², 70,8 % zauzimaju morska prostranstva stoga su već drevni Grci i Rimljani proučavali učinkovitost mora na ljudsko zdravlje i koristili ga kao metodu liječenja, posebice za liječenje rana i problema s dišnim sustavom. Korištenjem blagodati morskih voda i njenog okoliša razvila se metoda liječenja koja koristi ljekovite čimbenike mora u preventivne i terapijske svrhe. Morska voda sadrži obilje vitalnih elemenata i ljekovitih spojeva koji revitaliziraju ljudski organizam. Sastavom slična ljudskoj krvnoj plazmi, lako se apsorbira u tijelo izbacujući štetne tvari iz tijela. Pozitivni učinci mora na ljudsko zdravlje prepoznati su diljem svijeta i time postali sastavnica zdravstvenog turizma. Međutim, klimatske promjene, onečišćenje zraka i promjene u kvaliteti i količini voda izravno utječu na okoliš i povezani su s nizom nepovoljnih zdravstvenih ishoda. Budući da su mnoga velika vodna tijela povezana, lokalni problem može biti jedan od mnogih čimbenika koji neminovno dovodi do pojave nekog većeg problema. Voda u cjelini je i zajedničko globalno dobro koje dijele svi ljudi i svi živi organizmi na našem planetu. Brzi ekonomski i tehnološki razvoj kao i rast stanovništva rezultiraju povećanjem uporabe morskih voda i njenih čimbenika, a istovremeno i kontinuiranom devastacijom svih postojećih prirodnih resursa.
Ključne riječi: more, prirodni resursi, ljekoviti čimbenici

Ecology and Society
Ekologija i društvo

Ecology and Society / *Ekologija i društvo*
Oral presentation / *Usmeno priopćenje*

Visions of Ecological Transition in Europe: comparing perceptions, unveiling plurality

Diogo Guedes VIDAL[1], Fátima ALVES[2,3], Helena FREITAS[1]

[1] University of Coimbra, Centre for Functional Ecology, Science for People & the Planet (CFE), TERRA Associate Laboratory, Department of Life Sciences, Calçada Martim de Freitas, Coimbra, Portugal
[2] University of Coimbra, CDepartment of Social Sciences and Management, Universidade Aberta, Rua do Amial, nº 752m Porto, Portugal
[3] Centre for Functional Ecology—Science for People & the Planet (CFE), TERRA Associate Laboratory, Department of Life Sciences, alçada Martim de Freitas 3000, Coimbra, Portugal

Abstract
The wide dissemination of the Ecological transition concept, without the integration of different views, understandings and constraints, could undermine the collective efforts to pursue it. Therefore, in the scope of the H2020 European project "PHOENIX", this work aims to contribute to providing different visions on Ecological Transition across 6 European countries – Portugal, Spain, France, Italy, Hungary and Estonia - through the application of 41 interviews with policymakers, scientists, NGO actors, representatives of economics groups and citizens. From the interviews, it was clear that the adoption of pro-ecological behaviors is not only dependent on individual choices – lack of awareness or giving up on personal comfort. The interviewees highlight the financial barriers as the main constraints – both at an individual level and the macro level, i.e. the economic interests of companies -, as well as the lack of support of institutions as role models in this ecological transition. More importantly, a general perception of the ineffectiveness of traditional participation models was visible, limiting the possibility of intervention, especially for vulnerable social groups. People want to make part of this transition, but this can only be achieved through mechanisms of participation grounded in fair, inclusive and plural processes. The transformative policy postulated by the ecological transition must be based on in-depth knowledge of the biophysical and socio-economic-cultural characteristics of territories, which is a prerequisite that requires transformative processes at individual and structural levels.
Keywords: ecological transition, perceptions, Europe, plurality

Ecology and Society / *Ekologija i društvo*
Poster presentation / *Postersko priopćenje*

Croatian institutional approach towards Sustainable Development Goals (SDG-s)

Sanja KNEŽEVIĆ KUŠLJIĆ[1], Danijel KUŠLJIĆ[2]

[1] University of Slavonski Brod, Trg Ivane Brlić Mažuranić, Slavonski Brod, Croatia
[2] ImPPPact – Civil & Social Organization, Slavonski Brod, Croatia

Abstract
With technological advancements, human influence on society, nature and the planet has increased significantly and we need to approach this with the utmost responsibility for the benefit of future generations and the planet. The UN initiative for transforming our world: the 2030 Agenda for Sustainable Development that determines 17 Sustainable Development Goals (SDG-s) was adopted by all UN member states in 2015. The Croatian institutional approach toward SDG-s is analyzed in this paper. The institutional approach is analyzed through the perspective of an institutional framework and institutional activities for implementing and achieving SDG-s. Recognition of institutional support is through official declarations or statements available on websites or in published materials by the societal system stakeholders. The aim of the research is to assess SDG achievements in Croatia and provide a critical review of the institutional influence on SDG achievements. Research methodology is an extensive literature review combined with analysis and synthesis of available information sources. Research shows that structured institutional support for SDG initiatives, an integrated approach towards SDG-s and inclusion of diverse Croatian societal stakeholders in the SDG initiative have positive effects on SDG-s achievement in Croatia.
Keywords: UN 2030 Agenda, Sustainable Development Goals, Croatia, institutional framework

Ecology and Society / *Ekologija i društvo*
Poster presentation / *Postersko priopćenje*

Green Agenda for the Western Balkans - Generator of sustainable energy transition

Svetozar KRSTIĆ

University Metropolitan, Faculty for Applied Ecology Futura Belgrade, Požeška 83a, Belgrade, Serbia

Abstract

The European Union has decided to actively fight against climate change and environmental pollution. To that end, it adopted the Green European Agreement, which is becoming its Key document in the fight against climate change. The EU is aware that it cannot act alone in this fight and that the most critical regions are in the immediate neighborhood. Therefore, it allocated funds and proposed to the leaders of the Western Balkans the adoption of the Green Agenda for the Western Balkans, accompanied by significant financial support. The 16 Western Balkans plants pollute as much as 250 European Union plants In 2016, total SO_2 and PM 2.5 emissions from the 16 coal power plants (8.7 GW) In the Western Balkans were almost as high as from the 250 existing coal plants (156 GW) in the EU. The average coal power plant In the Western Balkans emits 20 times more SO_2 and 16 times more particulate matter (PM) than the average EU plant. Although the measures have not been elaborated in detail and the time frame for their implementation has not been specified, also war In Ukrajina will be the reason for the postponed application of the key measures, the conclusion is that the Gree Agenda for the Western Balkans will be a generator of sustainable energy transition in the region.

Keywords: energy, development, sustainability, climate, transition

Ecology and Society / *Ekologija i društvo*
Oral presentation / *Usmeno priopćenje*

The New European Bauhaus as a tool for building a desirable future

Sanda PAŠULD[1], Sanja SCITOVSKI[1], Zlata DOLAČEK-ALDUK[2]

[1] City of Osijek, Franje Kuhača 9, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Civil Engineering and Architecture Osijek, Vladimira Preloga 3, Osijek, Croatia

Abstract
Beautiful-sustainable-inclusive is what describes the idea of the New European Bauhaus, a movement that aims to change people's consciousness. In the modern age, the urban population is faced with the increasing consequences of climate change, whose life is increasingly losing quality through polluted air, increasing air temperature, unavailability of healthy food, but also an increase in the amount of waste. The idea of the New European Bauhaus connects the European Green Deal with our living space and aims to use the latest interdisciplinary knowledge, technologies and community in order to create a better future, and the sense of belonging creates a collective sensitivity to the beauty among citizens. This paper presents four selected locations in the City of Osijek, which should represent guidelines for the urban population to transform and promote beauty, sustainability and inclusion. Locations for which a different use is planned in terms of greener and more sustainable use are: the area next to the Art Nouveau well along the Drava Promenade, Oskar Nemon Park, Zrinjevac Park and part of Županijska Street in the city center. Although little has been written about the idea of the New European Bauhaus in scientific and professional works, it is a platform that can be upgraded with a series of positive actions to raise the awareness of the domestic public, with the aim of more effectively implementing its principles in all areas of the life of the local community: ecological, social, economic and cultural.
Keywords: New European Bauhaus, climate change, City of Osijek, sustainability, urban inclusiveness

Ecology and Society / *Ekologija i društvo*
Oral presentation / *Usmeno priopćenje*

Novi europski Bauhaus kao alat za izgradnju poželjne budućnosti

Sanda PAŠULD[1], Sanja SCITOVSKI[2], Zlata DOLAČEK-ALDUK[3]

[1] Grad Osijek, Franje Kuhača 9, Osijek, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Građevinski i arhitektonski fakultet Osijek, Ulica Vladimira Preloga 3, Osijek, Hrvatska

Sažetak:
Lijepo – održivo - uključivo ono je što opisuje ideju Novog europskog Bauhausa, pokreta kojemu je cilj mijenjati svijest kod ljudi. U suvremenom dobu, posebice urbano stanovništvo, suočeno je sa sve većim posljedicama klimatskih promjena, čiji život sve više gubi kvalitetu kroz onečišćeni zrak, povećanje temperature zraka, nedostupnost zdrave hrane, ali i povećanjem količine otpada. Ideja Novog europskog Bauhausa povezuje Europski zeleni plan s našim životnim prostorom te ima za cilj iskoristiti najnovija interdisciplinarna znanja, tehnologije i zajedništvo u cilju stvaranja bolje budućnosti, a osjećaj pripadnosti kod ljudi stvara kolektivnu osjetljivost prema lijepom. U ovom radu prikazane su četiri odabrane lokacije u gradu Osijeku, koje urbanom stanovništvu trebaju predstavljati putokaze za preobrazbu i promoviranje lijepog, održivog i uključivog. Obrađuju se lokacije za koje se planira drugačije korištenje u smislu zelenijeg i održivijeg korištenja, i to: područje uz secesijski zdenac uz dravsku šetnicu, Park Oskara Nemona, Park Zrinjevac i dio Županijske ulice u samom središtu grada. Iako se o ideji Novog europskog Bauhausa malo pisalo u znanstvenim i stručnim radovima, ona je platforma koja se može nadograditi nizom pozitivnih akcija za podizanje svijesti domaće javnosti, a u cilju učinkovitije provedbe njezinih načela u svim područjima života lokalne zajednice: ekološkom, socijalnom, gospodarskom i kulturnom.
Ključne riječi: Novi europski Bauhaus, klimatske promjene, Grad Osijek, održivost, urbana uključivost

Ecology and Society / *Ekologija i društvo*
Poster presentation / *Postersko priopćenje*

GMO: Public opinion in Federation of Bosnia and Herzegovina?

Jurica PRIMORAC, Mladen ZOVKO, Ana MANDIĆ

University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule b.b., Bosnia and Herzegovina

Abstract

None of the methods of producing plants and animals with new desirable traits have caused as much controversy as methods using genetic engineering techniques. Public opinion is extremely important in many issues concerning the policies of a country. The purpose of this research is to find out what respondents from entity Federation of Bosnia and Herzegovina know about the topic of genetically modified food through a questionnaire. Do they know what genetically modified food is, are they informed about this topic and if so, which media do they use, do they believe that GM food poses a health or environmental risk? These are just some of the questions that the respondents answered. The number of respondents was 305, and they included both sexes, different levels of education, and ages from 18 to over 51. Based on the answers, we found a general lack of knowledge about GMOs, which is somewhat lower among the highly educated compared to the low educated. The lack of knowledge corresponds to the fear of GM food. The question arises as to whether public opinion on GMOs is relevant at all, considering that a large part of the population does not even have basic knowledge about it.

Keywords: GMO, public opinion, knowledge

Ecology and Society / *Ekologija i društvo*
Poster presentation / *Postersko priopćenje*

EU Ecolabel use in everyday life

Ivana SEČANJ, Rosana ŠIMUNOVIĆ, Martina RUPČIĆ

Ires ekologija d.o.o., Prilaz baruna Filipovića 21, Zagreb, Hrvatska

Abstract:
At the beginning of March, the number of eco-labels was 456 in 199 countries and 15 sectors. The goal was to determine the general awareness of eco-labels and how much attention is paid to them during shopping. The EU Ecolabel, was selected for more detailed analysis. A survey was conducted to see the general population's attitude towards eco-labels, and especially towards the EU Ecolabel. Also, all products that received the EU Ecolabel in Croatia were reviewed and what criteria they had to fulfill. The survey mainly represents the younger consumer population, known as environmentally conscious. More than 80% of respondents have heard of eco-labels, but only a small part of them have heard of the EU Ecolabel. For the most part, the respondents don't know whether they have products with the EU Ecolabel in their household, which is related to the fact that they do not pay attention to the eco-labels of products when purchasing. The general population is interested in education about the EU Ecolabel certificat and believes that, after education, they would give products bearing this mark a chance. Education is necessary in order for consumers to pay attention to sustainable products and contribute to better environmental awareness.
Keywords: Eco certificates, EU Ecolabel, sustainable products

Ecology and Society / *Ekologija i društvo*
Poster presentation / *Postersko priopćenje*

Primjena EU Ecolabel oznake u svakodnevnom životu

Ivana SEČANJ, Rosana ŠIMUNOVIĆ, Martina RUPČIĆ

Ires ekologija d.o.o., Prilaz baruna Filipovića 21, Zagreb, Hrvatska

Sažetak
Početkom ožujka ažurirano je brojčano stanje eko oznaka te je on, u 199 država i 15 sektora, iznosio 456. Cilj je bio utvrditi koje je opće poznavanje eko oznaka i koliko se na njih obraća pažnja tijekom kupnje proizvoda. Odabrana je jedna eko oznaka, EU Ecolabel, za detaljniju analizu. Provedena je anketa kojom se kratko i jasno htio vidjeti stav opće populacije prema eko oznakama, a osobito prema oznaci EU Ecolabel. Također, sagledani su svi proizvodi koji su unutar Hrvatske dobili EU Ecolabel oznaku te koje su kriterije isti morali zadovoljiti prilikom certificiranja. Anketom je većinom zastupljena mlađa potrošačka populacija, a koja većinski za sebe kaže da je ekološki osviještena. Više od 80 % ispitanika je čulo za eko oznake, no za oznaku EU Ecolabel tek manji dio. Većinom, ispitanici ne znaju da li u svom kućanstvu posjeduju proizvode s EU Ecolabel oznakom, što je u svezi s time da prilikom kupnje ne obraćaju pažnju na eko oznake proizvoda. Opća populacija je zainteresirana za edukaciju o EU Ecolabel oznaci te smatra da bi proizvodima koji nose ovu oznaku, nakon edukacije, dali šansu. Edukacija je neophodna kako bi potrošači obraćali pažnju na održive proizvode te time doprinijeli kvalitetnijoj ekološkoj osviještenosti.
Ključne riječi: Eko certifikati, EU Ecolabel, održivi proizvodi

Ecology and Society / *Ekologija i društvo*
Oral presentation / *Usmeno priopćenje*

Two decades of becoming Smart - Koprivnica longitudinal case study

Robertina ZDJELAR[1], Dario JEMBREK[2], Domagoj FRANK[3]

[1] GKP Komunalac Koprivnica, Mosna 15, Koprivnica, Croatia
[2] City of Koprivnica, Zrinski trg 1, Koprivnica, Croatia
[3] University North, Trg dr. Žarka Dolinara 1, Koprivnica, Croata

Abstract
Today, the concepts of smart, sustainable, and resilient cities are incorporated into all strategic and planning documents periodically adopted and implemented by municipalities. Since 2015, the City of Koprivnica has strategically focused on three key growth areas: smart, sustainable, and inclusive, and its 2015-2020 Development Strategy was based on this foundation. One year after its adoption, Koprivnica began the process of implementing the WCCD ISO 37120 standard and in 2016 earned a platinum certificate and became the first smart city in Croatia. In the meantime, new strategic development documents have been adopted, including the Koprivnica Development Strategy 2030, the Sustainable Energy and Climate Action Plan (SECAP), Koprivnica Urban Area Development Strategy (ITU), and other program documents (green infrastructure, public lighting, etc.). This paper provides a comparison of indicator status from the previous period, the success of achieving set goals, challenges in achieving indicators during pandemic years, as well as an analytical and critical review of the development priorities, strategic goals, and indicators from the new strategic development documents of the City of Koprivnica, as well as the envisaged measures. A detailed analysis conducted in this paper provides answers to what has been learned out of implementation since 2010 and what needs to be done by 2030.
Keywords: smart city, WCCD ISO 37120, sustainable development, urban development, quality of life

Ecology and Society / *Ekologija i društvo*
Oral presentation / *Usmeno priopćenje*

Dva desetljeća Smart razvoja – longitudinalna studija na primjeru Koprivnice

Robertina ZDJELAR[1], Dario JEMBREK[2], Domagoj FRANK[3]

[1] GKP Komunalac Koprivnica, Mosna 15, Koprivnica, Hrvatska
[2] Grad Koprivnica, Zrinski trg 1, Koprivnica, Hrvatska
[3] Sveučilište Sjever, Trg dr. Žarka Dolinara 1, Koprivnica, Hrvatska

Sažetak
Danas se pojmovi pametnih, održivih i otpornih gradova ugrađuju u sve strateške i planske dokumente koje neka jedinica lokalne samouprave periodički donositi i provodi. Od 2015. godine Grad Koprivnica strateški se opredijelio staviti naglasak na tri ključna rasta: pametan, održiv i uključiv, stoga je na tome temeljena Strategija razvoja Grada Koprivnice za razdoblje 2015. – 2020. godine. Godinu dana nakon njezinog donošenja, Grad Koprivnica pokreće postupak implementacije WCCD ISO 37120 standarda te 2016. godine stječe platinast certifikat i time postaje prvi pametni grad u Hrvatskoj. U međuvremenu doneseni su nova Strategija razvoja grada Koprivnice do 2030. godine, Akcijski plan energetski i klimatski održivog razvitka grada Koprivnice (SECAP), Strategija razvoja urbanog područja Koprivnica (ITU) i drugi programski dokumenti (zelena infrastruktura, javna rasvjeta i dr.). U ovom radu donosi se usporedba stanja indikatora iz prethodnog razdoblja, uspješnost postizanja zacrtanih ciljeva, izazova u postizanju indikatora u pandemijskim godinama, te analitičko-kritički osvrt na razvojne prioritete, strateške ciljeve i indikatore iz novih strateških razvojnih dokumenata Grada Koprivnice kao i na predviđene mjere. Što je sve naučeno kroz provedbu od 2010. godine te što je sve potrebno poduzeti do 2030., odgovore donosi detaljna analiza koja je provedena u ovom radu.
Ključne riječi: pametni gradovi, održivi razvoj, WCCD ISO 37120, kvaliteta života, urbani razvoj

Environmental Engineering
Inženjerstvo okoliša

Environmental Engineering / *Inženjerstvo okoliša*
Poster presentation / *Postersko priopćenje*

Methods of immobilization TiO_2 on rubber tiles made from recycled tires and photocatalytic wind tunnel design for treatment of polluted air

Paula BENJAK[1], Marija TOMAŠ[1], Lucija RADETIĆ[1], Ivan BRNARDIĆ[2], Ivana GRČIĆ[1]

[1] University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia
[2] University of Zagreb, Faculty of Metallurgy, Aleja narodnih heroja 3, Sisak, Croatia

Abstract
The immobilization of titanium dioxide on the surface of recycled rubber tiles presents a solution for achieving passive air protection. Solar photocatalysis has been proven as a promising technology for air purification for real-scale applications. Nowadays, various reactors and methods of photocatalyst immobilization have been proposed. A completely new purpose for tiles was obtained by addressing air pollution and related health issues. The main idea was to achieve the synergistic action between immobilized TiO_2 on recycled rubber tiles and solar radiation (hereafter: photocatalytic rubber tiles, PRT). One of the most researched photocatalysts, TiO_2 irradiated with UV light, can decompose many organic compounds to water, carbon dioxide, and mineral acids or their salts. Immobilization was validated by SEM-EDS and FTIR analysis. The stability and environmental impact of PRT were investigated by leaching test and AAS and TOC analyses. Photocatalytic tests were done in a simulated polluted atmosphere to confirm the PRT activity as a new photocatalytic material. Photocatalytic oxidation of NH_3 was achieved using rubber tiles immobilized with 2 g of TiO_2, confirming the photocatalytic oxidation of NH_3 to N_2. The photocatalytic wind tunnel is a custom-made reactor designed by the principles of a wind tunnel with a blower. The whole construction was adjusted to the test chamber in order to achieve a simulation of an outdoor environment. This paper presents the experimental results of the immobilization of TiO_2 on recycled rubber tiles and the successful oxidation of NH_3 to N_2, also, a newly designed photocatalytic wind tunnel (PWT) as the reactor for testing photocatalytic degradation of airborne pollutants by TiO_2-immobilized on rubber tiles.
Keywords: titanium dioxide, solar photocatalysis, recycled rubber, air purification; photocatalytic wind tunnel

Environmental Engineering / *Inženjerstvo okoliša*
Oral presentation / *Usmeno priopćenje*

A geostrategic role of critical mineral raw materials in the energy transition

Darko PAVLOVIĆ[1], Melita SRPAK[2], Hrvoje MEAŠKI[3], Sanja KOVAČ[3]

[1] Plinacro Ltd. Savska cesta 88a, Zagreb, Croatia
[2] Institute for Spatial Planning, Mali plac 1a, Varaždin, Croatia
[3] University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia

Abstract
At the end of the second decade of the 21st century, humanity is at a turning point: either it will find effective answers to the global challenge of preventing the devastating changes caused by the sources of greenhouse gases emissions, resulting from human activity, or the world, as we know it today, will disappear. In this context, and starting from long-term trends of using geostrategic resources and mineral raw materials, it is noticeable that the world is going through an inevitable transition - an energy transition, a thorough transformation of the global energy and economic sectors. A demand for certain mineral raw materials, metals and minerals such as cobalt, lithium, magnesium, aluminum is growing fast. Digitalization, industry and energy transition are transforming and increasing the demand for raw materials. In this context, critical mineral raw materials and their circular use are of significant importance in the economy because mineral raw materials form the basis of the economy and are essential for maintaining and improving the quality of life. There is no doubt that it will not be possible to implement the European Green Plan - strategy without the usage of critical raw materials. Namely, less than 5 % of the world's critical resources are extracted in the EU, while EU industry accounts for about 20% of the world's consumption of these resources, and in this context, strengthening the European supply of critical raw materials is extremely important for the Green Plan and the resilience of the key industry.
Keywords: critical mineral raw materials, EU Green Plan, energy transition, research projects, hydrogen

Environmental Engineering / *Inženjerstvo okoliša*
Oral presentation / *Usmeno priopćenje*

Geostrateška uloga kritičnih mineralnih sirovina u energetskoj tranziciji

Darko PAVLOVIĆ[1], Melita SRPAK[2], Hrvoje MEAŠKI[3], Sanja KOVAČ[3]

[1] Plinacro d.o.o., Savska cesta 88a, Zagreb, Hrvatska
[2] Zavod za prostorno uređenje Varaždinske županije, Mali plac 1a, Varaždin, Hrvatska
[3] Geotehnički fakultet Sveučilišta u Zagrebu, Hallerova aleja 7, Varaždin, Hrvatska

Sažetak
Na kraju drugog desetljeća 21. stoljeća čovječanstvo se nalazi na prekretnici: ili će pronaći učinkovite odgovore na globalni izazov sprječavanja razarajućih promjena uzrokovanih izvorima stakleničkih plinova koji su rezultat ljudskog djelovanja ili će svijet kakav danas poznajemo nestati. U tom kontekstu, a polazeći od dugoročnih trendova korištenja geostrateških resursa te mineralnih sirovina uočljivo je da svijet prolazi kroz neizbježan prijelaz - energetsku tranziciju, temeljitu transformaciju globalnog kako energetskog tako i gospodarskog sektora. Potražnja za pojedinim mineralnim sirovinama, metalima i mineralima primjerice kobaltom, litijem, magnezijem, aluminijem raste velikom brzinom. Digitalizacija, industrija i energetska tranzicija transformiraju i povećavaju potražnju za sirovinama. U tom kontekstu, kritične mineralne sirovine i njihova cirkularna upotreba vrlo su važni u ekonomiji jer mineralne sirovine čine temelj gospodarstva i bitne su za održavanje i poboljšanje kvalitete života, te je nedvojbeno da europski zeleni plan – strategiju neće biti moguće provesti bez upotrebe kritičnih sirovina. Naime, manje od 5 % kritičnih svjetskih resursa vadi se u EU, dok na industriju EU-a otpada oko 20 % svjetske potrošnje tih resursa i u tom kontekstu jačanje europske opskrbe kritičnim sirovinama iznimno je važno za Zeleni plan i otpornost ključne industrije.
Ključne riječi: kritične mineralne sirovine, EU zeleni plan, energetska tranzicija, istraživački projekti, vodik

Environmental Engineering / *Inženjerstvo okoliša*
Poster presentation / *Postersko priopćenje*

The influence of the tributaries of the Mirna River (Croatia) on the sustainability of the ecosystem

Ivana PINTARIĆ[1], Magdalena DROŽĐAN[1] , Bojan ĐURIN[1], Fabio DI NUNNO[2]

[1] University North, Department of Civil Engineering, Jurja Križanića 31b, Varaždin, Croatia
[2] University of Cassino and Southern Lazio, Via Department of Civil and Mechanical Engineering (DICEM), Di Biasio, 43, Cassino, Frosinone, Italy

Abstract
Climate changes are one of today's biggest problems and represent consecutive changes in average values of the climate indicators for the climate period. Floods and droughts are becoming increasingly frequent, showing the impact of changes on water bodies. With extreme events, the characteristics of a particular flow change, lowering the water level and drying up rivers or lakes during dry periods. On the other hand, during extensive and consecutive rainy periods, the appearance of large amounts of water that rivers or lakes cannot accept leads to flooding. Together with their main watercourse, the tributaries drain their watershed's water to the other watercourse, sea, or lake. Whether these are watercourses in the alluvial or karst area, each has complex hydrological and environmental conditions, which require appropriate access to resolve the effects of climate change. The impact of human activities on the river ecosystem should also be considered. The tributaries of the Mirna River will be analyzed in the paper as their influence on floods is one of the indicators of the effect on the river ecosystem.
Keywords: river Mirna, tributary, ecosystem, climate changes, extremes, flood

Environmental Engineering / *Inženjerstvo okoliša*
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Determination of the micropollutants' presence in water samples of Zagreb area

Lucija RADETIĆ[1], Sanja KALAMBURA[2], Ivana GRČIĆ[1]

[1] University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia
[2] University of Applied Sciences Velika Gorica, Zagrebačka ulica 5, Velika Gorica, Croatia

Abstract
Nowadays, the pollution of surface waters is of great importance, primarily because surface waters feed aquifers, the sources of potable water. The state of surface waters reflects people's behaviors and habits regarding the use of products. Therefore, pharmaceuticals, pesticides, personal care products and endocrine disruptors are most often classified as micropollutants which can be found in industrial wastewater, runoff from agricultural areas, livestock farms and aquaculture; leachate from landfills and wastewater from households and hospitals in various concentrations ranging from nano to micrograms per liter. In order to address the pollution of surface waters by micropollutants, water samples were taken from River Sava and Lake Jarun in Zagreb. Initial identification of the micropollutants was determined by a high-resolution analytical technique, a hybrid Q-TOF LC/MS. The results have shown that certain micropollutants such as TPPA/Triphenly phosphate, hormone (Progesterone), endocrine disruptor (DBP), herbicide (Cycluron), antibiotic (Azithromycin), and hormone (Diethylstilbestrol) could be found in samples with probability higher than 90%.
Keywords: micropollutants, water pollution, Zagreb area

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Environmental Engineering / *Inženjerstvo okoliša*
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Modeling of photocatalytic degradation of air pollutants in compound parabolic collector reactor by solar photocatalysis

Benjamin RADETIĆ, Paula BENJAK, Marija TOMAŠ, Ivana GRČIĆ

University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia

Abstract
Solar photocatalysis is an advanced oxidation process that in combination with solar irradiation and photocatalyst creates hydroxyl radicals which mineralize pollutants to CO2 and H20. Solar photocatalysis has been widely researched as a promising method for the improvement of air quality due to degradation of pollutants, sustainability, requirements of no additional chemicals, non-toxicity, low-cost and long-term photostability. Ammonia (NH3) and nitrogen oxides (NOx) are one of the air pollutants responsible for various environmental and health issues like the production of tropospheric ozone, acid rain and respiratory and immune system diseases. The application of photocatalytic degradation of pollutants brought to question the importance of appropriate photocatalytic reactor design. Therefore, in this work multiphysics approach to modeling was applied by using computational fluid dynamics (CFD) due to faster data processing and a reduced number of experiments for photocatalytic degradation of air pollutants (NH_3 and NO_x) in a compound parabolic collector (CPC) reactor with immobilized TiO_2 on a rubber pads under simulated solar irradiation. Experiments were carried out in a CPC reactor under simulated solar irradiation. Experimental results were used to set up, compare and validate results with COMSOL Multiphysics software. The obtained CFD model was used to optimize process parameters and reduce the number of further experiments.
Keywords: ammonia, nitrogen oxides, compound parabolic collector reactor (CPC), solar photocatalysis

Acknowledgement: This work has been supported by the following projects „Recycled rubber & solar photocatalysis: ecological innovation for passive air and health protection", KK.01.1.1.07.0058 and "Waste & Sun for photocatalytic degradation of micropollutants in water"(OS-Mi), KK.01.1.1.04.0006, both supported by European Regional Development Fund.

Environmental Engineering / *Inženjerstvo okoliša*
Oral presentation / *Usmeno priopćenje*

Analysis of the state of sustainable management of raw minerals in the Republic of Croatia with reference to the construction industry

Melita SRPAK[1], Darko PAVLOVIĆ[2], Hrvoje MEAŠKI[3], Sanja KOVAČ[3]

[1] Institute for Physical Planning of Varaždin County, Mali plac 1a, Varaždin, Croatia
[2] Plinacro d.o.o., Savska cesta 88a, Zagreb, Croatia
[3] University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia

Abstract
Mining activity in the Republic of Croatia has its own legislation harmonized with EU regulations and market economy principles appropriate for Europe. Raw minerals are important for starting the economy of a particular country, and their use depends on the demand for energy, supplies, assumptions about the economic growth of certain regions and the state of the environment. The goal of the research is based on the research of strategic planning documents and studies that provide data on exploitation fields and exploration areas of mineral resources in the territory of the Republic of Croatia. The results of the research are based on previous knowledge about the exploration areas/exploitation fields and the data obtained from the research, which were determined on the basis of the resource base of the raw minerals, i.e. mining-geological studies. Mining-geological studies define the area where it is possible to explore and exploit raw mineral and serve as a basis for creating spatial plans in the part that deals with the management of raw minerals. In conclusion, the exploitation fields of raw minerals in the Republic of Croatia statistically do not cover large areas and it is possible to plan and produce them only in places where they exist, because the locations for exploration and exploitation depend on the geological composition of the area. Mining activity can disrupt the natural balance of the environment and space. In such situations, it is important to establish a balance between the market's (economy's) need for raw minerals and society's tendency to maximize environmental protection. The construction industry in the Republic of Croatia is an important factor that determines the need for the exploitation of technical construction stone, gravel and sand, as well as brick clay.
Keywords: exploitation, mineral raw materials, mining activity, fees, Croatia

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Analiza stanja održivog gospodarenja mineralnim sirovinama na prostoru Republice Hrvatske s osvrtom na građevinsku industriju

Melita SRPAK[1], Darko PAVLOVIĆ[2], Hrvoje MEAŠKI[3], Sanja KOVAČ[3]

[1] Zavod za prostorno uređenje Varaždinske županije, Mali plac 1a, Varaždin, Hrvatska
[2] Plinacro d.o.o., Savska cesta 88a, Zagreb, Hrvatska;
[3] Sveučilište u Zagrebu, Geotehnički fakultet, Hallerova aleja 7, Varaždin, Hrvatska

Sažetak
Rudarska djelatnost u Republici Hrvatskoj ima svoje zakonodavstvo usklađeno s propisima EU i principima tržnog gospodarstva primjerenim za Europu. Mineralne sirovine važne su za pokretanje gospodarstva pojedine države, a njihovo korištenje ovisi o potražnji za energijom, zalihama, pretpostavkama o gospodarskom rastu pojedinih regija i stanju okoliša. Cilj istraživanja temelji se na istraživanju strateških planskih dokumenata i studija koji daju podatke o eksploatacijskim poljima i istražnim prostorima mineralnih sirovina na prostoru Republike Hrvatske. Rezultati istraživanja temelje se na prethodnim saznanjima o istražnim prostorima/eksploatacijskim poljima te podacima dobivenim istraživanjem koju su određeni na temelju resursne osnove mineralnih sirovina odnosno rudarsko-geoloških studija. Rudarsko-geološke studije definiraju prostor na kojem je moguće istraživanje i eksploatacija mineralnih sirovina te služe kao podloga za izradu prostornih planova u dijelu koji se bavi gospodarenjem mineralnim sirovinama. Zaključno, eksploatacijska polja mineralnih sirovina u Republici Hrvatskoj statistički ne zahvaćaju velike površine te ih je moguće je planirati i proizvoditi samo na mjestima gdje one postoje jer lokacije za istraživanje i eksploataciju ovise o geološkom sastavu područja. Rudarskom djelatnošću može se poremetiti prirodna ravnoteža okoliša i prostora. U takvim situacijama važno je uspostaviti ravnotežu između potrebe tržišta (gospodarstva) za mineralnim sirovinama i tendencije društva za maksimalnim očuvanjem okoliša. Građevinska industrija na prostoru Republike Hrvatske važan je čimbenik koji određuje potrebu za eksploatacijom tehničko-građevnog kamena, šljunka i pijeska, ali i ciglarskom glinom.
Ključne riječi: eksploatacija, mineralne sirovine, rudarska djelatnost, naknade, Hrvatska

Environmental Engineering / *Inženjerstvo okoliša*
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Catalysts based on red mud for catalytic removal of NO_x, CO and VOC_s

Žaklina TASIĆ, Maja NUJKIĆ, Snežana MILIĆ, Dragana MEDIĆ, Sonja STANKOVIĆ, Anđela BOGDANOVIĆ, Dušan DIMITRIJEVIĆ

University of Belgrade, Technical Faculty in Bor, Vojske Jugoslavije 12, Bor, Serbia

Abstract
Discovering efficient and effective techniques that will deal with increasing environmental pollutants, growing population and urbanization has become a major challenge for the entire scientific community. Red sludge, as a solid waste generated during production in the aluminum industry, can cause serious environmental pollution and problems with human health. For that reason, the catalytic removal of various organic and inorganic pollutants, through oxidation processes, has proven to be very successful in regards to many techniques in today's practice. This paper provides a comprehensive overview of already existing research and knowledge on the topic of catalysts based on red mud for the removal of typical air pollutants because of increasing interest from researchers. More precisely, special attention will be given to the catalytic reduction of nitrogen oxides (NOx) by NH_3, and the catalytic oxidation of CO and volatile organic compounds (VOCs).
Keywords: catalysts, red mud, pollutants

Environmental Impact Assessment
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Challenges in the identification of microplastics in seafood by micro FTIR

Boban ANĐELKOVIĆ[1], Tamara MUTIĆ[1], Simeon MINIĆ[1], Bratislav OBRADOVIĆ[1,2], Tanja ĆIRKOVIĆ VELIČKOVIĆ[1]

[1] University of Belgrade, Faculty of Chemistry, Studentski trg 12-16, Belgrade, Serbia
[2] University of Belgrade, Faculty of Physics, Studentski trg 12-16, Belgrade, Serbia

Abstract
The plastic particles smaller than 5 mm called microplastic (MP) are in the focus of researchers for the last half-century. This type of contaminant is present in seafood, the main source of nutrition for millions of people. It is crucial to establish a reliable standard operating procedure for the characterization and quantification of MP, which will ensure the best quality of analyses. The pyrolysis GC-MS, FT-IR, and Raman spectroscopy were successfully implemented on MP in water and sediment samples and they are increasingly used in analysis of MP in food. For characterization and quantification of MP from seafood samples after digestion the Nicolet™ iN™10 Infrared Microscope was used. The samples were filtered on 1 µm silicate fitters and analyzed using Omnic Picta software. Wizard software was used for the recognition of MPs, and FTIR spectra were recorded in reflection mode. Dark and Light modes were used for particle recognition. For the best coverage of MPs particle recognition isolated from tissues, it was necessary to combine information obtained from both modes and check each hit from software Identified Library Components. This is a time-consuming step requiring manual inspection but it is essential in order to obtain reliable data.
Keywords: microplastics pollution, seafood contaminates, µFTIR polymers identification

Environmental Impact Assessment / *Procjene utjecaja na okoliš*
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Impact Assessment of the exploitation of mineral raw materials on bats - Case study Gradusa

Aleksandra ANIĆ VUČINIĆ[1], Mirna MAZIJA[2], Lana KRIŠTO[3], Ivana PRESEČKI[1]

[1] University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia
[2] Supernatural d.o.o., Koledinečka ulica 3, Zagreb, Croatia
[3] Mundo Melius d.o.o., Ivana Banjavčića 22, Zagreb, Croatia

Abstract
The exploitation of mineral raw materials can represent a significant impact, therefore it is necessary to carry out environmental impact assessment and appropriate assessment. In the close vicinity of the Gradusa exploitation field (Sisak - Moslavina County) is the Gradusa cave, which is part of the Natura 2000 ecological network under code *HR2001342* as a site important for species and habitat types. The Mediterranean Horseshoe bat (*Rhinolophus euryale*) and the Schreibers' Bent-winged bat (*Miniopterus schreibersii*) are species of interest and the cave itself as habitat type 8310 Caves and pits are closed to the public. In addition to the environmental impact assessment procedure, the procedure for the appropriate assessment was carried out for the Gradusa exploitation field project, however, the existing research on the bat population status in the Gradusa cave was not sufficient to assess the impact of mining on the Gradusa cave and the bats as their habitat. Therefore, an interdisciplinary team conducted research on the impact of blasting on bats in the Gradus cave. A calculation of the spread of vibrations and noise level due to blasting was made, and on the basis of the obtained theoretical data, test blasting was started. Three test blasts were carried out at different locations and data on the stability of the cave entrance, noise and vibrations, and the activity of bats inside the cave (IR camera and ultrasound detector) were collected. Based on the results, it was assessed that the test blasting did not cause a negative impact on the cave or the bats inside, in any of the possible consequential effects that were highlighted as possibly significantly negative.
Keywords: environmental impact assessment, exploitation of mineral raw materials, habitat conservation, bats, noise and vibrations

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Procjena utjecaja eksploatacije mineralnih sirovina na šišmiše – analiza slučaja Gradusa

Aleksandra ANIĆ VUČINIĆ[1], Mirna MAZIJA[2], Lana KRIŠTO[3], Ivana PRESEČKI[1]

[1] Sveučilište u Zagrebu Geotehnički fakultet, Hallerova aleja 7, Varaždin, Hrvatska
[2] Supernatural d.o.o., Koledinečka ulica 3, Zagreb, Hrvatska
[3] Mundo Melius d.o.o., Ivana Banjavčića 22, Zagreb, Hrvatska

Sažetak

Eksploatacija mineralnih sirovina može predstavljati značajan utjecaj stoga je nužno provesti postupak procjene utjecaja na okoliš i prirodu. U neposrednoj blizini eksploatacijskog polja Gradusa (Sisačko - moslavačka županija) smještena je špilja Gradusa koja je dio ekološke mreže Natura 2000 pod šifrom *HR2001342* kao područje očuvanja značajno za vrste i stanišne tipove . Ciljne vrste su južni potkovnjak (*Rhinolophus euryale*) i dugokrili pršnjak (*MIniopterus schreibersii*) te sama špilja kao stanišni tip *8310 Špilje i jame zatvorene za javnost*. Uz postupak procjene utjecaja na okoliš provodio se i postupak glavne ocjene utjecaja zahvata na prirodu za zahvat eksploatacijsko polje Gradusa, međutim postojeća istraživanja o stanju populacija šišmiša u Gradusi nisu bila dostatna kako bi se utvrdio utjecaj eksploatacije miniranjem na špilju Gradusa i šišmiše koji u špilji imaju stanište. Stoga je interdisciplinarni tim proveo istraživanje utjecaja miniranja na šišmiše u špilji Gradusa. Napravljen je izračun širenja vibracija i razine buke zbog miniranja te se temeljem dobivenih teoretskih podataka pristupilo probnom miniranju. Provedena su tri probna miniranja na različitim lokacijama te su prikupljeni podaci o stabilnosti ulaza u objekt, buci i vibracijama te aktivnosti šišmiša unutar špilje (IR kamera i ultrazvučni detekor). Temeljem dobivenih podataka utvrđeno je da probno miniranje nije uzrokovalo negativan utjecaj na špilju ili šišmiše koji u njoj obitavaju, niti u jednom od mogućih posljedičnih efekata koji su bili naglašeni kao moguće značajno negativni.

Ključne riječi: procjena utjecaja na okoliš, eksploatacija mineralnih sirovina, očuvanje staništa, šišmiši, buka i vibracije

Environmental Impact Assessment / *Procjene utjecaja na okoliš*
Oral presentation / *Usmeno priopćenje*

Port-related ship emissions – estimation and implications of cruise shipping on the Port of Split

Filip BOJIĆ, Anita GUDELJ, Rino BOŠNJAK

University of Split, Faculty of Maritime Studies, Ruđera Boškovića 37, Split, Croatia

Abstract
Exhaust gases emitted by ship engines are widely recognized as one of the main contributors to atmospheric pollution. The problem of air quality degradation caused by shipping is particularly significant in urbanized port areas, where it poses a direct threat to the local environment and human health. In order to identify, evaluate and manage ship-induced air pollution, it is necessary to estimate the emission levels relevant to the port area and to the ship types. That is why, the objective of this work is to calculate and analyze the emissions of cruise shipping for the Port of Split, as a destination with growing cruise activity. To obtain accurate estimates of cruise emissions, an energy-based bottom-up methodology was applied to real-time shipping data from the Automatic Identification System (AIS). In the process, levels of carbon dioxide (CO_2), nitrogen oxides (NO_X), sulphur oxides (SO_2) and particulate matter (PM) were estimated over a twelve-month period from 2019 to 2020. After the calculation, the temporal and spatial distribution of cruise ship emissions was analyzed, the amounts of pollutants emitted during the different movement modes were compared, and their impact on the port was studied.
Keywords: air pollution, ship emissions, port sustainability, AIS, cruise shipping

Environmental Impact Assessment / *Procjene utjecaja na okoliš*
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Climate Delegated Act contribution to environmental impact assessment procedures

Paula BUCIĆ, Ivana SEČANJ, Helena SELIĆ

Ires ekologija d.o.o., Prilaz baruna Filipovića 21, Zagreb, Croatia

Abstract
According to the Taxonomy Regulation, economic activity should not be considered environmentally sustainable if its harmful effect on the environment exceeds its benefits. The Regulation establishes six environmental goals, based on which it is determined whether an economic activity is environmentally sustainable, and it is considered environmentally sustainable, i.e. harmonized with the EU Taxonomy if: a) it significantly contributes to one or more environmental goals; b) do no significant harm any environmental objective (DNSH); c) is carried out in accordance with minimum protective measures; d) it complies with the technical verification criteria. The technical verification criteria are listed in the so-called Delegated Act, and currently, the first act containing technical criteria for verifying a significant contribution and not causing significant damage to the first two environmental goals - mitigation and adaptation to climate change - has been published. Even before the adoption of the Taxonomy Regulation, the DNSH principle was already integrated in a certain way into the environmental impact assessment. According to some estimates, for as many as 70% of DNSH criteria, compliance can be proven through the implementation of various EU directives or environmental impact assessment procedures, and the aim of this paper is to show to what extent the adoption of the Climate Delegated Act contributed to the assessment of the impact of climate change in environmental impact assessment procedures.
Keywords: EU taxonomy, Climate Delegated Act, DNSH, climate change, EIA

Environmental Impact Assessment / *Procjene utjecaja na okoliš*
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Doprinos Delegiranog akta o taksonomiji klimatski održivih djelatnosti u postupcima procjene utjecaja na okoliš

Paula BUCIĆ, Ivana SEČANJ, Helena SELIĆ

Ires ekologija d.o.o., Prilaz baruna Filipovića 21, Zagreb, Hrvatska

Sažetak

Prema „Uredbi o taksonomiji“ gospodarsku djelatnost ne bi trebalo smatrati okolišno održivom ako njezin štetan učinak na okoliš premašuje njezine koristi. Uredbom je utvrđeno šest okolišnih ciljeva na temelju kojih se određuje je li neka gospodarska djelatnost okolišno održiva, a ista se smatra okolišno održivom, odnosno usklađenom s EU Taksonomijom ako: a) znatno doprinosi jednom okolišnom cilju ili više njih; b) ne šteti bitno nijednom okolišnom cilju (DNSH); c) provodi se u skladu s minimalnim zaštitnim mjerama; d) usklađena je s kriterijima tehničke provjere. Tehnički kriteriji provjere navedeni su u takozvanom Delegiranom aktu, a trenutno je objavljen prvi akt koji sadrži tehničke kriterije za provjeru značajnog doprinosa i ne nanošenja bitne štete za prva dva okolišna cilja – ublažavanje i prilagodbu klimatskim promjenama. Načelo DNSH se i prije donošenja „Uredbe o taksonomiji“ već na određeni način integriralo u procjenu utjecaja na okoliš. Prema nekim procjenama za čak 70 % DNSH kriterija usklađenost se može dokazati kroz provedbu različitih EU direktiva ili postupaka procjene utjecaja na okoliš, a cilj ovog rada je prikazati u kojoj mjeri je donošenje Delegiranog akta doprinijelo procjeni utjecaja klimatskih promjena u postupcima procjene utjecaja na okoliš.

Ključne riječi: EU Taksonomija, Delegirani akt o taksonomiji klimatski održivih djelatnosti, DNSH, klimatske promjene, PUO

Environmental Impact Assessment / *Procjene utjecaja na okoliš*
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Evaluating sustainability in a multi-project environment - comparison of the application of P5 ontology in construction and non-construction projects

Domagoj NAKIĆ[1], Jelena KLJAIĆ ŠEBREK[2], Mario PROTULIPAC[2]

[1] University of Zagreb, Faculty of Civil Engineering, Kačićeva 26, Zagreb, Croatia
[2] WYG savjetovanje d.o.o., Ulica grada Vukovara 269 G, Zagreb, Croatia
[3] Okviri znanja d.o.o., Vranyczanyeva ulica 6, Karlovac, Croatia

Abstract
The need for active reflection and action in sustainable development also includes project management. Achieving sustainable development goals requires changes, and projects are the essential tool for bringing about changes in all segments of social and economic development. It is necessary to apply methods, tools and techniques for evaluating the project's contribution to sustainable development in order to achieve impacts on sustainable development goals. The P5 ontology developed by the international organization GPM Global is a comprehensive tool that connects the measurement of the project's impact on individual components of sustainable development with a globally growing application in different types of projects. The purpose of the paper is to evaluate the applicability of the subcategories and elements of the P5 ontology within the "Planet" category on projects that include a constructional component and projects without an emphasized constructional component. The work is based on case studies of projects from different sectors analyzed using qualitative research methods. A multicriteria analysis based on the simulation of the application of the P5 ontology was carried out. The paper showed that the P5 ontology in the "Planet" category applies to both types of projects but with certain specificities, i.e. different emphasis on specific subcategories and elements of the ontology. The results directly benefit project managers in planning elements of sustainability throughout all phases of the project life cycle and in the post-project phase.
Keywords: green project management, sustainability, sustainable projects, infrastructure and non-infrastructure projects, P5 ontology

Environmental Impact Assessment / *Procjene utjecaja na okoliš*
Oral presentation / *Usmeno priopćenje*

Vrednovanje održivosti u multiprojektnom okruženju - usporedba primjene P5 ontologije u građevinskim i ne-građevinskim projektima

Domagoj NAKIĆ[1], Jelena KLJAIĆ ŠEBREK[2], Mario PROTULIPAC[2]

[1] Sveučilište u Zagrebu, Građevinski fakultet, Kačićeva 26, Zagreb, Hrvatska
[2] WYG savjetovanje d.o.o., Ulica grada Vukovara 269 G, Zagreb, Hrvatska
[3] Okviri znanja d.o.o., Vranyczanyeva ulica 6, Karlovac, Hrvatska

Sažetak
Potreba za aktivnim promišljanjem i djelovanjem u održivom razvoju obuhvatila je i područje projektnog menadžmenta. Za ostvarivanje ciljeva održivog razvoja potrebne su promjene, a projekti su osnovni alat za donošenje promjena u svim segmentima društvenog i gospodarskog razvoja. Kako bi projektni menadžment sustavno i organizirano doprinosio ciljevima održivog razvoja, nužno je primijeniti metode, alate i tehnike za vrednovanje doprinosa projekta održivom razvoju. P5 ontologija razvijena od strane međunarodne organizacije GPM Global sveobuhvatni je alat koji povezuje mjerenje utjecaja projekta na pojedine komponente održivog razvoja, s globalno rastućom primjenom u različitim tipovima projekata. Svrha rada je ocijeniti primjenjivost potkategorija i elemenata P5 ontologije unutar kategorije "Planet" na projektima koji uključuju infrastrukturnu komponentu i projektima bez naglašene infrastrukturne komponente. Rad se temelji na studijama slučaja projekata iz različitih sektora analiziranih primjenom kvalitativnih metoda istraživanja. Provedena je multikriterijska analiza koja se temelji na simulaciji primjene P5 ontologije. U radu je pokazano da je P5 ontologija u kategoriji "Planeta" primjenjiva na oba tipa projekata, ali s određenim specifičnostima, tj. različitom težištu na pojedinim potkategorijama i elementima ontologije. Rezultati direktno koriste voditeljima projekata u planiranju elemenata održivosti kroz sve faze životnog ciklusa projekta i u post-projektnoj fazi.
Ključne riječi: održivi projektni menadžment, održivost, održivi projekti, građevinski i ne-građevinski projekti, P5 ontologija

Environmental Impact Assessment / *Procjene utjecaja na okoliš*
Oral presentation / *Usmeno priopćenje*

Environmental impact assessment in Slovenia

Urška STOPAR

University of Ljubljana, Faculty of Law, Poljanski nasip 2, Ljubljana, Slovenia

Abstract
An environmental impact assessment is a process for identifying how a particular development will affect the environment. Based on this, the impacts on the environment should be identified and assessed, as well as the integration into the plan of the environmental protection, nature conservation, human health, climate change and climate resilience objectives, landscape and cultural heritage requirements. Any intervention in the environment will undoubtedly have an impact on the environment. An interesting question arises when we are weighing up between two interests. In certain cases, if all the conditions are met, the public interest or the common good can be given priority, even if negative environmental impacts are identified. In my work, I will present in particular how the impact assessment process works in Slovenia. I will describe environmental impact assessment examples in the case of the construction and planning of a hydroelectric power plant. Hydroelectric power plants are a renewable source of energy. However, in this case, there is often a balancing of the different interests of environmental protection and the interests of generating electricity (especially renewable energy).
Keywords: environmental impact assessment, hydroelectric power plants; renewable energy, environmental law

Environmental Impact Assessment / *Procjene utjecaja na okoliš*
Oral presentation / *Usmeno priopćenje*

Environmental benefits of making temperature-sensitive food products last longing by sustainable temperature indicators

Janez TURK[1], Katja MALOVRH REBEC[1], Marta KLAJNŠEK GUNDE [2,3], Barbara TREPPO MEKIŠ[1], Barbara ŠUMIGA[3], Petra STRAŽAR[3], Anja LEŠEK[1], Patricija OSTRUH[1]

[1] Slovenian National Building and Civil Engineering Institute, Dimičeva ulica 12, Ljubljana, Slovenia
[2] National Institute of Chemistry, Hajdrihova 19, Ljubljana, Slovenia
[3] MyCol d.o.o, Hajdrihova 19, Ljubljana, Slovenia

Abstract
Innovative printed temperature indicators show the temperature mistakes and errors in the cold chain through irreversible (permanent) coloration coloring, which can protect any temperature-sensitive product. When cold chain protection measures are improved using the new indicators, higher food safety and quality are is achieved, the possibility of illness is reduced, and less unnecessary food waste is generated. The temperature indicators are particularly relevant for organically produced foods, which have a high environmental impact and are very sensitive to temperature. Since the new indicators do not contain electronic components, they can be recycled together with the packaging like ordinary packaging ink paint. Using the Life Cycle Assessment (LCA) method, we have demonstrated the environmental benefits of using smart packaging with directly printed or labeled temperature indicators. The environmental footprint of a temperature indicator printed/labeled on the food packaging is small compared to the environmental footprint of the food packaging itself. Since the new indicators provide good control over each packaging package in the cold chain, the amount of wasted food wasted could be reduced. Food production has a significant environmental footprint. For example, the global warming potential of a liter of cow's milk is about 1 kg of CO_2 -equivalent, whereas a label with an indicator printed on it indicator is only 0.000096 kg CO_2 -equivalent. The use of temperature indicators printed or labeled temperature indicators on food products such as milk, yogurt, and ice cream helps to make these products last longer and less food is discarded thrown away. This means that the environmental impacts associated with food production are reduced, at least locally reduced.
Keywords: temperature indicator, irreversible coloration, environmental impacts, waste food, packaging

Environmental Monitoring
Monitoring okoliša

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Occurrence of glyphosate and its metabolite AMPA in irrigation water

Miroslav AGARSKI[1], Gorica VUKOVIĆ[2], Nikola PUVAČA[3], Bojan KONSTANTINOVIĆ[1], Tijana STOJANOVIĆ[1], Milena POPOV[1], Nataša SAMARDŽIĆ[1], Vojislava BURSIĆ[1]

[1] University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Serbia
[2] Field Test, Vinogradska 150b, Belgrade, Serbia
[3] University of Novi Sad, Faculty of Economics and Engineering Management in Novi Sad, Cvećarska 2, Serbia

Abstract
The hydrosystem Danube-Tisa-Danube (DTD) connects the Danube and the Tisa rivers through the northern part of Serbia, i.e. the AP Vojvodina, and is a unique hydrotechnical system. The main purposes of DTD are drainage, irrigation and water supply. The DTD canal is surrounded by agricultural land on which the use of plant protection products is high, especially of herbicides. During a year, the presence of glyphosate and AMPA was monitored in the surface water of the DTD canal. Every month, the water samples were collected from seven spots. The pesticide residues were detected by the validated LC-MS/MS method after the derivatization with FMOC-Cl. During the winter, the glyphosate concentration ranged from 0.02 to 0.05 µg/L, while in the spring it ranged from 0.03 to 0.2 µg/L. The maximum concentration during the summer was 0.3 µg/L, before being reduced to 0.17 µg/L during the fall. The maximum concentration of AMPA during the autumn was 1.23 µg/L, while during the winter it was in the interval from 0.06 to 0.13 µg/L. During the spring, AMPA had a maximum of 0.84 µg/L, while during the summer the concentration ranged from 0.79 to 1.5 µg/L.
Keywords: glyphosate, AMPA, LC-MS/MS, irrigation water

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Possible effects of pesticides on the natural population of European eel, *Anguilla anguilla* (Linnaeus, 1758)

Oliver BARIĆ[1], Tena RADOČAJ[1], Jurica JUG-DUJAKOVIĆ[2], Ana GAVRILOVIĆ[1]

[1] University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia
[2] Sustainable Aquaculture Systems Inc., 715 Pittstown Road, Frenchtown, United States of America

Abstract
Since the mid-last century European eel stocks have been in decline, and nowadays it is considered that their abundance is below sustainable biological limits. Spawner quantity and quality has been recognized as one of the influential causes of population decline and could be influenced by different pollutants. Eels reside in freshwater and coastal areas where they are often exposed to pollutants that are washed off from agricultural lands, such as pesticides. Pesticides have a long retention time in the environment, are lipophilic, and have the ability to biomagnify in the food web. During the transition into the adult stage, eels accumulate fat that is necessary for spawning migration and gonadal maturation. High pesticide concentrations in are known to disturb fat accumulation, alter lipid metabolism, and decrease glycogen levels while increasing lactic acid concentration in muscles. As the pesticides stored in fat get released into the bloodstream their toxic effect increases, possibly disabling eels from reaching their spawning grounds. Long-term exposure can disrupt endocrine, immune, nervous, and reproductive systems which not only impair reproductive success but, also make them susceptible to disease. The aim of this study is to compare the concentrations of pesticides in eels from the river Neretva delta to other investigated populations and to discuss its possible effects on eel stock.
Keywords: Neretva delta, pesticide concentration, Adriatic Sea, eel stock

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Chemical sensors for outdoor air quality monitoring

Dino BOSILJ, Nikola SAKAČ

University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia

Abstract
Air pollution is a global threat leading to large impacts on human health and ecosystems. Emissions and concentrations have increased in many areas and worldwide. In some areas of Europe, air quality remains very poor, despite reduced emissions and concentrations in the environment. Currently, the most important environmental risk to human health is air pollution, and Europeans are considered the second biggest concern for the environment, right after climate change. Major problems related to air quality have an impact on human health, and in particular on respiratory diseases. In response to the problems of poor air quality, there is political, media and public interest in air quality issues. The growing public influence over air pollution challenges, including ongoing civic scientific initiatives involved in supporting air quality monitoring and targeted initiatives to raise public awareness and change behavior, has led to increasing support and demand for measures to improve air quality. Due to increasing air pollution, great efforts are being made to develop various chemical methods and chemical sensors used to measure air quality. Cheaper gas-based sensors based on the Arduino system are available today. Given their simplicity and that they are more cost-effective, these sensors have proven to be very useful in some situations where it is necessary to detect certain gases in the air in a very short time. Several chemical methods have been developed that can also detect certain gases in the air. In this paper, only some methods by which gases and particles can be detected will be mentioned.
Keywords: chemical sensors, emissions, gas sensor, air pollutants, Arduino

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

A new potentiometric sensor for thiabendazole determination

Mateja BUDETIĆ[1], Igor DUNDOVIĆ[2], Mirela SAMARDŽIĆ[1]

[1] Department of Chemistry, Josip Juraj Strossmayer University of Osijek, Cara Hadrijana 8/A, Osijek, Croatia
[2] HIDROMODEL, obrt za savjetovanje i usluge, Mlinska 69, Osijek, Croatia

Abstract
Thiabendazole (TBZ) is a benzimidazole pesticide widely used to prevent mold, pests, and rot in fruit and vegetables or to keep the freshness of fruit. It is one of the most detected pesticides in the USA and Europe. The TBZ has low acute toxicity, but in high doses, it can be carcinogenic. Consequently, its residues should be monitored in order to prevent its intake through the diet. For that purpose, various analytical methods can be used. Although chromatographic methods are the most commonly used, they have a lot of disadvantages, such as complicated and tedious sample preparation, expensive instrumentation, and large consumption of organic solvents. Therefore, ion-selective electrodes can be a great alternative due to their simplicity, selectivity, and accuracy. The new potentiometric sensor for TBZ determination was the solid-contact electrode, developed using multi-walled carbon nanotubes modified with a sulfate group and a TBZ cation as the electroactive material in a liquid membrane. As the plasticizer, dibutyl sebacate was used. The analytical performances of the new sensor were characterized using direct potentiometry. The main purpose of the developed sensor was TBZ determination in fruit samples. The new sensor was fast, selective, and accurate.
Keywords: thiabendazole, ion-selective electrode, direct potentiometry

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Occurrence of marine biotoxins in *Venus verrucosa* from the Adriatic Sea

Antonija BULIĆ[1], Ivana UJEVIĆ[1], Romana ROJE-BUSATTO[1], Stjepan ORHANOVIĆ[2], Ivana ŽAPER[1,2]

[1] Institute of Oceanography and Fisheries, Laboratory of Plankton and Shellfish Toxicity, Šetalište I. Meštrovića 63, Split, Croatia
[2] University of Split, Faculty of Natural Science, Department of Chemistry, Ruđera Boškovića 33, Split, Croatia

Abstract
Harmful marine algal species produce a wide range of highly toxic organic substances, called biotoxins. To date, many different algal biotoxins have been discovered, differing in chemical structure, stability, polarity, type of toxicity, and associated symptoms. Generally, they are classified into two main groups: hydrophilic and lipophilic biotoxins. Occasionally, harmful marine algae attain high abundance in seawater. In such cases, shellfish that feed on marine algae by filtering them from large quantities of seawater can accumulate significant amounts of algal biotoxins in their tissues. Once consumed, toxic shellfish can pose a risk not only to marine organisms, but also to human health due to the thermostability of the biotoxins. The occurrence of shellfish toxicity may significantly affect the profitability of the growing aquaculture industry. The aim of this work was to investigate hydrophilic and lipophilic biotoxins in samples of warty venus *Venus verrucosa Linnaeus*, 1758 collected from January 2023 to March 2023 in Kaštela Bay in the eastern Adriatic Sea. The content of hydrophilic marine biotoxins causing Paralytic Shellfish Poisoning (PSP) was determined by UHPLC with fluorescence detection, while the lipophilic group and Amnesic Shellfish Poisoning toxins (ASP) were determined by LC-MS/MS. Domoic acid, which causes ASP, was detected in 7 samples in the range of 0.35-13.3 mg/kg, corresponding to 1.7-66.5% of the maximum level allowed by EU legislation (20 mg/kg). Other hydrophilic biotoxins, namely PSP, and lipophilic, including okadaic acid (OA) and its derivatives, dinophysistoxins (DTX), pectenotoxins (PTX), azaspiracids (AZA), yessotoxins (YTX) and cyclic imines (CI), were not detected.
Keywords: marine biotoxins, *Venus verrucosa,* Adriatic Sea, Kaštela Bay

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Geodesy and geomatics in support of Sustainable Development Goals (SDGs)

Vlado CETL, Danko MARKOVINOVIĆ, Sanja ŠAMANOVIĆ, Hrvoje MATIJEVIĆ, Olga BJELOTOMIĆ ORŠULIĆ, Milan REZO

University North, University Center Varaždin, Department of Geodesy and Geomatics, Jurja Križanića 31b, Varaždin, Croatia

Abstract
The achievement of 17 sustainable development goals (SDGs) and related targets is monitored through a set of indicators at the global, regional and national levels. Indicators are classified into three levels based on the methodology and availability of data for their calculation. A large number of indicators supporting individual goals and targets are based on geospatial data. Geospatial technologies significantly contribute to the fulfillment of many SDGs. Together with digital technologies, they have great potential for accelerating human progress, bridging the digital divide and developing knowledge societies, and serving as a support structure for all goals and more importantly in measuring, monitoring and reporting progress so far. The development of platforms for remote sensing such as unmanned aerial vehicles and satellites together with measuring sensors and technologies through cloud computing and artificial intelligence additionally help in achieving progress towards the achievement of goals. It is evident, especially in the fields of energy, agriculture, health, climate change, etc. This paper presents the role of geodesy and geomatics through the measuring, processing and use of geospatial data in the achievement and monitoring of SDGs.
Keywords: geodesy and geomatics, geospatial data, sustainable development goals (SDGs), indicators

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Geodezija i geomatika u podršci ciljevima održivog razvoja

Vlado CETL, Danko MARKOVINOVIĆ, Sanja ŠAMANOVIĆ, Hrvoje MATIJEVIĆ, Olga BJELOTOMIĆ ORŠULIĆ, Milan REZO

Sveučilište Sjever, Sveučilišni centar Varaždin, Odjel za geodeziju i geomatiku, Jurja Križanića 31b, Varaždin, Hrvatska

Sažetak

Ostvarivanje 17 ciljeva održivog razvoja te povezanih podciljeva prati se kroz skup indikatora na globalnoj, regionalnoj i nacionalnoj razini. Indikatori se klasificiraju u tri razine obzirom na metodologiju i dostupnost podataka za njihovo računanje. Velik broj indikatora koji podupiru pojedine ciljeve i podciljeve temelji se na geoprostornim podacima. Upravo geoprostorne tehnologije značajno doprinose ispunjenju svakog cilja održivog razvoja. Zajedno s digitalnim tehnologijama, imaju veliki potencijal za ubrzavanje ljudskog napretka, premošćivanje digitalnog jaza i razvoj društava znanja te služe kao struktura podrške svim ciljevima i još važnije u mjerenju, praćenju i izvješćivanju o dosadašnjem napretku. Razvoj platformi za potrebe daljinskih istraživanja kao što su bespilotne letjelice i sateliti te mjernih senzora i tehnologija kroz računalstvo u oblaku i umjetnu inteligenciju dodatno pomažu u postizanju napretka prema ostvarenju ciljeva, a posebno u područjima energije, poljoprivrede, zdravlja, klimatskih promjena i dr. U ovom radu prikazana je uloga geodezije i geomatike kroz prikupljanje, obradu i korištenje geoprostornih podataka u ostvarenju i praćenju ciljeva održivog razvoja.

Ključne riječi: geodezija, geomatika, geoprostorni podaci, ciljevi održivog razvoja, indikatori

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Trophic status assessment of the surface waters in the Kopački rit by measuring Chlorophyll A concentration throughout NATURAVITA project in the period July 2021 – June 2022

Ivan DAMJANOVIĆ[1], Hrvoje SUČIĆ[1], Danijela BEZIK[1], Dario KOLARIĆ[1], Marika KRALJ[1], Mirna HABUDA-STANIĆ[2], Nataša TURIĆ[1], Snježana BENKOTIĆ[1], Barbara PETROVICKY ŠVEIGER[1], Ines RUŠKAN[1], Hrvoje BEKINA[1]

[1] Teaching Institute of Public Health for the Osijek – Baranja County, Drinska 8, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia

Abstract
Chlorophyll a is the green pigment in the chloroplasts of plants, responsible for photosynthesis. By measuring the chlorophyll concentration, the assessment of phytoplankton biomass and the trophic state of surface waters is determined. The trophic state implies the intensity of primary production in surface waters. Chlorophyll a was determined using the spectrophotometric method SM 10200 H (2023) with a quantification limit of 0.25 µg/L on a spectrophotometer HACH DR 3900. The research goal is to assess the trophic state of the surface waters of Kopački rit based on the measured values of chlorophyll a. The research was conducted as part of the NATURAVITA project. A total of 166 samples at 15 different locations in the period from July 2021 to June 2022 were collected and analyzed. The range of measured values was from 1.15 to 491.97 µg/L. The highest values were recorded during the summer period from June to August. The lowest values were recorded during the winter months. According to the mean annual values of chlorophyll, a concentration ranged from 6.60 to 71.02 µg/L, the trophic state of the surface waters in the Kopački rit mostly classifies to eutrophic waters (13 locations) and one location to the mesotrophic and hypertrophic waters, respectively.
Keywords: NATURAVITA project, Kopački rit Nature Park, surface water, chlorophyll a, trophic state

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Ocjena trofičnog stanja površinskih voda Kopačkog rita mjerenjem koncentracije klorofila a u sklopu projekta NATURAVITA za razdoblje od srpnja 2021. do lipnja 2022. godine

Ivan DAMJANOVIĆ[1], Hrvoje SUČIĆ[1], Danijela BEZIK[1], Dario KOLARIĆ[1], Marika KRALJ[1], Mirna HABUDA-STANIĆ[2], Nataša TURIĆ[1], Snježana BENKOTIĆ[1], Barbara PETROVICKY ŠVEIGER[1], Ines RUŠKAN[1], Hrvoje BEKINA[1]

[1] Nastavni zavod za javno zdravstvo Osječko-baranjske županije, Drinska 8, Osijek, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek, Franje Kuhača 18, Osijek, Hrvatska

Sažetak
Klorofil a je zeleni pigment u kloroplastima biljaka, odgovornima za fotosintezu. Mjerenjem koncentracije klorofila a određuje se procjena biomase fitoplanktona i trofičko stanje površinskih voda. Trofičko stanje podrazumijeva intenzitet primarne produkcije u vodama. Klorofil a se određivao spektrofotometrijskom metodom SM 10200 H (2023) s granicom kvantifikacije od 0,25 µg/L na spektrofotometru HACH DR 3900. Cilj rada je temeljem izmjerenih vrijednosti klorofila a procijeniti trofičko stanje površinskih voda Kopačkog rita. Istraživanje je provedeno u sklopu projekta Naturavita, a analizirano je ukupno 166 uzoraka prikupljenih na 15 različitih lokacija u razdoblju od srpnja 2021. do lipnja 2022. godine. Raspon izmjerenih vrijednosti klorofila a bio je od 1,15 do 491,97 µg/L. Najviše vrijednosti zabilježene su tijekom ljetnog razdoblja od lipnja do kolovoza. Najniže vrijednosti zabilježene su tijekom zimskih mjeseci. Prema srednjim godišnjim vrijednostima koncentracije klorofila-a, koje su se kretale u rasponu od 6,60 do 71,02 µg/L, trofičko stanje površinskih voda Kopačkog rita u najvećem dijelu pripada skupini eutrofnih voda (13 lokacija) te po jedna lokacija pripada skupini mezotrofnih, odnosno hipertrofnh voda.
Ključne riječi: projekt Naturavita, Park prirode Kopački rit, površinska voda, klorofil-a, trofičko stanje

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Monitoring of greenhouse gas emissions according to the IED directive in the HEP Production, Plant EL-TO Zagreb

Anamarija DELLAVIA, Brigita POPOVIĆ

[1] HEP Production, Plant EL-TO Zagreb, Ulica grada Vukovara 37, Zagreb, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
Thermal power plant EL-TO Zagreb is primarily intended for the production of heat energy, while electricity is produced in a combined process (cogeneration). The main activity of the plant (EL-TO) Zagreb is fuel combustion in plants with a total nominal input thermal power of 50 MW or more. Climate change, industry and traffic greatly influence the increase in greenhouse gas emissions, in the thermal power plant EL-TO Zagreb applies continuous monitoring of emissions into the air, which is prescribed by the Environmental Permit. When using two fuels at the same time (liquid and gas), GVE is determined as follows:

$$GVE_{uk} = \sum_{x=1}^{N} \frac{Q_x \cdot GVE_x}{Q_{uk}},$$

Keywords: emission, greenhouse gases

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Monitoring emisija stakleničkih plinova prema IED direktivi u postrojenju HEP Proizvodnja, Pogon EL-TO Zagreb

Anamarija DELLAVIA, Brigita POPOVIĆ

[1] HEP Proizvodnja, Pogon EL-TO Zagreb, Ulica grada Vukovara 37, Zagreb, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti Osijek, V. Preloga 1, Osijek, Hrvatska

Sažetak

Termoenergetsko postrojenja EL-TO Zagreb prvenstveno je namijenjeno proizvodnji toplinske energije, dok se električna energija proizvodi u spojnom procesu (kogeneracija). Glavna djelatnost postrojenja (EL-TO) Zagreb je izgaranje goriva u postrojenjima ukupne nazivne ulazne toplinske snage 50 MW ili više. Klimatske promjene, industrija i promet uvelike utječu na povećanje emisija stakleničkih plinova, stoga se u termoenergetskom postrojenju EL-TO Zagreb primjenjuje kontinuirani monitoring emisija u zrak koji je propisan Okolišnom dozvolom. Kod korištenja dva goriva istovremeno (tekućeg i plinskog) GVE se određuju na sljedeći način:

$$GVE_{uk} = \sum_{x=1}^{N} \frac{Q_x \cdot GVE_x}{Q_{uk}},$$

Ključne riječi: emisija, staklenički plinovi

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Occurrence of zoonotic pathogens in forest spring used as drinking water source in Central Croatia

Valentina GORIČANEC[1], Mario ANTIČEVIĆ[1], Mario SVIBEN[1], Vinka ŠIMUNOVIĆ[1], Relja BECK[2], Ema GAGOVIĆ[2], Marina HUBLIN[3], Magdalena UJEVIĆ BOŠNJAK[1]

[1] Croatian Institute of Public Health, Rockefellerova 7, Zagreb, Croatia
[2] Croatian Veterinary Institute, Savska cesta 143, Zagreb, Croatia
[3] Institute of Public Health Zagreb County, Mokrička 54, Zaprešić, Croatia

Abstract
Animals can be a source of infectious waterborne microorganisms and their persistence in drinking water catchments makes them potentially significant reservoirs for zoonotic pathogens. Waterborne protozoan pathogens *Cryptosporidium spp.* and *Giardia duodenalis* are important causing agents of waterborne outbreaks, however, their detection in water is very challenging due to their low numbers and the complexity of the water matrix; consequently, only a few countries have legislated water monitoring for their presence. The aim of this study was to investigate the presence of these parasites in one forest spring used for public water supply in Central Croatia and to identify interactions between biotic/abiotic factors. During a preliminary 4-month study period presence of *Cryptosporidium* oocysts and *G. duodenalis* cysts were analyzed using ISO 15553:2006 and USEPA Method 1623.1 in line with microbiological (*E. coli*, enterococci, coliforms, colony count 22℃) and physico-chemical parameters such as pH, turbidity, conductivity, ions and metals. *Cryptosporidium* oocysts were detected in 6 out of 20 water samples (<1/ litre), while *Giardia* cysts were absent. Among 6 positive samples, two samples were raw and four drinking water samples. No correlation was found between oocyst counts and analyzed parameters. Forest springs although look very tempting can pose a risk to public health, however, according to the epidemiological data, there were no reported cases of cryptosporidiosis that could be related to this spring.
Keywords: *Cryptosporidium*, *Giardia*, forest spring, drinking water, Croatia

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Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Biomonitoring: Beehive air volatiles profile as an indicator of environmental contamination

Daria ILIC[1,2], Boris BRKIC[2], Sanja RADOVIC[1], Maja TURK SEKULIC[1]

[1] University of Novi Sad, Faculty of Technical Sciences, Department of Environmental Engineering and Occupational Safety and Health, Trg Dositeja Obradovica 6, Novi Sad, Serbia
[2] BioSense Institute, Dr Zorana Đinđića 1, Novi Sad, Serbia

Abstract
The well-being of the honeybee colonies and the health of humans are connected in numerous ways, requiring responsibility and commitment for the interest of healthy environment. The colony collapse disorder (CCD) phenomenon was first reported in 2006 when majority of bee colonies in Europe died out, due to increase of diseases infections, contamination of hive with agrochemical pesticides and persistent organic pollutants (POPs). Only 6 years after CCD intimation, about 7 million premature deaths were reported, due to the air pollution to which humans are continuously exposed. The use of insect species, such as honeybee *Apis mellifera L*. and air matrix inside the bee hive, can be used as a tool in biomonitoring, instead of traditional monitoring methods. This may have advantages in terms of cost-effective bioindicators of the environmental health status, showing the ability to record spatial and temporal pollutant variations. In this study, we present the in-field use of the portable membrane inlet mass spectrometry (MIMS) instrument for instant and effective determination of the environmental pollution levels. Application has been investigated through analytical identification of hive atmosphere volatile organic compound (VOCs) contaminants, contained in polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and pesticides. The samples have been taken from hives which are located in urbanized and rural regions, where significant differences in contamination levels were highlighted. The MIMS results are compared with the pollutant levels quatified by conventional laboratory technique, such as GC-MS.
Keywords: Biomonitoring, honeybees, VOCs, PAHs, pesticides, POPs, environmental pollution

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Monitoring of heavy metals pollution of the rivers Krivaja and Bosna

Enver KARAHMET[1], Senita ISAKOVIĆ[1], Fahir BEČIĆ[2], Ajla SMAILOVIĆ[3]

[1] University of Sarajevo, Faculty of Agriculture and Food Science, Zmaja od Bosne 8, Sarajevo, Bosnia and Herzegovina
[2] University of Sarajevo, Faculty of Pharmacy, Zmaja od Bosne 4, Sarajevo, Bosnia and Herzegovina
[3] Pharmacy & Bio" d.o.o. Šefika Loje 22, Sarajevo, Bosnia and Herzegovina

Summary
Water pollution of heavy metals caused by industrial activities and technological development represents a serious health- and environmental problem because of their toxic and non-biodegradable effect, they accumulate in living systems and have a long duration of lifetime in all environments. In comparison with river Krivaja which flows through natural beauty and rural areas with its bigger part of its flow, river Bosna with its own flow is a recipient of waste water from homes of several cities, industrial waste water and utility waste. The aim of this work was to determine the level and presence of heavy metals mercury (Hg), arsenic (As), and lead (Pb), with atomic absorption spectrophotometry. The results indicate the presence of heavy metals within limits that they can't cause disturbance of ecological balance. The watercourse of river Bosna in Maglaj is classified in the III-IV class and river Krivaja in Kovaci, municipality Zavidovici classified in the I-II class. The results confirmed the health safety of drinking water. It is necessary to monitor pollutants in water systems over a long period of time and in different periods in order to determine the source of pollution and prevent possible consequences for the ecosystem and human health.

Keywords: environment, water pollution, heavy metals, arsenic, lead, mercury, atomic absorption spectrophotometry

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Monitoring onečišćenja teškim metalima rijeke Krivaje i Bosne

Enver KARAHMET[1], Senita ISAKOVIĆ[1], Fahir BEČIĆ[2], Ajla SMAILOVIĆ[3]

[1] Univerzitet u Sarajevu, Poljoprivredno-prehrambeni fakultet, Zmaja od Bosne 8, Sarajevo, Bosna i Hercegovina
[2] Univerzitet u Sarajevu, Farmaceutski fakultet, Zmaja od Bosne 4, Sarajevo, Bosna i Hercegovina
[3] Pharmacy & Bio" d.o.o. Šefika Loje 22, Sarajevo, Bosna i Hercegovina

Sažetak

Zagađenje vode teškim metalima uzrokovano industrijskim aktivnostima i tehnološkim razvojem predstavlja ozbiljan zdravstveni i ekološki problem zbog toga što su toksični, nisu biorazgradivi, akumuliraju se u živim organizmima i imaju dugo poluvrijeme života u svim sredinama. Za razliku od rijeke Krivaje, koja svojim većim tokom protiče kroz ruralna područja, rijeka Bosna cijelim svojim tokom je recipijent otpadnih voda iz domaćinstava većeg broja gradova, industrijskih otpadnih voda i komunalnih ispusta. Uz navedeno, deponije svojim procjednim vodama značajno utječu na kvalitetu vode rijeke Bosna. Cilj ovog rada je bio utvrditi prisutnost i koncentraciju arsena (As), olova (Pb) i žive (Hg) atomskom apsorbcionom spektrofotometrijom u uzorcima vode iz rijeke Krivaje i Bosne. Rezultati ukazuju na prisutnost navedenih teških metala u vodi u koncentracijama koje ne mogu prouzrokovati poremećaj ekološke ravnoteže. Vodotok Bosne kod Maglaja je klasificiran u III-IV klasu a Krivaju u Kovačima, općina Zavidovići, u I-II klasu. Rezultati su potvrdili i zdravstvenu ispravnost vode. Potrebno je pratiti unos polutanata u vodne sustave tokom dužeg vremenskog razdoblja i u različitim periodima kako bi utvrdili izvori onečišćenja i spriječile eventualne posljedice po ekosustav i zdravlje ljudi.

Ključne riječi*:* životna sredina, onečišćenje vode, teški metali, arsen, olovo, živa, atomska apsorbciona spektrofotometrija

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Methodology for defining the biological minimum in multipurpose accumulations from the aspect of climate and morphological changes during exploitation on the example of accumulation SOT

Srđan KOLAKOVIĆ[1], Branko MILJANOVIĆ[1], Vladimir MANDIĆ[2], Slobodan KOLAKOVIĆ[1]

[1] University of Novi Sad, Faculty of Technical Sciences, Trg Dositeja Obradovića 4, Novi Sad, Serbia
[2] University of Kraljevo, Faculty of mechanical and civil engineering, Dositejeva 19, Kraljevo, Serbia

Abstract
During the exploitation life of an accumulation reservoir, especially in the period of 40-50 years, morphological changes occur due to fluvial and aeolian erosion, but also due to the deposition of organic matter. This leads to changes in the structure of the communities that inhabit the lake, primarily macrobenthos and fish. This study presents the procedure for defining the water balance of poorly studied river basins based on correlation dependences for precipitation, after which the methodology of hydrologically similar river basins was applied. This methodology is based on the fact that the river basins are located in the same climatic region, with the same distribution of precipitation, the same geomechanical groups of land cover, small areas of basins (less than 50 km^2) and approximately similar shape of the basin. After defining the balance of the lake, the analysis of the hydro-eco system through macrobenthos was performed by taking mud samples from the bottom, the phytoplankton community was analyzed by filtering the water, and as a third parameter, by faunistic research of the ichthyofauna in the lake water. In addition to the hydro-biological parameters, basic physic-chemical parameters were also measured in the field for the purposes of this research. Based on the aforementioned complex analyses, along with the fact that more than 40 years have passed since the moment of the construction of the dam and the formation of the lake, during which period, in addition to the filling of the lake, there were also negative climate changes for the water balance, it is necessary to define a new biological minimum in order to preserve the existing eco-system.
Keywords: eco-system, lakes, biological minimum

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Correlation analysis of microbiological indicators of water quality

Sanja KOVAČ, Anita PTIČEK SIROČIĆ, Alice ŠEBINA

University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia

Abstract
Water represents one of the basic conditions for life. The basic division of water use is defined with regard to water quality. Water quality is the determination of individual indicators of a certain substance or energy. For testing the quality of bathing water, data is collected through continuous monitoring. The quality of bathing water depends primarily on microbiological indicators, that is, on the number of Escherichia coli (E. coli) and intestinal enterococci. Regular monitoring of microbiological indicators is necessary, especially at locations used for recreation or other purposes in order to prevent possible infections. The aim of this work is to perform a correlation analysis of the water quality parameters measured during several consecutive years, as well as to correlate the mutual influence of microbiological indicators depending on the season.
Keywords: microbiological indicators, water quality, correlation analysis

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Potential Causes of Tropospheric Pollution During the COVID-19 Pandemic in the Kopački Rit Nature Reserve Park

Elvira KOVAČ-ANDRIĆ, Vlatka GVOZDIĆ, Brunislav MATASOVIĆ

Josip Juraj Strossmayer University of Osijek, Department of Chemistry, Cara Hadrijana 8/A, Osijek, Croatia

Abstract
Since the beginning of 2020 pandemic of COVID-19 spread all over the world. Severe quarantine measures have been imposed worldwide which included firstly complete stop of human activities and later their intensity. It is expected that such measures would have a positive impact on the air quality, *i.e.* less pollution. Analysis of PM_{10} data for the period from 2019 to 2021 shows that there is the lowest concentration of those particles during 2020 at the period of the most severe quarantine. The highest pollution by PM_{10} in 2020 was noted at the beginning of the quarantine which is in agreement with the original presumption and maybe just a continuation of the highest pollution noted a year before which occurred in the last months of 2019. Based on the days with the highest pollution during the year, air mass trajectories show that air masses came to this area from the East. A longer period (up to 5 days) shows that air masses originate further to the East (from Russia and Central Asian states) or, in one case, from the south (Italy).
Keywords: PM_{10}, COVID-19, air trajectory analysis

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Chlorophyll-based plant bio photonics application in urban ecology and biomonitoring – a case study of Black pine trees in Belišće (Croatia)

Hrvoje LEPEDUŠ[1], Tomo TRSTENJAK[2]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Humanities and Social Sciences, L. Jägera 9, Osijek, Croatia
[2] State Inspectorate, Ulica Hrvatske Republike 21, Osijek, Croatia

Abstract
The topic of the present investigation was to reveal how chlorophyll *a* driven fluorescence that originates from green parts of plants can be efficiently used as a tool for the biomonitoring of urban pollution. This is the case study where a single source from which several aero pollutants (H_2S, mercaptans, NH_3) were emitted was near one of two chosen locations in the city of Belišće (Croatia) with abundant Black pine (*Pinus nigra* Arnold) trees. Two photosynthesis-related physiological parameters (Fv/Fm – a maximum quantum yield of the photosystem II and PI_{ABS} – performance index) were determined in pine needles using the specialized fluorimeter (Plant Efficiency Analyzer, Handy-PEA, Hansatech, UK). Since photosynthesis is largely influenced by different environmental stressors it allows to us study their effects on plant development and physiology. Our results revealed differences in pine trees' vitality between the two chosen locations. Trees that were grown near the pollution source had significantly lower PI_{ABS} values than trees from other, more distant locations. Such an approach provided the possibility to create a tree vitality map that allowed a direct visual comparison of the two investigated locations. It can be concluded that *in vivo* chlorophyll fluorescence measurement was proven as a very useful and informative tool in the assessment of urban vegetation vitality.
Keywords: chlorophyll fluorescence, photosynthesis, Pinus, pollution

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Primjena biljne biofotonike temeljene na klorofilu u urbanoj ekologiji i biomonitoringu – studija slučaja stabala crnog bora u Belišću (Hrvatska)

Hrvoje LEPEDUŠ[1], Tomo TRSTENJAK[2]

[1] Sveučilište Josipa Jurja Strossmayera u Osijeku, Filozofski fakultet Osijek, L. Jägera 9, Osijek, Hrvatska
[2] Državni inspektorat, Ulica Hrvatske Republike 21, Osijek, Hrvatska

Sažetak
Tema ovog istraživanja jest pokazati mogućnost učinkovite upotrebe fluorescencije klorofila *a*, koja potječe od zelenih dijelova biljaka, u biomonitoringu urbanog zagađenja. Ovo je studija slučaja u kojoj je istražen utjecaj točkastog izvora koji emitira nekoliko zračnih polutanta (H_2S, merkaptane i NH_3), a koji se nalazi u blizini jedne od dvije odabrane lokacije u gradu Belišće (Hrvatska), na stabla crnog bora (*Pinus nigra* Arnold). Dva fiziološka parametra povezana s fotosintezom (Fv/Fm – maksimalni prinos kvanta fotosustava II i PI_{ABS} – indeks fotosintetske učinkovitosti) određeni su u iglicama bora upotrebom posebnog fluorometra (Plant Efficiency Analyzer, Handy-PEA, Hansatech, UK). Budući da je učinkovitost fotosinteze uvelike uvjetovana djelovanjem različitih stresora iz okoliša, moguće je koristiti fotosintetske parametre u proučavanju njihovih učinaka na razvoj i fiziologiju biljaka. Naši rezultati pokazuju razlike u vitalnosti stabala bora između dvije odabrane lokacije. Iglice stabala koja rastu bliže izvoru zagađenja imale su značajno snižene vrijednosti parametra PI_{ABS} u odnosu na stabla s druge, udaljenije, lokacije. Ovakav pristup dopušta kreiranje karata vitalnosti vegetacije na određenom području, čime je omogućena direktna vizualna usporedba istraživanih lokacija. Zaključno, *in vivo* mjerenja fluorescencije klorofila *a* pokazala su se kao vrlo koristan alat koji daje veliki broj informacija potrebnih za procjenu vitalnosti urbane vegetacije.
Ključne riječi: fluorescencija klorofila, fotosinteza, *Pinus*, zagađenje

Environmental Monitoring / *Monitoring okoliša*
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The European Corn Borer, *Ostrinia nubilalis* (Hubner), as a vector of aflatoxigenic and ochratoxigenic fungi

Jelena LONČAR, Tomislav KOS, Ana GAŠPAROVIĆ-PINTO, Lucija BRONIĆ, Slaven ZJALIĆ

University of Zadar, Mihovila Pavlinovića 1, Zadar, Croatia

Abstract
The European Corn Borer (*Ostrinia nubilalis* Hubner) is a polyphagous pest, meaning it attacks multiple plant species, particularly maize and wheat. Usually, the moth overwinters in plant debris in the adult caterpillar stage and in our conditions, it has two generations per year. The caterpillars cause damage in the leaf sheath or move towards the young leaf where they feed. The European Corn Borer uses maize as its main food source, making it a potential vector for mycotoxin transmission. Mycotoxins are secondary metabolites of fungi, dangerous for human and domestic animal health. In the framework of the project "Production of food, biocomposites and biofuels from cereals in a circular bioeconomy" a field experiment was conducted in Osijek. A total of 200 European Corn Borer specimens were collected during two seasons. The results of the first year's research showed that of the 179 isolated pure cultures, 2.7% were producers of aflatoxin B1 and 3.4% were producers of ochratoxin A. The results of the second year's research are in line with the preliminary results of the first year's research, which showed the presence of aflatoxin and ochratoxin fungi with a share of less than 5% in the total microflora. Morphological determination of fungi was conducted, with the largest share belonging to *Aspergillus* and *Penicillium* genera. Although the presence of aflatoxin and ochratoxin fungi is not alarmingly high, due to the risk of contamination it is necessary to monitor the situation for preventive measures.
Keywords: corn earworm, polyphagous pest, caterpillar, aflatoxin, ochratoxin

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Kukuruzni moljac *Ostrinia nubilalis* (Hubner) kao prijenosnik aflatoksigenih i okratoksigenih gljivica

Jelena LONČAR, Tomislav KOS, Ana GAŠPAROVIĆ-PINTO, Lucija BRONIĆ, Slaven ZJALIĆ

Sveučilište u Zadru, Mihovila Pavlinovića 1, Zadar, Hrvatska

Sažetak
Kukuruzni moljac (*Ostrinia nubilalis* Hubner) predstavlja polifagnog štetnika, što znači da napada više biljnih vrsta, osobito kukuruz i pšenicu. Uobičajeno, moljac prezimljava u biljnim ostacima u stadiju odrasle gusjenice a u našim uvjetima ima dvije generacije godišnje. Gusjenice nanose štetu u pazušcu lista ili se kreću prema mladom lišću gdje se hrane. Kukuruzni moljac koristi kukuruz kao svoju glavnu hranu, što ga čini potencijalnim vektorom za prijenos mikotoksigenih gljivica. Mikotoksini su sekundarni metaboliti gljivica, opasni po ljudsko zdravlje i zdravlje domaćih životinja. U sklopu projekta "Proizvodnja hrane, biokompozita i biogoriva iz žitarica u kružnom biogospodarstvu" provedeno je istraživanje na pokusnom polju u Osijeku. Ukupno je prikupljeno 200 jedinki kukuruznog moljca tijekom dvije sezone. Rezultati istraživanja prve godine pokazali su da je od ukupno 179 izoliranih čistih kultura utvrđeno 2,7 % proizvođača aflatoksina B1 i 3,4 % proizvođača okratoksina A. Rezultati istraživanja druge godine su u skladu s preliminarnim rezultatima prvogodišnjeg istraživanja koje je pokazalo prisutnost i aflatoksigenih i okratoksigenih gljica s postotkom zastupljenosti u odnosu na ukupnu mikofloru manjim od 5 %. Provedena je morfološka determinacija gljivica od kojih najveći udio čine gljivice roda *Aspergillus* i *Penicillium*. Iako prisutnost aflatoksigenih i okratoksigenih gljivica nije zabrinjavajuće visoka, zbog rizika od kontaminacije potrebno je pratiti stanje zbog preventivnih mjera.
Ključne riječi: kukuruzni moljac, polifagan štetnik, gusjenica, aflatoksin, okratoksin

Environmental Monitoring / *Monitoring okoliša*
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Corn smut (*Diabrotica virgifera virgifera* LeConte) as a carrier of aflatoxigenic and ochratoxigenic fungi

Jelena LONCAR, Tomislav KOS, Ana GASPAROVIC-PINTO, Bruno MARTIC, Slaven ZJALIC

University of Zadar, Mihovila Pavlinovića 1, Zadar, Croatia

Abstract
The Western Corn Rootworm (*Diabrotica virgifera virgifera* LeConte) is one of the most important pests of corn, whose larvae cause the most damage to the corn roots. This causes curling or complete collapse of the plant, insufficient development of the ears, and difficulty in mechanized harvesting. Adults can also cause damage by feeding on green parts of the corn. The Western Corn Rootworm belongs to the beetle family, has one generation per year, and goes through three developmental stages. Also, the Western Corn Rootworm can be a potential vector of mycotoxigenic fungi. Mycotoxins are secondary metabolites of fungi that develop under favorable conditions of temperature, humidity, or mechanical damage to the plant and can be dangerous to humans and animals. The most important mycotoxins are aflatoxin B1 and ochratoxin A. In order to investigate this, 200 samples of adult Western Corn Rootworms were collected during two seasons. The results of the first season showed that out of the total of 179 pure cultures, the percentage of aflatoxin B1 producers was 2.8%, and ochratoxin A 3.4%. The results of the second season showed 4.67% aflatoxin B1 producers and 8.41% ochratoxin A producers out of the total of 107 isolated pure cultures. Samples that were positive for aflatoxin B1 and ochratoxin A belong to the genera *Aspergillus* and *Penicillium*.
Keywords: Ochratoxin A, fungi, *Aspergillus*, *Penicillium*

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Kukuruzna zlatica (*Diabrotica virgifera virgifera* LeConte) kao prijenosnik aflatoksigenih i okratoksigenih gljivica

Jelena LONČAR, Tomislav KOS, Ana GAŠPAROVIĆ-PINTO, Bruno MARTIĆ, Slaven ZJALIĆ

Sveučilište u Zadru, Mihovila Pavlinovića 1, Zadar, Hrvatska

Sažetak
Kukuruzna zlatica (*Diabrotica virgifera virgifera* LeConte) spada pod najznačajnije štetnike kukuruza, čije ličinke prave najveću štetu na korijenu kukuruza. Time uzrokuje povijanje ili potpuno polijeganje biljke, nedovoljni razvitak klipova i otežanu mehaniziranu berbu. Štete mogu uzrokovati i odrasli oblici hraneći se zelenim dijelovima kukuruza. Kukuruzna zlatica spada u red kornjaša, ima jednu generaciju godišnje i prolazi kroz tri razvojna stadija. Također, kukuruzna zlatica može biti i potencijalni prijenosnik mikotoksigenih gljivica. Mikotoksini su sekundarni metaboliti gljivica koji se razvijaju u povoljnim uvjetima temperature, vlage ili mehaničkog oštećenja biljke, a mogu biti opasni za ljude i životinje. Najznačajniji mikotoksini su aflatoksin B1 i okratoksin A. U svrhu istraživanja prikupljeno je 200 uzoraka odraslog oblika kukuruzne zlatice tijekom dvije sezone. Rezultati istraživanja prve sezone prikazali su da je od ukupno 179 čistih kultura postotak proizvođača aflatoksina B1 iznosio 2,8 %, a okratoksina A 3,4 %. Rezultati istraživanja druge sezone pokazali su 4.67 % proizvođača aflatoksina B1 i 8.41% proizvođača okratoksina A od ukupno 107 izoliranih čistih kultura. Uzorci koji su se pokazali pozitivnim na aflatoksin B1 i okratoksin A pripadaju u rodove *Aspergillus* i *Penicillium*.
Ključne riječi: okratoksin A, gljivice, *Aspergillus*, *Penicillium*

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

The presence of aflatoxigenic fungi in a test field in Osijek

Jelena LONČAR, Tomislav KOS, Ana GAŠPAROVIĆ-PINTO, Nina MRDALJ, Vjera MARASOVIĆ, Slaven ZJALIĆ

University of Zadar, Mihovila Pavlinovića 1, Zadar, Croatia

Abstract
Mycotoxins are secondary metabolites synthesized by molds that have dangerous and toxic effects on human and animal health. Contamination of food and animal feed, especially cereals, poses problems on a global scale. Aflatoxins are a group of mycotoxins that have carcinogenic and hepatotoxic effects. The most common producers of aflatoxins are molds from the genus *Aspergillus*. As part of the project "Production of food, biocomposites, and biofuels from cereals in circular biogas economy", the migration of aflatoxigenic fungi in the air was studied in a field experiment in Osijek. The research was conducted by sampling the air in May, July, and October 2021 and 2022 in the field experiment in Osijek using the "Air Sampler" device. Fungal conidia were isolated on two types of nutrient media: potato-dextrose agar (PDA) and Sabouraud agar (SAB). The samples were isolated on pure substrates and morphologically determined. After the extraction of potential producers, thin-layer chromatography and HPLC were used for the quantitative and qualitative detection of mycotoxins. The results of the first year of research show that out of a total of 152 pure cultures of fungi, 6.6% were identified as producers of aflatoxin B1. The results of the second year of research show that out of a total of 202 isolated pure cultures, 4.5% were positive producers of AFB1. Although the presence of aflatoxigenic fungi is not alarmingly high, due to the risk of contamination, it is necessary to monitor the situation for preventive measures.
Keywords: mycotoxins, aflatoxins, molds, contamination, food

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Prisutnost konidija aflatoksiigenih gljivica na pokusnom polju u Osijeku

Jelena LONČAR, Tomislav KOS, Ana GAŠPAROVIĆ-PINTO, Nina MRDALJ, Vjera MARASOVIĆ, Slaven ZJALIĆ

Sveučilište u Zadru, Mihovila Pavlinovića 1, Zadar, Hrvatska

Sažetak
Mikotoksini su sekundarni metaboliti koje sintetiziraju plijesni koje imaju opasna i toksična djelovanja na zdravlje ljudi i životinja. Kontaminacijom hrane i hrane za životinje posebice žitarica predstavljaju probleme na globalnoj razini. Aflatoksini su skupina mikotoksina koja ima kancerogena i hepatotoksična djelovanja. Najčešći proizvođači aflatoksina su plijesni iz roda *Aspergillus.* U sklopu projekta "Proizvodnja hrane, biokompozita i biogoriva iz žitarica u kružnom biogospodarstvu" istraživanjem na pokusnom polju u Osijeku proučavane su migracije aflatoksigenih gljivica u zraku. Istraživanje se provodilo uzorkovanjem zraka u svibnju, srpnju i listopadu 2021. i 2022. godine u pokusnom polju u Osijeku korištenjem uređaja „Air Sampler". Konidije gljivica su izolirane na dva tipa hranjivih podloga: krumpirov-dekstrozni agar (PDA) i Sabouraudov agar (SAB). Uzorci su izolirani na čiste podloge te morfološki determinirani. Nakon ekstrakcije potencijalnih proizvođača, tankoslojnom kromatografijom i HPLC-om izvršila se kvantitativna i kvalitativna detekcija mikotoksina. Rezultati u prvoj godini istraživanja pokazuju da je od ukupno 152 čiste kulture gljivica utvrđeno 6,6 % proizvođača aflatoksina B1. Rezultati druge godine istraživanja pokazuju da je od ukupno 202 izolirane čiste kulture utvrđeno 4,5 % pozitivnih proizvođača AFB1. Iako prisutnost aflatoksigenih gljivica nije zabrinjavajuće visoka, zbog rizika od kontaminacije potrebno je pratiti stanje zbog preventivnih mjera.
Ključne riječi: mikotoksini, aflatoksini, plijesni, kontaminacija, sigurnost hrane

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

The presence of ochratoxigenic fungi in a test field in Osijek

Jelena LONČAR, Tomislav KOS, Ana GAŠPAROVIĆ-PINTO, Nina MRDALJ, Vjera MARASOVIĆ, Slaven ZJALIĆ

University of Zadar, Mihovila Pavlinovića 1, Zadar, Croatia

Abstract
Ochratoxins are secondary metabolites of mycotoxinogenic fungi. They can be harmful to human and animal health. Fungi can be transmitted through the air, which means they can easily spread and contaminate the food consumed by humans and animals. Cereals, which are widely consumed, are particularly susceptible to contamination. The problem of mycotoxins is considered a problem of global proportions, so it is extremely important to investigate the causes and consequences of this phenomenon. To achieve this, as part of the project *"Production of food, biocomposites, and biofuels from cereals in a circular bioeconomy"*, the air was sampled using an "Air sampler" device at the experimental field in Osijek. Sampling was carried out in May, July, and October 2021 and 2022. Pure cultures were isolated and morphological determination of fungi was carried out. Potential producers of ochratoxins A were cultivated on liquid nutrient media, extracted, and detected by the HPLC method. The results showed the highest presence of fungi during the month of May, while the lowest was in July during both seasons. The percentage of ochratoxin-producing fungi in relation to pure cultures during 2021 was 1.8%, while a slight increase of 4% was recorded in 2022. Although the level of ocratoxigenic fungi in the air is low, it is necessary to continue monitoring in order to implement preventive control measures against ochratoxin contamination.
Keywords: mycotoxins, ochratoxin A, contamination, food safety

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Prisutnost konidija okratoksigenih gljivica na pokusnom polju u Osijeku

Jelena LONČAR, Tomislav KOS, Ana GAŠPAROVIĆ-PINTO, Nina MRDALJ, Vjera MARASOVIĆ, Slaven ZJALIĆ

Sveučilište u Zadru, Mihovila Pavlinovića 1, Zadar, Hrvatska

Sažetak
Okratoksini su sekundarni metaboliti mikotoksigenih gljivica. Oni mogu biti štetni za ljudsko i životinjsko zdravlje. Gljivice se mogu prenositi putem zraka, što znači da se mogu lako širiti i kontaminirati hranu s kojom se hrane ljudi i životinje. Osobito su podložne kontaminaciji žitarice, koje se konzumiraju u širokoj mjeri. Problem mikotoksina smatra se problemom globalnih razmjera, te je stoga iznimno važno istražiti uzroke i posljedice ove pojave. Da bi se to postiglo u sklopu projekta *"Proizvodnja hrane, biokompozita i biogoriva iz žitarica u kružnom biogospodarstvu"* na pokusnom polju u Osijeku uzorkovan je zrak pomoću uređaja „Air sampler". Uzorkovanje je provedeno u svibnju, srpnju i listopadu 2021. i 2022. godine. Izdvojene su čiste kulture te je provedena morfološka determinacija gljivica. Potencijalni proizvođači okratoksina A kultivirani su na tekućim hranjivim podlogama, ekstrahirani i dokazani HPLC metodom. Rezultati su pokazali najvišu prisutnost gljivica tijekom mjeseca svibnja, dok je najniža bila u srpnju tijekom obje sezone. Postotak okratoksigenih gljivica u odnosu na čiste kulture tijekom 2021. godine iznosio je 1,8 %, dok je blagi porast od 4% zabilježen u 2022.g. Premda je razina okratoksigenih gljivica u zraku niska potrebno je nastaviti praćenje radi provođenja preventivnih mjera kontrole kontaminacije okratoksinom.
Ključne riječi: mikotoksini, okratoksin A, kontaminacija, sigurnost hrane

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Investigation of the occurrence of cellulolytic fungi in the Archbishop's and Kaptol's libraries in Zadar

Jelena LONČAR, Antonija MLIKOTA, Doris VALČIĆ, Slaven ZJALIĆ

University of Zadar, Mihovila Pavlinovića 1, Zadar, Croatia

Abstract:
Microbiological studies have shown that all types of material cultural heritage containing organic molecules are sensitive to biological degradation under the creation of favorable conditions for microbial colonization. Some of the most important causative agents of book heritage degradation are mitosporic fungi (molds) whose conidia and spores are found in the air and dust. Humidity and temperature conditions favorable for mold growth can lead to physical and chemical damage to the book's heritage. As part of the "KultBaMikroo" project - Protection of Zadar's cultural heritage from the negative impact of microorganisms, a survey was conducted to determine the risk of biological degradation of valuable book material located in the Archbishop's and Kaptol's libraries in Zadar. Sampling was carried out using the "Air Sampler" device in two rooms quarterly during 2022. Fungi were grown on three different nutrient media in order to cover a wider spectrum of aerogenic fungi. In the laboratory, fungi were morphologically determined and transferred to specific media for the detection of cellulolytic enzyme production. The results showed that the CFU (colony forming unit) value was highest during September at both locations. The presence of cellulolytic fungi was highest during December in the library, while in the Kaptol's library, the highest presence was recorded during September. The most common cellulolytic fungi belonged to the *Penicillium* and *Aspergillus genera*.
Keywords: cellulolytic fungi, book material, cultural heritage

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Istraživanje pojavnosti celulolitičkih gljivica u Nadbiskupskoj i Kaptolskoj knjižnici u Zadru

Jelena LONČAR, Antonija MLIKOTA, Doris VALČIĆ, Slaven ZJALIĆ

Sveučilište u Zadru, Mihovila Pavlinovića 1, Zadar, Hrvatska

Sažetak
Mikrobiološka istraživanja pokazala su da su sve vrste materijalnih kulturnih baština koje sadrže organske molekule osjetljive na biološku degradaciju uz stvaranje povoljnih uvjeta za kolonizaciju mikroorganizama. Jedni od najvažnijih uzročnika degradacije knjiške baštine ubrajaju se mitosporične gljivice (plijesni) čiji se konidiji i spore nalaze u zraku i prašini. Uvjeti vlažnosti i temperature koji su povoljni za rast plijesni mogu dovesti do fizičkih i kemijskih oštećenja knjiške baštine. U sklopu projekta "KultBaMikroo"- Zaštita zadarske kulturne baštine od negativnog utjecaja mikroorganizama, provedeno je istraživanje u svrhu utvrđivanja rizika od biološke degradacije vrijedne knjiške građe koja se nalazi u Kaptolskoj i Nadbiskupskoj knjižnici u Zadru. Uzorkovanje je provedeno uz upotrebu uređaja "Air Sampler" u dvije prostorije kvartalno tijekom 2022. Godine. Gljivice su uzgojene na tri različite hranjive podloge kako bi se obuhvatio što širi spektar aerogenih gljivica. U laboratoriju su gljivice morfološki determinirane, te presađene na specifične podloge za dokazivanje proizvodnje celulolitičkih enzima. Rezultati su pokazali da CFU (colony forming unit) vrijednost bila najveća tijekom rujna na obje lokacije. Zastupljenost celulolitičkih gljivica bila je najveća tijekom prosinca u Nadbiskupskoj knjižnici dok je u Kaptolskoj knjižnici najveća zastupljenost zabilježena tijekom mjeseca rujna. Najučestalije celulolitičke gljivice pripadale su rodovima *Penicillium* i *Aspergillus*.
Ključne riječi: celululotičke gljivice, knjiška građa, kulturna baština

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Green analytical chemistry in surfactant analysis in environmental samples

Dubravka MADUNIĆ-ČAČIĆ[1], Blaženka ĆIŠKO-ANIĆ[1], Nikola SAKAČ[2], Marija JOZANOVIĆ[3]

[1] Saponia Chemical, Pharmaceutical and Foodstuff Industry, Inc., Ul. Matije Gupca 2, Osijek, Croatia
[2] University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia
[3] Josip Juraj Strossmayer University of Osijek**,** Department of Chemistry, Ul. cara Hadrijana 8a, Osijek, Croatia

Abstract
The idea of green chemistry (GC) has its roots in sustainable development, initially mainly focused on industrial processes and products. Over time, green analytical chemistry (GAC) is separated as a special field of GC. With GAC development came the need for clear, concise guidelines in the form of GAC principles that will be helpful in greening laboratory practices. In 2013, Namiesnik et al. proposed a set of 12 principles consisting of familiar concepts (i.e. reduction of reagent and energy use, and elimination of waste, risk and hazard) together with some new ideas (i.e. use of natural reagents), which will be important for the future of GAC. Potentiometric titrations as analytical methods for the quantitative determination of surfactants (whether anionic, cationic or nonionic) comply with the principles of GAC. They are highly automated instrumental methods easy to perform, with simple sample preparation. As such, they are an excellent alternative to the most widely used methods today, which are time-consuming and tedious to perform, and use harmful organic solvents (chloroform). In here presented investigations, the emphasis is on environmental samples, especially wastewater samples. Since these samples contain low analyte concentrations, sensors with high sensitivity and fast dynamic response were used. Standardized solutions with high affinity for the analyte were used as titrants: 1,3-didecyl-2-methylimidazolium chloride for anionic surfactants, sodium tetrapheylborate for cationic and nonionic surfactants.
Keywords: surfactant, green analytical chemistry, environmental sample, potentiometric sensor

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Monitoring of water quality at public sources with the aim of preventing harmful effects on the public health

Ivana MRAVUNAC, Antonija KOVAČEVIĆ, Marina HUBLIN, Nikolina CIBAN

Zagreb County Institute of Public Health, Mokrička 54, Zaprešić, Croatia

Abstract
Harmful factors from the environment that can significantly impair the health of the population are important for the prevention of infectious and non-infectious diseases to be continuously monitored. The program of public health measures to protect health from harmful environmental factors in Zagreb County includes testing water for human consumption at publicly accessible regulated springs. Recent trends indicate an increase in the number of people turning to nature. With the increase in the number of recreationists, mountaineers and cyclists, water from regulated springs is used more and more. It is known that people from the near and wider surroundings come to get this water and use it in their households for drinking, cooking and personal hygiene. Such springs, of which there are quite a few in the County, are not covered by any legislation. The use of unsanitary water can have a harmful effect on the health of the population. The program included 20 springs in the county, and samples were taken three times a year at each location. Water samples for human consumption were taken from publicly accessible and frequently used wells in the County. Out of a total of 60 samples, 44 of them were non-compliant, while 16 of them were in accordance with the requirements of the Ordinance. The most common cause of non-compliance was microbiological contamination. For the most part, those were bacteria from the environment, and sometimes bacteria that indicate fecal pollution. In order to bring the results closer to people, all of them can be found on the Institute's website, combined in a map with the exact location of the sources, findings and information about correctness.
Keywords: water, environment, monitoring

Environmental Monitoring / *Monitoring okoliša*
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Allium test in water toxicity screening

Barbara PENAVIĆ[1], Marijana BUBALO[2], Adrijana FILIPOVIĆ[3,1], Ana CRNOGORAC[3,1], Ana MANDIĆ[1]

[1] University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule bb, Mostar, Bosnia and Herzegovina
[2] JP Parkovi d.o.o Ljubuški, Laboratorij za vode, LJubuški, Bosnia and Herzegovina
[3] Federal Agromediterranean **Institut** of Mostar, Mostar, Biskupa Cule 10, Mostar Bosnia and Herzegovina

Abstract
The Allium test is a fast and sensitive test for the detection of genotoxins and mutagens in the environment. It allows the evaluation of several endpoints such as micronucleus formation, chromosomal aberrations, and miivan totic index. In this paper, genotoxic effects were investigated by planting onion bulbs on surface waters (rivers Neretva, Jasenica, Buna and Bijelo Polje) and for comparisons of wastewater from two wastewater treatment plants (inlet, aeration tank and outlet). Research also included water enriched with heavy metals Cu and Zn as elements commonly used in agricultural practice and distilled water was positive control. Statistical analysis was done with ANOVA GLM procedure and T-test. Significant differences are found for the number of roots formed, root length, number of chromosomal aberrations and index of mitosis. When analyzed as sets there were no differences among river waters and control and waste water and control for index of mitosis. All other combination was significant. Cytogenetic analysis showed the highest number of chromosomal aberrations in wastewater (stickiness of chromosomes, C-mitosis, anaphase bridges, anaphase with residual chromosomes). Fast, cheap, and accurate tests are important for environment monitoring and Allium test can be used respecting certain settings.
Keywords: Allium test, environment monitoring, genotoxicity

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Radon in wells and natural springs in Croatia

Marina POJE SOVILJ, Igor MIKLAVČIĆ, Goran ŠMIT, Denis STANIĆ, Vanja RADOLIĆ

Josip Juraj Strossmayer University of Osijek, Department of Physics, Laboratory for Low-level Radioactivity, Trg Ljudevita Gaja 6, Osijek, Croatia

Abstract
Water from wells and natural springs is considered cleaner than surface water, which along with socioeconomic reasons, explains its wide use, especially in rural areas. In different geological structures in which wells are drilled, naturally occurring radionuclides are found in different concentrations and can be found in the aquifer surrounding such structures. Radon ^{222}Rn is a radioactive gas and is part of the uranium (^{238}U) series, which is formed by the alpha radioactive decay of the parent nucleus of radium ^{226}Ra. Because it is a gas, it has greater mobility through the geological layers compared to the parent nuclei - the metals that mostly remain inside the minerals. Radon enters the water and dissolves, and through ingestion of water it contributes to the annual effective dose of the population. Dissolved radon can again change to the gaseous phase by using water in the household and by inhalation contributing to the annual effective dose. The EURATOM Directive determined for all EU member states a parametric value of 100 Bq/L (above which the risk is assessed and remediation considered) and a maximum value of 1000 Bq/L. Concentrations of radon activity in water in wells and natural springs were measured in 10 counties using the manometric method (AlphaGUARD and AquaKIT) and the liquid scintillation method (LSC TriCarb 2900). The obtained mean value and corresponding standard deviation was (7.5±4.0) Bq/L, with minimum and maximum measured values of 0.7 and 154 Bq/L determined in 135 samples.
Keywords: radon, wells, natural springs, geology, effective dose

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Radon u bunarima i prirodnim izvorima u Hrvatskoj

Marina POJE SOVILJ, Igor MIKLAVČIĆ, Goran ŠMIT, Denis STANIĆ, Vanja RADOLIĆ

Sveučilište Josipa Jurja Strossmayera u Osijeku, Odjel za fiziku, Laboratorij za niske radioaktivnosti, Trg Ljudevita Gaja 6, Osijek, Hrvatska

Sažetak

Voda iz bunara i prirodnih izvora smatra se čišćom od površinske vode što uz socioekonomske razloge objašnjava njezinu široku uporabu, posebice u ruralnim područjima. U različitim geološkim strukturama u kojima se bunari buše, prirodno prisutni radionuklidi nalaze se u različitim koncentracijama te se mogu naći u vodonosniku koji okružuje takve strukture. Radon ^{222}Rn je radioaktivni plin i dio je uranijevog (^{238}U) niza, koji nastaje alfa radioaktivnim raspadom jezgre roditelja radija ^{226}Ra. Budući da je plin ima veću mobilnost kroz geološke slojeve u usporedbi s jezgrama roditelja – metalima koji uglavnom ostaju unutar minerala. Radon ulazi u vodu gdje se otapa, te ingestijom vode doprinosi godišnjoj efektivnoj dozi stanovništva. Otopljeni radon ponovno može prijeći u plinovitu fazu uporabom vode u kućanstvu i inhalacijom doprinijeti godišnjoj efektivnoj dozi. EURATOM Direktiva odredila je za sve zemlje članice EU parametrijsku vrijednost od 100 Bq/L (iznad koje se procjenjuje rizik i razmatra remedijacija) i maksimalnu vrijednost od 1000 Bq/L. Koncentracije aktivnosti radona u vodi u bunarima i prirodnim izvorima mjerene su u 10 županija emanometrijskom metodom (AlphaGUARD i AquaKIT) i tekućinskom scintilacijskom metodom (LSC TriCarb 2900). Dobivena srednja vrijednost i pripadna standardna devijacija iznosila je (7,5±4,0) Bq/L, s minimalnom i maksimalnom izmjerenom vrijednosti od 0,7 i 154 Bq/L određenom u 135 uzoraka.

Ključne riječi: radon, bunari, prirodni izvori, geologija, efektivna doza

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Analysis of the agricultural production type and traffic on the Nitrogen oxides emissions

Brigita POPOVIĆ[1], Ante BUBALO[1], Mirna HABUDA-STANIĆ[2], Irena IŠTOKA OTKOVIĆ[3]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology in Osijek, Franje Kuhača 18, Osijek, Croatia
[3] Josip Juraj Strossmayer University of Osijek, Faculty of Civil Engineering and Architecture Osijek, Vladimira Preloga 3, Osijek, Croatia

Abstract
Protection of air from pollution is one of the basic principles of sustainable development, and this article analyzes the joint impact of various types of agricultural production and traffic on Nitrogen oxides (NOx) emissions. The analysis of the impact of traffic was made using microsimulation traffic modeling on three different traffic infrastructure facilities while from the aspect of agricultural production, the impact of the winter wheat production in the open field and the intercropping system walnuts and winter wheat production was observed. Different traffic flow structures were analyzed and the influence of different proportions of freight vehicles and heavy goods vehicles was evaluated. Calculations of NOx emissions from the production of winter wheat on the open field and the walnut-winter wheat intercropping system were made with the BioGrace model (version 4d 2015) based on the application of N-fertilizers during the growing season and using the BioGrace excel NOx emission tools. The results showed that all the best scenarios for NOx emissions from traffic show sensitivity to the share of goods and heavy goods vehicles. The difference in the emission of NOx gases depending on the type of agricultural production indicates a reduction of NOx emissions in the walnut-winter wheat system by 30% compared to the production of winter wheat in the open field. This study suggests that agriculture production in intercropping systems with a traffic flow with a share of 10% goods and 5% heavy goods vehicles can be recommended as suitable practices that contribute to the reconstruction of the optimal balance between NOx emissions from agricultural production and traffic.
Keywords: NOx emissions, traffic, agricultural production systems, microsimulation models

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Analiza utjecaja vrste poljoprivredne proizvodnje i prometa na emisiju dušikovih oksida

Brigita POPOVIĆ[1], Ante BUBALO[1], Mirna HABUDA-STANIĆ[2], Irena IŠTOKA OTKOVIĆ[3]

[1] Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti Osijek, Vladimira Preloga 1, Osijek, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet u Osijeku, Ulica Franje Kuhača 18, Osijek, Hrvatska
[3] Sveučilište Josipa Jurja Strossmayera u Osijeku, Građevinski i arhitektonski fakultet Osijek, Vladimira Preloga 3, Osijek, Hrvatska

Sažetak

Zaštita zraka od onečišćenja jedno je od osnovnih načela održivog razvoja, a u okviru ovog članka analiziran je zajednički utjecaj različite vrste poljoprivredne proizvodnje i prometa na emisiju dušikovih oksida (NOx). Analiza utjecaja prometa napravljena je primjenom mikrosimulacijskog prometnog modeliranja na tri različita prometna infrastrukturna objekta dok je s aspekta poljoprivredne proizvodnje promatran utjecaj proizvodnje ozime pšenice na otvorenom polju i sustava međuusjeva orah-ozima pšenica. Analizirane su različite strukture prometnog toka i variran je postotak udjela teretnih vozila i teških teretnih vozila. Proračuni emisija NOx iz proizvodnje ozime pšenice i međususjeva orah- ozima pšenica rađeni su BioGrace modelom (verzija 4d 2015) temeljem primjene N-gnojiva tijekom vegetacije i korištenjem liste alata BioGrace excel NOx emisije. Rezultati su pokazali da svi najbolji scenariji za emisiju NOx od prometa pokazuju osjetljivost na udio teretnih i teških teretnih vozila. Razlika u emisiji NOx plinova ovisno o vrsti poljoprivredne proizvodnje ukazuje na smanjenje emisije NOx u sustavu orah-ozima pšenica za 30 % u odnosu na proizvodnju ozime pšenice na otvorenom polju. Ova studija sugerira da se proizvodni sustavi međusussjeva ratarskih kultura i višegodišnjih nasada uz opterećenje prometa sa udjelom teretnih vozila od 10% i uteških teretnih vozila od 5%, mogu preporučiti kao pogodne prakse koje doprinose rekonstrukciji optimalne ravnoteže između emisija NOx iz poljoprivredne proizvodnje i prometa.

Ključne riječi: emisija NOx, promet, sustavi poljoprivredne proizvodnje, mikrosimulacijski modeli

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Various puzzles of long-standing radioactive, NORM residue, issues at environmentally valuable location of ex. chemical plant facility "Jugovinil" at the shores of Kaštela bay

Ivica PRLIĆ

Institute for Medical Research and Occupational Health (IMROH), Ksaverska cesta 2, Zagreb, Croatia

Abstract
The precautionary principle is explicitly laid down in the EU treaty and is one of the starting points of its environmental policy. Decades of industrialization and extensive exploitation of natural resources have left several areas in the country “heavily” polluted. It is essential that old environmental burdens left behind by past state-controlled industries be addressed: problems that were once the governments have now been transferred over to new owners, in most cases without clear specification of environmental responsibility. Measure based on the precautionary principle is hazard characterization of the site enabling the acceptable remediation program to be laid down. A decade after the last amount of sludge was pumped to be precipitated in the tailing dam of the closed plant totally independent microecological terrestrial system was generated on that precipitation tailing surface which is still today left on its own. To acquire relevant radiological data about biota behavior while populating the site, growing and feeding itself exclusively with the nutrients incorporated in coal ash & sludge representing possible residues and fallout the overall impact of the terrestrial flourishing biota with the seawater life immediately at the coastal tailing dam protecting wall is researched targeting knowledge collection of Meditteranean biodiversity.
Keywords: NORM residues, hazard, exposure to residues, remediation, green energy

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Estimation of the amount of by-catch in different fishing gear

Tena RADOČAJ[1], Oliver BARIĆ[1], Neven IVEŠA[2], Ivan ŠPELIĆ[1], Jurica JUG-DUJAKOVIĆ[3], Ana GAVRILOVIĆ[1]

[1] University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia
[2] Juraj Dobrila University of Pula, Zagrebačka ulica 30, Pula, Croatia
[3] Sustainable Aquaculture Systems Inc., 715 Pittstown Road, Frenchtown, United States of America

Abstract
The research on the share of by-catch in commercial fishing was conducted in the area of the fishing subzone G5, as part of the "Fisheries and Science Network of the City of Ploče" and "Fisheries and Science Cooperation of the Municipality of Gradac" projects within the framework of Measure I.3. „Partnership between scientists and fishermen for the period 2017-2020“. Sampling was carried out during joint field work with fishermen in November 2020 and January, March, May, June and November of 2021 using five different fishing gear: bottom trawl, gillnet, two types of trammel nets, and a longline. Bycatch, which has to be discarded before landing, is defined as fish species without marketable value, commercial species of insufficient mass and damaged fish. After lifting each individual fishing gear, the total catch was weighed, different fish species were selected, and commercially valuable fish were separated from the by-catch. During the research, a total of 1684.5 kg of fish was caught. The analysis of the total catch of bottom trawl nets showed a 29% mass representation of by-catch, which is 367.64 kg. In the total catch of gillnets, the weight of the by-catch was 12%, i.e. 37.61 kg. The analysis of the catch of the two different tramel net types revealed a 39% mass representation of by-catch (6.96 kg) in one type, and 55% (11.74 kg) in the other. In the total longline catch, the bycatch represented 5%, which is 3.59 kg. In the total catch of all fishing gear combined, the mass representation of bycatch was 25%, which means that our research showed that 25% of the commercial catch is still discarded as worthless take, even though it could be valuable raw material used in blue bioeconomy.
Keywords: fisheries, Adriatic Sea, blue bioeconomy, catch discard

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

New surfactant sensor based on 1,3-dioctadecyl-1*H*-1,2,3-triazol-3-ium

Nikola SAKAČ[1], Nada GLUMAC[2], Sanda DRENOVAC[3], Iva KOŠČAK[3], Tanja POTOČNIK-HUNJADI[3], Dean MARKOVIĆ[4], Dubravka MADUNIĆ-ČAČIĆ[5], Marija JOZANOVIĆ [6]

[1] University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia
[2] Međimurske Vode d.o.o., Čakovec, Croatia
[3] Varaždin General Hospital, Ul. Ivana Meštrovića 1, Varaždin, Croatia
[4] University of Rijeka, Department of Biotechnology, Ul. Radmile Matejčić 2, Rijeka, Croatia
[5] Saponia Chemical, Pharmaceutical and Foodstuff Industry, Inc., Ul. Matije Gupca 2, Osijek, Croatia
[6] Josip Juraj Strossmayer University of Osijek, Department of Chemistry, Ul. cara Hadrijana 8a, Osijek, Croatia

Abstract
Surfactants are used for cleaning, washing and disinfection in professional and home applications. Even though they have many benefits, they can cause skin irritation, disintegrate the cell membranes, they reduce the oxygen exchange on the air/water border, etc. Since their usage and applications is constantly growing, their impact on the environment and health is also increasing. For this reason, there is a need to establish fast and reliable tools for their analytical quantification in waters and quality control, to overcome the limitations of classical methods. A new surfactant based on 1,3-dioctadecyl-1*H*-1,2,3-triazol-3-ium was fabricated, characterized and tested on real samples: COVID-19 disinfectants, mouthwash liquids, hand washing detergents and liquid detergents. The results were compared with the standard two-phase titration method and showed good agreement. The presented potentiometric sensor is low-cost, easy to use and requires minimal chemical usage by green chemistry principles.
Keywords: surfactant, potentiometric sensor, COVID-19 disinfectants, detergents

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Bioassessment of the surface water bodies in the Adriatic Sea Basin in Bosnia and Herzegovina

Svjetlana STANIĆ-KOŠTROMAN, Anita DEDIĆ, Dragan Škobić

University of Mostar, Faculty of Science and Education, Rodoč bb, Mostar, Bosnia and Herzegovina

Abstract

Hydromorfological alternation, and nutrient enrichment driven by human activities are the main factors for the ecological compromise of freshwater ecosystems. According to the application of the European Water Framework Directive bioassessment of surface water bodies is one of the most important approaches to provide the deterioration of ecosystems and achieve environmental sustainability. Therefore, in 2022, we conducted research and bioassessment for 40 water bodies in the Adriatic Sea Basin, which included monitoring of (1) physico-chemical, (2) chemical, (3) hydro-morphological, and (4) biological factors. Most of the investigated water bodies were in the category of good or high ecological status or good or maximum ecological potential. Despite the satisfactory conditions in the water bodies, we still noted the changes as challenges (eg. water blooms, eutrophication, invasive species, biodiversity declining, trophic cascades) which we will and look for solutions in the near future. Bioassessment in surface water bodies, based on the data obtained, can be used in the context of risk assessment to determine the level of pollution or contamination as well as for guiding environmental decision-making.

Keywords: bioassessment, karstic water, ecological status/potential

Biološka procjena površinskih vodnih tijela u slijevnom području Jadranskog mora, Bosna i Hercegovina

Svjetlana STANIĆ-KOŠTROMAN, Anita DEDIĆ, Dragan ŠKOBIĆ

Sveučilište u Mostaru, Fakultet prirodoslovno-matematičkih i odgojnih znanosti, Rodoč bb, Mostar, Bosna i Hercegovina

Sažetak

Hidromorfološke promjene i antropogeno uvjetovano obogaćivanje hranjivim tvarima glavni su čimbenici degradacije vodenih ekosustava. Prema Europskoj okvirnoj direktivi o vodama biološka procjena površinskih vodnih tijela jedan je od najvažnijih pristupa za praćenje poremećaja unutar vodenih ekosustava i osiguranje okolišne dimenzije održivosti. Stoga smo tijekom 2022. godine proveli istraživanja i bioprocjenu za 40 vodnih tijela u slijevnom području Jadranskog mora, što je uključivalo praćenje (1) fizikalno-kemijskih, (2) kemijskih, (3) hidromorfoloških i (4) bioloških čimbenika. Većina istraživanih vodnih tijela bila je u kategoriji dobrog ili visokog ekološkog stanja odnosno dobrog ili maksimalnog ekološkog potencijala. Unatoč zadovoljavajućim uvjetima u vodnim tijelima, ipak smo zabilježili promjene kao izazove s kojima ćemo se suočavati i iznalaziti rješenja u bliskoj budućnosti; izazove kao što su eutrofikacija, cvjetanje vode, invazivne vrste, smanjenje bioraznolikosti, poremećaji u trofičkoj kaskadi i sl. Biološka procjena u površinskim krškim vodnim tijelima, temeljem dobivenih podataka, može se koristiti i u okviru procjene rizika za utvrđivanje razina onečišćenja ili kontaminacije kao i za usmjeravanje donošenja odluka o okolišu.

Ključne riječi: biološka procjena, krške vode, ekološki status/potencijal, Bosna i Hercegovina

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Cyanobacteria as a tool for freshwater quality monitoring

Filip STEVIĆ, Tea KRISTIĆ, Katarina PEHARDA, Dubravka ŠPOLJARIĆ MARONIĆ, Tanja ŽUNA PFEIFFER, Nikolina BEK

Josip Juraj Strossmayer University of Osijek, Department of Biology, Ulica cara Hadrijana 8/A, Osijek, Croatia

Abstract
Cyanobacteria are present in a wide range of aquatic environments, including freshwater ecosystems. In recent years, there has been an increased interest in using cyanobacteria as a tool for freshwater monitoring due to their sensitivity to environmental changes and ability to respond rapidly to water quality alterations. As part of the Naturavita project, this study aimed to analyze cyanobacterial communities and their response to changes in environmental conditions in the broader area of Kopački Rit Nature Park. Phytoplankton sampling was carried out during the two years (from July 2020 to June 2022) at 15 stations. A total of 57 cyanobacterial taxa belonging to Chroococcales, Nostocales, Oscillatoriales, Spirulinales and Synechococcales were determined. Cyanobacteria were recorded in all localities and in a total of 315 samples of 360 analyzed. The highest contribution of cyanobacteria to the total phytoplankton biomass was 39.78%. Based on a canonical correspondence analysis, the dominant species were strongly related to environmental conditions. Thus, non-nitrogen-fixing cyanobacteria were characterized by high nitrogen concentrations, while nostocalean species were associated with high water temperatures. High temperatures and nutrient concentrations are known factors that promote cyanobacterial blooms and represent a serious global issue in freshwaters, decreasing phytoplankton diversity. With the ongoing threat of climate change and the increasing agricultural activities, using cyanobacteria as a monitoring tool can provide valuable information on the water quality and protection of freshwater ecosystems.
Keywords: Kopački Rit, natural floodplain, phytoplankton

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Occurrence of persistent organic pollutants in the Neretva River sediment, Croatia

Sanja STIPIČEVIĆ[1], Snježana HERCEG ROMANIĆ[1], Gordana MENDAŠ[1], Sanja FINGLER[1], Ivana JAKOVLJEVIĆ[1], Goran JAKŠIĆ[2]

[1] Institute for Medical Research and Occupational Health, Ksaverska cesta 2, Zagreb, Croatia
[2] Aquatika – Karlovac Freshwater Aquarium, Ul. B. Čavlovića Čavleka 1a, Karlovac, Croatia

Abstract
The Neretva River (230 km) is the largest river in the Eastern Adriatic watershed, originating in Bosnia and Herzegovina, but with the last 20 km of its waterflow in Croatia. A total river basin of 5581 km^2 represents a significant input to coastal seawater affecting wildlife. Besides that, the river water is used for crop irrigation, fishing and recreation. It is thus important to highlight sources of pollution to prevent pollutant transport. The occurrence of persistent organic pollutants (POPs) in the Neretva River can be expected due to industrial facilities and five hydroelectric power plants situated along the river's upstream and middle course. Fossil-fueled ship traffic can impact the lower course river. The Neretva delta is well-known by fruit plantations and many other agricultural products seasonally treated with pesticides. All these air and water contaminants can be deposited into the river sediment for a long time. This study is the first evidence of the levels and distribution of the priority POPs (11 PAHs, 20 PCBs, DDx, total HCH, HCB) in the Neretva River sediments collected at four sites in Croatia, indicating a different pollution entry point that should be systematically explored by further studies.
Keywords: polyaromatic hydrocarbons, organochlorine contaminants, river sediment, Adriatic Sea, Neretva

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Water quality assessment of groundwater for irrigation purposes in Mačva region, Serbia

Milica VRANEŠEVIĆ[1], Radoš ZEMUNAC[1], Ksenija MAČKIĆ[2], Andrea SALVAI[1]

[1] University of Novi Sad, Faculty of Agriculture, Department of Water Management, Trg Dositeja Obradovića 8, Novi Sad, Serbia
[2] University of Novi Sad, Faculty of Agriculture, Department of Field and Vegetable Crops, Trg Dositeja Obradovića 8, Novi Sad, Serbia

Abstract
Groundwater is often used as a source of irrigation water in the region of Mačva, Republic of Serbia. The main aim of this research is to get a usability assessment of this water for irrigation purposes. The quality of groundwater for irrigation was assessed for the observed period of ten years, at two monitoring locations, using international classifications such as FAO and USSL, but also using domestic classifications, the Neigebauer classification and the Stebler's coefficient. In addition, an assessment was made using specific indices such as soluble sodium percentage (SSP), residual sodium carbonate (RSC), Kelly index (KI), permeability index (PI), magnesium adsorption ratio (MAR) and potential salinity (PS). The ionic abundance is in the order of Ca_2^+>Na^+>Mg_2^+>K^+ for cations, while for anions it is HCO_3^->$SO4_2^-$>Cl^- >NO_3^-. Comprehensive results obtained on the basis of groundwater quality indicate that almost all samples of water used for irrigation are generally of good quality therefore regularly controlled water can be used without major restrictions.
Keywords: water quality, irrigation, suitability of groundwater

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Ocjena kvalitete podzemnih voda za potrebe navodnjavanja u Mačvanskoj regiji, Srbija

Milica VRANEŠEVIĆ[1], Radoš ZEMUNAC[1], Ksenija MAČKIĆ[2], Andrea SALVAI[1]

[1] Univerzitet u Novom Sadu, Poljoprivredni fakultet, Departman za Uređenje voda, Trg Dositeja Obradovića 8, Novi Sad, Srbija
[2] Univerzitet u Novom Sadu, Poljoprivredni fakultet, Departman za Ratarstvo i povrtarstvo, Trg Dositeja Obradovića 8, Novi Sad, Srbija

Sažetak
Podzemna voda se u Mačvanskoj regiji, Republika Srbija, često koristi kao izvor vode za navodnjavanje. Glavni cilj ovog istraživanja je ocjeniti upotrebljivost ove vode u svrhu navodnjavanja. Kvaliteta podzemne vode za navodnjavanje je ocijenjena za razdoblje od deset godina i to na dva mjerna mjesta, korištenjem međunarodnih klasifikacija kao što su FAO i USSL, ali i korištenjem domaćih klasifikacija, Nejgebauer klasifikacijom i Steblerovim koeficijentom. Uz navedeno, kvaliteta vode je ocijenjena i specifičnim indeksima kvalitete kao što su: stupanj adsorpcije natrija (SAR), rezidualni natrijevi karbonati (RSC), Kelijev indeks (KI), indeks permeabilnosti (PI), stupanj adsorpcije magnezija (MAR) i potencijalna zaslanjenost (PS). Ionska zatupljenost kod kationa je po redu Ca^{2+}>Na^{+}>Mg^{2+}>K^{+}, dok je za anione HCO_3^->SO_4^{2-}>Cl^->NO_3^-. Sveobuhvatni rezultati koji su dobiveni na osnovu kvalitete podzemne vode pokazuju da su gotovo svi uzorci vode, koja se koristi za navodnjavanje, uglavnom dobre kvalitete i uz kontrolu ovakva voda se može koristiti bez većih ograničenja.
Ključne riječi: kvaliteta vode, navodnjavanje, pogodnost podzemne vode

Environmental Monitoring / *Monitoring okoliša*
Poster presentation / *Postersko priopćenje*

Assessment of the trophic status of natural lakes Ohrid, Prespa and Dojran, R.N. Macedonia

Elizabeta VELJANOSKA SARAFILOSKA, Orhideja TASEVSKA

PSI Hydrobiological Institut Ohrid, Naum Ohridski 50, Ohrid, R.N. Macedonia

Abstract
Accelerated eutrophication of aquatic ecosystems, resulting from human activity, leads to the degradation of water quality, ecosystem health and biodiversity. The natural lakes Ohrid, Prespa and Dojran are the most important reservoirs of fresh water in North Macedonia, therefore, determining their trophic status is of great importance for their protection and sustainable use. The aim of this study is to assess water quality and trophic status in these lakes based on some physico-chemical parameters and biological indicators. The sampling was conducted seasonally, by the height of a water column at different depths of the lakes. The Trophic State Index, based on water transparency and nutrient concentrations (total phosphorus and nitrogen), categorized Lake Ohrid as an oligotrophic lake, Lake Prespa as a mesotrophic lake. TSI values for Lake Dojran crossed the limit of the eutrophic water. The species composition, diversity indices and abundance of rotifers were used in order to assess the water quality of the lakes. The study revealed that rotifer community structure and their abundance differ significantly among the three types of water bodies due to their different trophic state. The diversity index was evidenced to decrease with an increasing degree of eutrophication and the highest diversity of rotifers was observed in oligotrophic Lake Ohrid.
Keywords: eutrophication, water quality, nutrients, rotifers

Environmental Monitoring / *Monitoring okoliša*
ral presentation / *Usmeno priopćenje*

Seasonal Variations of the Total Organic Carbon (TOC) Concentrations in the surface waters of Kopački rit - NATURAVITA project in the period July 2021 - June 2022

Hrvoje SUČIĆ[1], Ivan DAMJANOVIĆ [1], Marika KRALJ[1], Danijela BEZIK[1], Dario KOLARIĆ[1], Mirna HABUDA-STANIĆ[2], Nataša TURIĆ[1], Snježana BENKOTIĆ[1], Barbara PETROVICKY ŠVEIGER[1], Ines RUŠKAN[1]

[1] Teaching Institute of Public Health Osijek–Baranja County, Drinska 8, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia

Abstract
Total organic carbon (TOC) plays an important role in the carbon cycle and in biological, geological and physicochemical reactions that take place in surface waters. Seasonal changes in the concentration of TOC in the water column are affected by the intake of organic matter through soil leaching and algal blooms, then hydrological transport, flow, heat exchange between water layers, and biological decomposition, which is conditioned by temperature, light and nutrients. The research goal of the work is to use the high-temperature catalytic oxidation method to measure the concentration of total organic carbon (TOC) in surface water samples of the Kopački rit Nature Park, to show the obtained values through seasonal variations. As part of the NATURAVITA project, a total of 226 samples collected at 19 different locations in the period from July 2021 to June 2022 were processed. The range of measured values of total organic carbon was from 2.6 to 140 mg C/L. The 50th percentile values for the total organic carbon indicator ranged from 3.05 to 16.5 mg C/L. Based on the obtained values for total organic carbon, lower values were recorded mostly in the winter months, and higher in the autumn, spring and summer months due to high temperatures during the summer, which led to an increase in the amount of carbon that can be washed away and contribute to a greater increase in TOC during the summer and autumn months than in winter and spring.
Keywords: total organic carbon, seasonal changes, surface water, Kopački rit Nature Park, NATURAVITA

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Sezonske varijacije koncentracije ukupnog organskog ugljika (TOC) u površinskim vodama Kopačkog rita - projekt NATURAVITA u razdoblju srpanj 2021. - lipanj 2022. godine

Hrvoje SUČIĆ[1], Ivan DAMJANOVIĆ [1], Marika KRALJ[1], Danijela BEZIK[1], Dario KOLARIĆ[1], Mirna HABUDA-STANIĆ[2], Nataša TURIĆ[1], Snježana BENKOTIĆ[1], Barbara PETROVICKY ŠVEIGER[1], Ines RUŠKAN[1]

1 Nastavni zavod za javno zdravstvo Osječko-baranjske županije, Drinska 8, Osijek, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek, Franje Kuhača 18, Osijek, Hrvatska

Sažetak
Ukupni organski ugljik (TOC) ima važnu ulogu u ciklusu ugljika te u biološkim, geološkim i fizikalno-kemijskim reakcijama koje se odvijaju u površinskim vodama. Na sezonske promjene koncentracije TOC-a unutar vodenog stupca utječe unos organske tvari ispiranjem tla i cvjetanjem algi, zatim hidrološki transport, strujanje, izmjena topline između vodenih slojeva te biološka razgradnja koja je uvjetovana temperaturom, svjetlošću i hranjivim tvarima. Cilj rada je koristeći metodu visoko temperaturne katalitičke oksidacije za mjerenje koncentracije ukupnog organskog ugljika (TOC) u uzorcima površinskih voda Parka prirode Kopački rit, prikazati dobivene vrijednosti kroz sezonske varijacije. U sklopu projekta NATURAVITA obrađeno je ukupno 226 uzoraka prikupljenih na 19 različitih lokacija u razdoblju od srpnja 2021. do lipnja 2022. godine. Raspon izmjerenih vrijednosti ukupnog organskog ugljika bio je od 2,6 do 140 mg C/L. Vrijednosti 50-og percentila za pokazatelj ukupni organski ugljik kretale su se od 3,05 do 16,5 mg C/L. Temeljem dobivenih vrijednosti za ukupni organski ugljik, niže vrijednosti zabilježene su većinom u zimskim mjesecima, a više u jesenskim, proljetnim i ljetnim mjesecima zbog visokih temperatura tijekom ljeta koje dovode do porasta količine ugljika koji se može isprati i pridonijeti većem porastu TOC-a tijekom ljetnih i jesenskih mjeseci nego u zimi i proljeću.
Ključne riječi: ukupni organski ugljik, sezonske promjene, površinska voda, Park prirode Kopački rit, NATURAVITA

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Protection and preservation of water and water-dependent ecosystems in Kopački Rit Nature Park as part of NATURAVITA Project

Ivan TOT

Hrvatske vode, Ulica grada Vukovara 220, Zagreb, Croatia

Abstract

As part of the NATURAVITA Project, Hrvatske vode implements activities of the protection and preservation of water and water-dependent ecosystems in the Kopački Rit Nature Park. Water management and protection of water-dependent ecosystems in the project area is an integral part of works important for the restoration and preservation of forests and forest land as well as for the protection and preservation of overall natural values of protected areas, since the preservation and protection of biodiversity of the studied area depend on the preservation of hydrological, morphological, physico-chemical, and biological properties of water. The main task under sub-activity 1 was to identify the retention capacity and baseline of aquatic ecosystems of the Kopački Rit Nature Park floodplain, as part of which a baseline study of water and water-dependent ecosystems and a detailed monitoring plan were prepared and a 3D elevation model was developed. As part of sub-activity 2, exploratory works were carried out to establish a network of exploratory boreholes (10 exploratory boreholes were drilled), and five additional water gauging stations were built. Activities implemented over a 3-year period include: monitoring of surface water ecological status and monitoring of additional biological indicators; monitoring of surface water chemical status; groundwater monitoring; investigation and monitoring of recent sedimentation; monitoring of habitats and flora; monitoring of molluscs; monitoring of insects; monitoring of herpetofauna; monitoring of birds; and monitoring of the otter and the beaver. As part of sub-activity 3, a restoration study is being prepared including restoration measures for aquatic ecosystems of the Kopački Rit Nature Park floodplain which will contain the results of earlier activities with an analysis of variant technical solutions with the selection of the optimum one, as well as a proposal of all the key restoration measures and a proposal and establishment of long-term (permanent) monitoring.

Keywords: Kopački Rit, NATURAVITA, water protection and preservation, restoration

Environmental Monitoring / *Monitoring okoliša*
Oral presentation / *Usmeno priopćenje*

Zaštita i očuvanje voda i o vodama ovisnih ekosustava u Parku prirode Kopački rit u sklopu projekta NATURAVITA

Ivan TOT

Hrvatske vode, Ulica grada Vukovara 220, Zagreb, Hrvatska

Sažetak
U sklopu projekta NATURAVITA Hrvatske vode provode aktivnost zaštite i očuvanje voda i o vodama ovisnih ekosustava u Parku prirode Kopački rit. Upravljanje vodama i zaštita o vodi ovisnih ekosustava na projektnom području sastavni je dio radova važnih za obnovu i očuvanje šuma i šumskog zemljišta kao i za zaštitu i očuvanje ukupnih prirodnih vrijednosti zaštićenih područja jer o očuvanju hidroloških i morfoloških te fizikalno-kemijskih i bioloških značajki voda ovisi očuvanje i zaštita biološke raznolikosti razmatranog područja. U sklopu prve podaktivnosti osnovni zadatak je bio utvrđivanje retencijskog kapaciteta i nultog stanja vodenih ekosustava poplavnog područja obuhvata Parka prirode Kopački rit, u sklopu koje je izrađena je studija nultog stanja voda i o vodama ovisnih ekosustava i detaljni plan monitoringa te je izrađen 3D model terena. U sklopu druge podaktivnosti proveli su se istražni radovi uspostave piezometarske mreže (izbušeno 10 piezometara) te je izgrađeno 5 dopunskih vodomjernih postaja. U trajanju od tri godine provodi se monitoring ekološkog stanja površinskih voda i monitoring dodatnih bioloških pokazatelja, monitoring kemijskog stanja površinskih voda, monitoring podzemnih voda, istraživanja i praćenje recentne sedimentacije, monitoring staništa i flore, monitoring mekušaca, monitoring kukaca, monitoring herpetofaune, monitoring ptica i monitoring vidre i dabra. U sklopu treće podaktivnosti izrađuje se studija revitalizacije s restauracijskim mjerama vodenih ekosustava poplavnog područja Parka prirode Kopački, koja će sadržavati rezultate iz prethodnih aktivnosti uz analizu varijantnih tehničkih rješenja s odabirom optimalne varijante, kao i prijedlog svih ključnih mjera revitalizacije te prijedlog i uspostavu dugoročnog (trajnog) monitoringa.
Ključne riječi: Kopački rit, NATURAVITA, zaštita i očuvanje voda, restauracija

Monitoring of pesticides in Croatian drinking water

Magdalena UJEVIĆ BOŠNJAK, Iva ŠUŠIĆ, Filip GAJŠAK, Ivana PUKLJAK, Maja REČIĆ, Valentina GORIČANEC

Croatian Institute of Public Health, Rockefellerova 7, Zagreb, Croatia

Abstract:
Pesticides are widely used in agriculture to protect crops, while their global production and use grow in time. One or more active substances contained in certain pesticides can enter the surface as well as ground waters used for drinking water supply. Said compounds are thus monitored according to the Drinking Water Directive (DWD). However, the list of pesticides to be monitored is not regulated at EU level. In Croatia, the list of pesticides to be monitored in drinking water is determined by the Croatian Ministry of Health, and all pesticides from the list need to be monitored in each drinking water supply zone. The risk-based approach is built on the assumption that only those pollutants that are likely to be present in each water supply cycle should be monitored. This study investigates pesticide occurrence in raw water used for water supply, as well as in drinking water supplied to consumers in more than 200 water supply zones in Croatia. In total, 317 samples of raw water and 631 samples of supplied drinking water were analyzed for pesticides in Croatia in 2021, covering 35 pesticides and 15 metabolites. The majority of the pesticides monitored have not been detected. Nine pesticides with individual concentrations ranging from <limit of quantitation (LOQ) to 0.1 µg/L were identified. The maximum individual concentrations of atrazine, desethyl atrazine, desethyl deisopropyl atrazine (DEDIA), metolachlor, chlorpyrifos ethyl, terbuthylazine, malathion, bromacil, and azoxystrobin equaled 0.04, 0.04, 0.04, 0.05 0.02, 0.03, 0.03, 0.1 and 0.07 µg/L, respectively. The results emphasize that monitoring should be tailored to each individual water supply zone and focus on priority pesticides since the majority of the pesticides have a low priority.
Keywords: pesticides, drinking water, monitoring, water supply zone, Croatia

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Environmental Regulations and Laws
Okolišno pravo i zakonska regulativa

Implementing ETS in shipping sector: Assessing the sustainability of the new system

Michael BOVIATSIS

University of Piraeus, Department of Maritime Studies, M. Karaoli & A. Dimitriou St. 80, Piraeus, Greece

Abstract

The European Parliament has decided to introduce shipping into the emission trading system (ETS) gradually from 2024, requiring shipping companies to buy allowances for emissions emitted by their ships. Shipping companies can buy allowances for 100% of ships' emissions for voyages within the European Union and 50% of ships' emissions for voyages to or from the EU. Under this framework, there will be a three-year adjustment period during which shipping companies can buy emissions trading allowances for 40% of emissions in 2024 before gradually increasing to 75% in 2025 and 100% in 2026. Initially, emissions will cover carbon dioxide (CO_2), but from 2026 other emerging pollutants, such as methane and nitrous oxide emissions (NO_x), will be included. This research will examine the sustainability of this system during its implementation in the shipping sector and discuss any legislative issues as well as incentives that can be given to shipping companies to implement this legislation.

Keywords: ETS, CO_2, VGP, maritime sustainability

Environmental Regulations and Laws / *Okolišno pravo i zakonska regulativa*
Oral presentation / *Usmeno priopćenje*

Does unlimited liability impact maritime sustainability? An evaluation of US maritime legislation compared to international legislation and incentives

Michael BOVIATSIS

University of Piraeus, Department of Maritime Studies, M. Karaoli & A. Dimitriou St. 80, Piraeus, Greece

Abstract
The role of the shipping industry in global trade and transport is of paramount importance– however, it is also linked to numerous environmental and safety concerns. Various international and national conventions have been established to address these concerns and promote responsible practices that govern the activities of port authorities and shipping companies. In the United States, port authorities operate under the jurisdiction of the United States Coast Guard (USCG), responsible for ensuring maritime safety and environmental protection. This research aims to provide an in-depth analysis of the legislation governing US port authorities and highlight the key differences between US Acts and other international and national conventions. In addition, the research will discuss the response to intentional pollution under U.S. legislation, namely Oil Pollution Act 90, Vessel General Permit, Clean Water Act and other legislation, in conjunction with competent international legislation, utilizing distinct case law. Finally, the concept of unlimited liability, introduced by the US Oil Pollution Act 90, will be assessed, and its connection to the principles of maritime sustainability will be evaluated.
Keywords: USCG, OPA 90, VGP, maritime sustainability

Environmental Regulations and Laws / *Okolišno pravo i zakonska regulativa*
Oral presentation / *Usmeno priopćenje*

Legal Aspects of rigging CO_2 emission data and the global fraud of the German automobile giant

Danija BUDIMIR, Sara KORADE

Danija Budimir Attorney at Law, Office in Zagreb, Avenija Većeslava Holjevca 40, Zagreb, Croatia

Abstract
Eight years after the outbreak of the Volkswagen emissions scandal and two years after the trial in Germany started, the expected decision in one of the biggest affairs of the world car market has still not been made. Four former executives of one of the world's leading automakers are facing indictments before the German court accusing them of various crimes for secretly installing manipulated software on millions of cars that made Volkswagen vehicles appear cleaner than other cars in laboratory tests, even though they emitted several times higher amounts of harmful exhaust gases than permitted. After the revelation of the affair in the USA, the American courts have already passed judgments against the responsible persons and the main actors of Volkswagen because of what the corporation has already compensated the injured parties in amounts reaching several billion dollars. Since the described affair in the Republic of Croatia, in contrast to other European and world countries, has not received enough attention from the public and the media, this presentation aims to raise awareness of the enormous success of environmental associations and activists, given that it was through their efforts that one of the biggest scandals in the history of the automotive industry was revealed.
Keywords: Volkswagen, gas emission, indictment, environmental pollution, ecological associations, compensation, "clean diesel"

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Pravni aspekti lažiranja podataka o emisiji CO_2 i globalne prijevare njemačkog automobilskog giganta

Danija BUDIMIR, Sara KORADE

Odvjetnica Danija Budimir, Odvjetnički ured Zagreb, Avenija Većeslava Holjevca 40, Zagreb, Hrvatska

Sažetak

Osam godina nakon izbijanja skandala zbog lažiranja rezultata testova o emisiji i kvaliteti ispušnih plinova Volkswagena te dvije godine nakon početka suđenja u Njemačkoj, iščekivana odluka u jednoj od najvećih afera na svjetskom tržištu automobila još uvijek nije donesena. Četvorica bivših vodećih osoba jednog od vodećih svjetskih proizvođača automobila pred njemačkim sudom suočeno je s optužnicama kojima se terete za razna kaznena djela zbog prešutnog instaliranja manipuliranog softvera na milijunima automobila, a kojima je omogućio da se Volkswagenova vozila u laboratorijskim ispitivanjima čine čišćima od ostalih automobila, iako su ispuštala nekoliko puta veće količine štetnih ispušnih plinova od dopuštene. Nakon otkrivanja afere u SAD-u, američki su sudovi već donijeli osuđujuće odluke protiv odgovornih osoba i glavnih aktera Volkswagena, a korporacija je oštećenike već i obeštetila u iznosima koji dostižu nekoliko milijardi dolara. Budući da opisanoj aferi u Republici Hrvatskoj, za razliku od ostalih europskih i svjetskih zemalja, nije pridodana dovoljna pažnja javnosti i medija, cilj je ove prezentacije podići svijest o ogromnom uspjehu ekoloških udruga i aktivista, s obzirom da je upravo njihovim zalaganjem došlo do rasvjetljavanja jednog od najvećih skandala u povijesti automobilske industrije.

Ključne riječi: Volkswagen, emisija ispušnih plinova, optužnica, onečišćenje okoliša, ekološke udruge, odšteta, „čisti dizel“

Environmental Regulations and Laws / *Okolišno pravo i zakonska regulativa*
Oral presentation / *Usmeno priopćenje*

Analysis of selected special administrative procedures in the field of environmental protection and administrative-juridical protection

Ana ĐANIĆ ČEKO

Josip Juraj Strossmayer University of Osijek, Faculty of Law Osijek, S. Radića 13, Osijek, Croatia

Abstract
Preservation of the human environment represents a constitutional value and the environment represents an asset of interest to the Republic of Croatia and enjoys its special protection. Every person has the right to live in a clean and healthy environment, taking into account the protection and improvement of the environment. Adequate environmental protection is necessary for human well-being and the enjoyment of basic human rights. Therefore, from an administrative-legal point of view, we consider it important to analyze a special administrative procedure in relation to the resolution of administrative matters and the adoption of administrative acts related to the field of environmental protection, i.e. assessment of interventions in the environment and issuance of environmental permits. The paper will present and analyze the legal framework based on the Environmental Protection Act. Competent authorities and the course of implementation of special administrative procedures related to the issuance of an environmental permit will be highlighted. The Ministry of Economy and Sustainable Development stands out as the main body of state administration responsible for making the aforementioned decisions. By comparing two procedural laws, the General Administrative Procedure Act (lex generalis) and the Environmental Protection Law (lex specialis), it will be established whether and to what extent certain deviations exist. Furthermore, further legal protection will be presented within the framework of the administrative dispute, regarding lawsuits for the assessment of the legality of acts. The analysis of specific court cases in the selected period will provide direct insight into the decision-making process of administrative courts and indicate the complexity of environmental issues.
Keywords: environmental protection, special administrative procedure, administrative-judicial protection, environmental permit, Ministry of Economy and Sustainable Development

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Oral presentation / *Usmeno priopćenje*

Analiza odabranih posebnih upravnih postupaka u području zaštite okoliša i upravno-sudske zaštite

Ana ĐANIĆ ČEKO

Sveučilište Josipa Jurja Strossmayera u Osijeku, Pravni fakultet Osijek, S. Radića 13, Osijek, Hrvatska

Sažetak

Očuvanje čovjekova okoliša predstavlja ustavnu vrednotu te okoliš predstavlja dobro od interesa za Republiku Hrvatsku i uživa njezinu posebnu zaštitu. Svaka osoba ima pravo živjeti u čistom i po zdravlje pogodnom okolišu, vodeći računa o zaštiti i unapređenju okoliša. Pri tome je odgovarajuća zaštita okoliša nužna za dobrobit čovjeka i uživanje osnovnih ljudskih prava. Stoga, s upravno-pravnog gledišta smatramo važnim analizirati poseban upravni postupak u odnosu na rješavanje upravnih stvari i donošenje upravnih akata vezanih za područje zaštite okoliša, odnosno procjene utjecaja zahtava na okoliš i izdavanje okolišne dozvole. U radu će se prikazati i analizirati pravni okvir temeljem Zakona o zaštiti okoliša. Istaknut će se nadležna tijela i tijek provođenja posebnih upravnih postupaka vezanih izdavanje okolišne dozvole. Kao glavno tijelo državne uprave nadležno za donošenje navedenih rješenja ističe se Ministarstvo gospodarstva i održivog razvoja. Usporedbom dvaju procesnih zakona, Zakona o općem upravnom postupku (*lex generalis)* i Zakona o zaštiti okoliša (*lex specialis*), ustvrdit će se postoje li i u kojem mjeri određena odstupanja. Nadalje, prikazat će se daljnja pravna zaštita u okviru upravnog spora, povodom tužbi radi ocjene zakonitosti akata. Analizom konkretnih sudskih predmeta u odabranom razdoblju, omogućit će se izravan uvid u način odlučivanja upravnih sudova i ukazati na složenost predmeta iz okolišne problematike.

Ključne riječi: zaštita okoliša, posebni upravni postupak, upravno-sudska zaštita, okolišna dozvola, Ministarstvo gospodarstva i održivog razvoja

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Oral presentation / *Usmeno priopćenje*

Sustainable artificial intelligence in public policies proposals

Antonija HINCKEL OSOJNIK

University of Göttingen, Faculty of Law, Platz d. Göttinger Sieben 6, Göttingen, Germany

Abstract
Considering the growing importance of artificial intelligence in the fight against climate change, AI systems *for* sustainability are becoming a significantly important topic. This paper aims to draw a connection between sustainability and AI systems as desirable regulatory targets. While using a transdisciplinary method, it also clarifies the concept of 'sustainable AI', which focuses on the sustainability of AI systems during the whole cycle. Recently proposed, the Commission's AI Act emphasizes AI risks and individual harm that could result from AI systems, but it misses the opportunity to address sustainability. While being aware of technological transformation challenges and opportunities, both policy targets could be achieved by fostering 'sustainable AI': digitalization and sustainability. The environmental footprint of digital transformation should not be considered irrelevant when implementing new policies. Although the environmental footprint and societal harm could result from AI systems applications, they are already familiar notions in environmental law. Environmental law focuses on local communities and the preservation of public good, and it can steer the AI systems towards the same goals. Thus, environmental law can offer valuable insights when regulating AI systems.
Keywords: environmental law, sustainability, sustainable AI, artificial intelligence, societal harms

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Oral presentation / *Usmeno priopćenje*

Održiva umjetna inteligencija u prijedlozima javnih politika

Antonija HINCKEL OSOJNIK

Sveučilište u Göttingenu, Pravni fakultet, Platz Göttinger Sieben 6, Göttingen, Njemačka

Sažetak
S obzirom na sve veću važnost umjetne inteligencije u borbi protiv klimatskih promjena, AI sustavi za održivost postaju značajno bitna tema. Cilj ovog rada je povući vezu između održivosti i umjetne inteligencije kao regulatornog cilja. Koristeći transdisciplinarnu metodu, rad pojašnjava koncept 'održive umjetne inteligencije', koji se fokusira na održivost sustava umjetne inteligencije tijekom cijelog ciklusa. Nedavno predloženi Akt o umjetnoj inteligenciji Europske komisije naglašava rizike od umjetne inteligencije i pojedinačnu štetu koja bi mogla proizaći iz sustava umjetne inteligencije, a propušta priliku adresirati održivost. Uz svijest o izazovima i prilikama koje proizlaze iz tehnološke transformacije, poticanjem 'održive umjetne inteligencije' mogla bi se postići oba cilja javnih politika: digitalizacija i održivost. Iako bi ekološki otisak i šteta za okoliš mogli proizaći iz primjene AI sustava, oni su već poznati pojmovi u okolišnom pravu. Ekološke posljedice digitalne transformacije ne bi smjele biti zanemarene prilkom provedbe novih javnih politika. Ekološko pravo je usredotočeno na lokalne zajednice i očuvanje javnog dobra i može usmjeriti sustave umjetne inteligencije prema istim ciljevima. Stoga okolišno pravo regulatorima može ponuditi dragocjene uvide prilikom regulacije sustava umjetne inteligencije.
Ključne riječi: okolišno pravo, održivost, održiva umjetna inteligencija, umjetna inteligencija, šteta za okoliš

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Poster presentation / *Postersko priopćenje*

Integration of the „do no significant harm“ (DNSH) principle in the Strategic Environmental Assessment (SEA) of programme documents of Republic of Bulgaria for the management of EU funds for the 2021-2027 programme period

Stanimira IVANOVA[1], Rayna GEORGIEVA[2], Petar PETROV[2]

[1] P-United Ltd., 1797 Sofia, 14 Kliment Ohridski Blvd., Bulgaria
[2] University of Forestry, 1797 Sofia, 10 Kliment Ohridski Blvd., Bulgaria

Abstract
In view of the growing importance of sustainable finance to complement the legislative agenda of the European Green Deal, the DNSH principle, introduced through the Taxonomy Regulation, is at the heart of a classification system of environmentally sustainable economic activities, which is applicable in several pieces of legislation in the area of sustainable finance. In accordance with the Common Provisions Regulation, the Funds should support activities that respect the climate and environmental standards and that would do no significant harm to the environmental objectives. The aim of the current article is to explore the DNSH relevance of programme documents of the Republic of Bulgaria for the management of European funds for the 2021-2027 programme period and to demonstrate the integration of the DNSH principle in SEA. Two programmes have been explored – Programme Environment and Marine, Fisheries and Aquaculture Programme. The SEA was used to demonstrate and to evidence the DNSH compliance. Two approaches have been applied – for the Programme Environment separate DNSH assessment has been carried out and the results have been integrated in the SEA, for the Marine, Fisheries and Aquaculture Programme the DNSH compliance was directly incorporated in the SEA. Both programmes were approved by the European Commission in 2022.
Keywords: SEA, DNSH, taxonomy, sustainable, programme

Environmental protection before the Court of Justice of the European Union

Tunjica PETRAŠEVIĆ, Dunja DUIĆ, Veronika SUDAR

Josip Juraj Strossmayer University of Osijek, Faculty of Law, S. Radića 13, Osijek, Croatia

Abstract
The right to environmental protection is one of the fundamental human rights guaranteed by the Charter of Fundamental Rights of the European Union (further: Charter). Specifically the Charter, in Art. 37 obliges the European Union to include and ensure a high level of protection and improvement of the quality of the environment in the policies it adopts with the application of sustainable development principles. The Treaty on the Functioning of the European Union contains almost the same provision in Art. 11 and in Art. 191 - 193, according to which the fight against climate change is an explicit goal of environmental policy. Furthermore, according to Art. 3 of the Treaty on the European Union, the European Union works on sustainable development, which is based, among other things, on a high level of protection and improvement of the quality of the environment, very similar to what is prescribed by the Charter. European Union policies protect the right to environmental protection and strive to reduce the risk of climate change and the risk to human health and biological diversity. In a large number of legislative acts in the field of environmental protection, the European Green Deal stands out. The goal of the European Green Deal is to turn Europe into the first carbon-neutral continent, which will be achieved in part through the development of clean energy sources and green technologies. Nevertheless, there is an increasing number of cases before the Court of Justice of the EU related to the violation of environmental protection rights, that is, violations of environmental protection provisions adopted by the European Union. Through the analysis of selected case law, the authors will try to determine which are the most frequent violations committed by member states or citizens of the European Union in the area of environmental protection.
Keywords: European Union, environmental protection law, the Court of Justice of the EU, sustainable development

Zaštita okoliša pred Sudom Europske unije

Tunjica PETRAŠEVIĆ, Dunja DUIĆ, Veronika SUDAR

Sveučilište Josipa Jurja Strossmayera u Osijeku, Pravni fakultet Osijek, S. Radića 13, Osijek, Hrvatska

Sažetak

Pravo zaštite okoliša jedno je od temeljnih ljudskih prava zajamčenih Poveljom Europske unije o temeljnim pravima (dalje: Povelja). Konkretno, čl. 37. Povelje obvezuje Europsku uniju na uključivanje i osiguravanje visoke razine zaštite i poboljšanja kvaliteta okoliša u politikama koje donosi uz primjenu načela održivog razvoja. Gotovo istu odredbu sadrži i Ugovor o funkcioniranju Europske unije u čl. 11. te u čl. 191. - 193. prema kojima je borba protiv klimatskih promjena izričit cilj politika u području okoliša. Nadalje, prema čl. 3. Ugovora o Europskoj uniji, Europska unija radi na održivom razvoju koji se temelji između ostalog na visokoj razini zaštite i poboljšanja kvalitete okoliša, vrlo slično kako j to propisano Poveljom. Politikama Europske unije štiti se pravo zaštite okoliš i nastoji se smanjiti rizike od klimatskih promjena te rizike za zdravlje ljudi i biološku raznolikost. U velikom broju zakonodavnih akata iz područja zaštite okoliša posebno se ističe Europski zeleni plan. Cilj Europskog zelenog plana je pretvoriti Europu u prvi ugljično neutralan kontinent, što će se dijelom ostvariti razvojem čišćih izvora energije i zelenih tehnologija. Ipak, postoji sve veći broj predmeta pred Sudom EU koji se odnose na povrijede prava zaštite okoliša, odnosno kršenja odredbi o zaštiti okoliša koje je Europska unija donijela. Autori će kroz analizu odabranih predmeta sudske prakse pokušati utvrditi koje su najčešće povrjede koje države članice ili građani Europske unije čine u području zaštite okoliša.

Ključne riječi: Europska unija, održivi razvoj, pravo zaštite okoliša, Sud Europske unije

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Oral presentation / *Usmeno priopćenje*

Charging Towards a Green Future: Challenges to Electromobility Regulation in Croatia

Raul PENDE

University of Zagreb, Faculty of Law, Trg Republike Hrvatske 14, Zagreb, Croatia

Abstract
Recognized by the European Union as one of the building blocks of an energy-efficient future, e-mobility is a turning point for legislation relating to public and private property management. The implementation of charging infrastructure requires a set of challenging undertakings, more so in circumstances of co-ownership. An in-depth analysis of current and prospective, national and EU, legislation has revealed a dire need for guidance and improvement in the sector. Firstly, an overview is made of the legislation regarding some key aspects of e-mobility. That is either through public policies or by mandating certain improvements on private property real estate. Secondly, an exhaustive analysis is provided which encompasses all relevant steps that co-owners must undergo in order to successfully install EV charging stations. The regulatory framework covered in the latter section includes building regulations, Electric Power System regulation and property law, with special regard to decision-making processes in cases of real-estate co-ownership. Finally, having taken into consideration planned regulatory developments on the EU level, a reasoned opinion on the necessity of a national legislative reform in the field of e-mobility is provided.
Keywords: electromobility, co-ownership management, charging infrastructure, Electric Power System efficiency

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Croatian Organic Agriculture within the Common Agricultural Policy of the European Union

Ines POHAJDA[1], Jelena GADŽE[1], Kristina BATELJA LODETA[2]

[1] Ministry of Agriculture, Ulica grada Vukovara 78, Zagreb, Croatia
[2] University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia

Abstract
Croatian organic agriculture was introduced in 2001 by the Law on Organic Production of Agricultural and Food Products. Since 2002, national subsidies for this production have been mandatory. With the accession of the Republic of Croatia to the European Union, the Common Agricultural Policy offers new opportunities. Under the Rural Development Programme of the Republic of Croatia for the period 2014-2020 (RDP), financed by the European Agricultural Fund for Rural Development (EAFRD), organic production has been financed since 2015 through Measure 11 Organic Farming (M 11). With the aim of identifying the strengthening of Croatian organic farming under the Common Agricultural Policy, this study analyzed two periods of organic production (thirteen years without the application of M 11 and seven years with the application of M 11). The continuous increase of areas under M 11 is proportional to the increase in the total number of areas under organic farming. Accordingly, in 2015, there were 69280 ha and in 2021, 116459 ha within M 11. The conducted research shows a significant increase in organically farmed areas with the introduction of M 11. It is important to continue this support within the framework of the Strategic Plan of the Common Agricultural Policy of the Republic of Croatia 2023-2027.
Keywords: organic production, organic production subsidies, RDP, Measure 11, EAFRD

Environmental Regulations and Laws / *Okolišno pravo i zakonska regulativa*
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Protection against environmental pollution from harmful noise emissions and light emissions in the light emission of the administrative principle of proportionality

Domagoj ROŽAC, Daša PANJAKOVIĆ SENJIĆ

University of Applied Sciences "Lavoslav Ružička" in Vukovar, Županijska ulica 50, Vukovar, Croatia

Abstract
In the paper, the authors compare and analyze the provisions of the Noise protection act (Official Gazette, No. 30/2009, 55/2013, 153/2013, 41/2016, 114/2018 and 14/2021, hereinafter: NPA) and Protection against light pollution act (Official Gazette, No. 14/2019, hereinafter: PALPA) as lex specialis, with the provisions of the Environmental Protection Act as *lex generalis*, the basic concepts of environmental protection that will lead to harmful light and noise immissions. In the rest of the paper, using the method of deduction and induction through the administrative principle of proportionality, the authors analyzed and summarized the behavior of institutions in determining and imposing administrative measures. They related this to the objective of timeliness of the same measures, the application of the most effective technique and technology and their economic feasibility to protect the environment from pollution. From this, the occurrence of new forms of pollution with the mentioned immissions, as well as their reduction and prevention, were identified, whereupon it was necessary to link the drawn conclusions with the latest conclusions, goals, and measures of the Paris Agreement, and based on which the strategy "Creating a Climate Resilient Europe" - the new EU strategy for adaptation to climate change - was adopted. The aim of the work is to harmonize the principles, institutes of administrative legal protection against harmful light immissions and noise immissions, pointing out the problem of partial or total failure to take measures to reduce the impact on the environment caused by the aforementioned sources as much as possible, so that the environment can recover in a certain period of time.
Keywords: proportionality principle, environmental pollution, noise immission, light immission

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Oral presentation / *Usmeno priopćenje*

Zaštita od onečišćenja okoliša od štetnih imisija buke i svjetlosnih imisije u emisiji u svjetlu primjene upravnog načela razmjernosti

Domagoj ROŽAC, Daša PANJAKOVIĆ SENJIĆ

Veleučilište „Lavoslav Ružička“ u Vukovaru, Županijska ulica 50, Vukovar, Hrvatska

Sažetak
Kroz rad autori će primjenom usporedbe i analize odredbi Zakon o zaštiti od buke (Narodne novine, 30/2009., 55/2013., 153/2013., 41/2016., 114/2018. i 14/2021. dalje: ZZB) i Zakon o zaštiti od svjetlosnog onečišćenja (Narodne novine, broj: 14/2019., dalje: ZZSO) kao lex specialisima, sa odredbama Zakona o zaštiti okoliša kao lex generalisa, utvrdili osnovne pojmove zaštite okoliša koje će dovesti u vezu sa štetnim svjetlosnim imisija i imisija buke. U daljnjem dijelu rada autori su primjenjujući metodu dedukcije i indukcije kroz upravno načelo razmjernosti analizirali te sintetizirali postupanje institucija prilikom određivanja i izricanja upravnih mjera. Prethodno navedeno dovodeći u vezu s ciljem pravovremenosti istih mjere, primjene najučinkovitije tehnike i tehnologije te njihove gospodarske provedivosti u zaštiti od onečišćenja okoliša. Iz kojih je određena pojavnost novih oblika onečišćenja imenovanim imisijama kao i njihovo smanjivanje i sprječavanje na osnovu kojih je valjalo izvedene zaključke povezati sa recentnim zaključcima, ciljevima i mjerama donesenim u Pariškom sporazumu, a na osnovu kojeg je usvojena strategija „Stvaranje Europe otporne na klimatske promjene“ – nova strategija EU-a za prilagodbu klimatskim promjenama. Povod izrade rada je približavanja načela, instituta upravnopravne zaštite od štetnih svjetlosnih imisija i imisija buke kroz ukazivanje na problematiku djelomičnog ili potpunog izostanka poduzimanja mjera, kako bi se posljedice na okoliš s osnov navedenih izvora smanjile u što većoj mjeri, čime bi se okoliš kroz određeno vremensko razdoblje oporavio.
Ključne riječi: načelo razmjernosti, onečišćenje okoliša, imisija buke, svjetlosna imisija.

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Oral presentation / *Usmeno priopćenje*

With legal regulation to green transport - state and challenges

Aleksandra VASILJ[1], Biljana ČINČURAK ERCEG[1], Iva IŽAKOVIĆ[2]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Law, S. Radića 13, Osijek, Croatia
[2] University of Applied Sciences "Lavoslav Ružička" in Vukovar, Županijska ulica 50, Vukovar, Croatia

Abstract
Climate change and a polluted environment are among the biggest threats to humanity. Air, water, and soil pollution are largely affected by traffic. Also, with the development of urban areas, the transport infrastructure occupies more and more green areas. In response to climate change, the European Commission presented the "European Green Deal" in 2019, which aims to create Europe as a climate-neutral continent by 2050. The above requires changes in all economic sectors, especially in transport. The aim is to reduce greenhouse gas emissions by encouraging sustainable mobility, strengthening public transport, and using sustainable alternative fuels. The paper analyses the provisions of the European Green Deal, the European Climate Law (Regulation (EU) 2021/1119), and the legislative proposals package "Fit for 55%". The question is whether the Republic of Croatia is ready to implement European environmental regulations and standards? The national legal order has no special regulation of sustainable transport. Changing inadequate legal solutions and harmonizing them with European regulation is necessary. Although the National Recovery and Resilience Plan, as well as the Transport Development Strategy of the Republic of Croatia, propose adopting various plans for sustainable mobility, it is an ambitious, long-term, and complex process. The paper aims to determine whether the legislator at the national level has adequately regulated the introduction of modern transport trends and whether this contributes to the creation of sustainable (green) transport and environmental protection.
Keywords: transport, sustainable development, environmental protection, environmental law, legal regulation

Environmental Regulations and Laws / *Okolišno pravo i zakonska regulativa*
Oral presentation / *Usmeno priopćenje*

Pravnom regulativom do zelenog prometa – stanje i izazovi

Aleksandra VASILJ[1], Biljana ČINČURAK ERCEG[2], Iva IŽAKOVIĆ[2]

[1] Sveučilište Josipa Jurja Strossmayera u Osijeku, Pravni fakultet Osijek, S. Radića 13, Osijek, Hrvatska
[2] Veleučilište „Lavoslav Ružička" u Vukovaru, Županijska 50, Vukovar, Hrvatska

Sažetak
Klimatske promjene i onečišćeni okoliš među najvećim su prijetnjama čovječanstva. Na onečišćenje zraka, vode i tla u velikoj mjeri utječe promet. Također, razvojem urbanih područja prometna infrastruktura zauzima sve više zelenih površina. Kao odgovor na klimatske promjene Europska komisija predstavila je 2019. godine „Europski zeleni plan" kojim do 2050. godine želi stvoriti Europu kao klimatski neutralni kontinent. Navedeno zahtijeva promjene u svim gospodarskim sektorima, posebice u prometu. Cilj je smanjiti emisije stakleničkih plinova poticanjem održive mobilnosti, jačanjem javnog prijevoza i uporabom održivih alternativnih goriva. U radu se analiziraju odredbe Europskog zelenog plana, Europskog zakona o klimi (Uredba (EU) 2021/1119) te paketa prijedloga izmjene zakonodavstva „Spremni za 55%". Postavlja se pitanje je li Republika Hrvatska spremna za implementaciju europskih ekoloških propisa i standarda? U nacionalnom pravnom poretku nije donesen poseban propis koji regulira održivi promet. Potrebno je izmijeniti neadekvatna pravna rješenja i uskladiti ih s europskom regulativom. Iako se u Nacionalnom planu oporavka i otpornosti kao i u Strategiji prometnog razvoja Republike Hrvatske predlaže donošenje različitih planova za održivu mobilnosti, riječ je o ambicioznom, dugotrajnom i kompleksnom procesu. Cilj rada je utvrditi je li zakonodavac na nacionalnoj razini adekvatno regulirao uvođenje suvremenih prometnih trendova i pridonosi li se time stvaranju održivog (zelenog) prometa i zaštiti okoliša.
Ključne riječi: promet, održivi razvoj, zaštita okoliša, pravo okoliša, pravna regulativa

Forestry and Urban Forestry
Šumarstvo i urbano šumarstvo

Demining, restoration and protection of forest and forestland in protected and Natura 2000 sites in Danube-Drava Region – NATURAVITA

Irena FRANJIĆ, Dragomir PFEIFER, Blaž ŠTEFANEK

Croatian Forests Ltd. Directorate, Department for Green Energy and Projects financed by EU Funds and for International Projects, Ulica kneza Branimira 1, Zagreb, Croatia

Abstract
Croatian Forests Ltd., together with project partners Croatian Waters, the Ministry of the Interior, the Ministry of Regional Development and EU Funds and Public Institution Nature Park Kopacki rit have been implementing the project "Naturavita" which includes activities of mine clearance, restoration and protection of forests and forest land and protection of water resources and on water dependant ecosystems in the nature park "Kopački rit" and the Regional Park "Mura-Drava". The total value of the project is EUR 49,971,620.31, of which 85% is financed by the EU from the Cohesion Fund. The Project will be implemented by the end of 2023. Through the implementation of project activities, more than 25 km^2 of forests and forest land in the project area was cleared of mines and other unexploded. One of the targets of the project is to carry out biological restoration of forests on 868.87 ha. The largest share of the restored areas is the area restored with pedunculate oak (*Quercus robur*) seedlings 295.61 ha (34%), followed by white willow (*Salix alba*), 257.43 ha, black poplar (*Populus nigra*) 173.83 ha, narrow-field ash (*Fraxinus angustifolia*) 108.85 ha and white poplar (*Populus alba*) 32.55 ha. About 2 million seedlings were produced and planted for the needs of the project. After the planting of seedlings, care of young forest stands is carried out in all restored areas, which implies the mechanical removal of competing species. The Naturavita project will raise awareness of the importance of biological diversity and sustainable forest management through the implementation of educational programs for school children. The final project outcomes include increased forest ecosystem services in the project area.
Keywords: biological forest regeneration, forest protection, forest pedagogy

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Poster presentation / *Postersko priopćenje*

Razminiranje, obnova i zaštita šuma i šumskog zemljišta u zaštićenim i Natura 2000 područjima u Dunavsko-dravskoj regiji – NATURAVITA

Irena FRANJIĆ, Dragomir PFEIFER, Blaž ŠTEFANEK

Hrvatske šume d.o.o., Sektor za zelenu energiju i projekte sufinancirane sredstvima EU fondova i međunarodne projekte, Ulica kneza Branimira 1, Zagreb, Hrvatska

Sažetak

Hrvatske šume d.o.o. zajedno s partnerima Hrvatskim vodama, Ministarstvom unutarnjih poslova, Ministarstvom regionalnoga razvoja i fondova Europske unije i JU Parkom prirode Kopački rit od 2015. godine provode projekt razminiranja, obnove i zaštite šuma, šumskog zemljišta i vodnih resursa unutar područja zaštićenih ekološkom mrežom Natura 2000, a koja uključuju Park prirode Kopački rit i Regionalni park Mura – Drava. Ukupna vrijednost projekta je 49.971.620,31 EUR od čega 85 % čine bespovratna sredstva EU iz Kohezijskog fonda, a prvodit će se do kraja 2023. godine. Kroz projekt je razminirano više od 25 km^2 šuma i šumskog zemljišta u PP Kopački rit i Regionalnom parku Mura-Drava. Jedan od ciljeva projekta je provesti biološku obnovu šuma na 868,87 ha. Najveći udjel u obnovljenim površinama imaju površine obnovljene sadnicama hrasta lužnjaka (*Quercus robur*) 295,61 ha (34 %), zatim slijede obična vrba (*Salix alba*) 257,43 ha, crna topola (*Populus nigra*) 173,83 ha, poljski jasen (*Fraxinus angustifolia*) 108,85 ha i bijela topola (*Populus alba*) 32,55 ha. U tu svrhu proizvedeno je i posađeno oko 2 milijuna sadnica. Nakon sadnje sadnica, na svim obnovljenim površinama provode se radovi njege mladih šumskih sastojina što podrazumijeva mehaničko uklanjanje konkurentskih vrsta. Projektom Naturavita podizat će se svijest o važnosti biološke raznolikosti i održivom gospodarenju šumama kroz razvoj i provedbu edukacijskih programa za školsku djecu, studente i lokalno stanovništvo u obnovljenom Edukacijsko posjetiteljskom centru "Podravlje". Aktivnostima projekta povećat će se vrijednost općekorisnih funkcija šuma projektnog područja.

Ključne riječi: biološka obnova šuma, zaštita šuma, šumska pedagogija

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Oral presentation / *Usmeno priopćenje*

Development of European standards in urban forestry and arboriculture

Goran HULJENIĆ, Ana Marija MARIN, Andrija MAJIĆ

Urbani šumari d.o.o, Športska ulica 11, Novo Čiče, Croatia

Abstract
The importance of urban green areas is growing every day, as the number of urban residents is also growing. In order to optimize the planning of the future and maintenance of existing green areas in urban areas, European and international experts and scientists have been actively developing European standards in the interdisciplinary field of urban forestry and arboriculture since 2018. The first Erasmus+ project "Technical Standards in Tree Work-TeST" was established: the European tree pruning standard, the tree planting standard and the tree stabilization standard. The current Erasmus+ project "European Consulting Standards in Tree Work - EcoST" establishes 3 standards for consultants: the European tree assessment standard, the tree value assessment standard and the tree protection standard during construction work. Through future Erasmus+ projects, European experts will work on the development and establishment of a new European education and certification for consultants "European Tree Assessor" and education and certification for management staff of local self-government units "Urban Tree Management Skills Certification". Croatia is represented in the development of standards and education by the experts of the company Urbani šumari d.o.o., and they lead the development of the first educational and certification center for Croatia and SE Europe licensed by the European Council for Arboriculture (EAC) through the Erasmus+ project "Developing digital forms of learning and new certification programs in the field of arboriculture and urban forestry at the level of SE Europe". The creation and implementation of European standards promotes the sustainable development of urban areas.
Keywords: European standards, Erasmus+, green areas, sustainability, education

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Oral presentation / *Usmeno priopćenje*

Razvoj europskih standarda u urbanom šumarstvu i arborikulturi

Goran HULJENIĆ, Ana Marija MARIN, Andrija MAJIĆ

Urbani šumari d.o.o, Športska ulica 11, Novo Čiče, Hrvatska

Sažetak
Važnost urbanih zelenih površina svakodnevno raste jer i broj stanovnika gradova raste. Kako bi se planiranje budućih i održavanje postojećih zelenih površina u urbanim područjima optimiziralo europski i međunarodni stručnjaci i znanstvenici od 2018. godine aktivno razvijaju europske standarde u interdisciplinarnom području urbanog šumarstva i arborikulture. Prvim Erasmus+ projektom „Technical Standards in Tree Work-TeST“ uspostavljeni su: Europski standard orezivanja stabala, standard sadnje stabala i standard stabilizacije stabala. Aktualnim Erasmus+ projektom „European Consulting Standards in Tree Work – EcoST“ uspostavljaju se 3 standarda za konzultante: Europski standard prosudbe stabala, standard procjene vrijednosti stabla i standard zaštite stabala prilikom građevinskih radova. Kroz buduće Erasmus+ projekte europski stručnjaci će raditi i na razvoju i uspostavi nove europske edukacije i certifikacije za konzultante „European Tree Assessor“ te edukaciji i certifikaciji za rukovodeće kadrove jedinica lokalne samouprave „Urban Tree Management Skills Certification“. Hrvatsku u razvoju standarda i edukacija predstavljaju stručnjaci poduzeća Urbani šumari d.o.o., te vode razvoj prvog edukacijskog i certifikacijskog centra za Hrvatsku i JI Europu sa licencom Europskog vijeća za arborikulturu (EAC) kroz Erasmus+ projekt „Razvijanje digitalnih oblika učenja i novih certifikacijskih programa u području arborikulture i urbanog šumarstva na razini JI Europe“. Stvaranje i implementacija europskih standarda utječe na održivi razvoj urbanih područja.
Ključne riječi: Europski standardi, Erasmus+, zelene površine, održivost, edukacija

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Poster presentation / *Postersko priopćenje*

Digital system for the management of woody greenery - the basis of good management in urban forestry

Goran HULJENIĆ, Ana Marija MARIN, Andrija MAJIĆ

Urbani šumari d.o.o, Športska ulica 11, Novo Čiče, Hrvatska

Abstract
Urban forestry is an extremely interdisciplinary field in which, in addition to the care of woody greenery, numerous other forms of infrastructure and management are intertwined, therefore a well-established system of inventory and management of woody greenery (SIMWG) is of particular importance. A well-established system enables the direct connection of an individual tree in the field with its digital card, which contains all the necessary data from the health status to the necessary rehabilitation measures and methods of implementation of the measures. SIMWG must respect the most modern professional standards and enable fast and effective management. The participation of citizens and their information through SIMWG are today considered imperative and can lead to the resolution of numerous conflicts in the environment. With a well-established system of management of woody greenery and professionally conducted inventory according to systematically set parameters, it is possible to fully plan maintenance costs that are in accordance with the principles of sustainability. A properly implemented system enables the recording and valorization of biodiversity in urban areas, as well as the methodology of recommending the protection of microhabitats, which are very important niches for numerous endangered species. It is also important to enable the calculation of ecological benefits of existing urban greenery (CO2 compensation, impact on the heat island, impact on drainage, etc.), as well as by planning new urban planting projects. SIMWG enables the implementation of modern methods of tree diagnostics, which affects the preservation, especially of older trees, and the safety of all stakeholders in their environment.
Keywords: woody vegetation inventory, woody vegetation management, ecosystem services, sustainable management, digitization of tree management

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Poster presentation / *Postersko priopćenje*

Digitalni sustav za upravljanje drvenastim zelenilom – osnova dobrog gospodarenja u urbanom šumarstvu

Goran HULJENIĆ, Ana Marija MARIN, Andrija MAJIĆ

Urbani šumari d.o.o, Športska ulica 11, Novo Čiče, Hrvatska

Sažetak
Urbano šumarstvo je izuzetno interdisciplinarno područje u kojem se osim brige o drvenastom zelenilu isprepliću brojni drugi oblici infrastruktura i gospodarenja, stoga je dobro uspostavljen sustav inventarizacije i upravljanja drvenastim zelenilom (SIIUDZ) od posebne važnosti. Dobro uspostavljen sustav omogućuje izravno povezivanje pojedinog stabla na terenu s njegovim digitalnim kartonom koji sadrži sve potrebne podatke od zdravstvenog stanja do potrebnih mjera sanacije i metoda provedbe mjera. SIIUDZ mora uvažavati najmodernije standarde struke i omogućavati brzo i efektivno gospodarenje. Participacija građana i njihovo informiranje putem SIIUDZ danas se smatraju imperativnim i mogu dovesti do rješavanja brojnih konflikta u okolišu. Kod dobro uspostavljenog sustava upravljanja drvenastim zelenilom i stručno provedenom inventarizacijom prema sustavno postavljenim parametrima moguće je u potpunosti planirati troškove održavanja koji su u skladu s načelima održivosti. Pravilno izveden sustav omogućuje bilježenje i valorizaciju bioraznolikosti u urbanim sredinama, kao i metodologiju preporuka zaštite mikrostaništa koja su vrlo važne niše za brojne ugrožene vrste. Važno je i omogućiti izračun ekoloških benefita postojećeg urbanog zelenila (CO_2 kompenzacija, utjecaj na toplinski otok, utjecaj na odvodnju i dr.), kao i novih nasada. SIIUDZ omogućuje implementaciju modernih metoda dijagnostike stabala što utječe na očuvanje, posebice starijih, stabla i sigurnost svih dionika u okružju istih.
Ključne riječi: inventarizacija drvenastog zelenila, upravljanje drvenastim zelenilom, usluge ekosustava, održivo gospodarenje, digitalizacija upravljanja stablima

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Poster presentation / *Postersko priopćenje*

Initial monitoring of leaf chlorophyll concentration of trees in an urban environment

Marko OŽURA, Nina POPOVIĆ, Zrinka MESIĆ

Karlovac University of Applied Sciences, Trg J. J. Strossmayera 9, Karlovac, Croatia

Abstract
Analysis of leaf chlorophyll concentration is important in assessing the physiological condition and health status of target plants for both research and management purposes. Nondestructive methods for determining leaf chlorophyll content allow rapid and repeated measurements of the same leaves over time and immediate assessment of the relative health status of plants. During the spring and summer seasons we estimated foliar chlorophyll content using the SPAD 502DL meter from the leaves of 30 trees of maple (*Acer sp.*). Measurements were collected from two permanent plots in the town of Karlovac. We obtained data on the physiological response of trees to the construction of communal infrastructure in the immediate vicinity. Trees as a horticultural element in an urban environment require special care and the use of rapid, nondestructive methods as a tool to define the effects of construction practices on photosynthetic performance and health status. The initial monitoring of photosynthetic activity parameters will be continued during the next few growing seasons.
Keywords: leaf chlorophyll concentration, SPAD 50_2 meter, urban environment

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Poster presentation / *Postersko priopćenje*

Početno praćenje koncentracije klorofila u lišću drveća u urbanom okolišu

Marko OŽURA, Nina POPOVIĆ, Zrinka MESIĆ

Veleučilište u Karlovcu, Trg J. J. Strossmayera 9, Karlovac, Hrvatska

Sažetak
Analiza koncentracije klorofila u listu važna je u procjeni fiziološkog stanja i zdravstvenog statusa ciljnih biljaka kako za potrebe istraživanja tako i za potrebe upravljanja. Nedestruktivne metode za određivanje sadržaja klorofila u lišću omogućuju brza i ponovljena mjerenja istih listova tijekom vremena i neposrednu procjenu relativnog zdravstvenog stanja biljaka. Tijekom proljetne i ljetne sezone procijenili smo sadržaj klorofila u lišću pomoću uređaja SPAD 502DL iz lišća 30 stabala javora (*Acer sp.*). Mjerenja su prikupljena s dvije stalne plohe u gradu Karlovcu. Dobili smo podatke o fiziološkom odgovoru stabala na izgradnju komunalne infrastrukture u neposrednoj blizini. Stabla kao hortikulturni element u urbanom okruženju zahtijevaju posebnu brigu i korištenje brzih, nedestruktivnih metoda kao alata za definiranje učinaka građevinskih praksi na njihov fotosintetski proces i zdravstveni status. Inicijalno praćenje parametara fotosintetske aktivnosti bit će nastavljeno tijekom sljedećih nekoliko vegetacijskih razdoblja.
Ključne riječi: koncentracija klorofila u listovima, SPAD 502 klorofilmetar, urbani okoliš

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Oral presentation / *Usmeno priopćenje*

Hidden broad strokes in a shortcut for landscape resilience: rediscovering the lost Belgrade river shore

Boris RADIĆ, Milena VUKMIROVIĆ, Suzana GAVRILOVIĆ

University of Belgrade, Faculty of Forestry, Kneza Višeslava 1, Belgrade, Serbia

Abstract
Ecological connectivity is a vital characteristic of the landscape pattern, which enables its superior climate resilience and the conservation of the vitality of the landscape's character and connection with the past. Urban areas generally do not have the potential to provide an adequate level of connectivity due to their significant representation in built-up areas. For this reason, the realization of this landscape capacity is mainly realized at the expense of urban recycling, where abandoned or non-functional surfaces are transformed into multifunctional elements of green infrastructure that provide a wide range of ecosystem services. The quest for a new identity for Belgrade's urban landscape touched on the previous space, which was the territory of the forerunner of the city and functioned according to different natural principles. Newly designed open urban spaces must define a new ambient unit in the urban landscape and create spatial, ecological, social, and cultural connections between diverse city areas and functions. The primary design strategy for urban landscapes must identify natural and cultural preferences that serve as a template for mimicry-based replicabilities.
Keywords: landscape resilience, ecological connectivity, Belgrade river shore

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Poster presentation / *Postersko priopćenje*

Creating forest management plans as ecological network management plans – Ecomanager

Mile RADOČAJ, Irena FRANJIĆ, Blaž ŠTEFANEK

Croatian Forests Ltd. Directorate, Department for Green Energy and Projects financed by EU Funds and for International Projects, Ulica kneza Branimira 1, Zagreb, Croatia

Abstract
All forests and forest lands in the territory of the Republic of Croatia make up a forest management area of 2.7 million ha. Forest management plans are basic documents for the management and use of forests and forest lands in the territory of the Republic of Croatia, and the first plans were created in the middle of the 18th century. When Croatia joined the EU, it assumed the obligation to manage the ecological network Natura 2000, which covers 37% of the land territory and 16% of the territorial sea and inland sea waters, a total of 2,569,200 ha. The aim of the "ECOMANAGER" project is to ensure sustainable management of biodiversity in the Nature 2000 forest areas through the creation of a Program for the management of economic units with a Management Plan for the ecological network which will adequately consider the requirements of the ecological network. The process of creating a Program for the management of economic units with a Management Plan for the ecological network is defined in detail by the Forest Management Ordinance. The project implementation period is from January 2018 to June 2023. The total value of the project is 18,077,084.86 EUR of which 85% are EU funds. The project area includes 559,413 ha of forests and forest land owned by the Republic of Croatia managed by Croatian Forests, and 382,536 ha are within the Natura 2000 ecological network. Through the project, 167 Programs with established conservation measures and activities will be created, in accordance with the provisions of the Habitats Directive and the Birds Directive, and will represent a unique document that will manage the forest part of the Natura 2000 area, more precisely with 15% of the terrestrial part of the Natura 2000 area in the Republic of Croatia.
Keywords: Ecomanager, Natura 2000, forest management plans, ecological network management plans

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Poster presentation / *Postersko priopćenje*

Izgradnja šumskogospodarskih planova kao planova upravljanja ekološkom mrežom – Ecomanager

Mile RADOČAJ, Irena FRANJIĆ, Blaž ŠTEFANEK

Hrvatske šume d.o.o., Sektor za zelenu energiju i projekte sufinancirane sredstvima EU fondova i međunarodne projekte, Ulica kneza Branimira 1, Zagreb, Hrvatska

Sažetak

Sve šume i šumska zemljišta na području Republike Hrvatske čine šumskogospodarsko područje površine 2,7 milijuna ha. Šumskogospodarski planovi temeljni su dokumenti za gospodarenje i korištenje šuma i šumskih zemljišta na području RH, a prvi planovi nastali su polovicom 18. stoljeća. Ulaskom u EU, RH je preuzela obvezu upravljanja ekološkom mrežom Natura 2000 koja obuhvaća 37 % kopnenog i 16 % teritorijalnog mora i unutarnjih morskih voda, ukupno 2.569.200 ha. Cilj projekta „ECOMANAGER" je osigurati održivo upravljanje bioraznolikošću u šumskim područjima Nature 2000 kroz izradu Programa gospodarenja gospodarskim jedinicama s planom upravljanja područjima ekološke mreže (PGEM) koji će na odgovarajući način sagledavati zahtjeve ekološke mreže. Proces izrade PGEM-ova detaljno je definiran Pravilnikom o uređivanju šuma. Razdoblje provedbe projekta je od siječnja 2018. do lipnja 2023. godine. Ukupna vrijednost je 18.077.084,86 EUR od čega su 85 % sredstva EU iz Kohezijskog fonda. Projektno područje obuhvaća 559.413 ha šuma i šumskog zemljišta u vlasništvu RH s kojima gospodare Hrvatske šume, a 382.536 ha nalazi se unutar ekološke mreže Natura 2000. Kroz projekt će biti izrađeno 167 PGEM-ova s utvrđenim mjerama i aktivnostima za očuvanje, sukladno odredbama Direktive o staništima i Direktive o pticama i predstavljat će jedinstveni dokument kojim će se upravljati šumskim dijelom Natura 2000 područjem, točnije s 15 % kopnenog dijela Natura 2000 područja u RH.

ključne riječi: Ecomanager, Natura 2000, šumskogospodarski planovi, planovi upravljanja ekološkom mrežom

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Poster presentation / *Postersko priopćenje*

Developing Urban and Peri-urban Forests Planning and Management Guidelines through a Transnational Project – What have we learned and what can we share with other cities?

Klemen STRMŠNIK, Matjaž HARMEL, Samo ŠKRJANEC, Matevž Premelč

ZaVita d.o.o., Tominškova 40, Ljubljana, Slovenia

Abstract
Urban and Peri-urban Forests (UPFs) are under increasing pressure from the ever-increasing number of users and the ever-expanding set of activities. Without proper cooperation between all key actors – owners, managers and users of UPFs – conflicts and unsustainable use of forests arise. This is why 7 cities – Ljubljana, Vienna, Budapest, Zagreb, Cluj-Napoca, Belgrade and Ivano-Frankivsk joined forces and decided to improve the management and utilization of their UPFs through the URBforDAN project – a transnational project implemented under the INTERREG Danube Programme framework. All experiences, results and lessons learned were collected in Urban and Peri-urban Forests Planning and Management Guidelines. They actively promote cooperation between all key actors, equip them with needed knowledge, and practical experience. They offer a comprehensive representation of the planning process, as well as of applicative use of ecosystem services in the urban environment and participatory involvement of all key actors – developed, tested and implemented on a city level on 11 pilot sites. So far, no similar tool or guide devoted to cities existed. As such they represent a new standard in sustainable urban planning and management of UPF, and a best practice example of how cities can use their UPF to move from theory to practice on climate change issues and improve the wellbeing of their citizens. All experiences, results and lessons learned will be showcased in this poster presentation.
Keywords: Urban Forests, Participatory Planning, Adaptive Management, Guidelines, From Theory to Practice

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Oral presentation / *Usmeno priopćenje*

Forest health resources: New approaches in applied ecology

Marina VUKIN[1], Mirjana BARTULA[1], Radomir MANDIC[1], Goran KNEZEVIC[1], Dragan NOVAKOVIC[1], Adiba DZUDOVIC[2]

[1] Metropolitan University, Faculty of Applied Ecology 'Futura', Pozeska 83a Belgrade, Serbia
[2] SE 'Srbijasume' FE 'Belgrade' K. Milosa 55 Belgrade, Serbia

Abstract
Besides the forest economic-social discourse, innovative forest health-recreation programs have gained their place in contemporary scientific research studies and multidisciplinary approaches to the topic. Within the scope of knowledge of social ecosystem services of forests, applied ecology has recognized new areas of ecoforestry and nature-based tourism. The terms *'Natural Wellness'*, *'Prescribing Nature'*, *'Natural Selfness'*, *'Forest Wellness'*, *'Forest Bathing*,' *'Shinrin Yoku'*, *'Cure Forest'*, *'Healing Forest'* and others have been defined. They all point to the sanitary-hygienic aspect of forest resources, transformative experience in nature and the body and spiritual health improvement of an individual and the community. The first phase of the research presented specific knowledge and skills related to the promotion of healthy lifestyles and the management of forest resources, especially in protected natural areas. The general review was followed by the second phase of the research - a case study conducted in a special-purpose forest in the suburban zone of the city of Belgrade, Serbia: 'Lipovička Forest - Dugi Rt' Nature Monument. The research area was singled out and qualified, environmental conditions were studied and the sanitary-hygienic effects of the forest complex were determined. The results of the research indicated favorable environmental conditions, appropriate natural facilities and infrastructure and the provision of social benefits of this special-purpose forest. The new approaches to the use of forest resources here obtained will help us declare the first 'therapeutic forest' in the region, as a prominent segment of the total tourist product of the management of the protected area.
Keywords: resources, 'Shinrin Yoku', therapeutic forest

Forestry and Urban Forestry / *Šumarstvo i urbano šumarstvo*
Oral presentation / *Usmeno priopćenje*

Šumski resursi u službi zdravlja: Novi pristupi u primijenjenoj ekologiji

Marina VUKIN[1], Mirjana BARTULA[1], Radomir MANDIĆ[1], Goran KNEŽEVIĆ[1], Dragan NOVAKOVIĆ[1], Adiba DŽUDOVIĆ[2]

[1] Univerzitet 'Metropolitan, Fakultet za primijenjenu ekologiju „Futura", Požeška 83a, Beograd, Srbija
[2] JP 'Srbijašume' ŠG 'Beograd' K. Miloša 55, Beograd, Srbija

Sažetak
Inovativni zdravstveno-rekreacijski programi u šumama postali su, uz ekonomsko-socijalni diskurs, dio suvremenog znanstveno-istraživačkog rada i multidisciplinarnog pristupa temi. U sklopu spoznaja o društvenim ekosustavnim uslugama šuma, primijenjena ekologija izdvojila je nova područja ekošumarstva i turizma utemeljenog na prirodi. Definirani su pojmovi *'Natural Wellness'*, *'Prescribing Nature'*, *'Natural Selfness'*, *'Forest Wellness'*, *'Forest Bathing*,' *'Shinrin Yoku'*, *'Cure Forest'*, *'Healing Forest'* i drugi; koji ukazuju na sanitarno-higijenski aspekt šumskih resursa i fenomen transformativnog iskustva u prirodi te zdravstvenog i duhovnog razvoja pojedinca i zajednice. U prvoj fazi istraživanja prezentirana su specifična znanja i vještine vezane za promicanje zdravih stilova života i menadžment šumskih resursa, posebno u zaštićenim prirodnim područjima. Nakon općeg pregleda, u drugoj fazi istraživanja provedena je studija slučaja u šumi posebne namjene, u prigradskoj zoni grada Beograda, Srbija: Spomenik prirode 'Lipovička šuma-Dugi Rt'. Provedena je identifikacija i kvalifikacija objekta istraživanja, uz proučavanje ekoloških uvjeta i proračun sanitarno-higijenskih učinaka šumskog kompleksa. Rezultati istraživanja ukazali su na povoljne ekološke uvjete, odgovarajuću prirodnu i infrastrukturnu opremljenost i osigurane socijalne funkcije šume posebne namjene. Definirani novi pristupi korištenju šumskih resursa omogućit će certificiranje prve 'ljekovite šume' u regiji, kao istaknutog segmenta ukupnog turističkog proizvoda upravljača zaštićenog područja.
Ključne riječi: resursi, *'Shinrin Yoku'*, ljekovita šuma

Green Architecture and Construction
Zelena arhitektura i gradnja

Green Architecture and Construction / *Zelena arhitektura i gradnja*
Poster presentation / *Postersko priopćenje*

Transformation of the existing envelope of the building with the aim of using renewable energy sources

Haris BRADIĆ, Amir ČAUŠEVIĆ, Nerman RUSTEMPAŠIĆ

University of Sarajevo, Faculty of Architecture, Patriotske lige 30, Sarajevo, Bosnia and Herzegovina

Abstract
The existing architecture as the biggest consumer of energy is becoming an increasing challenge in the process of transformation into an energy-efficient one, with a lower need for energy, reduced CO_2 emissions and improved internal comfort and general awareness towards its environment and its future exploitation. The paper will present an example case from the research in the field of existing masonry architecture from the end of the 19th century, and it is about the Safvet Beg Bašagić Elementary School in Sarajevo, built in 1890. The building is of extremely great importance in the overall architectural heritage of Bosnia and Herzegovina, as it is one of the rare examples of the active use of its original purpose, or rather the initially designed functions of education from the period of Austro-Hungarian rule. The transformation of the existing state of high energy needs, high CO_2 emissions and poor comfort of the space where children stay required a study of the possibility of applying renewable energy sources on the existing envelope, which is under the primary protection of the Commission for the Preservation of National Monuments of the State of BiH. The object primarily receives a new layer of outer envelope as a kinetic membrane, as a response to the protection of the interior space and at the same time an absorber of solar energy for the needs of electrical appliances. Such a new structure, in addition to the great impact on the architectural identity of the Gimnazijska street ensemble, also represents an additional challenge from the aspect of implementation on the existing masonry construction of the building, which initiated a comprehensive analysis of the application possibilities and the impact on the entire constructive system.
Keywords: energy transformation, envelope, renewable energy sources, masonry construction

Green Architecture and Construction / *Zelena arhitektura i gradnja*
Poster presentation / *Postersko priopćenje*

Transformacija postojeće ovojnice zidanog objekta s ciljem korištenja obnovljivih izvora energije

Haris BRADIĆ, Amir ČAUŠEVIĆ, Nerman RUSTEMPAŠIĆ

Univerzitet u Sarajevu, Arhitektonski fakultet, Patriotske lige 30, Sarajevo, Bosna i Hercegovina

Sažetak

Postojeća arhitektura kao najveći konzument energije postaje sve veći izazov u procesu transformacije u energetski učinkovitu, s manjom potrebom energije, umanjenom emisijom CO_2 te poboljšanju unutarnjeg komfora i sveopćim osviještenjem prema svom okruženju i budućoj svojoj eksploataciji. Rad će prikazati primjer slučaj iz istraživanja na području postojeće zidane arhitekture s kraja 19 stoljeća, a radi se objektu Osnovna škola Safvet Beg Bašagić u Sarajevu građen 1890 godine. Objekat je od iznimno velikog značaja u cjelokupnoj arhitektonskoj baštini BiH, jer spada u rijetke primjere aktivnog korištenja prvobitne namjene, točnije inicijalno projektiranih funkcija obrazovanja iz perioda Austrougarske vladavine. Transformacija postojećeg stanja visoke energetske potrebe, visoke emisije CO_2 i lošeg komfora prostora u kojem borave djeca je zahtijevalo studiju mogućnosti primjene obnovljivih izvora energije na postojećoj ovojnici koja je pod primarnom zaštitom komisije za očuvanje nacionalnih spomenika države BiH. Objekat primarno dobija novi sloj ovojnice s vanjske strane kao kinetičku membranu, kao odgovor o zaštiti unutarnjeg prostora a ujedno i absorber sunčeve energije za potrebe elektro uređaja. Takva nova struktura osim velikog utjecaja na arhitektonski identitet ansambla objekata ulice Gimnazijska, predstavlja i dodatni izazov sa aspekta implementacije na postojećoj zidanoj konstrukciji objekta što je iniciralo sveobuhvatnu analizu mogućnosti primjene, ali i utjecaja na cjelokupan konstruktivni sistem.

Ključne riječi: energetska transformacija, ovojnica, obnovljivi izvori energije, zidana konstrukcija

Green Architecture & Construction / *Zelena arhitektura i gradnja*
Oral presentation / *Usmeno priopćenje*

Ecological Aspects of the Use of Waste Rubber in Road Construction

Ivana BARIŠIĆ, Tamara BRLEKOVIĆ, Mario GALIĆ

Josip Juraj Strossmayer University of Osijek, Faculty of Civil Engineering and Architecture Osijek, Vladimira Preloga 3, Croatia

Abstract

Civil engineering is an activity that relies heavily on the exploitation of natural resources. This especially applies to road construction, where large amounts of natural resources such as gravel, stone and sand are consumed for the construction of new and the rehabilitation and maintenance of existing roads. For the sustainable development of road construction, reducing the negative impact on the environment can be achieved by more efficient disposal of waste material and the use of various unconventional materials in all parts of the road as a structure. In an effort to find new areas of application of waste materials, the impact of incorporating such materials into building structures on the environment is often neglected. This is especially important for materials incorporated into the roads, as pavement structures and road embankments are in direct contact with the surrounding soil and potential contamination can very easily reach the groundwater. In this paper, the possibilities of using waste rubber in road construction will be presented, with special reference to the ecological effects. The results of laboratory research on the application of waste rubber in pavement load-bearing layers and eluate characteristics will be presented, along with an assessment of the impact on the environment of the pavement layer constructed in this way.

Keywords: road construction, environment protection, waste rubber, heavy metals, leaching

Green Architecture and Construction / *Zelena arhitektura i gradnja*
Oral presentation / *Usmeno priopćenje*

Ekološki aspekti primjene otpadne gume u cestogradnji

Ivana BARIŠIĆ, Tamara BRLEKOVIĆ, Mario GALIĆ

Sveučilište Josipa Jurja Strossmayera u Osijeku, Građevinski i arhitektonski fakultet Osijek, Vladimira Preloga 3, Osijek, Hrvatska

Sažetak

Građevinarstvo je djelatnost koja se bitno oslanja na iskorištavanje prirodnih resursa. To se posebno odnosi na cestogradnju u kojoj se za izgradnju novih te sanaciju i održavanje postojećih cesta troše velike količine prirodnih resursa poput šljunka, kamena i pijeska. Za održivi razvoj cestogradnje, smanjenje negativnog utjecaja na okoliš moguće je postići učinkovitijim zbrinjavanjem otpadnog materijala te korištenjem različitih nekonvencionalnih materijala u svim djelovima ceste kao građevine. U nastojanju da se iznađu nova područja primjene otpadnih materijala, utjecaj ugradnje takvih materijala u građevinske konstrukcije na okoliš često puta ostaje zanemaren. Ovo je posebno važno za materijale ugrađene u konstrukciju ceste jer su kolničke konstrukcije i nasipi ceste u izravnom kontaktu s okolnim tlom i potencijalno onečišćenje može vrlo lako dospjeti u podzemne vode. U ovom radu će biti prikazane mogućnosti primjene otpadne gume u cestogradnji s posebni osvrtom na ekološke učinke. Prikazati će se rezultati laboratorijskih istraživanja primjene otpadne gume u nosivim slojevima kolničkih konstrukcija cesta te karakteristike eluata uz procjenu utjecaja na okoliš ovako izvedenog sloja kolnika.

Ključne riječi: cestogradnja, zaštita okoliša, otpadna guma, teški metali, procjeđivanje

Who will carry out the energy renovation of the buildings?

Ivana CAREVIĆ, Ana BEŠKER, Bojan MILOVANOVIĆ, Nina ŠTIRMER, Ivana BANJAD PEČUR

University of Zagreb Faculty of Civil Engineering, Fra Andrije Kačića Miošića 26, Zagreb, Croatia

Abstract
In Croatia, energy-inefficient buildings are responsible for 40% of energy consumption and 36% of CO_2 emissions, while 30% of buildings are categorized as buildings with the worst energy performance. Increased intensity of energy renovation of existing buildings and deployment of new nZEB buildings would greatly reduce energy consumption and CO_2 emissions in the building sector, positively contributing to the energy and climate goals of Croatia and the EU by 2030. To achieve these ambitious goals, Croatia needs a workforce educated in the usage of new technologies, innovative renovation/construction methods, building standards (nZEB), application of new materials in construction, application of digitalization in the construction process and other factors that contribute to the decarbonization goals in the building sector. In the CRO skills RELOAD project, preliminary analyses were done encompassing (a) detailed national policies and strategies that contribute to the EU 2030 energy and climate targets in the building sector; (b) key data on building and energy sectors; (c) current situation regarding education and training of all construction professionals (blue and white collar workers) (d) identification of new emerging skills to achieve the 2030 energy targets and (e) analysis of barriers related to the qualification of the construction workers which may hinder the country's achievements of the 2030 targets in the building sector.
Keywords: construction sector; buildings; blue-collar workers; white collar workers; energy renovation

Green Architecture and Construction / *Zelena arhitektura i gradnja*
Poster presentation / *Postersko priopćenje*

Significance and comparisons of the application of green areas on roof structures of the envelope of existing and newly designed buildings

Amir ČAUŠEVIĆ, Nerman RUSTEMPAŠIĆ, Haris BRADIĆ

University of Sarajevo, Faculty of Architecture, Patriotske lige 30, Sarajevo, Bosnia and Herzegovina

Abstract

The increase of the human population to 8 billion and the persistent tendency of the population to migrate from rural to urban areas, raises a question of how the urban fabric can survive today while keeping its green context. This population's tendency also requires higher energy demands, depending on the climate zone, both for heating and cooling/ventilation. Urban tissues are becoming more and more centric, magnetic for humans both in the sense of business and housing. This corroborates to the importance of the issues of green urban areas in the future. It is important to find an answer as to how the image of cities can remain or become "green". There are two logical solutions. First, the greening of the existing roof structures, both flat and sloping (other shapes), depends on the age of the buildings, which is often longer than a century. The second direction is the application of green roofs on new buildings, which will contribute to both the reduction of CO_2 emissions within city zones, and improve the daily use of urban zones, with the fifth facade representing a part of the public area, parks, children's playgrounds, and zones for socialization. The paper will present analyses of the application of green surfaces aimed at reducing CO_2 emissions, static effects on the existing architectural structures, and their application on roofs of newly designed residential structures (built examples) in Germany. The findings will be presented through the obtained energy results, reductions in CO_2 emissions, and a review provided on the significance of the existing and future visual context of urban zones.

Keywords: green roof, existing roof structure, reduction of CO_2 emission, green urban identity

Značaj i komparacije primjene zelenih površina na krovnim strukturama ovojnice postojeće i novoprojektirane arhitekture

Amir ČAUŠEVIĆ, Nerman RUSTEMPAŠIĆ, Haris BRADIĆ

Univerzitet u Sarajevu, Arhitektonski fakultet, Patriotske lige 30, Sarajevo, Bosna i Hercegovina

Sažetak

Povećanje ljudske populacije na 8 milijardi i stalna tendencija stanovništva da migrira iz ruralnih u urbana područja, postavlja pitanje kako urbano tkivo danas može preživjeti, a da zadrži svoj zeleni kontekst. Ova populacijska tendencija također zahtijeva veće potrebe za energijom, ovisno o klimatskoj zoni, kako za grijanje tako i za hlađenje/ventilaciju. Urbana tkiva postaju sve više i više centrična, magnetska za ljude kako u poslovnom tako i u stambenom smislu. To govori o važnosti pitanja zelenih urbanih površina u budućnosti. Važno je pronaći odgovor na koji način imidž gradova može ostati, odnosno postati „zelen“. Postoje dva logična rješenja. Prvo, ozelenjivanje postojećih krovnih konstrukcija, ravnih i kosih (drugih oblika), ovisno o starosti objekata, koja je često duža od jednog stoljeća. Drugi smjer je primjena zelenih krovova na novogradnji, što će pridonijeti kako smanjenju emisije CO_2 unutar gradskih zona, tako i poboljšanju svakodnevnog korištenja urbanih zona, pri čemu peta fasada predstavlja dio javnih površina, parkova, dječja igrališta i zone za socijalizaciju. U radu će biti prikazane analize primjene zelenih površina u cilju smanjenja emisije CO_2, statičkih učinaka na postojeće arhitektonske objekte, te njihove primjene na krovovima novoprojektiranih stambenih objekata (izgrađeni primjeri) u Njemačkoj. Nalazi će se prezentirati kroz dobivene energetske rezultate, smanjenje emisija CO_2 te dati osvrt na značaj postojećeg i budućeg vizualnog konteksta urbanih zona.

Ključne riječi: zeleni krov, postojeća krovna struktura, umanjenje emisije CO_2, zeleni urbani identitet

Green Architecture and Construction / *Zelena arhitektura i gradnja*
Oral presentation / *Usmeno priopćenje*

The reconditioning of the Market Hall of Pécs in the context of the sustainability - Environmental emergency and architecture through an academic semester

András GREG, Gábor VERES

Department of Architecture and Urban Planning Faculty of Engineering and Information Technology, University of Pécs, Boszorkány út 2, Pécs, Hungary

Abstract
The survival of humanity depends on the usage of energy since the beginning of creation. The basis of sustainability is always based on well-thought energy consumption, but unconsumed energy can serve better the protection of the environment as prevention. Sustainability means that we keep the opportunity for future generations to ensure their own living conditions. All research and studies related to sustainable development emphasize the necessity of a change of attitude and the responsibility of universities in its implementation. The Academic class like engineers, and political–economic decision-makers are going to define the future of society, what society will be able to create the balance and the "fair play" between the environment, society, nature, and economy, and undertake responsibility. What can we do as architects to promote a change in attitude? During an academic semester, students at the University of Pécs had a project about current social-economic issues in architecture and urbanism. The task was to recycle the vacant building of the Market Hall of Pécs and the surrounding city block. The solutions show that sustainability is not only important when designing new buildings, but it is also our duty to recycle our existing built infrastructure.
Keywords: sustainability, reconditioning, revitalization, heritage, architecture

Green Architecture and Construction / *Zelena arhitektura i gradnja*
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Effect of 40-day seawater treatment of Spanish broom fibers on the mechanical properties of reinforced cement mortar

Sandra JURADIN[1], Ivanka NETINGER GRUBEŠA[2], Ema RIBAROVIĆ[3]

[1] University of Split, Faculty of Civil Engineering, Architecture and Geodesy, Matice hrvatske 15 Split, Croatia
[2] University North, Department for Civil Engineering, 104. Brigade 3, Varaždin, Croatia
[3] Sting d.o.o., Vukovarska 162, Split, Croatia

Abstract
Recently, there has been increasing interest in natural fibers as a reinforcement for cement composites. Natural fibers are low-cost, low-density, non-abrasive, biodegradable, and non-toxic. The limits for the application of natural fibers are their high water absorption, improper adhesion with a matrix material, high dispersion of mechanical properties, and decomposition of fibers in cement composites due to the influence of alkalis. Some of these problems can be overcome by treating the fibers. The most common chemical treatment method is alkaline, which dissolves lignin and hemicellulose in fibers. Treatment of fibers with seawater can be used as an alternative to chemical treatment, which is a more natural and environmentally friendly process. This paper considered Spanish broom fibers treated with seawater for 40 days. After the seawater treatment, half of the branches of the Spanish broom were immediately washed and fibers were separated under the tap water. The other half of the branches were left to dry for a few days and the fibers were washed with tap water after separation from the dry woody part. Fibers of the second group break under a low tensile force. 13 series of cement mortars were made: reference mortar and mortars reinforced with fibers of 1, 2, and 3 cm length in amounts of 0.5 and 1% of the total volume. Compressive strength and flexural strength were tested on 28-day-old specimens. Reinforced mixtures have lower mechanical properties than the reference mixture. Specimens reinforced with fibers that were immediately washed in water have a 3 - 8 % higher flexural strength, and the compressive strength of the reinforced specimens is almost the same. The mixture with the first group of fibers 1 cm long and added to the mixture in the ratio of 0.5% achieved the highest strength of all reinforced specimens.
Keywords: Spanish broom fibers, cement mortars, mechanical properties, seawater maceration

Green Architecture and Construction / *Zelena arhitektura i gradnja*
Poster presentation / *Postersko priopćenje*

Ecosystem services generated by implementing carbon footprint reduction measures for infrastructure projects

Petru NICOLAE, Raluca-Ioana NICOLAE, Andreea-Raluca SLAVE, Ștefan Cătălin POPESCU

Geostud, Strada Sângerului 11, București, Romania

Abstract
Transport infrastructure projects are essential for economic growth, but they can have negative impacts on the environment, particularly in terms of carbon emissions. However, implementing carbon footprint reduction measures can generate ecosystem services that can provide various benefits to society. Large-scale transportation infrastructure has a very ample carbon footprint and resource consumption. The primary aim of our research is to assess the ecosystem services generated by an afforestation project implemented as a measure to reduce the carbon footprint. The paper presents a case study in Romania, regarding the afforestation of a surface as a measure to reach net zero emissions for an infrastructure project. Meanwhile, an evaluation of the connex ecosystem services is being undertaken, to identify all the benefits resulting from the study. The paper includes the analysis of the economic advantages, the well-being of local communities and also, the circularity principles.
Keywords: ecosystem services, sustainability, carbon footprint, infrastructure

Green Architecture and Construction / *Zelena arhitektura i gradnja*
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Spatial Programming Study for Objects - temporary residence of pedestrians and/or cyclists, using the routes through the Republic of Serbia, as part of trans-European paths

Borislav PETROVIC[1], Srecko SIMOVIC[2]

[1] University of Belgrade, Faculty of Architecture, Bulevar kralja Aleksandra 73/II, Belgrade, Serbia
[2] School Center, Kidričeva cesta 55, Kranj, Slovenia

Abstract
The spatial program study aims to consider the resource, spatial possibilities and limitations of the construction of these *points*, with the task of adopting the general conception, the selection criteria of location and the spatial disposition of the object through the evaluation procedures. At the same time, the basic functional, technological and technical characteristics of the building, the method of construction, the conditions of exploitation, the relation to space and the environment, as well as the bases for economic analysis should be determined. The basic configuration is generated by the ready-made structure of shipping containers, as a chassis capable of accommodating all the necessary elements for this type of content. In the further work, the directions of research were at the following levels: - reviewing the survey of cycle-tourists and considering their criteria and priorities, - reviewing the term self-sufficient, that is, its concretization in the context defined here, -technical-technological solutions that enable the above-stated points of view.
Keywords: self-sufficiency, recycling, low-cost, environment-friendly sport infrastructure

Green Architecture and Construction / *Zelena arhitektura i gradnja*
Oral presentation / *Usmeno priopćenje*

Fiber-reinforced concrete as an aspect of green construction technology

Radmila SINDJIC GREBOVIC[1], Marko GREBOVIC[2]

[1] University of Montenegro, Faculty of Civil Engineering, Bul. Danila Petrovića, Podgorica, Montenegro
[2] University of Donja Gorica, Faculty for Information Systems and Technologies, Oktoih 1, Podgorica, Montenegro

Abstract
This paper investigates the effects of the different types and percentages of fiber reinforcements in concrete on structures' design life. The primary parameter of the analysis is the bending tensile strength of concrete in correlation with compressive strength in dependence on the type and quantity of fibers. Using fiber reinforcement allows obtaining a pattern of evenly distributed micro-cracks instead of the usual system of localized individual relative wide cracks and increases the durability of structures. The durability of concrete is evaluated from the probability of the appearance of cracks through a comparative analysis of the results of experimental tests for mixtures with different types and amounts of fibers. The subject of the analysis is also a mixture of concrete made by increasing the coarse aggregate from recycled materials content and lowering consumption of cementitious materials as a green concrete option with improved resistance to aggressive environmental influences. The main goal is to assess fiber-reinforced concrete (FRC) as cost-effective and green by increasing the recycled aggregate content and lowering the consumption of cementitious materials. A comparative analysis of results gained by statistical and machine learning methods is performed for the influential parameters' assessment of the FRC structures' design life. Should your text contain formulas, equations, or other non-standard characters, and/or if you are displaying images, they are to be well integrated into the document, sharp, and clearly visible.
Keywords: fiber-reinforced concrete, design life, durability, green technology

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Energy retrofit analysis in the iconic building

Arta SYLEJMANI[1], Bojan MILOVANOVIĆ[2], Ivana BANJAD PECUR[2], Violeta NUSHI[3]

[1] Ministry of Environment, Spatial Planning and Infrastructure, former Rilindja building, Pristina, Kosovo
[2] University of Zagreb, Kačićeva 26, Zagreb, Croatia
[3] University of Pristina "Hasan Prishtina", St. Architect Karl Gega 1, Prishtina, Kosovo

Abstract
The renovation process is considered a key factor in improving existing buildings to make them more energy efficient, increase thermal comfort and preserve cultural heritage through the latest standards and technologies. The building taken as a model is a socialist modernist office building (former Rilindja printing house), an iconic building built in 1979 in Pristina, Kosovo. In 2010, the building envelope was completely changed in the name of revitalization. The comparison of this building before and after renovation in terms of energy performance is considered necessary due to the lack of treatment of such studies in the local literature and legislation. A package of energy efficiency measures is also presented. The analysis is performed considering the cost-optimal calculation for the selection of energy efficiency measures that lead to the best energy efficiency and financial optimization of this building. The design and dynamic simulation are developed using Archicad software and the add-on EcoDesigner STAR. Therefore, this study provides several options and proposed measures to illustrate their potential for the application of energy efficiency, based on the general literature and local legislation. Finally, the main advantages and potential of the cost-optimal analysis are discussed and highlighted as an approach for similar cases.
Keywords: energy efficiency measures, socialist modernist building, cost-optimal analysis, dynamic simulations

Green Architecture and Construction / *Zelena arhitektura i gradnja*
Oral presentation / *Usmeno priopćenje*

Optimization of thermal bridges of composite lightweight panels with integrated steel load-bearing structure

Domagoj TKALČIĆ, Bojan MILOVANOVIĆ, Ivana BANJAD PEČUR, Marija JELČIĆ RUKAVINA

University of Zagreb, Faculty of Civil Engineering, Fra Andrije Kačića Miošića 26, Zagreb, Croatia

Abstract
In order to maintain the quality of construction in nearly zero energy buildings, and to reduce pressure on construction workers in addition to the need for faster and simpler construction, the use of cavity-insulated LSF panels is increasingly common. High requirements for performance quality, quality of life and low energy consumption have generated the need for a a closer look at heat transfer through building elements. With their impact on increased heath losses, thermal bridges can cause structural damage due to the increased possibility of water vapor condensation. Solving thermal bridges is crucial in the case of a building with a lower heat transfer coefficient due to their greater relative influence. In this paper, an analysis of heat transfer and optimization of thermal bridges was made in order to reduce heat losses. Various variants of ceiling–wall, wall–window, wall – -floor joints were created, and for each detail, the temperature distribution for each section and the heat flow through the elements were calculated. The results show a significant influence of different designs of a joint detail on the 2D heat flow. This paper presents an optimized solution for the joints of cavity-insulated LSF panels in terms of thermal conductivity.
Keywords: lightweight steel frame, thermal bridges, nearly zero energy buildings, modular construction, thermal conductivity

Green Architecture and Construction / *Zelena arhitektura i gradnja*
Oral presentation / *Usmeno priopćenje*

Optimizacija toplinskih mostova kompozitnih laganih panela s integriranom nosivom konstrukcijom

Domagoj TKALČIĆ, Bojan MILOVANOVIĆ, Ivana BANJAD PEČUR, Marija JELČIĆ RUKAVINA

Sveučilište u Zagrebu, Građevinski fakultet, Fra Andrije Kačića-Miošića 26, Zagreb, Hrvatska

Sažetak
Kako bi se zadržala kvaliteta izgradnje u zgradama gotovo nulte energije, a istovremeno smanjio pritisak na građevinske radnike zbog potrebe za bržom i jednostavnijom gradnjom, sve se češće koriste LSF paneli. Visoki zahtjevi za kvalitetom izvedbe, kvalitetom života i niskom potrošnjom energije stvorile su potrebu za proučavanje prolaska topline kroz građevne elemente. Osim što mogu dovesti do povećanih gubitaka topline, toplinski mostovi mogu uzrokovati nastanak građevinske štete, zbog povećane mogućnosti kondenzacije vodene pare. Rješavanje toplinskih mostova važno je u slučaju zgrada s većom debljinom izolacije odnosno nižim koeficijentom prolaska topline zbog njihovog većeg relativnog utjecaja. Zbog navedenog, u ovom radu rađena je analiza prolaska topline i optimizacija toplinskih mostova kako bi se smanjili toplinski gubici. Napravljene su različite varijante detalja spojeva strop – zid, zid – prozor i zid – pod, te za svaki detalj proračunata raspodjela temperature po presjeku i toplinski tok kroz elemente. Rezultati prikazuju značajan utjecaj različitih izvedbi detalja spojeva na 2D toplinski tok. Ovaj rad prikazuje optimizirano rješenje spojeva elemenata laganih kompozitnih elemenata s integriranom nosivom konstrukcijom u pogledu toplinske provodljivosti.
Ključne riječi: kompozitni lagani panel, toplinski mostovi, zgrade gotovo nulte energije, predgotovljeni elementi, toplinska vodljivost

Green Architecture and Construction / *Zelena arhitektura i gradnja*
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Preliminary small-scaled thermal resistance testing of a masonry wall with enhanced electromagnetic shielding effectiveness

Ivan VRDOLJAK, Hrvoje KRSTIĆ

Josip Juraj Strossmayer University of Osijek, Faculty of Civil Engineering and Architecture Osijek, Vladimir Prelog St. 3, Osijek, Croatia

Abstract
This study presents the preliminary results of the small-scale masonry wall thermal resistance (R-value) measurement. Two small-scale masonry walls (boxes) were constructed using regular bricks and bricks with Antimony tin oxide, which has shown potential for improving the protection against the penetration of electromagnetic (EM) radiation. R-values of the walls were measured using a FluxDAQ device equipped with a heat flux sensor and two temperature sensors for collecting heat flux, inside and outside temperature during the measurement. Parallel, the bricks' thermal conductivity (λ) was measured in the Heat Flow Meter. Both results can be used for determining the walls' thermal transmittance (U-value), which is often used for describing the energy losses and as a measure of the wall's energy efficiency. The results showed that the R-value of the masonry wall with the EM shielding material was lower than that of a standard brick wall, indicating improved thermal insulation properties. These findings suggest that the use of this EM shielding material in masonry walls has the potential to improve both thermal insulation and EM shielding in building construction.
Keywords: small-scale testing, R-values, thermal properties, EM shielding material

Green Chemistry and Chemical Engineering
Zelena kemija i kemijsko inženjerstvo

Application of nanofluids and nanocomposites for enhanced oil recovery

Amra BRATOVCIC

University of Tuzla, Faculty of Technology, Urfeta Vejzagica 8, Tuzla, Bosnia and Herzegovina

Abstract
The low recovery of oil (only one-third) is mainly related to the displacement efficiency of porous media, which is influenced by wettability and interfacial tension. Since a large amount of oil deposits, two-thirds of the original oil-in-place, is trapped by the capillary forces, there is a need to recover residual oil by improving oil recovery techniques. Although gas, thermal, microbial, and chemical injection is very popular and highly used techniques, they have some disadvantages. Therefore, tertiary oil recovery techniques such as the application of nanofluids and nanocomposites may solve this problem. The selection of appropriate techniques depends on the reservoir and economics. The mobility ratio and the mechanisms for nano-enhanced oil recovery have been also explained. Silica, zinc oxide, titanium dioxide, carbon-based nanoparticles, graphene quantum dots, graphene oxide nanosheets, as well as anionic surfactants are widely used in enhanced oil recovery research. From nanocomposites were discussed recently prepared potassium chloride/silicium dioxide/xanthan and zink oxide/silicium dioxide/xanthan nanocomposite and others. The reviewed literature experimental data has shown that it is possible to increase the enhanced oil recovery in the range of 10 to 79% depending on the applied nanofluid or nanocomposite.
Keywords: nanofluids, nanocomposites, enhanced oil recovery, wettability, interfacial tension

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Poster presentation / *Postersko priopćenje*

Degradation of polyolefin microplastics by UV-C/$S_2O_8^{2-}$ treatment

Kristina BULE MOŽAR, Viktorija MARTINJAK, Martina MILOLOŽA, Matija CVETNIĆ, Tomislav BOLANČA, Dajana KUČIĆ GRGIĆ, Marinko MARKIĆ, Šime UKIĆ

University of Zagreb, Faculty of Chemical Engineering and Technology, Marulićev trg 19, Zagreb, Croatia

Abstract

Polyolefins are a family of thermoplastics that includes polyethylene and polypropylene. Due to their numerous advantages, they represent the largest class of synthetic polymers produced and used today, and their presence in the environment in the form of microplastics (MP) has become a global concern. In this study, the applicability of UV-C/$S_2O_8^{2-}$ an advanced oxidation process for the degradation of MP polyolefins was tested. The influence of oxidant concentration, exposure time and pH on the degradation of MP polyolefins was investigated. FTIR spectroscopy was used to analyze the surface changes of MP, focusing on the bending of the symmetric CH_3 bond. The highest degradation rates were obtained for the boundary treatment conditions: maximum UV-C irradiation time (90 min) and minimum oxidant concentration (1 mM), and for the minimum irradiation time (30 min) and maximum oxidant concentration (20 mM). Therefore, further studies are required to determine the optimum conditions for the degradation of polyolefins by the UV-C/$S_2O_8^{2-}$ process.

Keywords: polyolefins, polypropylene, polyethylene, advanced oxidation process, UV-C/$S_2O_8^{2-}$

Acknowledgments: The authors would like to acknowledge the financial support of the Croatian Science Foundation through a project entitled Advanced Water Treatment Technologies for Microplastics Removal (AdWaTMiR, IP-2019-04-9661).

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Poster presentation / *Postersko priopćenje*

Green Synthesis of Pyridine- and Quinoline-Based Hydrazone

Valentina BUŠIĆ, Dora ZOBUNDŽIJA, Dajana GAŠO-SOKAČ

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia

Abstract
Ultrasound-based synthesis at room temperature produces valuable compounds greener and safer than most other methods. In this study, we developed a fast, single-step sonochemical strategy for the green manufacturing of a pyridine- and quinoline-based hydrazone. Hydrazone derivatives of vitamin B6, pyridine-4-carbaldehyde and 2-quinolinecarbaldehyde were synthesized. Phenyl-hydrazine and substituted phenyl-hydrazines were used for the synthesis: 2,4-dinitrophenyl-hydrazine, 4-chlorophenyl-hydrazine, 4-fluorophenyl-hydrazine, 4-methylphenyl-hydrazine. The reactions were performed in ethanol. The sonification process was carried out for 5 minutes at room temperature. It also examined the effectiveness of ultrasonic synthesis compared to conventional synthesis. The structures of the synthesized compounds were confirmed by ^{1}H and ^{13}C NMR spectroscopy and mass spectrometry. Studies show that ultrasound-based synthesis accelerates chemical synthesis with a better yield and higher purity in comparison to conventional methods.
Keywords: green synthesis, pyridine-based hydrazone, ultrasound-based synthesis

Green synthesis of Silver Nanoparticles Using the Aqueous Extract of *Ophiostoma novo-ulmi*

Vlatka GVOZDIĆ[1], Elvira KOVAČ ANDRIĆ[1], Ana PETROVIĆ[2], Zorana KATANIĆ[3], Ljiljana KRSTIN[3], Iva RADOJKOVIĆ[1]

[1] Josip Juraj Strossmayer University of Osijek, Department of Chemistry, Cara Hadrijana 8/A, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Dental Medicine and Health, Crkvena 21, Osijek, Croatia
[3] Josip Juraj Strossmayer University of Osijek, Department of Biology, Cara Hadrijana 8/A, Osijek, Croatia

Abstract
Green synthesis is a method that uses non-toxic, biodegradable chemicals for the synthesis of nanoparticles. In the present study, for the first time, we report an eco-friendly approach for the synthesis of silver nanoparticles (AgNPs) using an aqueous extract of the fungus *Ophiostoma novo-ulmi* as a reducing and capping agent. *Ophiostoma novo-ulmi* is a phytopathogenic ascomycete that causes Dutch elm disease (DED), a devastating vascular wilt disease of elms. The biosynthesized nanoparticles were characterized by UV-Vis, FTIR and PXRD. The results of the characterization of the synthesized nanoparticles indicate the successful synthesis using *O. novo-ulmi* extract as a reducing agent, with a UV-Vis absorption peak at 413 nm. FTIR identified major phytochemical compounds, which could be responsible for bio-reducing potential. The PXRD peaks show a face-centered cubic (*fcc*) structure. From PXRD data, the crystallite diameter of AgNPs was obtained using the Scherrer equation to be 30 nm. The investigation displayed the good catalytic activity of AgNPs on the degradation of methylene blue dye.
Keywords: green synthesis, nanoparticles, fungus

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Poster presentation / *Postersko priopćenje*

Exploring the Potential of Deep Eutectic Solvents for Eco-Friendly Extraction of Bioactive Onion Peel Compounds

Maša ISLAMČEVIĆ RAZBORŠEK[1], Saša STANKOVIĆ[2]

[1] University of Maribor, Faculty of Chemistry and Chemical Engineering, Smetanova ulica 17, Maribor, Slovenia
[2] Krka d. d., Šmarješka cesta 6, Novo mesto, Slovenia

Abstract
Onion peels (*Allium cepa* L.), a by-product of onion processing, represent a valuable source of flavonoids with various health benefits. However, conventional extraction methods using organic solvents are expensive and have negative impacts on the environment and human health. This study aimed to develop an environmentally friendly and sustainable extraction method for bioactive compounds from onion peels, using deep eutectic solvents (DES) as an alternative to conventional organic solvents. The bioactive compounds were identified and quantitatively evaluated by HPLC-UV and LC-MS. The most successful extraction of phenolic compounds was achieved with DES, using acetic acid, lactic acid, and 1,4-butanediol as hydrogen bond donors. The antioxidant activity of the DES and methanolic extracts of the peel was also analyzed using four different assays: ABTS, TPC, FRAP, and DPPH. The results showed that onion peels contain numerous bioactive components, including protocatechuic acid, quercetin, quercetin-3,4'-diglucoside, and quercetin-3-β-D-glucoside, and can be used as a source of natural phenolic compounds with high antioxidant potential. This study provides an important step toward the development of a sustainable approach for the extraction of bioactive compounds from onion peels.
Keywords: *Allium cepa* L., DES solvents, antioxidant activity, phenolic compounds, HPLC-UV, LC-MS

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Poster presentation / *Postersko priopćenje*

Development of a microreactor for laccase-catalyzed oxidations of phenolic compounds

Mojca SERUČNIK[1], Samo SOTLAR[1], Katarina ŠIMUNOVIĆ[2], Ines MANDIĆ-MULEC[2], Polona ŽNIDARŠIČ-PLAZL[1]

[1] University of Ljubljana, Faculty of Chemistry and Chemical Technology, Večna pot 113, Ljubljana, Slovenia
[2] University of Ljubljana, Biotechnical Faculty, Večna pot 111, Ljubljana, Slovenia

Abstract
Laccases are multi-copper glycoproteins ubiquitous in nature, which use molecular oxygen to oxidize a wide variety of organic and inorganic compounds, including diphenols, polyphenols, diamines, and aromatic amines. Protein CotA that is present in the outer coat of *Bacillus subtilis* spores exhibits laccase activity. The application of endospores instead of purified enzyme eliminates the costs and time needed to purify the enzyme. Besides, *B. subtilis* spores show high resistance to harsh environmental conditions and long-term endurance. In this work, the development of a microbioreactor with immobilized endospores *of B. subtilis* by means of magnetic microparticles in magnetic-field assisted microreactors is presented. The influence of the microparticles-to-spores ratio and the buffer pH on immobilization efficiency was evaluated and a microreactor system between two plates with permanent magnets was developed. During continuous laccase-catalyzed oxidation of a model compound in a microreactor, less than 2% of the spores leached from the device in the period of 5 h. The developed microbioreactor can be efficiently used for the treatment of wastewater contaminated with phenolic compounds and dyes.
Keywords: laccase, endospores, *Bacillus subtilis*

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Poster presentation / *Postersko priopćenje*

Green extraction of ginkgetin from ginkgo leaves with natural deep eutectic solvents

Anita ŠALIĆ[1], Matea BAJO[2], Mia RADOVIĆ[3], Marina CVJETKO BUBALO[2], Ana JURINJAK TUŠEK[2], Bruno ZELIĆ[1,3], Dunja ŠAMEC[3]

[1] University of Zagreb, Faculty of Chemical Engineering and Technology, Marulićev trg 19, Zagreb, Croatia
[2] University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia
[3] University North, Trg dr. Žarka Dolinara 1, Koprivnica, Croatia

Abstract
Ginkgetin is a dimeric flavonoid that has the potential to treat various inflammation-related diseases such as cancer, cardiovascular disease, inflammation caused by viruses and bacteria, and neurodegenerative disorders. In this study, natural deep eutectic solvents (NADES) were used for efficient and environmentally friendly extraction of ginkgetin, from ginkgo (*Ginkgo biloba* L.) leaves. Initially, COSMOtherm software was used to select the best of 288 analyzed NADES for biflavonoid extraction from gingko. Based on the predictions obtained from COSMOtherm, 15 NADES were used in a batch extraction experiments. The selected NADES were synthesized and the extraction was carried out in a series of batch experiments. The obtained results were compared with the extraction performed under the same conditions using 70% methanol as solvent. A total of four NADES, betaine:ethylene glycol (B:EG) (1:2) containing 20% (w/w) and 30% (w/w) water, choline chloride:ethylene glycol (ChCl:EG) 1:2 containing 20% (w/w) water and choline chloride:urea:ethylene glycol (ChCl:U:EG) 1:2 containing 10% (w/w) water, showed higher extraction efficiency of flavonoids compared to the extraction performed with 70% methanol. When betaine:ethylene glycol (B:EG) (1:2) containing 30% (w/w) water was used, 24% higher extraction efficiency was obtained compared to extraction with 70% methanol. To achieve maximum extraction efficiency for extraction performed with betaine:ethylene glycol (B:EG) (1:2) containing 30% (w/w), the process conditions (extraction time, mass ratio shredded leaves/NADES, and temperature) were optimized using the experimental Box-Behnken design. The highest extraction efficiency was achieved at the following process conditions: 45 min extraction time, 0.02:1 g/g mass ratio, and temperature of 25°C In addition to ginkgetin, other monomeric and dimeric flavonoids were detected in the extracts using HPLC-DAD method. In conclusion, NADES could become promising and efficient solvents for the safe, low toxic and efficient extraction of bioactive components from ginkgo.
Keywords: ginkgetin, ginkgo, NADES, COSMOtherm, extraction

Green Chemistry and Chemical Engineering / *Zelena kemija i kemijsko inženjerstvo*
Oral presentation / *Usmeno priopćenje*

One-step enzyme isolation and immobilization in a microreactor for sustainable transamination

Borut ŠKETA, Polona ŽNIDARŠIČ-PLAZL

University of Ljubljana, Faculty of Chemistry and Chemical Technology, Večna pot 113, Ljubljana, Slovenia

Abstract

Biocatalysis is considered more sustainable than conventional catalysis because it follows several principles of green chemistry. The enzymes used are generally nontoxic, biodegradable, and work optimally in aqueous solution under mild conditions, i.e., low temperature, atmospheric pressure, and near-neutral pH. Enzyme immobilization can improve enzyme stability and long-term usability, while waste generation can be reduced by using highly efficient microreactors leading to process intensification. In this work, direct immobilization of amine transaminase with a hexahistidine tag from the cell lysate was performed in a membrane microreactor. Based on preliminary studies, Tiss®-IMAC-Cu membrane was selected. The enzymes were expressed as a soluble protein in *Escherichia coli* BL21(DE3) and the lysate was continuously pumped through the reactor to immobilize the enzyme. *In operando* testing of the microreactor with an immobilized enzyme was performed. A high load of over 1000 U mL^{-1} was achieved, resulting in space-time yields of over 20 U mL^{-1}. The enzyme retained over 90% of its initial activity after 4 days of operation without the addition of a cofactor. Direct immobilization from lysate allowed us to skip the purification steps, avoiding the use of imidazole and reducing the generated waste.

Keywords: immobilization, biotransformation, microreactor

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Poster presentation / *Postersko priopćenje*

Development of functional and protective textiles using waste plant material

Sebastijan ŠMID, Marija GORJANC

University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerčeva 12, Ljubljana, Slovenia

Abstract
Global research is increasingly focused on the preservation of non-renewable natural resources and the development of ecologically acceptable new materials. As a result, the use of waste plant material is coming to the forefront of research to develop functional and protective textiles. Invasive alien plants cause economic and ecological damage in our ecosystem. However, they are a cheap, biodegradable material from renewable sources with an untapped source of biomolecules for textile applications. Our research focused on creating toxic-free and sustainable colorful textiles with antioxidant properties and protection against ultraviolet (UV) radiation by coating fabrics with an aqueous extract of Japanese knotweed (JK) rhizome. The extracts were prepared with and without ultrasonication and cold-impregnated one and five times, respectively, onto untreated, alkali-treated, and chitosan-treated fabrics. The functionalized fabrics were analyzed for color and color yield using Datacolor reflectance spectrophotometer. The antioxidant activity of the fabrics was analyzed using the 1,1-diphenyl-2-picrylhyrazyl (DPPH) free radical scavenging method, and the protection against UV radiation was analyzed by measuring the transmittance of the fabrics for UVA and UVB radiation using the Varian Cary UV/VIS spectrometer equipped with the DRACA301 integrating sphere and operated with Solarscreen software. The UV protection factor of the measured samples was calculated according to the standard AATCC TM 183. The results show that sonication slightly improves the extraction process and consequently allows higher color yield, antioxidant properties and better protection against UV radiation of the treated fabric. The untreated sample and the samples impregnated only once with the extract had the lightest color and showed quite low functional and protective properties. The best results were obtained when the fabric was treated with both alkali and chitosan before being impregnated five times with JK extract.
Keywords: waste plants, Japanese knotweed, green textile functionalization, UV protection, antioxidant activity

Green Chemistry and Chemical Engineering / *Zelena kemija i kemijsko inženjerstvo*
Poster presentation / *Postersko priopćenje*

Potentiostatic electrodeposition of zinc in the presence of surfactants

Noura TOUABI[1,2], Sanja MARTINEZ[1], Moussa BOUNOUGHAZ[2], Malek AMMAR[3]

[1] University of Zagreb, Faculty of Chemical Engineering and Technology, Department of Electrochemistry, Marulićev trg 19, Zagreb, Croatia
[2] University M'Hammed Bougara Boumerdes/Team electro polymerization and corrosion, Laboratory of Forming and Treatment of fibrous polymers, Algeria
[3] University M'Hammed Bougara Boumerdes/Research unit of materials, processes and environment (UR-MPE), Algeria

Abstract
Wastewater pollution by heavy metals including Zinc remains today one of the biggest environmental problems to solve in industrialized countries. Along with the increased production, Zinc quantities in the environment have increased which still poses a threat to society due to their high toxicity and cumulative properties. Various conventional methods are used to remove heavy metals from wastewater. Electrodeposition is usually applied for the recovery of Zinc. The recovery process is considered of great importance for reducing environmental emissions and for substantial savings. In the present work, Potentiostatic Zinc electrodeposition at a graphite electrode from synthetic 0.05M Zinc (II) sulfate solution was studied at pH3. In order to optimize electrodeposition and facilitate recovery, we have added surfactant at different concentration to the zinc (II) sulfate electrolyte. Cyclic voltammetry; electrochemical impedance spectroscopy and chronoamperometry were used to characterize the kinetics of nucleation and electroplating of Zinc deposits. Zinc was deposited potentiostatically at -1300 mV on a graphite electrode. Characterization of the deposits formed was done by scanning electron microscopy (SEM), and X-ray diffraction (XRD). The effect of the concentration of surfactant on current-potential curves shows that increasing the concentration of surfactant to a certain limit enhances the deposition by increasing the deposition rate. Zinc deposits formed in the absence of surfactant reveal a very compact growth and adhere well to the electrode surface. In the presence of surfactants the morphology of zinc deposits changes and deposits less attached to the electrode was presented which facilitates the zinc deposits recovery.
Keywords: potentiostatic zinc electrodeposition, surfactant, zinc recovery

Green Chemistry and Chemical Engineering / *Zelena kemija i kemijsko inženjerstvo*
Poster presentation / *Postersko priopćenje*

Biodegradation of PS and PVC microplastics using *Geotrichum candidum* and *Candida parapsilosis*

Šime UKIĆ, Kristina BULE MOŽAR, Marija KUŠTRO, Dubravka TAVRA, Viktorija MARTINJAK, Martina MILOLOŽA, Matija CVETNIĆ, Tomislav BOLANČA, Dajana KUČIĆ GRGIĆ, Marinko MARKIĆ

University of Zagreb, Faculty of Chemical Engineering and Technology, Marulićev trg 19, Zagreb, Croatia

Abstract
Polystyrene (PS) and polyvinyl chloride (PVC) are among the most well-known commercial plastics used in various industries. PS and PVC have recently become the concern of scientists around the world due to their increasing concentration in the environment, especially in the form of microplastics (MPs), which have a high hazardous potential. In this study, the potential of yeasts *Geotrichum candidum* and *Candida parapsilosis* for biodegradation of MPs from PS and PVC was tested. MPs with a particle size of 25-100 µm were exposed to the yeasts for 30 days. During the experiment, the number of live yeast cells (expressed as Colony Forming Units, CFU) in the system and the concentrations of total, organic and inorganic carbon were monitored. PS and PVC microparticles were analyzed before and after the experiment using FTIR-ATR spectroscopy. During the experiments, the formation of aggregates of *Geotrichum candidum* was observed, which affected the determination of CFU. On the other hand, *Candida parapsilosis* showed great potential for biodegradation of PS and PVC microparticles.
Keywords: polystyrene, polyvinyl chloride, biodegradation, *Geotrichum candidum, Candida parapsilosis*

Acknowledgments: The authors would like to acknowledge the financial support of the Croatian Science Foundation through the project entitled Advanced Water Treatment Technologies for Microplastics Removal (AdWaTMiR, IP-2019-04-9661).

Green Biotechnology
Zelena biotehnologija

Green Biotechnology / *Zelena biotehnologija*
Poster presentation / *Postersko priopćenje*

Enzymatic production of prebiotic oligosaccharides from seeds

Gabriela IBIETA[1,2], Jimena ORTIZ SEMPÉRTEGUI [1,2], Mauricio PEÑARRIETA[2], Javier LINARES-PASTÉN[1]

[1] Lund University, Faculty of Engineering, LundsTekniska Högskola (LTH), Biotechnology, P.O. Box 124, Lund, Sweden
[2] Universidad Mayor de San Andrés, Instituto de Investigaciones Químicas, Department of Chemistry, Calle 27 y Andrés Bello s/n Cota Cota, La Paz, Bolivia

Abstract
Prebiotics are considered important food additives; they stimulate the growth of healthy bacteria in the human gut. In recent years new green technologies have been developed in order to obtain prebiotic oligosaccharides, naturally found in many plants. The production of prebiotics from agro-industrial residues is a current trend for the valorization of by-products. Although seeds are edible parts, they contain a fraction of polysaccharides, such as cellulose and hemicelluloses, of limited functional or nutritional value. In this work, we are developing enzymatic processes to obtain promising prebiotic oligosaccharides from two Andean seeds: canhiñua (*Chenopodium pallidicaule*) and tarwi (*Lupinus mutabilis*). The seeds were first grounded and defatted, then, they were subjected to sequential enzymatic treatment with cellulases (both, endo and exo), amylase, and finally with a mixture of endo-xylanase and endo-glucoronoxylanase. The obtained products were analyzed using HPAEC-PAD. Xylo-oligosaccharides of different degrees of polymerization were detected and quantified. The prebiotic effect of these products will be tested in vitro assays by growing human probiotic bacteria, such as *Lacticaseibacillus rhamnosus*, *Lacticaseibacillus casei*, and *Propionibacterium freudenreichii*.
Keywords: prebiotics, oligosaccharides, enzymes

Green Biotechnology / *Zelena biotehnologija*
Poster presentation / *Postersko priopćenje*

Antioxidant Properties of Extracts from Invasive Species *Reynoutria japonica*

Jasmina IBRAHIMPAŠIĆ, Aida DŽAFEROVIĆ, Samira DEDIĆ, Halid MAKIĆ

University of Bihać, Biotechnical Faculty, Luke Marjanovića bb, Bihać, Bosnia and Herzegovina

Abstract
The aim of this research was to determine the content of polyphenols in the invasive plant *Reynoutria japonica*, in parts of the plant (stems, leaves and roots). Japanese knotweed (*Reynourtria japonica*, syn. *Fallopia japonica Houtt*.) is an invasive foreign plant species that is from East Asia, and was brought to Europe in the 19th century as an ornamental plant. Today, it is on the IUCN list of one hundred worst invasive species. The root of the plant has been used as a medicine in Chinese medicine since ancient times, and current research shows that the plant is rich in bioactive properties (antioxidant, antimicrobial, anti-inflammatory). Methanolic and ethanolic extracts of plant parts (stems, leaves and roots) were prepared by maceration at room temperature. Forty-eight polyphenolic compounds were identified, divided into three types; (9 flavanols, 24 flavonols and 15 phenolic acids), by liquid chromatography, LC-MSMS, qualitatively and quantitatively using ultra-performance liquid chromatography (UPLC). The content of polyphenols in stems, leaves and roots was determined on average from 626.46 in leaves 96.61 stems and roots 204.40 mg/100 g of dry matter. Due to the above-average content of polyphenolic compounds, the leaf can be used as a potential food additive for food enrichment, while the root has been shown to have a high content of polymeric procyanidins, catechins and epicatechins, and its use in the pharmaceutical and cosmetic industry is recommended.
Keywords: Invasive plant, *Reynourtria japonica*, Phenolic Compounds

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Enhancing lipid and starch production in *Parachlorella kessleri* under salt stress and nitrogen limitation

Sanja KEREZOVIĆ, Jasenka ANTUNOVIĆ DUNIĆ, Vesna PERŠIĆ

Josip Juraj Strossmayer University of Osijek, Department of Biology. Cara Hadrijana 8A, Osijek, Croatia

Abstract
Freshwater green algae have gained increasing attention as a promising source of lipid and starch production, and the addition of plant growth regulators under nutrient and salinity stress conditions could further enhance their productivity. This study examined the effect of 6-benzylaminopurine (6-BA), a synthetic cytokinin that promotes cell division and growth, on lipid and carbohydrate content induction in *Parachlorella kessleri* under nitrogen limitation (1% $NaNO_3$) and increased salinity (50 and 100 mM NaCl). A two-step cultivation strategy was used to overcome the trade-off between biomass, lipid, and carbohydrate production. The algae were cultured in a nutrient-rich medium with or without 6-BA until they reached the stationary growth stage. At this point, stress was induced for three days. According to the findings, applying salinity stress and nitrogen-limited conditions increased algae's lipid and carbohydrate content by 20–40% while at the same time inhibiting growth. Cytokinin addition in the first stage of cultivation maintained the biomass concentration during the second stage, thus enhancing lipid and carbohydrate yields. In conclusion, the study shows that adding 6-benzylaminopurine as a plant growth regulator could enhance lipid and carbohydrate production in *Parachlorella kessleri* under nitrogen-limited and increased salinity conditions, offering a promising strategy for optimizing algal productivity for various applications, including biofuels and bioremediation.
Keywords: phytohormones, nutrient depletion, salinity, algal biomass, lipid and carbohydrate accumulation

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Production of functional fatty acids from vegetable oils by a thermostable lipase (Tth-Lyp)

Jimena ORTIZ SEMPÉRTEGUI[1,2], Gabriela IBIETA[1,2], Cecilia TULLBERG[1], Mauricio PEÑARRIETA[2], Javier LINARES-PASTÉN[1]

[1] Lund University, Faculty of Engineering, Lunds Tekniska Högskola (LTH), Biotechnology, P.O. Box 124, Lund, Sweden
[2] Universidad Mayor de San Andrés, Instituto de Investigaciones Químicas, Department of Chemistry, Calle 27 y Andrés Bello s/n Cota Cota, La Paz, Bolivia

Abstract
Vegetable oils are mainly extracted from seeds and have gained a lot of research interest in recent years due to their fatty acid composition and for their antioxidant capacity and total content of phenolic compounds. The enzyme technology to produce vegetable oils and their derivatives is an environmentally friendly approach, with several advantages both for food processing and for the obtention of a variety of products of high functional and nutritional value. In this work, oils extracted from canhiñua (*Chenopodium pallidicaule*) and tarwi (*Lupinus mutabilis*) seeds, belonging to the Andean region of Bolivia, have been studied and are being enzymatically transformed (interesterification and hydrolysis) to obtain a new fatty aciď profile with possible functional properties. The oils extracted with green solvents like ethanol, have shown good yields, an interesting profile of fatty acids and a higher concentration of antioxidant and phenolic compounds compared to the commercial oils available in supermarkets. Currently, we are developing an enzymatic process for transforming cahñiua and tarwi oils into functional fatty acids. A recombinant thermostable lipase was produced (Tth-Lyp) using *E. coli* as the host cell, showing a melting point of 86°C, and immobilized by adsorption on hydrophobic support using porous polypropylene support (Accurel 1000) for reactions in hydrophobic environments.
Keywords: lipids, fatty acid, enzymatic interesterification, enzymatic immobilization

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Time Scale Analysis in Model-based Design of Microscale-Based Bioreactors

Igor PLAZL[1], Goran N. JOVANOVIC[2,3]

[1] University of Ljubljana, Faculty of Chemistry and Chemical Technology, Vecna pot 113, Ljubljana; Slovenia
[2] Oregon State University, School of Chemical, Biological and Environmental Engineering, Corvallis, Oregon, United States of America
[3] PTT-Laboratory of America, Corvallis, Oregon, United States of America

Abstract
The intensification and optimization of biochemical processes with better selectivity, highly efficient transport phenomena, product quality and the development of new and environmentally friendly technologies are possible with microreactor technology, in which model-based design plays an essential role.
Time Scale Analysis (TSA) and Characteristics Times are proposed as novel and useful tools for analyzing the performance of microscale bioreactors with immobilized enzymes and for flow diagrams of chemical processes. Transport rates, reaction kinetics, and phase contact can be easily represented by unique time constants that facilitate the understanding and representation of these processes through the "heat map" of characteristic times. Characteristic times are estimated based on first principles and controlled by the user to support meaningful analysis of chemical processes and provide insight or suggestions for successful design decisions. Characteristic times can be readily embedded in the time scale analysis (TSA) approach that enables the evaluation of preliminary microreactor and operating unit designs. In this work, we demonstrate the feasibility and usefulness of this novel tool by comparing a microbial biochemical reaction process conducted in a classical bioreactor with its performance in a microscale-based bioreactor design.
Keywords: process intensification, model-based design, microbioreactor

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Microalgae as a model system for the *in vivo* effects of materials

Anna ROMOLO[1,2], Aleš IGLIČ[2], Veronika KRALJ-IGLIČ[2]

[1] University of Ljubljana, Faculty of Health Sciences, Laboratory of Clinical Biophysics, Zdravstvena 5, Ljubljana, Slovenia
[2] University of Ljubljana, Faculty of Electrical Engineering, Laboratory of Physics, Trzaska 25, Ljubljana, Slovenia

Abstract
Microalgae are in focus of extensive study due to their abundance and important role in the equilibration of the global ecosystem. Living organisms communicate through nano-sized membrane-enclosed particles (Small Cellular Particles (SCPs)) which are continuously shed by cells but can also be fabricated artificially. Here we examined the effect of different hybridosomes composed of soybean lecithin and material from natural sources (e.g. spruce needles and hemp) on the conditioned media of marine microalgae *Phaeodactylum tricornutum*. Hybridosomes were prepared by mixing lecithin, respective aqueous solutions and glycerol. Microalgae were imaged by scanning electron microscope. Hybridosomes and isolates were imaged by a cryogenic transmission electron microscope. The number density of microalgae was assessed by flow cytometry. The number density and hydrodynamic diameter of hybridosomes and SCPs were assessed by interferometric light microscopy. In the treated samples we observed a considerable increase in the number density of microalgae with respect to control (untreated) samples in the interval of 3 days, which was connected to the amount of the material added. The concentration of SCPs was of the order of 10^6/mL and the average size of SCPs varied from 200-400 nm. Microalgae proved a convenient system for in vitro studies of the effects of materials.
Keywords: marine microalgae, *Phaeodactylum tricornutum*, nanoalgosomes

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Development of bioactive compounds from residual biomass from the processing of Asaí fruits (*E. precatoria*)

Sergio TORREZ ALVAREZ[1,2], Giovanna ALMANZA[2], Yonny FLORES[2], Javier A. LINARES-PASTÉN [1]

[1] Lund University, Faculty of Engineering, Lunds Tekniska Högskola (LTH), Biotechnology. P.O. Box 124, Lund, Sweden
[2] Universidad Mayor de SanAndrés, Instituto de Investigaciones Químicas, Department of Chemistry, Calle 27 y Andrés Bello s/n Cota Cota, La Paz, Bolivia

Abstract
The Asaí is a palm tree native to South America of great interest in recent years due to the antioxidant capacity of its edible fruit, which is considered a functional food. Asaí is industrialized for producing nutraceuticals, shakes, energy drinks, pastry recipes, and other food products. This industry generates large amounts of waste, including seeds, pulp remains, and rachis. The aqueous extract of the Asaí fruit contains anthocyanins, proanthocyanidins, flavonoids, and other phenolic compounds. Residues as seeds present polysaccharides, for example, galactomannans, mannans, lignans, and cellulose. This study aims to develop high-value compounds from each fraction of the residual biomass through enzyme technology and bioprocesses. The main interest is in the seed´s polysaccharides, rachis, fibers, and discarded pulp. The biorefinery approach in this work consists of fractionating the main biomass components, followed by enzymatic treatment. One of the dominant fractions is galactomannan, whose molecular structure is in the process of elucidation. At the same time, an endo-β-1,4-mannanase from *Thermotoga petrophila* has been produced, using recombinant technology, to obtain galactooligosaccharides, which will be subjected to bioactivity screenings to assess antioxidant, antibacterial, antiviral, and prebiotic activity.
Keywords: Asaí (*E. precatoria*), biomass, biorefinery, enzyme and recombinant technology, galactomannan

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(Micro)Flow Biocatalysis as a Key Enabling Technology in Sustainable Synthesis

Polona ŽNIDARŠIČ-PLAZL

University of Ljubljana, Faculty of Chemistry and Chemical Technology, Večna pot 113, Ljubljana, Slovenia

Abstract
Biocatalytic processes offer a transition to more sustainable manufacturing of chemicals, pharmaceuticals, fuels, and food. However, their potential in industrial production is far from being realized, mainly due to the challenges related to long-term biocatalyst use, the efficient regeneration of cofactors, and the prevention of biocatalyst deactivation under harsh industrial conditions. Protein engineering and efficient biocatalyst immobilization offer great opportunities to improve biocatalyst stability. Furthermore, reactor miniaturization, continuous operation, and integration with *in situ* product removal, process analytics, and cascade reactions that reduce the number of process steps enable process intensification. This presentation highlights recent achievements of the Microprocess Engineering Research Group established at the University of Ljubljana in biocatalytic process intensification based on efficient biocatalyst immobilization in micro bioreactors and multiphase biocatalytic processes comprising process integration with downstream processing.
Keywords: biocatalysis, process intensification, sustainable production

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Environmental Literacy and Sustainable Consumption – The Role of Higher Education

Kristina AFRIĆ RAKITOVAC[1], Aleksandra KRAJNOVIĆ[2], Alen BELULLO[1]

[1] Juraj Dobrila University of Pula, Faculty of economics and Tourism "Dr. Mijo Mirković", Preradovićeva 1, Pula, Croatia
[2] University of Zadar, Department for Economics, Splitska 1, Zadar, Croatia

Abstract
The first decades of the 21st century are largely marked by the urgent transition from a linear to a more responsible, circular economy and injustice that has been inflicted on the natural and social order in the world. Unsustainable production and consumption, and the need for more luxury and wealth have resulted in various social inequalities, ecosystem pollution, unsustainable exploitation of natural resources, which ultimately threaten human existence. The time has come for a different, more sustainable approach to the production of goods and services, as well as their consumption. The aim of the paper is to emphasize the importance of implementing the concept of sustainable consumption, for the purpose of altering unsustainable purchasing habits, and thereby guiding consumers towards sustainable consumption patterns, in order to achieve social cohesion, environmental protection and economic development. The authors consider the importance of environmental literacy as a necessary prerequisite for more responsible consumption patterns. The paper will propose systematic literature on the interdependence of environmental literacy and sustainable consumption. In order to obtain a better insight into the functioning and implementation of sustainable consumption when it comes to the decisions of individuals, the research will be conducted on a population of university students. We expect, according to various actual researches, that younger generations are environmentally conscious, although this is not necessarily reflected in their consumption habits.
Keywords: consumption patterns, environmental literacy, sustainable, consumption, higher education institutions, Croatia

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Analysis of investment efficiency in the production of bioplastics from industrial hemp

Zoran GALIĆ[1], Mirjana RADMAN FUNARIĆ[2], Katarina POTNIK GALIĆ[1]

[1] Technical School, Ratarnička 1, Požega, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Tourism and Rural Development Pozega, Vukovarska 17, Požega, Croatia

Abstract
Bioplastics are a type of plastic that is produced from renewable energy sources, as opposed to plastics traditionally produced from oil and natural gas. The biggest advantage of bioplastics is that the use of renewable sources reduces the dependence on fossil fuels and the harmful emission of greenhouse gases. Industrial hemp is suitable for the production of bioplastics due to its biodegradability, strength and availability. Namely, industrial hemp grows quickly and requires less water and pesticides than other crops. It decomposes in nature without harmful consequences, and as a raw material, it is available and affordable, which is why it represents a more sustainable alternative to traditional plastics. The production of bioplastics from industrial hemp is an important step towards a sustainable future, and its use should be carefully considered and planned in order to achieve the best possible effects on the environment. The aim of this work is to analyze the economic and financial profitability of investing in the production of bioplastics from industrial hemp. The basic research method will be a dynamic analysis of the investment efficiency in the described project. The aforementioned analysis is based on the assessment of the financial sustainability and profitability of the project in the long term, considering the results of net present value, internal rate of return, profitability index, investment return period and other methods for evaluating the efficiency of the project. Based on the results of the mentioned methods, the investment efficiency decision of producing bioplastics from industrial hemp will be made.
Keywords: renewable energy sources, industrial hemp, bioplastics, efficiency assessment of projects, project dynamic analysis

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Analiza učinkovitosti ulaganja u proizvodnju bioplastike od industrijske konoplje

Zoran GALIĆ[1], Mirjana RADMAN FUNARIĆ[2], Katarina POTNIK GALIĆ[1]

[1] Tehnička škola, Ratarnička 1, Požega, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet turizma i ruralnog razvoja u Požegi, Vukovarska 17, Požega, Hrvatska

Sažetak
Bioplastika je vrsta plastike koja se proizvodi od obnovljivih izvora energije za razliku od tradicionalno proizvedene plastike od nafte i prirodnog plina. Najveća je prednost bioplastike ta što se korištenjem obnovljivih izvora energije smanjuje ovisnost o fosilnim gorivima i štetna emisija stakleničkih plinova. Industrijska konoplja pogodna je za proizvodnju bioplastike zbog svoje održivosti, biorazgradivosti, čvrstoće i dostupnosti. Naime, industrijska konoplja raste brzo i zahtjeva manje vode i pesticida od drugih kultura. U prirodi se razgrađuje bez štetnih posljedica, a kao sirovina je dostupna i cjenovno prihvatljiva zbog čega predstavlja održiviju alternativu tradicionalnih plastici. Proizvodnja bioplastike od industrijske konoplje važan je korak prema održivoj budućnosti, a njena upotreba treba biti pažljivo razmotrena i planirana kako bi se postigli najbolji mogući učinci na okoliš. Cilj ovog rada je analizirati ekonomsko financijsku isplativost ulaganja u proizvodnju bioplastike od industrijske konoplje. Osnovna istraživačka metoda bit će dinamička analiza učinkovitosti ulaganja u opisani poslovni pothvat. Navedena analiza bazira se na procjeni financijske održivosti i isplativosti projekta u dugoročnom vremenskom razdoblju uzimajući u obzir rezultate čiste sadašnje vrijednosti, interne stope profitabilnosti, indeksa profitabilnosti, razdoblja povrata investicije te ostalih metoda za ocjenu efikasnosti projekta. Na temelju rezultata navedenih metoda donijet će se odluka o isplativosti ulaganja u projekt proizvodnje bioplastike od industrijske konoplje.
Ključne riječi: obnovljivi izvori energije, industrijska konoplja, bioplastika, ocjena učinkovitosti projekata, dinamička analiza projekta

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Creative enterprises and protection of intellectual property in the Republic of Croatia

Darija IVANKOVIĆ[1], Željka BORZAN[1], Ana ŠARIĆ[2]

[1] College of Applied Sciences „Lavoslav Ružička“ in Vukovar, Županijska Street 50, Vukovar, Croatia
[2] TERA Tehnopolis d.o.o., Ljudevit Gaj Square 6, Osijek, Croatia

Abstract
Creative enterprises, as holders of the creative industry activities, show a significant contribution to economic growth and employment. They create, produce and distribute creative goods and services and often include (exploit) various forms of intellectual property. Intellectual property, depending on the field of activity, includes copyright and related rights as well as industrial designs. The aim of the paper, based on desk research, is to present and analyze the forms of intellectual property by which the owners of creative enterprises in the Republic of Croatia protect their products and services and their position on the market, based on desk research. The research results point to the significant role of intellectual property not only in the protection of products and services but also in the process of commercialization of products based on knowledge and innovation.
Keywords: creative industry, creative enterprises, intellectual property, entrepreneurship, Croatia

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Kreativna poduzeća i zaštita intelektualnog vlasništva u Republici Hrvatskoj

Darija IVANKOVIĆ[1], Željka BORZAN[1], Ana ŠARIĆ[2]

[1] Veleučilište „Lavoslav Ružička“ u Vukovaru, Županijska 50, Vukovar, Hrvatska
[2] TERA Tehnopolis d.o.o., Trg Ljudevita Gaja 6, Osijek, Hrvatska

Sažetak
Kreativna poduzeća, kao nositelji aktivnosti kreativne industrije, pokazuju značajan doprinos gospodarskom rastu i zapošljavanju. Ona stvaraju, proizvode i distribuiraju kreativna dobra i usluge te nerijetko obuhvaćaju (iskorištavaju) različite oblike intelektualnog vlasništva. Intelektualno vlasništvo, ovisno o području djelatnosti, obuhvaća autorsko i srodna prava te prava industrijskog vlasništva. Cilj rada je na temelju desk istraživanja prikazati i analizirati oblike intelektualnog vlasništva kojima vlasnici kreativnih poduzeća u Republici Hrvatskoj štite svoje proizvode i usluge te položaj na tržištu. Rezultati istraživanja upućuju na značajnu ulogu intelektualnog vlasništva ne samo u zaštiti proizvoda i usluga, već i u procesu komercijalizacije proizvoda temeljenih na znanju i inovacijama.
Ključne riječi: kreativna industrija, kreativna poduzeća, intelektualno vlasništvo, poduzetništvo, Hrvatska

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The Role of Fishing Ports in the Sustainable Blue Economy

Gorana JELIĆ MRČELIĆ, Luka ŽIVANOVIĆ, Vedrana NERLOVIĆ

University of Split, Faculty of Maritime Studies, R. Boškovića 37, Split, Croatia

Abstract
Fishery and aquaculture have important economic, environmental and roles. The development of fishery and aquaculture depends on many factors, including adequately equipped ports and landing sites. The aim of this paper is to demonstrate the role of fishing ports in the sustainable blue economy. Fishing ports support the sustainable development of fishery and aquaculture by promoting best practices for environmental protection, maintaining food quality, creating fair prices, supporting workers' rights, integrating local communities and ports, and more. The FAO Blue Ports Initiative aims to strengthen the role of ports as drivers of sustainable development in coastal communities and promote the achievement of several key Sustainable Development Goals (SDGs), including SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 5 (Gender Equality), and SDG 14 (Life Below Water). However, ports are also encouraged to implement a blue economy approach to management to achieve long-term benefits for local communities. Port management, in collaboration with scientists, decision-makers, the private sector, and civil society, should emphasize inclusiveness, competitiveness, greening, and process efficiency, and support joint actions to improve the quality of life of local communities.
Keywords: fishery and aquaculture, ports, sustainability, blue economy, marine environment

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Uloga ribarskih luka u održivoj plavoj ekonomiji

Gorana JELIĆ MRČELIĆ[1], Luka ŽIVANOVIĆ[1], Vedrana NERLOVIĆ[2]

[1] Sveučilište u Splitu, Pomorski fakultet, R. Boškovića 37, Split, Hrvatska
[2] Sveučilište u Splitu, Sveučilišni odjel za studije mora, R. Boškovića 37, Split, Hrvatska

Sažetak
Ribarstvo i akvakultura imaju važnu gospodarsku, okolišnu i društvenu ulogu. Razvoj ribarstva i akvakulture, ovisi o mnogim faktorima, između ostalog, o adekvatnoj infrastrukturi što uključuje i odgovarajući opremljene luke i pristaništa. Cilj ovog rada je ukazati na ulogu ribarskih luka u održivoj plavoj ekonomiji. Ribarske luke pridonose održivom razvoju ribarstva i akvakulture podržavanjem dobri praksi zaštite okoliša, održanjem kvalitete hrane, kreiranjem pravičnih cijena, podržavanjem prava radnika, integracijom luka i lokalnih zajednica i na mnoge druge načine. FAO Blue Ports Initiative nastoji učvrstiti ulogu luka kao pokretača održivog razvoja obalnih zajednica i pomaže u ostvarenju nekoliko ključnih ciljeva održivog razvoja kao što su cilj 1 (Svijet bez siromaštva), cilj 2 (Svijet bez gladi), cilj 3 (Zdravlje i blagostanje), cilj 5 (Rodna ravnopravnost) i cilj 14 (Očuvanje vodenog svijeta). Inicijativa potiče primjenu plave ekonomije u upravljanju lukama radi ostvarenja dugoročne dobrobiti za lokalne zajednice. Upravljanje lukama treba biti uključivo, kompetitivno, zeleno i učinkovito, u suradnji sa znanstvenicima, donosiocima odluka, privatnim sektorom i širom društvenom zajednicom te poticati zajedničke akcije s ciljem unaprjeđenja kvalitete života lokalnih zajednica.
Ključne riječi: ribarstvo i akvakultura, luke, održivost, plava ekonomija, morski okoliš

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Circular economy as a zero-waste philosophy

Sanja JURIĆ, Sandra MANDINIĆ

Marko Marulić Polytechnic, Petra Krešimira IV. 30, Knin, Croatia

Abstract
The popular linear economic model is slowly but surely being replaced by the circular economy. It is still a relatively new economic model, despite the fact that the EPA has been implementing it since 2009. Through the reduction of the negative impact of the life cycle of materials, the positive impact on the climate, the reduction of the use of harmful materials and the separation of used materials, the circular economy promotes economic growth and meets social needs. As the non-circular economy is based on the policy of take, use and throw away, the circular economy as an economic model is based on nature and its protection and reuse of what has already been used. The model is applicable to all aspects of life, with a particularly moderate focus on energy efficiency and environmental sustainability with positive effects in economic savings, new green jobs, energy savings, resource savings and climate change mitigation. To what extent students are familiar with the philosophy of zero waste, to what extent do they personally participate in material recycling and environmental maintenance, how ready they are to start their own sustainable business, and what is their opinion about the representation of the circular economy in the Croatian economy with a view to the future, are asked research questions.
Keywords: circular economy, green economy, sustainable development, environmental protection

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Cirkularna ekonomija kao filozofija nepostojanja otpada

Sanja JURIĆ, Sandra MANDINIĆ

Veleučilište "Marko Marulić" u Kninu, Petra Krešimira IV. 30, Knin, Hrvatska

Sažetak
Popularni se linearni ekonomski model sporo, ali sigurno zamjenjuje cirkularnom ekonomijom. U pitanju je još uvijek relativno novi ekonomski model, unatoč činjenici da ga EPA provodi još od 2009. godine. Kroz smanjenje negativnog utjecaja životnog ciklusa materijala, pozitivnog utjecaja na klimu, smanjenje korištenja štetnih materijala i odvajanje iskorištenog materijala, cirkularna ekonomija potiče gospodarski rast i zadovoljava društvene potrebe. Kako se necirkularna ekonomija bazira na politici uzmi, iskoristi i odbaci, tako se cirkularna ekonomija kao ekonomski model bazira na prirodu i njenu zaštitu te ponovno korištenje već iskorištenog. Model je primjenjiv na sve aspekte života, s posebno umjerenom pažnjom na energetsku učinkovitost i ekološku održivost s pozitivnim učincima u ekonomskim uštedama, novim zelenim radnim mjestima, uštedi energije, uštedi resursa te ublažavanju klimatskih promjena. Koliko su studenti upoznati s filozofijom nepostojanja otpada, koliko osobno sudjeluju u recikliranju materijala i održavanju okoliša, koliko su spremni pokrenuti svoj održivi biznis te kakvo im je mišljenje o zastupljenosti cirkularne ekonomije u hrvatskom gospodarstvu s osvrtom na budućnost, postavljena su istraživačka pitanja.
Ključne riječi: cirkularna ekonomija, zelena ekonomija, održivi razvoj, zaštita okoliša

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Blue economy – biotechnology inspired by nature

Katarina MAROŠEVIĆ[1], Tihana SUDARIĆ [2], Igor JURIČIĆ[1]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Law Osijek, Ul. Stjepana Radića 13, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotehnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
The aim of the paper was to define the theoretical and applied concept of the blue economy using a qualitative method. Unlike the green economy, which relies on higher investment and higher expenditure on the finished product to preserve the environment, the blue economy also deals with the issue of sustainability but is not limited exclusively to conservation. The blue economy encourages renewal with an effort for ecosystems to preserve their evolutionary path. Like the green economy, the blue economy also tries to solve the issues of sustainable development, production, and agricultural waste, but it does so through the development of new jobs, innovation and digitization, all in favor of lowering prices for the consumer, who ultimately pays for the price of production at the end. The theoretical framework consisted of strategic alternatives intended for local and regional entities, i.e. blue economy initiatives should be recognized from the local resource base. The research questions were focused on business models in the blue economy, the strategy of a company that recognizes the importance of sustainable development but that adapts to changes to meet market needs both with product price and quality. In the concluding remarks, the significance of the blue economy is argued as a new development approach for the national economy through naturally inspired technologies such as ecosystem protection, energy needs, tourism, aquaculture, etc.
Keywords: blue economy, biotechnology, sustainable development, ecosystem

Green Economy / *Zelena ekonomija*
Oral presentation / *Usmeno priopćenje*

Plava ekonomija - prirodom inspirirana biotehnologija

Katarina MAROŠEVIĆ[1], Tihana SUDARIĆ[2], Igor JURIČIĆ[1]

[1] Sveučilište Josipa Jurja Strossmayera u Osijeku, Pravni fakultet Osijek, Ul. Stjepana Radića 13, Osijek, Hrvatska
[2] Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet agrobiotehničkih znanosti Osijek, Vladimira Preloga 1, Osijek, Hrvatska

Sažetak
Cilj rada bio je kvalitativnom metodom definirati teorijski i aplikativni koncept plave ekonomije. Za razliku od zelene ekonomije, koja počiva na većem ulaganju i većem izdatku za gotov proizvod kako bi se očuvao okoliš, plava ekonomija se također bavi pitanjem održivosti, ali nije ograničena isključivo na očuvanje. Plava ekonomija potiče obnavljanje uz nastojanje da ekosustavi sačuvaju svoj evolucijski put. Kao i zelena ekonomija i plava ekonomija pokušava riješiti pitanja održivog razvoja, proizvodnje, poljoprivrednog otpada i slično ali kroz razvoj novih radnih mjesta, inovacija i digitalizacije ali sve u korist snižavanja cijena za krajnjeg potrošača, koji u konačnici plaća cijenu proizvodnje. Teorijski okvir činile su strategijske alternative koje su namijenjene lokalnim i regionalnim subjektima, odnosno inicijative plave ekonomije trebaju biti prepoznate od lokalne resursne osnove. Istraživačka pitanja su bila usmjerena na poslovne modele u plavoj ekonomiji, strategiju poduzeća koji prepoznaje važnost održivog razvoja ali koje se prilagođava promjenama da zadovolji potrebe tržišta kako s cijenom proizvoda tako i s kvalitetom. U zaključnim razmatranjima argumentira se značaj plave ekonomije kao novi razvojni pristup za nacionalno gospodarstvo kroz prirodno inspirirane tehnologije kao što je zaštita ekosustava, energetske potrebe, turizam, akvakultura i slično.
Ključne riječi: plava ekonomija, biotehnologija, održivi razvoj, ekosustav

Green Economy / *Zelena ekonomija*
Oral presentation / *Usmeno priopćenje*

Green marketing is a logical answer to the consumer society

Ivan TOLIĆ

Zagreb School of Business, Vukovarska 68, Zagreb, Croatia

Abstract
In a very short time, green marketing has become a new trend in the orientation of companies in the world, where it represents a new face of modern marketing theory and is the answer to the current consumer society. The aim of this paper is to study the consumer society, its characteristics and its consequences on the community as a whole. The consumer today is no longer just a passive observer, but an active participant in the events - Such a role of the consumer in the modern market necessarily leads to a different marketing approach of companies. The conducted research aims to identify the green marketing concept and clarify the boundaries and elements associated with the new marketing concept. The research concluded that green marketing is the application of traditional marketing practices, putting environmental protection first as a priority when determining the elements of the marketing mix from product design, pricing, distribution and promotion. Also, it has been proven that green marketing is not limited to just one sector, but to world-leading experiences in almost all industrial branches.
Keywords: consumer society, green marketing, consumer rights, consumerism

Green Economy / *Zelena ekonomija*
Oral presentation / *Usmeno priopćenje*

Zeleni marketing logičan odgovor potrošačkom društvu

Ivan TOLIĆ

Poslovno Veleučilište Zagreb, Vukovarska 68, Zagreb, Hrvatska

Sažetak
Green marketing je u vrlo kratkom vremenu postao novi trend orijentacija poduzeća u svijetu, gdje predstavlja jedno novo lice moderne marketinške teorije i odgovor je dosadašnjem potrošačkom društvu. Cilj ovog rada je proučavanje potrošačkog društva, njegovih karakteristika i posljedica na zajednicu u cjelini. Potrošač danas, nije više samo pasivni promatrač, već aktivni učesnik zbivanja- Takva uloga potrošača na suvremenom tržištu neophodno dovodi i do drugačijeg marketing pristupa kompanija. Provedeno istraživanje ima za cilj identificirati green marketing koncept i razjasniti granice i elemente povezane s novim konceptom marketinga. Istraživanje je zaključilo da je zeleni marketing primjena tradicionalnog marketinga prakse, pri čemu na prvo mjestu stavlja zaštitu okoliša kao prioritet pri određivanju elemenata marketing miksa od dizajna proizvoda, cijene, distribucije i promocije. Također, je dokazano da zeleni marketing nije ograničen samo na jedan sektor, već na vodeća svjetska iskustva u gotovo svim industrijskim granama.
Ključne riječi: potrošačko društvo, zeleni marketing, prava potrošača, konzumerizam

Green Education
Zelena edukacija

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Education in solid waste management: A step towards achieving the Sustainable Development Goals

Jurislav BABIĆ[1], Sandra BUDŽAKI[1], Natalija VELIĆ[1], Darko VELIĆ[1], Antun JOZINOVIĆ[1], Mario PANJIČKO[2]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[2] Sustainable Development Technologies Centre - CROTEH Ltd. A/ Av. Dubrovnik 15, Paviljon 12/I, Zagreb, Croatia

Abstract
Waste generation is a global problem directly related to the way society produces and consumes. Waste management is, therefore, a global challenge that encompasses environmental, economic, social and political aspects and affects not only today's generations but also those to come. Consequently, waste management must be sustainable at its core and can be directly or indirectly linked to the achievement of the Sustainable Development Goals (SDG). SDG #4 emphasizes the importance of education in general as the foundation for creating a peaceful and prosperous world. Environmental education is critical to the successful implementation of sustainable waste management because it changes attitudes and provides learners with knowledge, values and skills that enable change in the way communities manage waste. It also raises public awareness and enables the implementation of a sustainable waste management system through more effective public participation. In addition to environmental education aimed at the general public, the training of qualified waste management professionals is also very important. Incentives aimed at developing formal and informal training in waste management are important to mitigate the negative impact of landfills on the environment in the long term.
Keywords: education, solid waste management, sustainable development goals

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

Environmental education: Environmental topics in Croatian language textbooks

Irella BOGUT, Antonija HULJEV

Josip Juraj Strossmayer University of Osijek, Faculty of Education, Cara Hadrijana 10, Osijek, Croatia

Abstract
Reflecting on the importance of environmental education and the fact that in Croatian education more emphasis is given to the educational aspect rather than to the upbringing aspect, the need to reflect on environmental topics and education must occupy an important position in the teaching of the Croatian language too. Given the fact that, according to the current curriculum for the subject Croatian language for primary schools and gymnasiums in the Republic of Croatia (2019), this subject structurally and organizationally includes three interconnected subject areas (Croatian language and communication, literature and creativity, culture and media). Therefore, consideration has to be given by all means to many possibilities that the teaching of the Croatian language can offer. Also, the curriculum, based on the principle of didactic transmission and the pedocentric position of school children, creates an incentive in the implementation of acquired knowledge and understanding, and most importantly, it mediates content and educational influence. In the paper, according to a suitable methodologically selected framework, a selection and analysis of the literary and non-literary texts represented in the textbooks for the Croatian language for 1 to 4 primary school grades, that can mediate educational ecological values, will be carried out. The interpretation possibilities of the mentioned texts are numerous, but the teaching will largely depend on the implicit pedagogy of each individual teacher, which also points to another important reason why environmental education should be approached from the earliest school age, as well as children's age.
Keywords: educational values, environmental education, teaching, textbooks, Croatian language

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

The importance of sustainable development integration at all levels of education

Edita BORIĆ, Irella BOGUT, Emina BERBIĆ KOLAR

Josip Juraj Strossmayer University of Osijek, Faculty of Education, Cara Hadrijana 10, Osijek, Croatia

Abstract
Education for sustainable development in both the natural, social and humanistic sciences is based on an integrated approach to economic, environmental and social development. It should be integrated through plans and programs at all levels of education and provide every child/pupil/student with knowledge, values and skills for future active and responsible citizenship - participation in decisions at the personal level and at different levels of a sustainable society, locally and globally. As part of the curricular reform, the Ministry of Science and Education of the Republic of Croatia introduced the Sustainable Development Topic of the Cross-curricular Curriculum. Educators and teachers with transformative competencies for including sustainable development topics in the learning process, must think about a paradigm for co-creating visions of the future world and encourage the necessary changes in the environment. This will ensure the flow and implementation of relevant scientific information and be a key factor in the environmental education process. Modern learning requires a transformative environment that provides space for thinking and increases cooperation between the economy and educational institutions through lifelong learning. This paper presents the implementation of education for sustainable development according to school curricula, and a review of university sustainable development programs. It was established that a one-subject approach to education for sustainable development with the application of the method of conveying facts is dominating at schools and that there is a lack of understanding of the integrated concept of sustainable development among educators. In the higher education system, there are individual initiatives for the development of study programs for experts in sustainable development. There is a need for a continuous coordinated educational process for sustainable development, from preschool to post-graduate educational levels.
Keywords: sustainable development, educators, transformative competencies, integrated concept, lifelong learning

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

Važnost integracije održivog razvoja na svim razinama obrazovanja

Edita BORIĆ, Irella BOGUT, Emina BERBIĆ KOLAR

Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet za odgojne i obrazovne znanosti, Cara Hadrijana 10, Osijek, Hrvatska

Sažetak

Obrazovanje za održivi razvoj u prirodnim, društvenim i humanističkim znanostima temelji se na integriranom pristupu ekonomskom, ekološkom i društvenom razvoju. Ono treba biti integrirano kroz planove i programe na svim razinama obrazovanja i omogućiti svakom djetetu/učeniku/studentu znanja, vrijednosti i vještine za buduće aktivno i odgovorno građanstvo - sudjelovanje u odlukama na osobnoj i na različitim razinama održivog društva, lokalno i globalno. U okviru kurikularne reforme Ministarstvo znanosti i obrazovanja Republike Hrvatske uvelo je Kurikulum međupredmetne teme Održivi razvoj. Odgojitelji, učitelji i nastavnici (edukatori) s transformativnim kompetencijama za uključivanje tema održivog razvoja u proces učenja, moraju razmišljati o paradigmi za sugeiranje vizija budućeg svijeta te potaknuti potrebne promjene u okolini. Time će osigurati protok i provedbu relevantnih znanstvenih informacija i biti ključni činitelji procesa obrazovanja za okoliš. Za suvremeno učenje neophodno je transformativno okruženje koje pruža prostor za razmišljanje i povećava suradnju gospodarstva i obrazovnih institucija kroz cjeloživotno učenje. Rad donosi prikaz provođenja obrazovanja za održivi razvoj prema kurikulumima u školama, a napravljen je i osvrt na sveučilišne programe održivog razvoja. Utvrđeno je da u školama dominira jednopredmetni pristup obrazovanju za održivi razvoj uz primjenu metode prenošenja činjenica te da kod odgojitelja, učitelja i nastavnika postoji nedostatak razumijevanja integriranog koncepta održivog razvoja. U visokoobrazovnom sustavu postoje pojedinačne inicijative za razvoj studijskih programa za stručnjake za održivi razvoj. Uočava se potreba kontinuiranog usklađenog obrazovnog procesa za održivi razvoj, od onog u predškolskim ustanovama pa do poslijediplomskih obrazovnih razina.

Ključne riječi: održivi razvoj, edukatori, transformativne kompetencije, integrirani koncept, cjeloživotno učenje

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Education for sustainable development in classroom textbooks - subjects Croatian language and Nature and society

Edita BORIĆ, Valentina MAJDENIĆ, Marta ZEČEVIĆ BERBIĆ

Josip Juraj Strossmayer University of Osijek, Faculty of Education, Cara Hadrijana 10, Osijek, Croatia

Abstract
Sustainable development in the education system requires a multidimensional holistic view of the ecological, economic and social dimensions of sustainable development. The transformation of education for sustainable development should begin already in lower primary school grades and be directed towards a transformative vision with 17 sustainable development goals. The school should provide comprehensive perspectives on complex cross-curricular topics such as sustainable development so that students are given the opportunity to develop individual decision-making skills. In classes, teachers encourage the development of student competencies with the use of different teaching aids in different teaching methodology scenarios. Textbooks are still prevalent in the teaching process and play a significant role in teaching because the learning outcomes are often evaluated in relation to their contents. Thus, textbooks are an important resource for both students and teachers since teachers sometimes believe that curriculum requirements are met by following textbooks. This paper shows the role and possibilities of textbooks for promoting sustainable development in primary education. Based on the analysis of the content of the textbooks from the subject Croatian language and the subject Nature and society, it was investigated how the content on sustainable development is organized and formulated, how its multidimensional character is described and how problems related to achieving sustainability are solved. A comparative analysis of the results was made for all titles as well as the differences and similarities between the content of the sustainable development of the Croatian language and Nature and society. The selected courses cover interdisciplinary areas with an emphasis on the natural sciences, humanities and social sciences. An analysis of the textbooks for both subjects found that they provide stimulating content on sustainable development. Multidimensional relations between different subjects are insufficiently developed. Existing textbooks significantly limit the potential for critical assessment of students' problem-oriented actions.
Keywords: education for sustainable development, goals of sustainable development, Croatian language textbooks, nature and society textbooks, lower primary school teaching

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Obrazovanje za održivi razvoj u udžbenicima razredne nastave - nastavni predmet Hrvatski jezik i Priroda i društvo

Edita BORIĆ, Valentina MAJDENIĆ, Marta ZEČEVIĆ BERBIĆ

Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet za odgojne i obrazovne znanosti, Cara Hadrijana 10, Osijek, Republika Hrvatska

Sažetak

Održivi razvoj u obrazovnom sustavu zahtijeva višedimenzionalni holistički pogled na ekološke, ekonomske i društvene dimenzije održivog razvoja. Transformaciju obrazovanja za održivi razvoj treba početi već u razrednoj nastavi te ga usmjeriti na transformativnu viziju sa 17 ciljeva održivog razvoja (Agendu 2030,UNCitat2015). Škola treba pružiti sveobuhvatne perspektive o složenim međupredmetnim temama kao što je održivi razvoj tako da se učenicima pruži prilika da razviju sposobnosti za donošenje individualnih odluka. Učitelji na nastavi različitim metodičkim scenarijima potiču razvoj učeničkih kompetencija uz primjenu različitih nastavnih sredstava. Udžbenici su još uvijek najviše prisutni u nastavnom procesu i imaju značajnu ulogu u nastavi jer se ishodi učenja često vrednuju u odnosu na njihov sadržaje. Stoga su udžbenici važan izvor i za učenike i za nastavnike budući da učitelji ponekad vjeruju da se zahtjevi kurikuluma ispunjavaju praćenjem udžbenika. Ovaj rad prikazuje ulogu i mogućnosti udžbenika za promicanje održivog razvoja u primarnom obrazovanju. Na temelju analize sadržaja udžbenika iz nastavnog predmeta Hrvatski jezik i nastavnog predmeta Priroda i društvo istraženo je kako je organiziran i formuliran sadržaj o održivom razvoju, na koji način je opisan njegov višedimenzionalni karakter i kako se rješavaju problemi koji se odnose na postizanje održivosti. Napravljena je komparativna analiza rezultata za sve naslove kao i razlike i sličnosti između sadržaja održivog razvoja hrvatskog jezika i prirode i društva. Odabranim nastavnim predmetima obuhvaćena su interdisciplinarna područja s naglaskom na prirodoslovno, humanističko i društveno područje. Analizom udžbenika za oba predmeta utvrđeno je da pružaju poticajne sadržaje o održivom razvoju. Višedimenzionalni odnosi između različitih predmeta su nedovoljno razvijeni. Postojeći udžbenici značajno ograničavaju potencijal za kritičku procjenu problemski usmjerenih postupaka učenika.

Ključne riječi: obrazovanje za održivi razvoj, ciljevi održivog razvoja, udžbenici hrvatskog jezika, udžbenci prirode i društva, razredna nastava

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

Education for sustainable development from a future teachers' perspective

Maja BRUST NEMET[1], Katarina DRINOVAC[2], Ljubica NEDIĆ[1]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Education, Cara Hadrijana 10, Osijek, Croatia
[2] Elementary school Julije Benešić, Trg sv. Ivana Kapistrana 1, Ilok, Croatia

Abstract
Education for sustainable development implies the acquisition of competencies that are necessary for creating a sustainable future. Teachers' initial education and professional improvement should be in line with the needs of a sustainable society and teachers should also be qualified to integrate education for sustainable development in their teaching process as well as in other forms of educational processes. By changing the learning and teaching paradigms and introducing participatory and experiential methods that encourage students to actively learn, it is possible to adopt the principles and values of sustainable development which are prerequisites for predicting various forms of sustainable future. The aim of this research is to determine to what extent the students choose sustainable development as a topic of their theses as well as their attitudes towards sustainable development. The content analysis of the theses written from 2012/2013 to 2021/2022 by the students at the Faculty of Education in Osijek was used as a research instrument. With qualitative analysis of all theses written in those ten years, sustainable development topics were found in 90 of them which belong to natural, social and interdisciplinary studies. Qualitative analysis of 28 interviews determined the attitudes that future teachers have on sustainable development in education as well as self-evaluation of competencies to implement sustainable development activities in the school curriculum.
Keywords: ecology, education, sustainable development, students, Faculty of Education

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

Odgoj i obrazovanje za održivi razvoj iz perspektive budućih učitelja

Maja BRUST NEMET[1], Katarina DRINOVAC[2], Ljubica NEDIĆ[1]

[1] Sveučilište Josipa Jurja Strossmayera u Osijeku, Fakultet za odgojne i obrazovne znanosti, Cara Hadrijana 10, Osijek, Hrvatska
[2] Osnovna škola Julija Benešića, Trg sv. Ivana Kapistrana 1, Ilok, Hrvatska

Sažetak
Odgoj i obrazovanje za održivi razvoj podrazumijeva stjecanje kompetencija potrebnih za oblikovanje održive budućnosti. Inicijalno obrazovanje i profesionalno usavršavanje učitelja trebalo bi biti usklađeno s potrebama održivog društva, a učitelji osposobljeni za integraciju obrazovanja za održivi razvoj u nastavni proces i druge oblike odgojno-obrazovnog rada. Promjenom paradigme učenja i poučavanja te uvođenjem participativnih i iskustvenih metoda koje potiču studente i učenike na aktivno učenje omogućava se usvajanje načela i vrijednosti održivog razvoja koje su preduvjet za djelovanje i predviđanje održivih verzija budućnosti. Cilj je rada utvrditi u kojoj mjeri studenti odabiru teme održivog razvoja u diplomskim radovima, kao i stavove studenata o održivom razvoju. Instrumenti su istraživanja analiza sadržaja diplomskih radova u razdoblju od 2012./2013. do 2021./2022. akademske godine i visoko strukturirani intervju za studente Integriranog prijediplomskog i diplomskog sveučilišnog Učiteljskog studija Fakulteta za odgojne i obrazovne znanosti Sveučilišta Josipa Jurja Strossmayera u Osijeku. Kvalitativnom analizom svih diplomskih radova u desetogodišnjem razdoblju izdvojeno je 90 diplomskih radova koji su uključivali teme održivog razvoja, a pripadaju području prirodnih, društvenih i interdisciplinarnih područja znanosti. Kvalitativnom analizom 28 intervjua utvrdili su se stavovi budućih učitelja o važnosti tema održivog razvoja u odgojno-obrazovnom sustavu, kao i samoprocjena spremnosti budućih učitelja za implementacijom aktivnosti održivog razvoja u kurikulume škole.
Ključne riječi: ekologija, obrazovanje, odgoj, održivi razvoj, studenti, Fakultet za odgojne i obrazovne znanosti

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

Education, engagement & empowerment in green local food systems transformation - Insights from the Living Food Lab study

Bent EGBERG MIKKELSEN

University of Copenhagen, Department of Geosciences and Natural Resource Management, Rolighedsvej 23, Frederiksberg C, Copenhagen, Denmark

Abstract
The transformation of the food system in a way that is supportive of the SDGs needs to utilize all the resources in the socio-technical fabric of society. Technologies are important, but so are policy-based strategies and citizen engagement. One of the most powerful ways of staging the transformation is through actions in the city and region. Urban Food Strategies, city-based food councils, and urban food hubs are some of the actions that have been taken at the local level. In this paper, we explore the transformative potentials of local food-living labs. We set out to explore to what extent this approach could be used to stage the co-creation and use of multi-actor approaches that are called for in the European Green Deal. For the study, we used a case from a cohort in the SESAM program. The program is part of the European Researchers Night and in our version, we use Food Systems Transformation as the science case. From the cohort of 6 schools, we picked one of them to test in detail the idea that a Living Food Lab could function as a hub for local food system changes. The study is based on qualitative interviews with teachers and students and mentors.
Keywords: education, local food-living labs, SESAM program

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

Digital classrooms on Food Policy in higher education

Eva FALCH[1], Massimo BUSUOLI[2]

[1] Norwegian University of Science and Technology (NTNU), Department of Biotechnology and Food Science, Akrinn, Kalvskinnet, Sverresgt 10-12, Trondheim, Norway
[2] Norwegian University of Science and Technology (NTNU),, Brussels Office, Rue Guimard 9, Brussels, Belgium

Abstract
The food industry is facing major changes in the road towards sustainability of which the food regulatory framework is an essential part. Norway's largest university, NTNU, has for the last 6 years included food policy into the curriculum for master study programs in food to prepare the students prepared for the important tasks they will meet in their future jobs as professionals. The course Food Industry Framework comprises the following modules: (1) Digital classrooms (3 days) with student dialogue with policy actors in EU on chosen hot sustainability topics, (2) Guest lectures from a range of relevant food actors, (3) Workshop with regional food businesses on the chosen topics, (4) Training in methodology for complex problems, and (5) Semester work where the food policy meets the challenges for the food producers. We will share experiences from these first years of teaching and on particular module 1, digital classrooms on food policy. Equipping students with the right knowledge, skills, tools, competence, and network may prepare them to become the important game changers needed in the work toward sustainable food systems. Introducing food policy understanding in the curriculum values their co-creation with the food actors and leads to a system understanding.
Keywords: green education, food policy, systems approach, sustainability, food industry

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

Interactive education on sustainable use of electrical devices

Jernej FRANGEŽ, Marko JESENIK

University of Maribor, Faculty of Electrical Engineering and Computer Science, Koroška cesta 46, Maribor, Slovenia

Abstract
Education in GREEN electrical energy and production usage is essential for young people. Every consumer can do a lot if they use electrical devices wisely. This paper will present the design, intention and use of a didactical learning exhibit for middle and high school students during technical days on faculty and faculty promotions and for educational purposes. Our main goal is to introduce students to how some everyday electrical devices work, how much energy they use and how they can save as users. The most significant emphasis will be electromagnetic devices such as elevators and devices we use daily. We will use a professional approach and design for that purpose, but we will focus on presenting it on an interactive touchscreen and small examples of those devices. The content will be in graded expertise levels, from simple picture and animation calculations to advanced picture and mathematical model presentations. The exhibit will be designed modularly so that content or presentation can change quickly and be made from recycled or sustainable materials as much as possible.
Keywords: sustainable, educational, electricity, electromagnetic devices

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Developing active and ecologically aware generations

Ljiljana KENCEL, Barbara MARAS

Students dorm Podmurvice Rijeka, Branka Blečića 3, Rijeka, Croatia

Abstract
The Student Dormitory Podmurvice Rijeka has a gold eco-dormitory certificate and implements key educational activities related to the development of ecological awareness and a sustainable way of living through active citizenship. The goal of the project *Developing active and Ecologically Aware Generations* is to increase inclusiveness and diversity in the implementation of existing programs and provide students with modern ways of developing awareness about ecology and sustainable development. We are focused on achieving awareness about the importance of pollinators for environmental protection and its impact on climate change. The activities are lectures and workshops on urban beekeeping, drama education with implementation of ecological content, installation of habitats for solitary bees, printing of educational leaflets with ecological content and planting plants for pollinators in the Dormitory environment. The project includes 300 students and employees of the Dormitory, the Beekeeping Association *Milutin Barač Rijeka*, the Association of the Physically Disabled of the City of Rijeka and the *Association* for the *Blind of the Primorje-Gorski Kotar County*. By developing awareness about the importance of ecology and climate change, we raise ecologically aware and active young generations, empower students in the fight against climate change, enable them to adopt healthy behaviors towards the environment and motivate them to apply acquired knowledge in their communities.
Keywords: ecology, climate change, sustainability, pollinators, active citizenship

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Razvijanje aktivnih i ekološki osviještenih generacija

Ljiljana KENCEL, Barbara MARAS

Učenički dom Podmurvice Rijeka, Branka Blečića 3, Rijeka, Hrvatska

Sažetak
Učenički dom Podmurvice Rijeka posjeduje zlatni certifikat eko-doma te sustavno provodi ključne odgojno-obrazovne aktivnosti vezane uz razvoj ekološke osviještenosti i održivi način življenja kroz aktivno građanstvo. Cilj projekta *Razvijanje aktivnih i ekološki osviještenih generacija* je povećati uključivost i raznolikost u realizaciji postojećih programa te omogućiti učenicima suvremene načine razvijanja svijesti o ekologiji i održivom razvoju. Posebno smo se usmjerili na postizanje veće svjesnosti o važnosti oprašivača za očuvanje okoliša i utjecaja na klimatske promjene. Aktivnosti predviđene projektom sastoje se od predavanja i radionica o urbanom pčelarenju, dramskog odgoja s implementacijom ekoloških sadržaja koji promiču važnost oprašivača, izrade i postavljanja nastambi za solitarne pčele, tiskanje edukativnih letaka s relevantnim ekološkim sadržajima te sjetve, sadnje i održavanja površina u okolišu Doma s biljkama za oprašivače. U projekt smo uključili 300 učenika i djelatnika Učeničkog doma, Pčelarsku udrugu „Milutin Barač“ Rijeka, Društvo tjelesnih invalida grada Rijeke i Društvo slijepih osoba Primorsko-goranske županije. Razvijanjem svijesti o važnosti ekologije, s naglaskom na svijest o klimatskim promjenama, odgajamo ekološki osviještene i aktivne mlade generacije, osnažujemo učenike u borbi protiv klimatskih promjena, omogućujemo im da usvoje zdrava ponašanja prema okolišu u svakodnevnom životu te ih motiviramo da stečena znanja primjene u svojim zajednicama.
Ključne riječi: ekologija, klimatske promjene, održivost, oprašivači, aktivno građanstvo

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Ecological education for a better tomorrow

Anita KULAŠ MIROSAVLJEVIĆ

University of Slavonski Brod, Ivana Brlić Mažuranić Square 2, Slavonski Brod, Croatia

Abstract
The problem of ecology and environmental protection is more than a current topic today. People do things every day consciously or unconsciously, the consequences of which cause the destruction of nature. This is precisely why it is necessary for all stakeholders in society to be aware of how their daily behavior towards the environment can negatively affect it. The purpose of this paper is to investigate ecological education. The prerequisite for solving existing environmental problems lies in the environmental awareness of all stakeholders. Ecological education should be an integral part of the educational process, but also of education within the community itself. The research in this paper attempts to gain insight into the knowledge, attitudes, habits and possibilities of involving citizens in caring for a clean and healthy environment. The methodology in this paper uses descriptive statistics that will provide information about variables in a given dataset and highlight relationships between variables in a sample. The limitation of the present study is the available time for the completion of the questionnaire. As it is an online questionnaire, access to it is restricted by time. Finally, sample size and representativeness are an issue to be addressed. Along with the limitations of the study, we need to highlight the importance of conducting further research in order to obtain more valid results such as a larger sample should be used.
Keywords: ecology, environmental protection, ecological education, ecological awareness

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Ekološko obrazovanje za bolje sutra

Anita KULAŠ MIROSAVLJEVIĆ

Sveučilište u Slavonskom Brodu, Trg Ivane Brlić Mažuranić 2, Slavonski Brod, Hrvatska

Sažetak
Problem ekologije i zaštite okoliša danas je više nego aktualna tema. Ljudi svakodnevno iz neznanja i/ili (ne)svjesno čine stvari čije posljedice uzrokuju uništavanje prirode. Upravo zbog toga potrebno je da svi dionici društva budu svjesni kako njihovo svakodnevno ponašanje prema okolišu može negativno utjecati na isti. Svrha ovog rada je istražiti ekološko obrazovanje. Preduvjet za rješavanje priustnih ekoloških problema leži u ekološkoj osviještenosti svih dionika. Ekološko obrazovanje bi trebalo biti sastavni dio odgojno-obrazovanog procesa, ali i obrazovanja unutar same zajednice. Istraživanjem u ovom radu pokušava se dobiti uvid u znanje, stavove, navike i mogućnosti uključivanja građana u brigu za čist i zdrav okoliš. Metodologija u ovom radu koristi deskriptivnu statistiku koja će pružiti informacije o varijablama u danom skupu podataka i istaknuti odnose između varijabli u uzorku. Ograničenje ove studije je raspoloživo vrijeme za ispunjavanje upitnika. Budući da se radi o online upitniku, pristup mu je vremenski ograničen. Naposljetku, veličina i reprezentativnost uzorka problem su kojim se treba pozabaviti. Uz ograničenja studije, mora se istaknuti važnost provođenja daljnjih istraživanja kako bi se dobili valjaniji rezultati, koristići veći uzorak.
Ključne riječi: ekologija, zaštita okoliša, ekološko obrazovanje, ekološka svijest

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

Competencies for project sustainability and contribution to the UN's sustainable development goals

Mario PROTULIPAC

Okviri znanja d.o.o., Vranyczanyeva ulica 6, Karlovac, Croatia

Abstract
The integration of sustainability into education in project management is increasingly vital as the need to apply the principles of sustainable development in the preparation and implementation of projects grows. However, in the field of project management, there still needs to be recognized competencies that contribute to sustainable project management. Namely, the expected learning outcomes in the competence framework of project management are not aligned with the UN's Sustainable Development Goals. As projects are an essential factor in contributing to positive changes, thus contributing to the goals and indicators of sustainable development, by strengthening the competencies of project team members compatible with the UN SDGs, the probability of project success in the relevant sectors increases. The purpose of the paper is to investigate the gap between the most commonly used competence frameworks in project management with the goals of Sustainable Development, which refer to the contribution to protecting nature and the environment. The work is based on qualitative methods of comparative analysis of the description and purpose of individual competencies for project management to the purpose and indicators of sustainable development goals. The analysis results show that the existing competence framework better covers some SDGs but that there are also sustainable development goals that are, to a negligible extent, covered by the competencies of the project manager. The applicability of the research results lies in the contribution to developing the competence framework. This contributes to the quality of education in sustainable project management.
Keywords: Sustainable project management, education, competencies, Sustainable Development Goals, SDGs

Green Education / *Ekološko obrazovanje*
Oral presentation / *Usmeno priopćenje*

Kompetencije za održivost projekata i doprinos UN-ovim ciljevima održivog razvoja

Mario PROTULIPAC

Okviri znanja d.o.o., Vranyczanyeva ulica 6, Karlovac, Hrvatska

Sažetak

Integracija održivosti u obrazovanje u području projektnog menadžmenta sve je važnija kako raste potreba za primjenom načela održivog razvoja u pripremi i provedbi projekata. U specifičnom području upravljanja projektima i dalje je relativno malo prepoznatih kompetencija koje doprinose održivom projektnom menadžmentu. To znači da predviđeni ishodi učenja u području kompetencijskog okvira projektnog menadžmenta nisu usklađeni s, primjerice UN-ovim Ciljevima održivog razvoja (SDG). Svrha rada je istražiti raskorak između postojećih kompetencijskih okvira u projektnom menadžmentu sa ciljevima održivog razvoja koji se odnose na doprinos zaštiti prirode i okoliša. Rad se temelji na kvalitativnim metodama usporednih analiza opisa i svrhe pojedinih kompetencija za upravljanje projektima u odnosu na svrhu i pokazatelje ciljeva održivog razvoja. Rezultati rada pokazuju kako su pojedini SDG-jevi kvalitetnije pokriveni postojećim kompetencijskim okvirom, ali da također postoje ciljevi održivog razvoja koji su u zanemarivo pokriveni kompetencijama. S o projekti važan faktor u doprinosu pozitivnim promjenama, pa tako i doprinosu ciljevima i pokazateljima održivog razvoja, jačanjem kompetencija članova projektnog tima kompatibilnih sa UN-ovim SDG-jevima, povećava se vjerojatnost uspješnosti projekata u predmetnim sektorima. Zaključak je kako će se daljnjim razvojem kompetencija voditelja projekata poboljšati kvaliteta i uspješnost projekata koji izravno doprinose realizaciji predmetnih SDG-jeva, a primjenjivost rezultata istraživanja je u doprinosu razvoja kompetencijskog okvira. Time se doprinosi i kvaliteti obrazovanja u području održivog projektnog menadžmenta.

Ključne riječi: održivi projektni menadžment, obrazovanje, kompetencije, ciljevi održivog razvoja, SDGs

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Environmental education and sustainable development through music - the results of the project "Four Seasons: Synergy of Music and Ecology"

Antoaneta RADOČAJ-JERKOVIĆ, Majda ŠKRLEC, Anja PAPA

Josip Juraj Strossmayer University of Osijek, Academy of Arts and Culture in Osijek, Kralja Petra Svačića 1/F, Osijek, Croatia

Abstract
The current issues have emerged in the field of art and culture relating to new practices of sustainable development, based on three components - society, environment and economy. The Institute of Choral Music - Polifonija, which includes several best choir ensembles, has recognized the importance of sustainability and has designed the project “Four Seasons - synergy of Music and Ecology” in the field of non-institutional education. The project, conceived as an artistic activism, was successfully carried out in the course of 2021/2022 in cooperation with eight project partners. The project initiative of Polifonija was also recognized by the Ministry of Science and Education of the Republic of Croatia, which expressed its strong support for the project. The paper presents the results of the project comprising 24 creative workshops conducted in participation of 140 pupils from primary schools in Osijek-Baranja County. The following workshops were conducted: music-ecological workshops titled “Pjesma Planeti”("Songs to the Planet") focused on musical development of the participants and the promotion of the importance of environmental protection through music and choral singing; workshops under the title “Dječja ekologija” (“Children's ecology”) included the topics of sustainable development, preservation of biodiversity, water sources, and ecological gardening. The workshops conducted under the title “Jedem fino, jedem zdravo” ("I eat well, I eat healthy") aimed at raising awareness of the importance of a healthy diet and a healthy lifestyle. The result of the project was a recording of the new song titled “Šareni planet” (Planet of Plenty colors), for which audio recording in the studio and a video spot recording in the area of the Nature Park Kopački rit were done.
Keywords: environmental education through music, music and ecology, sustainability in art and culture, sustainable development, non-institutional education

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Ekološko obrazovanje i održivi razvoj kroz glazbu - predstavljanje rezultata projekta "Četiri godišnja doba: sinergija glazbe i ekologije"

Antoaneta RADOČAJ-JERKOVIĆ, Majda ŠKRLEC, Anja PAPA

Sveučilište Josipa Jurja Strossmayera u Osijeku, Akademija za umjetnost i kulturu u Osijeku, Kralja Petra Svačića 1/F, Osijek, Hrvatska

Sažetak

Nove prakse održivog razvoja, temeljene trima sastavnicama – društvom, okolišem i gospodarstvom predstavljaju vrlo aktualno pitanje u području umjetnosti i kulture. Institut za zborsku glazbu Polifonija, u sklopu kojeg djeluje više vrhunskih pjevačkih zborova, prepoznao je važnost održivosti te je u području izvaninstitucionalnog odgoja i obrazovanja osmislio projekt „Četiri godišnja doba – sinergija glazbe i ekologije". Projekt, koncipiran kao umjetnički aktivizam, proveden je i uspješno realiziran tijekom šk. god. 2021./2022. zajedno s osam projektnih partnera. Inicijativu Polifonije prepoznalo je i Ministarstvo znanosti i obrazovanja RH koje je projektu iskazalo snažnu potporu. U radu su prikazani rezultati projekta tijekom kojeg je održano 24 kreativne radionice, a u kojima je sudjelovalo 140 djece osnovnoškolskog uzrasta s područja OBŽ: glazbeno-ekološke radionice „Pjesma planeti" usmjerene na glazbeni razvoj sudionika te promociju važnosti očuvanja okoliša kroz glazbu i zborsko pjevanje; radionice „Dječja ekologija" koje su uključivale teme održivog razvoja, očuvanja bioraznolikosti, očuvanja vode, ekološkog vrtlarstva i slično te radionice „Jedem fino, jedem zdravo" koje su za cilj imale osvješćivanje važnosti zdrave prehrane te zdravijeg stila života. Kao rezultat projekta nastala je i nova pjesma „Planet šareni" za koju je, nakon studijskog audio snimanja, snimljen i glazbeni video spot u Parku prirode Kopački rit.

Ključne riječi: ekološko obrazovanje kroz glazbu, glazba i ekologija, održivost u umjetnosti i kulturi, održivi razvoj, izvaninstitucionalni odgoj i obrazovanje

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

The "Bees" project is an example from practice and the foundation of excellent education for the development of creativity

Aleksandra ROTAR

Sveučilište Jurja Dobrile u Puli, Fakultet za odgojne i obrazovne znanosti u Puli, Zagrebačka 30, Pula, Hrvatska

Abstract
The internal project of the Juraj Dobrila University, Pula, entitled "Bees", whose author and head was methodologist Assistant Professor Aleksandra Rotar, D.A., was run in the 2012 academic year. Art and cultural activities are founded on artistic language, communication is made with the elements that make up bees, different types of bees, their anatomy, using recent works by professional visual artists. After the introductory multimedia work, thoroughly prepared in advance by the students to motivate the children, the creation of works of art begins, using the planned technique, and during their work, the children pass through a phase of personal development, and their expressive creativity grows within them. All they have seen, experienced and tried accumulates within the children's subconscious as important elements that will be recognized in the future during their education as knowledge, maturity in creative work and other fields, not just in the field of artistic expression. In the methodology of art education, synergy is created between art and many other educational fields, whereby, through this interaction, complexity and layering are achieved of homogeneous and heterogeneous forms of expression. In the realization of the project, the most important part was the process itself, during which it was possible to achieve quality progress in the development of many layers of creativity, that is, productive, inventive, innovative, emergent creativity in all fields of life interest and occupation. Education, acquired skills, awareness and knowledge must be developed from the moment of birth and not just after a child reaches seven years of life. This paper gives an example of an artistic activity, realized by students.
Keywords: bees, education, project, methodology of fine arts

Green Education / *Ekološko obrazovanje*
Poster presentation / *Postersko priopćenje*

Projekt "Pčele" je primjer iz prakse i temelj odličnog odgoja i obrazovanja za razvoj kreativnosti

Aleksandra ROTAR

Sveučilište Jurja Dobrile u Puli, Fakultet za odgojne i obrazovne znanosti u Puli, Zagrebačka 30, Pula, Hrvatska

Sažetak

Interni projekt Sveučilišta Jurja Dobrile u Puli s naslovom „Pčele", čija je autorica i voditeljica metodičarka doc.art.dr.phil. Aleksandra Rotar, ostvaren je 2012. akad. godine. Likovne aktivnosti i kultura se temelje na likovnom jeziku, vrši se komunikacija s elementima od kojih je pčela sastavljena, vrstama, anatomijom, recentnim djelima profesionalnih likovnih umjetnika. Nakon uvodnog multimedijski ostvarenog dijela, unaprijed temeljito pripremljene motivacije djece od strane studenata, nastupa stvaranje likovnih djela predviđenom tehnikom a djeca tijekom rada prolaze kroz fazu osobnog razvoja, i u njima samima, rasta ekspresivne kreativnosti. Viđeno, proživljeno, iskušano, djeci se akumuliraju u podsvijesti kao važni elementi koji će u budućnosti biti prepoznati tijekom odgoja i obrazovanja kao znanje, zrelost u kreativnom radu i u drugim područjima, ne samo u području likovnog izražavanja. U metodici likovne kulture ostvaruje se sinergija mnogih odgojno-obrazovnih područja s likovnim, tako se kroz interaktivnost postiže kompleksnost i slojevitost homogenih i heterogenih načina izražavanja. U projektu najbitniji je bio sam proces, tijekom kojega je moguće ostvariti kvalitetan napredak u razvoju sve viših stupnjeva kreativnosti, tj. produktivne, inventivne, inovativne, emergentne kreativnosti iz svih područja životnih zanimanja. Odgoj, stjecanje umijeća, svijesti i znanja razvijati je nužno od rođenja djece a ne tek od sedme godine života. U radu se navodi primjer jedne likovne aktivnosti ostvarene od strane studentica.

Ključne riječi: pčele, odgoj, obrazovanje, projekt, metodika likovne kulture

Green Technology
Zelene tehnologije

Green Technology / *Zelene tehnologije*
Poster presentation / *Postersko priopćenje*

Thermal stability of hesperidin-microcapsules drug delivery systems prepared through an entirely green route

Marija BANOŽIĆ[1], Krunoslav ALADIĆ[2], Małgorzata KRZYWONOS[3], Hanna PIŃKOWSKA[4], Igor MUCHA[5], Adrianna ZŁOCIŃSKA[5], Stela JOKIĆ[2]

[1] University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule bb, Mostar, Bosnia and Herzegovina
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[3] Wroclaw University of Economics and Business, Business and Management Faculty, Komandorska 118/120, Wroclaw, Poland
[4] Wroclaw University of Economics and Business, Faculty of Production Engineering, Komandorska 118/120, Wroclaw, Poland
[5] Wroclaw Medical University, Faculty of Pharmacy, Borowska 211A, Wroclaw, Poland

Abstract
Citrus peel forms around 40–50% of the total citrus fruit mass but is generally considered a waste. However, it is a substantial source of naturally occurring health-enhancing compounds, particularly hesperidin as a main phenolic compound. In this study, citrus peel extracts were produced with 70% ethanol as a solvent using ultrasound-assisted extraction while the microcapsules were produced using spray and freeze drying. Thermogravimetric analysis was carried out using a TG 209 F1 thermobalance with a heating rate of 10 K/min in the temperature range of 25–900 °C. Obtained microcapsules containing hesperidin delivered from citrus peel predominantly decomposed in two steps. Hesperidin microcapsules started decomposing at temperatures between 111-285°C with a maximum of decomposition at temperatures between 201 and 214°C. The second stage of decomposition occurred at the temperature range from 228 to 593°C with a maximum of decomposition between 300 and 331°C. Encapsulated pure hesperidin was thermally stable up to the temperature of 212°C. One of the most crucial properties of microcapsules is thermal stability. It can be used to objectively assess the encapsulation efficiency as well as qualitatively judge whether the microencapsulation was successful. The thermal stability of microcapsules is critical for the design, preparation, and application of microcapsules in food products, food supplements, cosmetic and functional materials.
Keywords: hesperidin, citrus peel, thermal stability, microcapsule

Green Technology / *Zelene tehnologije*
Poster presentation / *Postersko priopćenje*

Application of green technologies in nature protection

Ivo BAŠIĆ[1], Mateja PETRAČIĆ[2]

[1] Public Institution Nature Park Kopački rit, Mali Sakadaš 1, Kopačevo, Bilje, Croatia
[2] Karlovac University of Applied Sciences, Trg J.J. Strossmayera 9, Karlovac, Croatia

Abstract
The name "green technology" or ecological technology includes, for example, devices, means and equipment, technical and technological procedures for environmental protection, or for reviving, recycling and repairing already damaged ecosystems. Today, green technologies have applications in many areas of activity. They can be implemented in private and business areas. Their role is, in addition to reducing costs, to increase social responsibility, especially in the context of nature and environmental protection. For this reason, green technology solutions are increasingly supported and implemented in business practice. Companies that base their business on the principle of social responsibility place special emphasis on the use of green technologies in production and service processes, as well as in the final products of their work. Green technologies relate to digital technology and the interaction of green and digital solutions increases the efficiency of technological processes, products, and services. The aim of this paper is to contribute to increasing environmental awareness and highlight the benefits of using green technologies in business. Given that conventional technological solutions have proven to be environmentally unacceptable in many areas, and digital technology has greatly enabled the development of green technologies, a great opportunity has been created to combine these two technologies and implement them in corporate social responsibility.
Keywords: nature protection, corporate social responsibility, environment, green technology

Green Technology / *Zelene tehnologije*
Poster presentation / *Postersko priopćenje*

Primjena zelenih tehnologija u zaštiti prirode

Ivo BAŠIĆ[1], Mateja PETRAČIĆ[2]

[1] Javna ustanova Park prirode Kopački rit, Mali Sakadaš 1, Kopačevo, Bilje, Hrvatska
[2] Veleučilište u Karlovcu, Trg J.J. Strossmayera 9, Karlovac, Hrvatska

Sažetak

Naziv „zelena tehnologija“ ili ekološka tehnologija podrazumijeva primjerice naprave, sredstva i opremu, tehničke i tehnološke postupke za zaštitu okoliša ili za ponovno oživljavanje, recikliranje i popravak već oštećenih eko-sustava. Zelene tehnologije danas imaju primjenu u brojnim područjima djelovanja. One se mogu implementirati u privatnu i poslovnu okolinu. Njihova uloga je, osim smanjenja troškova, povećanje društvene odgovornosti, posebno u kontekstu zaštite prirode i okoliša. Iz navedenog razloga zelena tehnološka rješenja sve više se podržavaju i implementiraju u poslovnu praksu. Poduzeća koja svoje poslovanje temelje na principu društvene odgovornosti poseban naglasak stavljaju na korištenje zelenih tehnologija u proizvodnim i uslužnim procesima, kao i u krajnjim produktima njihovog rada. Zelene tehnologije povezane su sa digitalnom tehnologijom te interakcijom zelenih i digitalnih rješenja povećava se sama učinkovitost tehnoloških procesa, proizvoda i usluga. Cilj ovog rada je dati doprinos u povećanju svjesnosti o zaštiti okoliša te istaknuti dobrobiti korištenja zelenih tehnologija u poslovanju. S obzirom kako su se konvencionalna tehnološka rješenja u brojnim područjima pokazala kao ekološki neprihvatljiva, a digitalna tehnologija je uvelike omogućila razvoj zelenih tehnologija stvorila se velika mogućnost za spajanjem tih dviju tehnologija te implementaciji u društveno odgovornom poslovanju.

Ključne riječi: zaštita prirode, društveno odgovorno poslovanje, okoliš, zelena tehnologija

Green Technology / *Zelene tehnologije*
Poster presentation / *Postersko priopćenje*

Bioremediation and sustainability in Croatia

Barbara BERTOVIĆ[1], Barbara TONKOVIĆ[1], Juraj LAZIĆ[1], Marija VUKOVIĆ DOMANOVAC[2]

[1] STSI – Integrirani tehnički servisi d.o.o., Lovinčićeva 4, Zagreb, Croatia
[2] University of Zagreb, Faculty of Chemical Engineering and Technology, Marulićev trg 19, Zagreb, Croatia

Abstract
INA d.d. is a European petroleum company active in oil and gas exploration, refining and distribution, basing its growth on the principles of sustainable development, recognizing hydrocarbon pollution of petroleum as a significant risk. In 2015, STSI began bioremediating soils as a member of the INA Group, and to date, approximately 15,000 tonnes of contaminated soil have been cleaned to the point where it can be meaningfully reused in the environment. In this work presents the bioremediation process of soils excavated during the remediation of two gasoline stations where the initial concentration of total petroleum hydrocarbons was (1) 1,694.6 mg/kg and (2) 1,159.4 mg/kg. Ex-situ bioremediation with commercial bacterial products was conducted under optimal environmental conditions. The fact that the purification process took longer for soils with lower pollutant concentrations (2) shows the complexity of the process, which is significantly affected by soil composition. A high percentage of clay fraction significantly reduced the bioavailability of the pollutants, so the process stagnated until the addition of sawdust increased the looseness of the soil and the process was successfully completed. STSI has successfully implemented bioremediation, an environmentally friendly technology, and our goal is to further develop this method.
Keywords: bioremediation, soil, petroleum hydrocarbon, sustainable development, green technology

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Bioremediation potential of hydrocarbon-degrading bacteria from oil-contaminated soils

Barbara BERTOVIĆ[1], Nolla TODOROVIĆ[2], Ivan ZGREBEC[2], Monika ŠABIĆ RUNJAVEC[2], Marija VUKOVIĆ DOMANOVAC[2]

[1] STSI – Integrirani tehnički servisi d.o.o., Lovinčićeva 4, Zagreb, Croatia
[2] University of Zagreb, Faculty of Chemical Engineering and Technology, Marulićev trg 19, Zagreb, Croatia

Abstract
The release of oil into the environment is considered a pervasive problem and is usually the result of oil exploration, accidents, transportation, and releases from waste disposal or storage sites, or from industrial facilities. Compared to traditional and costly techniques, there is a great need to promote environmentally friendly and cost-effective methods of cleaning up oil-contaminated sites, such as bioremediation. Bioremediation is an attractive and promising alternative because it can selectively degrade pollution without affecting the natural features of the site and the flora and fauna that live there. The oil-polluted environment is enriched with microorganisms. Microbiological studies of the soil can provide information about the presence of viable microorganisms and the effects of pollution on their metabolic activity. Some microorganisms, such as bacteria, develop resistance to hydrocarbons and can use them as a carbon source. Characterization of bacterial strains living in oil-polluted areas can help improve the efficiency of bioremediation. The aim of this work is to characterize autochthonous microorganisms that have a high ability to degrade hydrocarbons from soils contaminated with oil and oil derivatives. Based on the evaluation of efficiency, isolates will be selected for bioaugmentation to improve bioremediation.
Keywords: bioremediation, hydrocarbon-degrading bacteria, soil, bioaugmentation

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Recovery of cellulose fibers by processing prints with innovative inks on a printing substrate with *Ulva sp*

Ivana BOLANČA MIRKOVIĆ[1], Zdenka BOLANČA[2], Goran MEDEK[3]

[1] University of Zagreb, Faculty of Graphic Arts, Getaldićeva 2, Zagreb, Croatia
[2] Croatian Academy of Engineering, Kačićeva 48, Zagreb, Croatia
[3] Lana Karlovačka tiskara d.d., Bnija ul. 127, Karlovac, Croatia

Abstract
The concept of circular sustainability is significant for the development of printing and includes material and energy flows, closed-loop systems, and cleaner technologies, economic and social factors, implementation of social values and quality. Environmental awareness and the aspect of safety play an important role in the innovation and development of printing technologies for the future. To monitor the efficiency of resource use and the effectiveness of the management system, the life cycle of the product should be considered and included in the planning and design starting from the early phase of the circular design of the graphic product. The paper presents the results of research into the characteristics of laboratory-made paper sheets obtained from the pulp after the recovery of offset prints with different percentages of renewable raw materials in inks, on a printing substrate with a certain percentage of *Ulva sp* algae from the Adriatic Sea. One series of prints is varnished with water-dispersive varnish, and the other with UV drying varnish. The results of the research, in addition to the scientific contribution in the field of substrate/ ink/ varnish interaction, are significant in producing graphic materials for the new formulation. The possibility the reusing the cellulose fibers obtained by our method is significant as a contribution to the field of waste disposal with special emphasis on a closed loop system, as a premise of circular ecological sustainability.
Keywords: recovery, offset prints, innovative inks, a printing substrate with algae

Oporaba celuloznih vlakanaca obradom otisaka s inovativnim bojama na tiskovnoj podlozi s algom *Ulva sp*

Ivana BOLANČA MIRKOVIĆ[1], Zdenka BOLANČA[2], Goran MEDEK[3]

[1] Sveučilište u Zagrebu, Grafički fakultet, Getaldićeva 2, Zagreb, Hrvatska
[2] Akademija tehničkih znanosti Hrvatske, Kačićeva 48, Zagreb, Hrvatska
[3] Lana Karlovačka tiskara d.d., Bnija ul. 127, Karlovac, Hrvatska

Sažetak

Pojam cirkularne održivosti značajan je za razvoj tiskarstva, a uključuje tokove materijala i energije, zatvorene sustave, čistije tehnologije, ekonomske i socijalne čimbenike, provedbu društvenih vrijednosti i kvalitete. Svijest o okolišu i aspekt sigurnosti igraju važnu ulogu u inovacijama i razvoju tiskarskih tehnologija za budućnost. Za praćenje učinkovitosti korištenja resursa i učinkovitosti sustava upravljanja okolišem treba uzeti u obzir životni ciklus proizvoda i uključiti ga u planiranje i projektiranje počevši od rane faze cirkularnog dizajna grafičkog proizvoda. U radu se prikazuju rezultati istraživanja karakteristika laboratorijski izrađenih listova papira dobivenih od pulpe nakon oporabe ofsetnih otisaka s grafičkim bojama s različitim udjelom obnovljive sirovine na tiskovnoj podlozi s određenim udjelom alge *Ulva sp* iz Jadranskog mora. Jedna serija otisaka lakirana je s vododisperivnim lakom, a druga s UV sušećim lakom. Rezultati istraživanja osim znanstvenog doprinosa u području interakcije podloga/boja /lak značajni su za proizvodnju grafičkih materijala novih formulacija. Mogućnost ponovnog korištenja celuloznih vlakanaca dobivenih našom metodom značajna je kao prilog u području zbrinjavanja otpada s posebnim naglaskom na zatvaranje kružnog toka, kao premisom cirkularne ekološke održivosti.

Ključne riječi: oporaba, ofsetni otisci, inovativne boje, tiskovna podloga s algom

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Formulation of quantitative indicators for comparative assessments of floating mariculture systems

Tena BUJAS, Manuela VUKIĆ, Marija KORIČAN, Ivan ĆATIPOVIĆ, Nikola VLADIMIR

University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, I. Lučića 5, Zagreb, Croatia

Abstract
Bearing in mind new trends highly focused on the environment and sustainability, alternative technologies for improving aquaculture production need to be studied. Sustainable food production is defined as the long-term management of resources and ecosystems to fulfill changing human needs and maintain or improve environmental quality. Following the "three pillar model", environmental, economic, and social factors are included in forming KPIs. Key Performance Indicators (KPIs) are quantitative indicators that represent an aquaculture production's environmental and economic performance. They are an evaluation tool for analyzing the success of the production, to achieve environmental, economic, and social goals. Therefore, it would be good to take KPIs into account when establishing aquaculture production and during its maintenance. The fish farming process is divided into four phases: fish breeding with associated activities, transportation, and handling of grown fish with associated operations, processing in the factory, and delivery to customers. Improvement activities in aquaculture are mostly focused on one task, either environmental improvement or higher profits. Based on the case study for an aquaculture farm, economic, social, and environmental factors are analyzed and discussed as profitable production considering the model of sustainability. All the results are based on 20 years of production, which consists of 10 production cycles. KPIs are calculated for conventional and alternative aquaculture systems.
Keywords: aquaculture, sustainability, economic, environment, society, Key Performance Indicators

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Ultrasound-assisted extraction to obtain sugars from olive leaves

Maja DENT, Dolores ŠAŠKO

University of Zagreb, Faculty of Food Technology and Biotechnology University of Zagreb, Pierottijeva 6, Zagreb, Croatia

Abstract
Olive leaves are produced in large quantities as agricultural waste resulting from the harvesting or processing of olive fruits. From an economic point of view, olive leaves are an excellent source of phytochemicals and an environmentally friendly source of sugar. The aim of this study was to investigate the influence of ultrasound-assisted extraction conditions (solvent type: water and ethanol/water (30 and 50%, *v/v*); extraction time: 5 - 40 min) on the yield of total sugars from olive leaves. The study shows that ultrasound-assisted extraction can be successfully used to obtain sugars from olive leaves. The average values for total sugars in the olive extracts ranged from 4.9% to 15%. The use of water alone as an extractant gave results comparable to those obtained with ethanol/water (30% and 50%, *v/v*). The yield of total sugars in olive leaves increased with the concentration of ethanol (30 to 50%, *v/v*). Longer extraction times did not affect the total sugars content, the best extraction time being 5 min. Notably, the best results were obtained with water/ethanol (50%, *v/v*) after only 5 min of ultrasound-assisted extraction. The results indicate that ultrasound-assisted extraction is a good choice for obtaining sugars from olive leaves.
Keywords: olive leaves, ultrasound-assisted extraction, total sugars

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Green Deal inspired characterization for safety profiling of 2D materials (ACCORDs)

Damjana DROBNE, Eva KRANJC, Sara NOVAK

University of Ljubljana, Biotechnical Faculty, Department of Biology, Večna pot 111, Ljubljana, Slovenia

Abstract
The ACCORDs project is funded by the European Union's Horizon Europe programme and aims to develop advanced characterization methods for assessing and predicting the health and environmental risks of 2D nanomaterials. The project is part of the "Digital and Emerging Technologies for Competitiveness and Fit for the Green Deal" call, which aims to drive Europe's competitiveness and sustainability. The ongoing development of nano-, advanced, smart materials and their commercial success require the development of reliable and cost-effective strategies that include safe and sustainable-by-design (SSbD) production, effective risk assessments along the life cycle of a product and the development of appropriate regulatory guidelines. Europe, for example, has successfully brought graphene innovation out of the laboratory and into many commercial products. This has led to increased human and environmental exposure from the use of these materials. However, further commercialization will also depend on tools to ensure the safe and sustainable use of nanomaterials. In this context, the motivation of the ACCORDs project is to develop a holistic, reliable and practical characterization framework that correlates 2D material characterization methods with their toxicity, thus supporting the commercialization of products containing graphene or other 2D materials.
Keywords: 2D materials, material characterization, imaging

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Textural properties of ultrasonic-assisted vacuum-dried *Cucurbita moschata* squash

Filip DUJMIĆ, Sven KARLOVIĆ, Marko ŠKEGRO, Damir JEŽEK, Mladen BRNČIĆ

University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia

Abstract
Mechanical properties of dried food and foodstuffs such as hardness, elasticity, stress, and strain, as well as several others, have a very important role in further processing steps in the food industry. This is especially the case when novel technologies are introduced in the drying process. Non-thermal technologies such as high-intensity ultrasonics can have a significant influence on the textural properties of food, and they can be used before, during, or after the drying of food. From the sustainability aspect of industry processes, ultrasonics can shorten drying time and enable drying at lower temperatures than usual. Both those properties contribute to less energy usage and significantly less waste production. This study investigated the effect of ultrasonic pre-treatment and vacuum drying of squash on its mechanical properties such as hardness and elasticity. Squash pieces were cut into cubes and processed at 480 W in the ultrasonic bath for 30 min, 45 min, and 60 min. Drying is conducted at 0.1, at 60°C Statistical analysis of control samples (without ultrasonic treatment) shows that the hardness was 24.09 ± 0.86 N and elasticity 2.61± 0.17 N. Shortest processing time (30 min) shows a slight decrease in hardness (20.26 ± 2.08 N), which can be contributed to starting of breaking of the cellular matrix due to the cavitation effect of ultrasonic waves. Further increase of processing time for 45 and 60 min did not show any statistically significant difference in hardness and elasticity compared to the control, which is a clear sign that the processing time of 30 to 45 min is optimal for obtaining wanted textural properties. Elasticity is in direct correlation to the length of ultrasonic treatment, which had a statistically relevant positive influence. Observed changes in elasticity from 2.61 ± 0.17 N in control to maximal 1.94 ± 0.10 N for samples treated at 60°C are also a consequence of mechanical and thermal effects of ultrasonic cavitation on cellular matrix and cell walls. Since there are no significant changes in elasticity after 45 min of processing time, it can be concluded based on both investigated properties that the optimal processing time was 45 min. Ultrasonic pre-treatment combined with vacuum drying has great potential in the drying industry, as it can produce dried pumpkin products using less amount of energy and less waste, and simultaneously retaining desired textural properties.
Keywords: pumpkin, drying ultrasonics textural properties

Acknowledgments: The work was supported by the Croatian Science Foundation (research project "Hybrid drying and valorization of plant food waste and by-products" IP-2019-04-9750) HYDRYBY.

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Characterization of biopolymer-coated plastic sheet enriched with clove essential oil

Domagoj GABRIĆ[1], Mia KUREK[1], Mario ŠČETAR[1], Mladen BRNČIĆ[1], Mario BOŽIĆ[2], Kata GALIĆ[1]

[1] University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia
[2] Procesteh d.o.o., Ul. Kreše Golika 3, Zagreb, Croatia

Abstract
Barrier (gas and water vapor), optical and antioxidative properties of polylactic sheet coated with chitosan and gelatin, and enriched with clove essential oil were analyzed. This material was produced aiming to replace traditional plastic multilayer films (like oriented poly(ethylene-terephthalate)/polypropylene (PET-O/PP), that are hardly or no recyclable and present a significant environmental concern. Nowadays packaging materials should be designed and used by boosting the efficient use of resources toward a clean and circular economy with less waste. The knowledge on barrier performance is important from the point of view of product stability, and consequently product shelf-life. Commercially available biobased materials often lack sufficient barrier needed for use in food preservation. Thus, by blending two or more biobased polymers it is possible to improve the barrier properties. In addition, by adding functional compounds it is possible to make antioxidant biobased films aimed at improving the oxidation stability of packed products. Chitosan and gelatin, produced from the wasted agro/biomass were used as a protective coating matrix for clove essential oil. Further, clove was used because of the powerful antioxidants contained in its phenolic profile. Commercial PET-O/PP was used as a control.
Keywords: biobased coating, barrier, antioxidative and optical properties

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Analysis of particles in the effluent from washing the biopolymer structure chitosan/polyester

Mirjana ČURLIN[1], Tea KAURIN[2], Tanja PUŠIĆ[2], Branka VOJNOVIĆ[2], Agata VINČIĆ[2]

[1] University of Zagreb Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia
[2] University of Zagreb Faculty of Textile Technology, Prilaz baruna Filipovića 28 a, Zagreb, Croatia

Abstract
Washing of textiles made of polyester (PES) and biopolymeric chitosan-polyester structures was performed in five cycles according to the standard procedure using ECE A detergent. The washing effluents were analyzed by standard physicochemical methods and by the laser diffraction method to determine the particle size distribution. The obtained parameters of the distribution curve (D10, D50, D90) in the effluent from the washing of the chitosan/polyester biopolymer structure show differences in comparison with standard textiles PES. The analysis of the evaluation of the particles in the effluent from the washing of biopolymer structures and the contribution of the effects of chitosan treatment will contribute to the knowledge of environmental protection from pollution by microfiber particles.
Keywords: washing process, chitosan/polyester structure, particle release, laser diffraction, particle size distribution

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Analiza čestične tvari u efluentu od pranja biopolimerne strukture kitozan/poliester

Mirjana ČURLIN[1], Tea KAURIN[2], Tanja PUŠIĆ[2], Branka VOJNOVIĆ[2], Agata VINČIĆ[2]

[1] Sveučilište u Zagrebu, Prehrambeno-biotehnološki fakultet, Pierottijeva 6, Zagreb, Hrvatska
[2] Sveučilište u Zagrebu, Tekstilno-tehnološki fakultet, Prilaz baruna Filipovića 28 a, Zagreb, Hrvatska

Sažetak
Proces pranja poliesterske (PES) tekstilije te biopolimerne strukture kitozan/poliester proveden je u pet ciklusa prema standardnom postupku uz ECE A deterdžent. Efluenti od pranja analizirani su standardnim fizikalno kemijskim metodama te primjenom metode laserske difrakcije za određivanje raspodjele veličina čestične tvari. Dobiveni parametri krivulje raspodjele (D_{10}, D_{50}, D_{90}) u efluentima od pranja biopolimerne strukture kitozan/poliester pokazuju razlike u odnosu na standardnu PES tekstiliju. Analiza procjene čestične tvari u efluentu od pranja biopolimerne strukture te doprinos utjecaja obrade kitozanom doprinjet će spoznajama u zaštiti okoliša od onečišćenja česticama mikrovlakana.
Ključne riječi: proces pranja, kitozan/poliester struktura, čestična tvar, laserska difrakcija, raspodjela veličina čestica

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Comparative analysis of *Salix fragilis* bark extracts obtained by different green extraction techniques

Emilia GLIGORIĆ[1], Ružica IGIĆ[2], Ljiljana SUVAJDŽIĆ[1], Branislava TEOFILOVIĆ[1], Nevena GRUJIĆ[1]

[1] University of Novi Sad, Faculty of Medicine, Department of Pharmacy, Hajduk Veljkova 3, Novi Sad, Serbia
[2] University of Novi Sad, Faculty of Sciences, Department of Biology and Ecology, Trg Dositeja Obradovića 2, Novi Sad, Serbia

Abstract
Nowadays, as environmental awareness is rising, there has been a global trend towards the utilization of environmentally friendly, green extraction techniques. Microwave-assisted extraction (MAE) and ultrasound-assisted extraction (UAE) are simple, inexpensive, eco-friendly extraction techniques, which are a good alternative to conventional solid-liquid extraction. Bark of *Salix fragilis* is an herbal remedy with analgesic, antipyretic and anti-inflammatory properties. The aim of this study was to compare the phenolic compounds profile of willow bark extracts obtained by MAE and UAE. MAE was carried out in a microwave oven for 5 min, while UAE in an ultrasonic bath at 25°C and 40 kHz for 30 min. Water was used as the solvent. Chemical characterization of extracts was performed by HPLC methods. In the analyzed extracts 11 bioactive compounds were quantified: the salicylic glycoside salicin, phenolic acids gallic, chlorogenic, p-hydroxybenzoic, vanillic, syringic and trans-cinnamic acids, as well as flavonoids epicatechin, rutin, quercetin and naringenin. Dominant compounds in extracts were chlorogenic acid, salicin and epicatechin. Significantly more salicin, gallic, chlorogenic and trans-cinnamic acid were found in the extract obtained by UAE, while *p*-hydroxybenzoic, syringic acid, epicatechin and rutin in that obtained by MAE. Significant amounts of phenolic compounds could be achieved by both green extraction techniques.
Keywords: *Salix*, ultrasound-assisted extraction, microwave-assisted extraction, phenolics

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Application of coatings based on chitosan and eucalyptol in the protection of steel against acid corrosion

Jasna HALAMBEK, Ivan ŠTIGLIĆ, Ines CINDRIĆ

Karlovac University of Applied Sciences, Trg J.J. Strossmayera 9, Karlovac, Croatia

Abstract
Corrosion is a spontaneous process that cannot be completely prevented but can be slowed down by applying different methods. The most common method of protecting metal from corrosion is the application of coatings, so today almost 3/4 of metal structures are protected with organic coatings. In addition to effective corrosion protection, modern coatings are also expected to be environmentally friendly. The ecological acceptability of organic coatings began to be applied by banning the use of toxic and carcinogenic pigments and inhibitors, limiting emissions of volatile organic compounds, and using solvents that are not flammable and do not have a harmful effect on human health. Nowadays, coatings based on natural polymers that are soluble in water, and which also contain active chemical compounds such as corrosion inhibitors, are being researched more and more. One of such polymer is chitosan, which in acidic aqueous solutions has an excellent ability to form a film, so it is suitable for use in various areas of protective coatings. In this work, the possibility of applying a coating based on chitosan with the addition of eucalyptol as protection of steel against acid corrosion was examined. The physico-chemical properties of the prepared coatings were determined, and the corrosion rate of steel samples in a 5% hydrochloric acid solution was determined gravimetrically. The surface roughness of all tested samples was determined, while the surfaces of the steel samples were examined with an optical metallographic microscope.
Keywords: chitosan, coatings, corrosion, eucalyptol, steel

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Primjena premaza na bazi kitozana i eukaliptola u zaštiti čelika od kiselinske korozije

Jasna HALAMBEK, Ivan ŠTIGLIĆ, Ines CINDRIĆ

Veleučilište u Karlovcu, Trg J.J. Strossmayera 9, Karlovac, Hrvatska

Sažetak
Korozija je spontani proces koji se ne može u potpunosti spriječiti, ali se može usporiti primjenom različitih metoda. Najzastupljenija metoda zaštite metala od korozije je nanošenje premaza i prevlaka, pa je tako danas organskim premazima zaštićeno gotovo 3/4 metalnih konstrukcija. Osim učinkovite zaštite od korozije, od suvremenih premaza očekuje se i ekološka prihvatljivost. Ekološka prihvatljivost organskih premaza počela se primjenjivati zabranom upotrebe toksičnih i kancerogenih pigmenata i inhibitora, ograničavanjem emisija hlapivih organskih spojeva, te korištenjem otapala koja nisu zapaljiva i koja nemaju štetan utjecaj na ljudsko zdravlje. Danas se sve više istražuju premazi na bazi prirodnih polimera koji su topljivi u vodi, a koji sadrže i aktivne kemijske spojeve kao što su inhibitori korozije. Jedan od takvih polimera je kitozan koji u kiselim vodenim otopinama ima izvrsnu sposobnost stvaranja filma pa je pogodan za primjenu u različitim područjima zaštitnih premaza. U ovom radu ispitana je mogućnost primjene premaza na bazi kitozana uz dodatak eukaliptola kao zaštita čelika od kiselinske korozije. Pripremljenim premazima određena su fizikalno-kemijska svojstva te je gravimetrijski određena brzina korozije uzoraka čelika u 5 % otopini solne kiseline. Svim ispitivanim uzorcima određena je hrapavost površine, te su ispitane površine uzoraka čelika optičkim metalografskim mikroskopom.
Ključne riječi: čelik, eukaliptol, kitozan, korozija, premazi

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Supercritical extraction of wild edible mushrooms (*Morchella steppicola* and *Macrolepiota procera)* and their lipid composition

Slađana KRIVOŠIJA[1], Igor JERKOVIĆ[2], Aneta RONDOVIĆ[1], Jelena KNEŽEVIĆ[1], Stela JOKIĆ[3], Krunoslav ALADIĆ[3], Mirjana SULEJMANOVIĆ[1]

[1] University of Novi Sad, Faculty of Technology Novi Sad, Boulevard cara Lazara 1, Novi Sad, Serbia
[2] University of Split, Faculty of Chemistry and Technology, N. Tesle 10/V, Split, Croatia
[3] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhaca 18, Osijek, Croatia

Abstract
Due to the presence of nutritional compounds in large amounts, mushrooms are well-known as a functional food. Their nutritional value is reflected in the presence of a large amount of fiber and nutrients such as proteins, vitamins and minerals, with a low fat and calorie content. Also, mushrooms contain bioactive compounds such as polysaccharides, glycoproteins and various secondary metabolites (polyphenols, alkaloids, sterols, etc.) which show hepatoprotective, anticancer, antiviral and other properties. Traditional methods that can be used to isolate these compounds have a number of disadvantages such as the use of a large amount of organic solvents, long extraction time, high cost, low efficiency and negative impact on the environment. In order to eliminate these drawbacks, attractive methods such as supercritical extraction (SFE-CO_2) have been developed. SFE-CO_2 is not only faster and more efficient but also prevents the degradation of thermolabile compounds, avoiding the use of toxic solvents, and enabling the production of solvent-free extracts. Therefore, in this study, the efficiency of Soxhlet extraction, as a conventional method, and SFE-CO_2 as an advanced method for the isolation of bioactive compounds from two species of mushrooms (*Morchella steppicola* and *Macrolepiota procera*) was examined. During the SFE-CO_2 process, the extraction time was reduced to 4h, the temperature was kept constant (40^{o}C), and the extraction pressure (100-300 bar) was varied. The obtained extracts were analyzed using GC-MS method. The dominant compounds identified by GC-MS were fatty acids (linoleic and hexadecanoic, followed by hexanoic and octanoic acid).
Keywords: mushrooms, supercritical extraction, GC-MS analysis, fatty acids

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Evaluation of changes at the fibers' molecular scale after an increased number of drying cycles

Branko NERAL, Manja KUREČIČ

University of Maribor, Faculty of Mechanical Engineering, Smetanova ulica 17, Maribor, Slovenia

Abstract

Textile laundering and drying are the most common household tasks. 78.8% of EU28 households own a tumble dryer, which they use 2.05 times/week. In addition to significant energy consumption (143 PJ/year) and greenhouse gas emissions (6.5 MT CO2- eq/year), the household drying process is also a source of other pollutants such as wastewater, microfibers, which are released into the air during and after the drying process and contaminate a household environment. The fact is that existing household textile tumble-drying procedures are based on intensive and sometimes even aggressive mechanical actions such as beating, falling, and rubbing of the fabric itself or with the metal surface of the perforated drying drum. These factors can cause damage down to the molecular scale of fabrics and thus, consequently, shorten the lifespan of household textiles and, at the same time, increase textile waste. One of the research phases of the "Low emission household tumble-drying with an evaluation of damage to textile materials", project was dedicated to investigating and evaluating changes at the fibres' molecular scale after increased dying cycles with the help of X-ray diffraction (XRD) analytical method. The research was focused on the most used fabrics, such as cotton, PES, PES/cotton blend and viscose.

Keywords: textiles, tumble-drying, XRD

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Preliminary research: The phenolic content of grape seeds of the most common grape varieties grown in Istrian vineyards

Martina PERŠIĆ, Slavica DUDAŠ, Melita ZEC-VOJINOVIĆ, Marin TOMIČIĆ

Polytechnic of Rijeka, Vukovarska ulica 58, Rijeka, Croatia

Abstract
Waste management is an important goal for sustainable agriculture and the circular economy. In wine production, grape pomace (the solid residue after pressing and/or fermentation of the grapes) is a by-product generated in large amounts. Traditionally, grape pomace has been used to make distilled spirits, as a fertilizer or animal feed. In recent decades, it has been recognized as a valuable substrate for the extraction of a wide range of substances used in the pharmaceutical and food industry. In this preliminary research, the phenolic content of the grape seeds of the most common Istrian grape varieties has been studied. The results show that the highest content of phenolic compound was in the grape seeds of the 'Teran' variety, and the lowest content was measured in the seeds of 'Cabernet Sauvignon'. In the 'Merlot' variety, the extraction of phenolics from the seeds is 92% higher after maceration and fermentation. Additionally, various extraction solvents have been studied to assess their efficiency. Among the studies, the best extraction method for extracting phenolic compounds from grape seeds was cooking in water.
Keywords: tannins, grapevine seeds, phenolics, grape pomace

Green Technology / *Zelene tehnologije*
Poster presentation / *Postersko priopćenje*

Preliminarno istraživanje: Sadržaj ukupnih fenola u sjemenkama grožđa najzastupljenihijih sorti vinove loze u istarskim vinogradima

Martina PERŠIĆ, Slavica DUDAŠ, Melita ZEC-VOJINOVIĆ, Marin TOMIČIĆ

Veleučilište u Rijeci, Vukovarska 58, Rijeka, Hrvatska

Sažetak
Gospodarenje otpadom je jedan od integralnih ciljeva održive poljoprivrede i kružne ekonomije. U proizvodnji vina, vinska komina (kruti ostatak nakon prešanja i/ili fermentacije grožđa) je nusproizvod koji se pojavljuje u značajnim količinama. Tradicionalno se komina grožđa koristila za proizvodnju destiliranih alkoholnih pića ili kao gnojivo i stočna hrana. Posljednjih desetljećaje vinska komina prepoznata kao vrijedan supstrat za ekstrakciju širokog spektra sekundarnih metabolita koje se koriste u farmaceutskoj i prehrambenoj industriji. U ovom preliminarnom istraživanju proučen je sadržaj ukupnih fenola u sjemenkama grožđa najčešćih istarskih sorti vinove loze. Rezultati pokazuju da najveći sadržaj fenolnih spojeva imaju sjemenke grožđa sorte 'Teran', a najmanje ‘Cabernet Sauvignon’. Kod sorte ‘Merlot’ ekstrakcija fenola iz sjemenki je 92 % veća nakon maceracije i fermentacije. Dodatno, proučavana su različita ekstrakcijska otapala kako bi se procijenila njihova učinkovitost. Među proučavanima, najbolja ekstrakcijska metoda za ekstrakciju ukupnih fenolnih tvari iz sjemenki grožđa je bila kratko prokuhavanje u vodi.
Ključne riječi: tanini, sjemenke grožđa, fenoli, komina

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Measurements of EM radiation propagation through biomaterial samples based on harvest residues

Slavko RUPČIĆ[1], Maja VARGA[1], Đurđica KOVAČIĆ[2]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, Kneza Trpimira 2b, Osijek, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
All life on Earth has been exposed to electromagnetic (EM) radiation since its inception, which until 150 years ago came exclusively from various natural sources, and since then numerous man-made sources of this radiation have been added. The increasing number of radiation sources has led to concern about the exposure of living things to this radiation and about normalization and control of radiation levels. The most effective method of protection from EM radiation is electromagnetic shielding with materials that reduce the propagation of waves through EM. The subject of this research is EM radiation absorbers based on biomaterials from crop residues: soybean straw, wheat straw, and alfalfa straw, which can be used for additional protection (or construction) of residential buildings. In order to determine their protective properties, the transmission parameter S21 was measured through the mentioned samples in the frequency range from 30 MHz to 5 GHz. The parameters of the measured samples that were examined are sample type, sample thickness (10 cm (weight 3.8 kg), 20 cm (weight 7.6 kg), 30 cm (weight 11.4 kg),) and humidity (1, 2 and 6 l/weight samples). The measurement results showed that the transmission parameters decreased with increased sample thickness, moisture, and frequency. Regarding the type of substrate, soybean straw shows the lowest values of parameter S21 for all measurements except for the case of the highest amount of moisture (6 l) for which clover straw shows the lowest value of the transmission parameter. The greatest reduction of the S_{21} transmission parameter is 50.8 dB for a soybean sample of 30 cm thickness at a frequency of 4.8 GHz. These tests were performed on samples that were not additionally structured (additives, pressing, additional shredding...) so that there is a possibility to optimize the structure and further research into their influence on the transmission of EM radiation through them.
Keywords: absorbers, biomaterial, electromagnetic radiation, electromagnetic transmission.

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Supercritical extraction of *Lycoperdum saccatum* lipophilic bioactive compounds

Siniša SIMIĆ, Mirjana SULEJMANOVIĆ, Slađana KRIVOŠIJA, Aleksandra GAVARIĆ, Nataša NASTIĆ, Senka VIDOVIĆ

University of Novi Sad, Faculty of Technology Novi Sad, Boulevard cara Lazara 1, Novi Sad, Serbia

Abstract
With the introduction of the green chemistry concept in recent years, a great step forward has been made in the field of plant extraction technologies. Until recently, the widely used traditional extraction methods have been replaced by more efficient and green techniques for obtaining bioactive components. Supercritical carbon dioxide extraction ($ScCO_2$) is one of the leading examples of an efficient, safe, and green extraction method successfully utilized to obtain lipophilic compounds. $ScCO_2$ not only eliminates the use of toxic solvents but also contributes to better preservation of thermosensitive components due to the mild extraction conditions. Similar to plant material, mushrooms also possess a range of bioactive lipophilic compounds including fatty acids, sterols, and other secondary metabolites, with several health-beneficial effects, such as antidiabetic, antimicrobial, and anticancer activity. Even though mushroom extracts can be efficiently obtained using $ScCO_2$ extraction this area remains largely unexplored. Therefore, this study demonstrates the efficiency of $ScCO_2$ extraction of the mushroom species *Licoperdon saccatum* (also known as puffball mushroom) in terms of fatty acid and sterol compound content. The $ScCO_2$ extraction was conducted under the conditions of 300 bar and 40°C, and the obtained extracts were analyzed using the GC-MS method. GC-MS analysis showed that the most dominant compound was linoleic acid (67,69%), while the most dominant sterol compound was 7,22-Ergostadienone (3,58%).
Keywords: supercritical extraction, green extraction, mushrooms

Green Technology / *Zelene tehnologije*
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Environmentally Friendly Subcritical Water Extraction of Ginger (*Zingiber Officinale*) Herbal Dust

Mirjana SULEJMANOVIĆ[1], Ioannis MOURTZINOS[2], Anastasia KYRIAKOUDI[2], Slađana KRIVOŠIJA[1], Nataša NASTIĆ[1], Senka VIDOVIĆ[1]

[1] University of Novi Sad, Faculty of Technology Novi Sad, Boulevard Cara Lazara 1, Novi Sad, Serbia
[2] Aristotle University of Thessaloniki, School of Agriculture, Laboratory of Food Chemistry and Biochemistry, Thessaloniki, Greece

Abstract
Richness in bioactives, gingerols and shogaols makes ginger (*Zingiber officinale*) a highly valuable natural product. Due to its antioxidant, antiviral, anticancer effects, ginger usage in the form of filter tea is increasing. However, conversion of ginger root to the form adequate for filter tea packaging, large quantities of plant material called "herbal dust" (diameter <0.315mm) are produced and discarded by this industry branch, causing environmental issues. In order to utilize ginger herbal dust, subcritical water extraction (SWE) was performed. The usage of small quantities of water as a solvent, and a short extraction time make SWE suitable for isolating different polarity compounds, a safe, and environmentally friendly extraction technique. The influence of temperature (120°C - 220°C) on the extraction yield (EY), total phenols content (TPC) and total flavonoids content (TFC), and dominant phenolic compounds was examined. Pressure (2MPa) and extraction time (15min) were kept constant. EY ranged from 39.33±4.95% (140°C) to 61.73±1.51% (180°C). The highest TPC (1.40±0.05 mgGAE/mlE) was achieved at a temperature of 220°C, a similar dependence was observed in the case of TFC, with values between 1.11 mgCAT/mlE and 2.78±0.02 mgCAT/mlE. The dominant compound was found to be 6-Gingerol, with the highest concentration (0.317mg/mlE) at the lowest temperature. In this way, potential pathways for further application of agro-industry waste in valuable product formulations is presented.

Keywords: ginger (*Zingiber officinale*), herbal dust, green extraction technologies

Green Technology / *Zelene tehnologije*
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Influence of high hydrostatic pressure on the particle size distribution of smoothies

Marko ŠKEGRO, Filip DUJMIĆ, Sven KARLOVIĆ, Damir JEŽEK

University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia

Abstract

Non-thermal processing technologies, such as high hydrostatic pressure (HHP) are increasingly used in the food industry. They offer many advantages in terms of maintaining quality during storage compared to heat treatment, which affects the original quality of such products. Smoothies are functional foods with a short shelf life, but with massive contributions to desired positive health effects. The aim of this study was to investigate the effect of HHP (350 MPa and 450 MPa, at room temperature for 5 and 15 minutes) on the particle size distribution of during storage (7,14,21 days / 4°C). For comparison with heat treatment, the samples were subjected to pasteurization (85℃ / 7 min). Analysis of the impact of HHP and pasteurization shows that there is no significant change in the average particle size, regardless of the applied procedure and parameters. However, during the pasteurization, a decrease in the d(0.1) and an increase in the d(0.9) parameter were found, which indicates an increase in the number of the largest particles and a decrease in the number of the smallest particles. Given that there is no increase in the average particle size, the mean value does not change significantly. In HHP samples, d(0,1) decreases significantly less, while d(0,9) values increase slightly. The processing time has the greatest influence on the particle size distribution, with a longer processing time creating a larger number of agglomerates and increasing the d(0.9) value. Considering an overall change in particle size distribution after HHP processing it can be concluded that HHP samples contribute to greater stability of smoothies throughout the entire storage period because of a lower proportion of large particles.

Keywords: high hydrostatic pressure, physical properties, particle size distribution, smoothies

Green Technology / *Zelene tehnologije*
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Deep Eutectic Solvents (DES) extraction from Lamiaceae plants

Branislava TEOFILOVIĆ[1*], Saša VUKMIROVIĆ[1], Milan VRANEŠ[2], Snežana PAPOVIĆ[2], Emilia GLIGORIĆ[1], Nevena GRUJIĆ[1]

[1] University of Novi Sad, Faculty of Medicine, Hajduk Veljkova 3, Novi Sad, Serbia
[2] University of Novi Sad, Faculty of Science, Trg Dositeja Obradovica 3, Novi Sad, Serbia

Abstract
DESs possess properties very similar to ionic liquids, such as their nonflammability, thermal stability, low vapor pressure and high dissolution capacity. However, compared to conventional ionic liquids, DESs have many advantages. The objective of the work was to examine the effectiveness of DES as extragens of phenolic compounds from herbal drugs. In this experiment single-component teas of the Lamiaceae family, produced at the Institute for the Study of Medicinal Plants, "Dr. Josif Pančić", were used. 10 samples of herbal drugs were examined (oregano, lavender, basil, winter savory, garden thyme, wild thyme, sage, rosemary, lemon balm and mint). Extraction was performed with DES (a mixture of menthol and methylsalycilate, 1:1). The content of phenolic acids and flavonoids in the tested preparations was determined using high-performance liquid chromatography (HPLC). The mixture of menthol:methylsalicylate (1:1) showed significant efficiency in the isolation of quercetin and naringenin from herbal drugs, as well as in the isolation of chlorogenic acid and cinnamic acid from all samples, and rosmarinic acid from basil. It can be concluded that DES could be widely used as an effective solvent for the extraction of phenolic compounds from Lamiaceae plants, especially considering its environmental nature and low cost.
Keywords: green solvents, DES, extraction, phenolic compounds, Lamiaceae

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Green Technology / *Zelene tehnologije*
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Biochar as NBS for remediation of the Vojvodina site-specific contamination challenge

Maja TURK SEKULIĆ[1], Jelena RADONIĆ[1], Szabolcs PAP[1,2], Mira PUCAREVIĆ[3], Nataša STOJIĆ[3]

[1] University of Novi Sad, Faculty of Technical Sciences, Department of Environmental Engineering and Occupational Safety and Health, Trg Dositeja Obradovica 6, Novi Sad, Serbia
[2] Environmental Research Institute, UHI North Highland, University of the Highlands and Islands, Thurso, Scotland, United Kingdom
[3] Educons University, Faculty of Environmental Protection, Vojvode Putnika 85-87, Sremska Kamenica, Serbia

Abstract
With Continental Europe's increasingly apparent climate change impacts and uneven adaptive capacity, one of particular importance is the effect of soil contamination on agriculture and therefore food security. The main environmental issues of the Vojvodina region are a lack of waste stream treatment facilities, unregulated landfill and waste management, a lack of land and windbreaks, a disastrously small percentage of woodlands, and natural disasters caused by climate change. By analyzing the soil near the landfills, agricultural and non-agricultural, we determined that the biggest problem is pollution with phthalate esters (PE). The obtained landscape pollution pattern presents a significant problem as the results of more than 4,000 sample analyses showed exceedance of the Maximum Allowable Concentration according to the regulation on soil quality in Serbia. Soil remediation is especially important for agricultural soil. That's why nature-based solutions (NBSs) should become mainstream land management strategies. Biochar is an environmentally friendly soil remediation technology (NBSs) that can effectively immobilise PE in soil. During the stabilisation/immobilisation approach to remediation, PE are bounded/adsorbed on a stabilising material (here biochar) to reduce their mobility in agricultural soil. The main goal of the technology will be to reduce contaminant bioavailability to receptors, thus mitigating human health and ecological risks. The biochar here will be produced by the combustion of waste biomass under a limited supply of oxygen in a controlled environment. In our opinion, the proposed nature-based remediation solution is cost-effective, technically easier to apply and more accessible to the farmer sector compared to the conventional soil remediation processes.
Keywords: phthalate esters, nature-based solutions, biochar, soil remediation

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Efficiency of ozone application in the storage of exotic citrus fruits

Helena VIRIC GASPARIC[1,2], Pave NINCEVIC[2], Mario BJELIS[3], Darija LEMIC[1,2]

[1] University of Zagreb, Faculty of Agriculture, Department of Agricultural Zoology, Svetosimunska 25, Zagreb, Croatia
[2] Green Environmental Research Ltd., Avenija Dubrovnik 15, Zagreb, Croatia
[3] University of Split, University Department of Marine Studies, Ruđera Boškovića 31, Split, Croatia

Abstract
Unlike most fruits, citrus fruits begin to rot immediately after harvest. Proper storage is a must to preserve the nutritional value especially when it comes to exotic products. The use of fungicides to prevent mold infestation is widespread, but the need for a "no pesticide" approach has been highlighted. The application of ozone, as biofumigant or dissolved in water, is a new green technology whose high efficiency has already been demonstrated in mandarins. In this study, the antifungal potential of ozone was tested as an alternative control method for curative suppression of *Penicillium italicum* on stored limes, lemons, kumquats, and limequats. During a period of 1 - 3 days, the artificially infected fruits were exposed to ozone treatments (10, 30 and 60 minutes). For lemons (Lisbon, Mayer and Eureka varieties), the efficiency was over 85% when treated for 30 and 60 minutes; for limes, repeated treatments resulted in almost 100% protection compared to fungicides; for limequat, ozone treatments of 60 minutes resulted in over 75% efficiency and were better than fungicidal treatments and for kumquat, after 30 days, double and triple applications of ozone for 60 minutes had the highest efficiency (86%) compared to all other as well as fungicidal treatments. Ozone is effective in replacing chemical treatments and can significantly extend the storage time from harvest to sale.
Keywords: kumquat, lemon, lime, limequat, ozone, postharvest treatment

Management Of Natural Protected Areas
Upravljanje zaštićenim područjima prirode

Management Of Natural Protected Areas / *Upravljanje zaštićenim područjima prirode*
Oral presentation / *Usmeno priopćenje*

Methods of comprehensive interdisciplinary planning and governance of the island space – the Island of Biševo example

Rene LISAC[1], Antonija HINCKEL OSOJNIK[2]

[1] University of Zagreb, Faculty of Architecture, Kačićeva 26, Zagreb, Croatia
[2] University of Göttingen, Faculty of Law, Platz d. Göttinger Sieben 6, Göttingen, Germany

Abstract
Life on the isolated Adriatic islands in previous decades has been going through intensive and significant development processes, which will irreversibly direct their economic, social, and spatial development. Traditional life scenarios, related to the land and the sea, have been replaced by tourism and hospitality for decades. Under the influence of digital technologies, mobile and remote work scenarios appear on the horizon. The presence of global pandemics also empowers those trends. On the one hand, transitional processes, power asymmetries, and interrelationships change between scenarios are guided exclusively by the economic principle of the market economy. On the other hand, the social and environmental component of sustainable development is nonexistent. Regulating the spatial-social relationship of scenarios in the planning sense and shaping them in a sustainable direction requires intervening in the existing "business as usual" processes and introducing integral participatory and interdisciplinary planning methods. This paper presents the results of methodological research into possible models of complete interdisciplinary planning and governance of island space. By applying the model to the example of the isolated and partially abandoned island of Biševo, the research proposed a research-planning process that would frame the development of the island in the desired direction. The process is interdisciplinary and participative, including all relevant professional, governmental, economic, and civil actors in the area, with the goal of guiding the island's sustainable development.
Keywords: comprehensive strategic planning, sustainable development, interdisciplinarity, participation, Adriatic islands

Management Of Natural Protected Areas / *Upravljanje zaštićenim područjima prirode*
Oral presentation / *Usmeno priopćenje*

Metode cjelovitog interdisciplinarnog planiranja i upravljanja otočnim prostorom na primjeru otoka Biševa

Rene LISAC[1], Antonija HINCKEL OSOJNIK[2]

[1] Sveučilište u Zagrebu, Arhitektonski fakultet, Kačićeva 26, Zagreb, Hrvatska
[2] Sveučilište u Göttingenu, Pravni fakultet, Platz d. Göttinger Sieben 6, Göttingen, Njemačka

Sažetak
Život na izoliranim jadranskim otocima u prethodnim desetljećima prolazi kroz intenzivne i značajne razvojne procese, koji će bespovratno usmjeriti njihov ekonomski, društveni i prostorni razvoj. Tradicionalni scenariji života vezani uz zemlju i more već desetljećima bivaju zamjenjeni turističko ugostiteljskim, a pod utjecajem digitalnih tehnologija na horizontu se javljaju i novi scenariji mobilnog rada i rada na daljinu. Prisutnost globalnih pandemija također podupire spomenute trendove. Procesi trenzicija, promjena snaga i međuodnosa među scenarijima su vođeni isključivo ekonomskim principom tržišnog gospodarstva, dok društvena i okolišna kompenanta održivog razvoja izostaje. Reguliranje prostorno-društvenog odnosa scenarija u planerskom smislu, i njihovo oblikovanje u održivom smjeru zahtjeva interveniranje u postojeće procese karaktera "bussiness as usual" te uvođenje metoda cjelovitog participativnog i interdisciplinarnog planiranja. Ovaj rad prezentira rezultate metodološkog istraživanja mogućih modelacjelovitog interdisciplinarnog planiranja i upravljanja otočnim prostorom. Primjenom modela na primjeru izoliranog i djelomično napuštenog otoka Biševa istraživanje je predložilo istraživačko-planerski proces koji bi usmjerio razvoj otoka u željenom smjeru. Proces je interdisciplinaran i participativan, uključuje sve relevantne stručne, upravljačke, gospodarske i civilne aktere u prostoru, sa zajedničkim ciljem usmjeravanja održivog razvoja predmetnog prostora.
Ključne riječi: cjelovito strateško planiranje, održivi razvoj, interdisciplinarnost, participacija, jadranski otoci

Management Of Natural Protected Areas / *Upravljanje zaštićenim područjima prirode*
Poster presentation / *Postersko priopćenje*

Ecosystem services assessment in protected areas – Lake Ohrid case study

Orhideja TASEVSKA[1], Maria Silvia GIAMBERINI[2], Antonello PROVENZALE[2], Illaria BANESCHI[2], Danijela MARKOVIC BREDTHAUER[3], Barbara ZENNARO[4], Elizabeta VELJANOSKA SARAFILOSKA[1], Suzana PATCHEVA[1], Goce KOSTOSKI[1] Saso TRAJANOVSKI[1]

[1] PSI Hydrobiological Institute, Ohrid, Naum Ohridski 50, Ohrid, N. Macedonia
[2] National Research Council of Italy, Via Giuseppe Moruzzi, 1, Pisa, Italy
[3] Osnabrück University of Applied Sciences, Faculty of Business Management and Social Sciences, Albrechtstraße 30, Osnabrück, Germany
[4] University of Bayreuth, Bayreuth Center of Ecology and Environmental Research (Bayceer), Universitatsstraße 30, Bayreuth, Germany

Abstract
Biophysical assessment of ecosystem services as a supporting tool in Lake Ohrid management has been completed within the ECOPOTENTIAL project (EU Horizon 2020 Programme, Grant Agreement #641762). Mind Maps of relevant ecosystem services were constructed based on the Common Classification of Ecosystem Services (CICES, https://cices.eu/) of the European Environment Agency (EEA), using available data (in situ, remote sensing or model-based). Starting from the description of the most important ecosystem services:
• Habitat for endemic species of economic and/or cultural value
• Food production
• Supply and regulation of freshwater, a set of essential variables necessary to monitor their status through key indicators has been defined.
The major threats have been identified and a DPSIR Scheme has been developed for eutrophication, which endangers the provision of habitat for endemic species. We also defined a suite of models necessary to link drivers and pressures to the description of the state of the environment and environmental impacts, in order to give the stakeholders an additional tool for supporting the decisions for guaranteeing a sustainable management of the economic activities around the lake.
Keywords: CICES, mind map, essential variables, threats, management

Renewable Energy
Obnovljivi izvori energije

Renewable Energy / *Obnovljivi izvori energije*
Poster presentation / *Postersko priopćenje*

Hydrated lime as a low-cost heterogeneous catalyst for biodiesel production by transesterification

Sabina BEGIĆ[1], Azra HALILOVIĆ[2], Indira ŠESTAN[1]

[1] University of Tuzla, Faculty of Technology, Urfeta Vejzagića 8, Tuzla, Bosnia and Herzegovina
[2] University of Zenica, Faculty of Metallurgy and Technology, Travnička Cesta 1, Zenica, Bosnia and Herzegovina

Abstract
The rapid growth of the global population and industrial development contribute to the accelerated depletion of fossil fuel reserves, which in turn imposes the need for the rapid introduction and use of alternative fuels. Among the tested biofuels, biodiesel, with its properties similar to diesel, proved to be a promising fuel for internal combustion engines, whether used alone or in mixtures with diesel. This resulted in intensive research into potential heterogeneous catalysts for the production of biodiesel by transesterification of vegetable oils, which would be more economical and the price of biodiesel would be competitive with that of diesel. Solid calcium-based catalysts are among the most researched. However, despite earlier claims about no or very weak catalytic activity of $Ca(OH)_2$, the published results of recent research on the use of hydrated lime indicate its high efficiency in the transesterification of vegetable oils, with the possibility of repeated use of this catalyst, without a significant decrease in biodiesel yield.
Keywords: biodiesel, transesterification, heterogeneous catalyst, hydrated lime

Renewable Energy / *Obnovljivi izvori energije*
Oral presentation / *Usmeno priopćenje*

Platinum Nanoalloys as Electrocatalysts for the Hydrogen Fuel Cell Vehicles

Tina ĐUKIĆ[1,2], Léonard Jean MORIAU[1], Matija GATALO[1,3], Nejc HODNIK[1]

[1] National Institute of Chemistry, Hajdrihova 19, Ljubljana, Slovenia
[2] Faculty of Chemistry and Chemical Technology, Večna pot 113, Ljubljana, Slovenia
[3] ReCatalyst d.o.o., Hajdrihova 19, Ljubljana, Slovenia

Abstract
There is no doubt that the increase in climate change becomes reflected in every individual's daily life. Therefore, it is not surprising that great efforts are being invested in finding solutions for this issue in all areas of society. One of the links in that chain is also renewable energy sources, where hydrogen could play a key role. Namely, the utilization of hydrogen as a fuel in the proton exchange membrane fuel cells (PEMFCs) enables zero-emission electricity production. Nevertheless, the main obstacle to the massive production of hydrogen-powered vehicles is the very high price of platinum (Pt) – an electrocatalyst mostly used for a very slow oxygen reduction reaction (ORR) on the cathode side of the PEMFC. This issue can be solved by alloying Pt with a less noble and less expensive metal such as Co, Cu, Ni or Fe. However, while the high ORR activity of the carbon-supported Pt-nanoalloys has already been proven, their stability remains an open question. Here, the main messages from recent findings regarding the stability of the Pt-alloy nanoparticles will be pointed out. The impact of different factors, such as temperature and potential window, on the stability of Pt and less noble metals, will be discussed.
Keywords: proton exchange membrane fuel cell (PEMFC), oxygen reduction reaction (ORR), carbon-supported Pt-nanoalloys, stability

Renewable Energy / *Obnovljivi izvori energije*
Poster presentation / *Postersko priopćenje*

Bioethanol production from two HTF corn hybrids

Đurđica KOVAČIĆ, Meri ENGLER, Dunja FOTEZ, Danijela SAMAC, Goran HERMAN, Lara ERGOVIĆ, Josipa JOVIĆ, Brigita POPOVIĆ

Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
Corn is one of the main feedstocks used to produce bioethanol in the world. However, due to the food vs. fuel controversy, different seeds-producing companies are striving to produce corn hybrids aimed at bioethanol production which are called High Total Fermentable Hybrids (HTF). In this research, two HTF hybrids of the FAO groups 470 and 520, were used to determine, and compare their suitability for bioethanol production. The experiment was conducted in 2-line years (2020 and 2021) in the eastern region of Croatia. After the field experiment, alcohol fermentation was performed by applying the Lemuz method. According to ANOVA Statistical analysis (LSD test, $P<0,05$), a statistically significant difference in bioethanol production was determined between the investigated years, with higher bioethanol production from both hybrids from 2020 (FAO 470 388,9 L/dry grain; FAO 520 382,7 L/dry grain) compared to 2021 (FAO 470 382,7 L/dry grain; FAO 520 329,5 L/dry grain). There was no statistically significant difference in bioethanol production between the investigated hybrids in 2020. In 2021, statistically significantly higher production of bioethanol from hybrid FAO 470 (368,9 L/dry grain) was determined if compared to hybrid FAO 520 (323,3 L/dry grain). Generally, both hybrids are suitable for bioethanol production, but the great climate effect should not be ignored.
Keywords: bioethanol, corn, FAO groups, HTF hybrids

A model for selecting the most suitable renewable source of electricity on vessels

Tomislav PEŠA[1], Maja KRČUM[2], Grgo KERO[1]

[1] Ministry of Defence of the Republic of Croatia, Trg kralja Petra Krešimira IV br.1, Zagreb, Croatia
[2] University of Split, Fuculty of Maritime Studies, Ulica Ruđera Boškovića 37, Split, Croatia

Abstract
The International Maritime Organization (IMO) is introducing increasingly strict controls in several aspects of maritime transport with the aim of preserving the environment. Various technologies are proposed and applied that reduce the emission of greenhouse gases. One of the approaches is the application of renewable energy sources RES. However, RES are not equally suitable for all types of ships sailing in different geographical areas. The flow diagram in the process of making a decision on the selection of the type of RES is proposed. This paper presents a model for selecting the most suitable RES on vessels. All significant parameters that influence the selection of the optimal solution can be considered and elaborated individually.
Keywords: renewable energy sources, maritime, model, decision algorithm

Renewable Energy / *Obnovljivi izvori energije*
Oral presentation / *Usmeno priopćenje*

Model za odabir najpogodnijeg obnovljivog izvora električne energije na plovnim objektima

Tomislav PEŠA[1], Maja KRČUM[2], Grgo KERO[1]

[1] Ministarstvo obrane Republike Hrvatske, Trg kralja Petra Krešimira IV br.1, Zagreb, Hrvatska
[2] Pomorski fakultet, Sveučilište u Splitu, Ulica Ruđera Boškovića 37, Split, Hrvatska

Sažetak
Međunarodna pomorska organizacija IMO uvodi sve striktnije kontrole u nekoliko aspekata pomorskog prometa s ciljem očuvanja okoliša. Predlažu se i primjenjuju različite tehnologije koje smanjuju emisiju stakleničkih plinova. Jedan od pristupa je primjena obnovljivih izvora energije OIE. Međutim OIE nisu jednako prikladni za sve vrste brodova koji plove u različitim geografskim područjima. Prikazan je dijagram toka u procesu donošenja odluke o odabiru vrste OIE. U ovom radu je predstavljen model za odabir najpogodnijeg OIE na plovnim objektima. Nadalje, upotrebom modela odabire se optimalno rješenje. Svi značajni parametri koji utječu na odabir optimalnog rješenja se mogu uzeti u obzir te su pojedinačno eleborirani.
Ključne riječi: obnovljivi izvori energije, pomorstvo, model, algoritam odlučivanja

Renewable Energy / *Obnovljivi izvori energije*
Oral presentation / *Usmeno priopćenje*

New views of the influence of hydropower plants on the environment - the example of the Donja Dobra River in Croatia

Ivana PINTARIĆ[1], Magdalena DROŽĐAN[1], Bojan ĐURIN[1], Julian HUNT[2]

[1] University North, Department of Civil Engineering, Jurja Križanića 31b, Varaždin, Croatia
[2] International Institute for Applied Systems Analysis (IIASA), Schloßpl. 1, Laxenburg, Austria

Abstract
The development of technology also increases the standard of living, and the main driver of this modern world is energy. Hydroenergy is one of the most significant renewable sources that can compete with fossil fuels economically and quantitatively. The resulting energy belongs to the purest forms of energy, but the process of its onset has harmful effects. The biggest problem is infrastructure objects that affect the environment because there are significant changes in the water flow regime. In addition to changing the flow of water, there are changes in the movement of water animals and the phenomena and/or disappearance of new plant species. One of the greatest advantages of hydropower plants is the production of electricity without creating large amounts of greenhouse gases. In addition, there are many disadvantages, such as changing the riverbed and destroying cultural and natural goods. However, there are many more advantages at this point than disadvantages that hydropower plants have a positive impact. Their environmental impact will be analyzed in the example of the Donja Dobra River, i.e., hydropower plant Lešće. In addition, alternative solutions for large hydropower plants will be shown which do not have a harmful environmental impact.
Keywords: hydropower plants, energy, environment, alternative solutions, river Donja Dobra

Renewable Energy / *Obnovljivi izvori energije*
Poster presentation / *Postersko priopćenje*

Overview of energy production potential in the wastewater sector

Dragana TOMAŠEVIĆ PILIPOVIĆ, Đurđa KERKEZ, Milena BEČELIĆ-TOMIN, Vesna PEŠIĆ, Dejan KRČMAR, Anita LEOVAC MAĆERAK, Božo DALMACIJA

University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Trg Dositeja Obradovica 3, Novi Sad, Serbia

Abstract
Most wastewater treatment plants are designed to meet certain effluent requirements without considering energy efficiency. However, this situation has changed in recent years, as both water and energy are critical elements. In most WWTPs, water quality is improved at the cost of consuming a large amount of energy. WWTPs are often ranked as the single largest energy consumers managed by a municipality. In a conventional WWTP, about 25-40% of operating costs can be attributed to energy consumption. Therefore, it is necessary to reduce energy consumption or improve energy independence. Over the last decade, energy self-sustaining wastewater treatment plants have been increasingly built and studied to reduce operating costs and energy consumption and to achieve carbon neutrality. The European Union has recognized wastewater as a resource for energy production since 2018. Facing such challenging situations, new solutions should rely on ways to improve energy recovery from wastewater (in the water line and in the sludge line) and minimize energy consumption. Energy can be recovered from wastewater in the form of biogas, biodiesel, hydrogen, electricity, and thermal energy. Hence, these new technologies with the potential for energy recovery and saving are the way to move towards the ultimate goal of energy-self-sustainable wastewater treatment.
Keywords: energy recovery, saving energy, wastewater treatment

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Sustainable Tourism
Održivi turizam

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Smart SPA and Sustainable Tourism – Measuring Sustainable Transformation of European Health Tourism Destinations

Kristina AFRIĆ RAKITOVAC[1], Izidora MARKOVIĆ VUKADIN[2], Nataša UROŠEVIĆ[1]

[1] Juraj Dobrila University of Pula, Faculty of economics and Tourism "Dr. Mijo Mirković", Preradovićeva 1, Pula, Croatia
[2] Institute for Tourism, Vrhovec 5, Zagreb, Croatia

Abstract
This paper deals with current issues and challenges related to measuring the sustainability of tourism destinations, with special emphasis on European spa towns. The research is focused on the development of systems of sustainability indicators relevant to health tourism destinations. It will include the identification of the relevant indicators that could be used to monitor the relevant issues within the existing frameworks as well as the evaluation of sustainable standards and creation of a sustainability indicators list for spa towns and spas (business entity): starting from the European tourism indicator system – ETIS (European Commission, 2016) and Indicators of Sustainable Development for Tourism Destinations A Guidebook – UNWTO Part B (UNWTO, 2004) to Indicators of sustainable development (UNWTO, 2007), Towards Sustainable Development – TSD (2008) and GSTC Destination Criteria (2019). The purpose of the research, conducted in the framework of the current EU project, is to revalorize European spa destinations as agents of positive transformative change and resilient society, elaborating on current sustainability issues. The authors critically evaluated the possibility of sustainable transformation, regeneration and reset of the current global tourism development model towards the Sustainable Development Goals, with a special emphasis on the transformative role of health and spa tourism for the wellbeing of European citizens coping with multiple crises. The research is focused on the most important sustainability issues and current challenges of European spas, such as infrastructure and traffic accessibility (public transport); necessary investments and property issues (private–public), which will be elaborated through the initial situational analysis and the proposal of the innovative systems of sustainability indicators for European health tourism destinations.
Keywords: sustainability indicators, health tourism, smart spas

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

Developmental determinants of continental tourism on the example of Osijek-Baranja County

Željka BORZAN, Darija IVANKOVIĆ

University of Applied Sciences "Lavoslav Ružička" in Vukovar, Županijska ulica 50, Vukovar, Croatia

Abstract
One of the strategic determinants of the development of the tourism offer of the Republic of Croatia until 2030 focuses on continental tourism as the main activity of sustainable development of rural areas. The tourist offer of Osijek-Baranja County is based on continental tourism: wine tourism, rural tourism, ecotourism, hunting and fishing tourism, health tourism and cultural tourism. The data indicates a growing trend in the development of continental tourism in this part of Croatia based on traditional, cultural heritage, and ecological preservation of natural resources. The growing trend shows that last year Osijek-Baranja County recorded an increase of 33% in overnight stays and 40% in arrivals. The aim of the paper is to present the development determinants of the tourist offer of continental tourism in Osijek-Baranja County based on desk research and to analyze the possibility of applying new forms of tourism that appeared in the world after the pandemic. The research results indicate that continental tourism is one of the basic instruments for the sustainable regional development of the Republic of Croatia and the establishment of year-round tourist offers. The development determinants are the branding, the Osijek-Baranja County as a tourism product based on ecological standards with the application of creative solutions of ICT technology that will result in economic development and greater recognition of the eastern part of Croatia as well.
Keywords: continental tourism, sustainable tourism, creative tourism, ICT, Osijek-Baranja County

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

Razvojne odrednice kontinentalnog turizma na primjeru Osječko-baranjske županije

Željka BORZAN, Darija IVANKOVIĆ

Veleučilište „Lavoslav Ružička“ u Vukovaru, Županijska ulica 50, Vukovar, Hrvatska

Sažetak
Jedna od strateških odrednica razvoja turističke ponude Republike Hrvatske do 2030. godine smješta u fokus kontinentalni turizam kao glavnu djelatnost održivog razvoja ruralnih sredina. Turistička ponuda Osječko-baranjske županije temelji se na raznim oblicima kontinentalnog turizma: vinskom turizmu, seoskom turizmu, ekoturizmu, lovnom i ribolovnom turizmu, cikloturizmu, zdravstvenom turizmu, izletničkom turizmu, kulturnom turizmu. Podaci ukazuju na rastući trend razvoja kontinentalnog turizma ovog dijela Hrvatske temeljenog na tradiciji, kulturnoj baštini i ekološkoj očuvanosti prirodnih resursa. Rastući trend pokazuje da je u prošloj je godini Osječko-baranjska županija zabilježila porast od 33% noćenja i 40% dolazaka. Cilj rada je na temelju desk istraživanja prikazati razvojne odrednice turističke ponude kontinentalnog turizma u Osječko-baranjskoj županiji i analizirati mogućnost primjene novih oblika turizma koji su se pojavili u svijetu nakon pandemije. Rezultati istraživanja ukazuju da je kontinentalni turizam jedan od osnovnih instrumenata za održiv regionalni razvoj Republike Hrvatske i uspostavljanje cjelogodišnje turističke ponude. Razvojne odrednice su brendiranje Osječko-baranjske županije kao turističkog proizvoda koje se temelje na ekološkim standardima uz primjenu kreativnih rješenja ICT tehnologija koja će rezultirati gospodarskim razvojem i većoj prepoznatljivosti i istočnog dijela Hrvatske.
Ključne riječi: kontinentalni turizam, održivi turizam, kreativni turizam, ICT, Osječko-baranjska županija

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

The contribution of esports to the sustainability of tourism

Nenad BRESLAUER, Tomislav HUBLIN, Vedran KOSEC, Nevenka BRESLAUER

Međimurje University of Applied Sciences in Čakovec, Ulica bana J.Jelačića 22A, Čakovec, Croatia

Abstract
Esports, as a new form of sport, is increasingly popular in the world and is slowly entering Croatia as well. Esports players gather around them numerous well-known sponsors, media that follow them, and teams around them that take care of them and their needs, from trainers, nutritionists, IT experts, chefs, psychologists, and a large number of fans who follow their fans at live competitions or online. Bearing in mind that they attract fans in large numbers, for tourist destinations in Croatia this can be a prerequisite for the extension of the season, i.e. the sustainability of tourism. The coverage of Croatia with the 5G network, which is necessary for playing esports games, the congress halls we have all over Croatia need their networking and the introduction of a competition system to ensure a competitive environment and the arrival of fans at the time of the competition. Video games, as the most popular leisure activities, gather more than two billion users worldwide (Newzoo, 2017), and that number is still growing. According to the Stream platform, which is the leader in video game sales, 1,239,456 players played only one video game (CS:GO) at the same time (Sokić, Crvenko, 2020). Although the professional development of esports is on the rise in the world, it is not used enough in tourist destinations in Croatia to extend the season through the preparations of e-players and their competitions.
Keywords: tourism, esports, competition, sustainability

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

Esport dio održivosti turizma

Nenad BRESLAUER, Tomislav HUBLIN, Vedran KOSEC, Nevenka BRESLAUER

Međimursko veleučilište u Čakovcu, Ulica bana J.Jelačića 22A, Čakovec, Hrvatska

Sažetak

Esport, kao novi vid sporta sve je popularniji u svijetu, a polako ulazi i u prostor Hrvatske. Igrači esporta oko sebe okupljaju brojne poznate sponzore, medije koji ih prate, te timove koji se brinu o njim i njihovim potrebama, od trenera, nutricionista, IT stručnjaka, kuhara, psihologa te velikog broja navijača kroji prate svoje fanove na natjecanjima uživo ili online. Imajući u vidu da privlače publiku navijače i to u velikom broju, za turističke destinacije u Hrvatskoj to može biti preduvjet za produženje sezone odnosno održivost turizma. Pokrivenost Hrvatske 5G mrežom koja je neophodna za igranje esportskih igara, kongresnih dvorana koje imamo diljem Hrvatske potrebno je njihovo umrežavanja te uvođenjem sustava natjecanja kako bi se osiguralo natjecateljsko okruženje i dolazak navijača u vrijeme natjecanja. Video igre, kao najpopularnije aktivnosti u slobodno vrijeme, okupljaju više od dvije milijarde korisnika širom sveta (Newzoo, 2017), a taj broj i dalje raste. Prema platformi Strim (Stream), koja je vodeća u prodaji video igara, 1.239.456 igrača je igralo u istom trenutku samo jednu video igru (CS:GO), (Sokić, Crvenko, 2020). Iako je profesionalni razvoj esporta u svijetu porastu, on u Hrvatskoj nije dovoljno iskorišten u turističkim destinacijama da bi produžili sezonu kroz pripreme eigrača i njihova natjecanja.

Ključne riječi: turizam, esport, natjecanje, održivost

Sustainable Tourism / Održivi turizam
Poster presentation / *Postersko priopćenje*

Energy and tourist potential of the old abandoned water mills on the rivers

Bojan ĐURIN[1], Dragana DOGANČIĆ[2], Nikola KRANJČIĆ[2], Suraj Kumar SINGH[3]

[1] University North, Department of Civil Engineering, Jurja Križanića 31b, Varaždin, Croatia
[2] University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia
[3] Suresh Gyan Vihar University, Centre for Sustainable Development, Jaipur, Rajasthan, India

Abstract
There are many old and abandoned water mills on the rivers in Croatia. In the past, they were successfully used for flour production. Nowadays, many of them are not in use. Due to the possibility of using the hydroenergy properties of the rivers, their transformation into hydro turbines has potential. With regard to the natural surroundings of such water mills, tourist potential should be considered. Also, the old tradition of flour production and the old heritage of the location added value to such water mills. The catering offer, instructive paths (educational content), extreme sports and other similar activities could be incorporated. The paper will show examples of the locations in Croatia where the presented idea could be applied.
Keywords: water mills, energy, tourism, rivers

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Management of the tourist content of the Adriatic islands in order to achieve sustainability

Boris JURIČ[1], Dijana VUKOVIĆ[2], Anica HUNJET[2]

[1] Međimurje University of Applied Sciences in Čakovec, Bana Josipa Jelačića 22a, Čakovec, Croatia
[2] University North, Jurja Križanića 31b, Varaždin, Croatia

Abstract
Sustainable development is not synonymous with environmental protection, as is often thought colloquially among the uninformed public. Sustainable development is much more than that because it encompasses, in addition to the ecological, primarily economic and social context. For this very reason, the islands are ideal for the implementation of sustainable development due to their isolation from many sides. the concept of sustainable island development that starts from a sustainable tourist destination. Sustainable tourist destinations recognize the need to protect natural and cultural-historical values, biological diversity and climate change, but also to encourage the economic and social development of the local population. A major role in the development of sustainable tourist destinations should be played by the marketing of tourist destinations woven into the wider spatial and institutional context of marketing - macromarketing. The sensitive island ecosystem requires an integral approach to the protection and preservation of biological diversity in unity with the rich cultural heritage and in accordance with the directions supervised by the development of tourism and other acceptable economic activities. Retaining existing and attracting new tourists is conditioned by a continuous offer of innovations and developments that require permanent connection and cooperation with all stakeholders in the creation of new value and excellence in ecotourism. The aim of the paper is to point out the role and significance of the content of the tourist offer of the Adriatic islands with a system of destination and emotional experiences based on the local peculiarities of the Adriatic islands, which is actually an essential prerequisite for efficient and successful placement on the increasingly demanding international tourism market.
Keywords: Adriatic islands, island tourism, sustainable development, ecosystem, tourist facilities

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Upravljanje turističkim sadržajem jadranskih otoka u cilju postizanja održivosti

Boris JURIČ[1], Dijana VUKOVIĆ[2], Anica HUNJET[2]

[1] Međimursko veleučilište u Čakovcu, Bana Josipa Jelačića 22a, Čakovec, Hrvatska
[2] Sveučilište Sjever, Jurja Križanića 31b, Varaždin, Hrvatska

Sažetak

Održivi razvoj nije istoznačnica zaštiti okoliša kako se najčešće kolokvijalno misli u dijelu javnosti koja je neinformirana. Održivi razvoj je puno više od toga jer obuhvaća, osim ekološkog, prvenstveno ekonomski a i društveni kontekst. Otoci su baš iz tog razloga idealni za provedbu održivog razvoja zbog svoje izoliranosti s više strana. konceptu održivog razvoja otoka koji polazi od održive turističke destinacije. Održive turističke destinacije prepoznaju potrebe za zaštitom prirodnih i kulturno-povijesnih vrijednosti, biološke raznolikosti, klimatskih promjena, ali i poticanjem gospodarskog te društvenog razvoja lokalnog stanovništva. Veliku ulogu u razvoju održivih turističkih destinacija treba imati marketing turističkih destinacija utkan u prostorno, ali i institucionalno širi kontekst marketinga – makromarketing. Osjetljivi otočni ekosustav zahtijeva integralni pristup zaštiti i očuvanju biološke raznolikosti u jedinstvu s bogatim kulturnim naslijeđem, a u skladu s usmjerenjima nadziranim razvojem turizma i drugih prihvatljivih gospodarskih djelatnosti. Zadržavanje postojećih i privlačenje novih turista uvjetovano je kontinuiranom ponudom inovacija i razvoja koje zahtijevaju permanentno povezivanje i suradnju sa svim dionicima u stvaranju nove vrijednosti i izvrsnosti ekoturizma. Cilj rada ukazati je na ulogu i značaj sadržaja turističke ponude jadranskih otoka sa sustavom destinacijskih i emotivnih doživljaja temeljenih na lokalnim posebnostima jadranskih otoka, što je zapravo bitni preduvjet za efikasan i uspješan plasman na sve zahtjevnijem međunarodnom tržištu turizma.

Ključne riječi: jadranski otoci, otočki turizam, održivi razvoj, ekosustav, turistički sadržaji

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

The impact of climate change on the hotel industry

Dinko JURJEVIĆ

Polytechnic of Rijeka, Vukovarska 58, Rijeka, Croatia

Abstract
Climate changes have become apparent and need to be analyzed because it can significantly affect the hotel business, and can even result in large losses and closure of the facility. The paper first determines the parameters of climate change and possible risks to the operation of the hotel complex for the area of the northern eastern Adriatic on the example of the complex in the town of Opatija and proposes adaptation measures and the financial aspect of doing business in new conditions. A customized risk assessment method will be used. An affinity diagram is selected to systematize risks. The developed risk assessment criteria are an essential tool for further assessments regardless of the form of climate change. After identifying and assessing risks and possible measures, it is necessary to provide for capital investments and finally to determine further developments by means of a financial plan. Other market disruptions, such as the energy crisis, need to be considered. Adaptation measures shall not contribute further to climate change. Originality/value is a developed method of assessing the risk of the effects of climate change with a proposal of measures for sustainable business.
Keywords: climate change, risk assessment, adaptation actions

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

Utjecaj klimatskih promjena na hotelijerstvo

Dinko JURJEVIĆ

Veleučilištu u Rijeci, Vukovarska 58, Rijeka, Hrvatska

Sažetak
Klimatske promjene postale su očite i potrebno ih je analizirati jer mogu dugoročno značajno utjecati na hotelsko poslovanje, a mogu čak rezultirati i velikim gubicima i zatvaranjem objekta. U radu se najprije utvrđuju parametri klimatskih promjena te mogući rizici na poslovanje hotelskog kompleksa za područje sjeverno istočnog Jadrana na primjeru kompleksa u Opatiji te se predlažu mjere prilagodbi i financijski aspekt poslovanja u novim uvjetima. Koristit će se prilagođena metoda procjene rizika. Odabran je dijagram afiniteta kako bi se sistematizirali rizici. Razvijeni kriteriji procjene rizika osnovni su alat za daljnje procjene bez obzira na oblik klimatskih promjena. Nakon utvrđivanja i procjene rizika i mogućih mjera potrebno je predvidjeti kapitalna ulaganja i konačno odrediti daljnji razvoj financijskim planom. Potrebno je razmatrati i druge poremećaje na tržištu, kao što je energetska kriza. Mjere prilagodbe ne smiju dodatno doprinositi klimatskim promjenama. Originalnost/vrijednost je razvijena metoda procjene rizika učinaka klimatskih promjena s prijedlogom mjera za održivo poslovanje.
Ključne riječi: klimatske promjene, procjena rizika, akcije prilagodbe

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

European Amazon as one of the initiators of sustainable tourism development

Ivana KIŠĆINAL

Public Institution County Development Agency of Osijek-Baranja County, Radićeva 4, Osijek, Croatia

Abstract
Public Institution County Development Agency of Osijek-Baranja County (CDA OBC) was founded as a public institution with the role of a regional coordinator, with a special aim of providing effective coordination and enticing regional development in Osijek-Baranya County territory. The mission of CDA OBC is to create a development strategy, and other strategic and development documents for Osijek-Baranya County, as well as provide technical expertise in the preparation and implementation of support programs for public bodies and public institutions (they have to be founded by the Republic of Croatia or Osijek Barany County). Yet another role of CDA OBC is to prepare and implement development projects of interest for Osijek-Barany County's prosperity, and especially projects co-financed by the European Structural and Investment (ESI) funds. In June 2017, CDA OBC successfully submitted a project called Amazon of Europe Bike Trail, together with 15 partners on an Interreg Danube Transnational Programme. The duration of the project was 36 months with a total budget of 3,176 MIL EUR. The project was implemented across five countries (Austria, Slovenia, Croatia, Hungary and Serbia) and it encompassed three rivers – Mura, Drava and Danube. The project aim was to contribute to the economic development of the "European Amazon" based on integrated sustainable management of natural and cultural heritage and resources, all in favor of the local population. The main project result was setting up a bicycle route "European Amazon" as a key product of sustainable tourism in the Mura-Drava-Danube biosphere reservation. It will ensure equal distribution of benefits for the local population, visitors and nature itself. Amazon of Europe Bike Trail attracts nature lovers and families, it provides "green" jobs for the local population and it finances solutions in line with nature protection in protected biosphere areas. This project is an example of good practice of sustainable tourism in greater European territory.
K**eywords:** sustainable tourism, bicycle route, European Amazon

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Europska Amazona kao jedna od pokretača razvoja održivog turizma

Ivana KIŠĆINAL

Javna ustanova Županijska razvojna agencija Osječko-baranjske županije, Radićeva 4, Osijek, Hrvatska

Sažetak

Javna ustanova Županijska razvojna agencija Osječko-baranjske županije (JU ŽRA OBŽ) osnovana je od strane OBŽ za obavljanje poslova regionalnog koordinatora s ciljem učinkovite koordinacije i poticanja regionalnog razvoja za područje OBŽ. Zadatak JU ŽRA OBŽ je izrada županijske razvojne strategije, drugih strateških i razvojnih dokumenata te pružanje stručne pomoći u pripremi i provedbi programa potpore javnopravnim tijelima i javnim ustanovama kojima su osnivači RH ili OBŽ, u pripremi i provedbi razvojnih projekata od interesa, a posebno projekata sufinanciranih sredstvima iz strukturnih i investicijskih fondova EU (JU ŽRA OBŽ, 2023). U lipnju 2017. godine JU ŽRA OBŽ prijavila je projekt Amazon of Europe Bike Trail zajedno s 15 partnera na Interreg Danube Transnational Programme. Projekt je trajao 36 mjeseci s ukupnim proračunom od 3,176 MIL EUR. Provodio se na području pet zemalja (Austrija, Slovenija, Hrvatska, Mađarska i Srbija) i obuhvatio je tri rijeke Muru, Dravu i Dunav. Cilj projekta bio je doprinos gospodarskom razvoju Europske Amazone temeljeno na integriranom održivom upravljanju prirodnom i kulturnom baštinom i resursima u korist lokalnog stanovništva. Glavni rezultat projekta je uspostava biciklističke rute Europska Amazona kao krovni proizvod održivog turizma u rezervatu biosfere Mura-Drava-Dunav koja će osigurati ravnomjernu raspodjelu benefita za lokalno stanovništvo, posjetitelje i prirodu. Amazon of Europe Bike Trail privlači ljubitelje prirode i obitelji, osigurava "zelene" poslove za lokalno stanovništvo i financira rješenja koja su u skladu sa zaštitom prirode u zaštićenim područjima biosfere. Ovaj projekt je primjer dobre prakse održivog turizma na širem području Europe.

Ključne riječi*:* održivi turizam, biciklističke rute, Europska Amazona

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Role of local communities in reaching the sustainable tourism paradigm

Vanja KRAJINOVIĆ

University of Zagreb, Faculty of Economics & Business, J. F. Kennedy 6 Sq., Zagreb, Croatia

Abstract
Tourism activity was severely disrupted recently, with negative impacts and slow growth rates still being registered worldwide. Tourism data have gone back to their values from 15 years ago, resulting in underperformance in the majority of destinations. Such a situation serves as the complete opposite to the issue of over-tourism, which was the focus of both academia and practitioners until the pandemic outbreak. However, in both of those environments local communities must be given the appropriate attention and they must remain in the focus of tourism development strategies. As one of the main purposes of sustainable tourism development is to reach a better living standard for the local communities, the development focus must be shifted from merely achieving economic benefits to ensuring the overall welfare. Even though the global focus is being redefined in this regard, the process of implementing such strategies still remains only within the sphere of declarative devotion. Hence, the main objective of this paper is to provide a thorough critical analysis of theoretical knowledge on local communities' welfare and the potential of achieving the balance of sustainability criteria on a community level. By using the case study method, the aim is to analyze the potential of reaching local communities' long-term prosperity by ensuring sustainable tourism development.
Keywords: sustainable tourism development, degrowth strategies, local communities, governance, welfare

The impact of cruise tourism on the sustainable development of the local community

Eli MARUŠIĆ, Anita GUDELJ, Marijana GRBEŠA

University of Split, Faculty of Maritime Studies, Ruđera Boškovića 37, Split, Croatia

Abstract
The global cruise market has grown significantly over the last decades, generating numerous economic, social, and environmental effects on local communities worldwide. There is a significant increase in cruise ships and passengers visiting Croatia, one of the promising nautical destinations globally. Sea passenger ports developing nautical tourism play a vital role in the sustainability of many coastal cities and areas, particularly in maritime and tourism-oriented countries. Considering cruise tourism's numerous socio-economic and ecological effects, seaports and surrounding destinations face various sustainability challenges. The paper aims to explore cruise tourism's impact on the observed seaport and encompassing tourist destinations from the local community members' perspective, using sustainability variables. A survey was conducted on a population sample from the tourist destination surrounding the Port of Split, the largest passenger port in Croatia and one of the most important ports of call for cruise ships in the Adriatic. The results show a significant impact of cruise tourism on the observed local community and the correlation between the sustainability variables used in the research.
Keywords: sustainable development, seaports, cruise tourism, sustainability variables, local community

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Utjecaj kruzing turizma na održivi razvoj lokalne zajednice

Eli MARUŠIĆ, Anita GUDELJ, Marijana GRBEŠA

Sveučilište u Splitu, Pomorski fakultet, Ruđera Boškovića 37, Split, Hrvatska

Sažetak
Globalno tržište kružnih putovanja značajno je naraslo tijekom posljednjih desetljeća, generirajući brojne ekonomske, društvene i ekološke učinke na lokalne zajednice diljem svijeta. Značajan je porast broja brodova i putnika na kružnim putovanjima koji posjećuju Hrvatsku, jednu od perspektivnih nautičkih destinacija u svijetu. Morske putničke luke koje razvijaju nautički turizam igraju ključnu ulogu u održivosti mnogih obalnih gradova i područja, posebice u pomorskim i turistički orijentiranim zemljama. Uzimajući u obzir brojne društveno-ekonomske i ekološke učinke kruzing turizma, morske luke i okolne destinacije suočavaju se s raznim izazovima održivosti. Cilj rada je istražiti utjecaj kruzing turizma na promatranu morsku luku i okolna turistička odredišta iz perspektive članova lokalne zajednice, koristeći se varijablama održivosti. Istraživanje je provedeno na uzorku stanovništva turističkog odredišta oko Luke Split, najveće putničke luke u Hrvatskoj i jedne od najvažnijih luka ticanja brodova na kružnim putovanjima u Jadranu. Rezultati pokazuju značajan utjecaj kruzing turizma na promatranu lokalnu zajednicu te povezanost varijabli održivosti korištenih u istraživanju.
Ključne riječi: održivi razvoj, morske luke, kruzing turizam, varijable održivosti, lokalna zajednica

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

Sustainable mobility linking Danube travel stories

Matej MARUŠIĆ[1], Vlatko ROŽAC[2], Georg FRANK[3]

[1] DANUBEPARKS – Danube River Network of Protected Areas, Schloss Orth, Orth an der Donau, Austria
[2] Public institution Nature Park Kopački rit, Mali Sakadaš 1, Kopačevo, Croatia
[3] Donau Auen National Park, Schloss Orth, Orth an der Donau, Austria

Abstract
Recognizing the vast cultural and natural heritage of the Danube region, within the Interreg DTP Transdanube Travel Stories project (July 2020 to December 2022) 6 new narratives and stories were created to support the development of innovative promotion concepts, and different sustainable mobility management tools. New narratives represent the holistic approach of letting visitors experience the heritage of a region as one entity transporting values and emotions. They are meant to link the stories of single destinations and thematically focused routes with each other, like pieces of a big puzzle, providing the visitor with a bigger picture under the umbrella of the Danube.
During the project, 6 new tourist trails were developed:
1. Europe of Contrasts (from Linz to Timişoara)
2. Nature Lover (from Kopačevo to Tulcea)
3. Roaming like a Roman (from Regensburg to Zaječar)
4. You had me at Culture (from Ulm to Murska Sobota)
5. Trading Hustle (from Ulm to Bucharest)
6. Soul-searching (from Budapest to Babadag)
DANUBEPARKS worked on the development of Trail #2, which is focused on the story of the relationship between nature and mankind. The trail passes through 8 protected areas in 5 Danube countries in the Lower Danube section.
Keywords: sustainable tourism, protected areas, sustainable mobility, Danube, nature trails

Camp "Glamping Vila Trilogy" – An example of sustainable continental tourism in Međimurje County

Jasmina OVČAR[1], Dora OVČAR[2]

[1] Međimurje University of Applied Sciences in Čakovec, Ulica bana J.Jelačića 22A, Čakovec, Croatia
[2] Balatinec and Nikolić Law Firm Ltd., Sveti Duh 28, Zagreb, Croatia

Abstract
The beginning of a serious commercial approach to investing in continental tourism in the Republic of Croatia dates back only a few decades. There is great potential in the peculiar indigenous localities, untouched nature and the specifics of the region that are increasingly attracting tourists, especially adventurers and lovers of simplicity, modesty and naturalness. These are the characteristics of sustainable tourism. Given that it has not taken on the scale of mass tourism, continental tourism is the potential for sustainable planning and design that will prevent uncontrolled construction and supply that would lead to consumerism. The purpose of the paper is to show a successful example of investing foreign capital in continental tourism in Međimurje County, in the village of Štrigova, with a fantastic view from the plateau of the surrounding "Štrigovske brege". The vision and enthusiasm of the owners and according to their refined sense of the simple and natural, the glamping-camp was created with a current accommodation capacity of eight people (with the possibility of development up to a maximum capacity of twenty people), with accompanying facilities - open fire, swimming pool, sunbathing area, jacuzzi, kitchen with dining room, etc. The project envisages all sustainability components; the imperative of retaining existing facilities, minimal financial investment, maximum respect for ambient values, ensuring the privacy of guests with the principle of optimal capacitation of the camp, etc. A particular challenge in the implementation of pioneering projects is compliance with legal regulations. The presentation of examples from practice raises a problematic issue of achieving the legality of simple buildings intended for tourism due to the non-compliance of construction regulations with the regulations for issuing licenses and categorization of tourist facilities.
Keywords: categorization of tourist facilities, continental tourism, glamping-camp, building regulations, sustainable tourism

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

Kamp "Glamping Vila Trilogy" – Primjer održivog kontinentalnog turizma Međimurske županije

Jasmina OVČAR[1], Dora OVČAR[2]

[1] Međimursko veleučilište u Čakovcu, Ulica bana J.Jelačića 22A, Čakovec, Hrvatska
[2] Odvjetničko društvo Balatinec i Nikolić d.o.o., Sveti Duh 28, Zagreb, Hrvatska

Sažetak

Početak ozbiljnog komercijalnog pristupa ulaganju u kontinentalni turizam u Republici Hrvatskoj datira tek nekoliko desetljeća. Očigledan je veliki potencijal u osebujnim autohtonim lokalitetima, netaknutoj prirodi i specifičnostima podneblja koja sve više privlače turiste, posebno avanturiste i ljubitelje jednostavnosti, skromnosti i povezanosti s prirodom. Upravo to su i obilježja održivog turizma. S obzirom da nije poprimio razmjere masovnog turizma, upravo je kontinentalni turizam potencijal za održivo planiranje i projektiranje koje će spriječiti nekontroliranu izgradnju i ponudu koja bi vodila u konzumerizam. Svrha rada je prikazati uspješan primjer investiranja stranog kapitala u kontinentalni turizam u Međimurskoj županiji, u naselju Štrigova, s fantastičnim pogledom s visoravni na okolne "štrigovske brege". Vizijom i entuzijazmom vlasnika te u skladu s njihovim istančanim osjećajem za jednostavno i prirodno, stvoren je glamping-kamp trenutačnog smještajnog kapaciteta osam osoba uz mogućnost razvoja do maksimalnog kapaciteta dvadeset osoba, uz prateće sadržaje - otvorena vatra, bazen, sunčalište, jacuzzi, kuhinja s blagovaonicom i dr. Projekt predviđa sve komponente održivosti; imperativ zadržavanja postojećih objekata, minimalno financijsko ulaganje, maksimalno poštovanje ambijentalnih vrijednosti, osiguranje privatnosti gostiju uz princip optimalnog kapacitiranja kampa i dr. Poseban izazov pri realiziranju pionirskih projekata jest usklađivanje sa zakonskom regulativom. Prikazom primjera iz prakse otvara se problematično pitanje postizanja legalnosti jednostavnih građevina namjenjenih turizmu zbog neusklađenosti građevinske regulative s onom koja uređuje daljnje pitanje - izdavanje dozvole za rad te kategorizacije turističkih objekata.

Ključne riječi: kategorizacija turističkih objekata, kontinentalni turizam, glamping-kamp, građevinska regulativa, održivi turizam

Environmental protection and sustainable tourism-examples of eco-certificates

Mateja PETRAČIĆ, Ivana ŠKRTIĆ, Sandi SALUHOVIĆ

Polytechnic of Karlovac, Trg Josipa Jurja Strossmayera 9, Karlovac Hrvatska

Abstract
Environmental protection is closely related to the concept of sustainable development warranting a change in the structure of global production and consumption that doesn't violate eco standards while adhering to its three principles: economic, ecological and sociocultural sustainability. Environmental protection thus ensures the complete preservation of environmental quality, biodiversity and the rational use of natural resources and energy in a way that is most favorable for the environment. Considering that we live in a time when environmental protection is of great importance for the survival of mankind due to pollution, it's also necessary to take care of the preservation of the environment in tourism, especially in the hotel industry. The importance of eco-certificates in tourism and how they attract an increasing number of tourists, and therefore a larger amount of income can best be seen in the examples of the hotels with EMAS certification mark, followed by EU ECOLABEL, GREEN KEY and BLUE FLAG, a certificate awarded for preserving the sea coast. In the tourism sector, it is possible to certify the destination, tourist transport, and accommodation capacities, which includes hotels, resorts, camps, hostels, rooms, as well as business (e.g. ecotourism) and mobility, i.e. business and private trips etc. Numerous countries are working to turn their tourist destinations to ecotourism, and sustainable tourism, all with the aim of protecting the environment and reducing CO_2 emissions. Hotels oriented towards sustainable tourism can operate throughout the year, and green eco-hotels are very suitable for health tourism. It's precisely these types of hotels that preserve the environment by rationally managing electricity while using energy-saving switches also known as RFID cards and by rationally managing water, while recycling the waste produced in the hotel.
Keywords: eco-certificates, sustainable development, sustainable tourism, tourism, environmental protection

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

Zaštita okoliša i održivi turizam na primjeru eko certifikata

Mateja PETRAČIĆ, Ivana ŠKRTIĆ, Sandi SALUHOVIĆ

Veleučilište u Karlovcu, Trg Josipa Jurja Strossmayera 9, Karlovac, Hrvatska

Sažetak
Zaštita okoliša usko je povezana s pojmom održivog razvoja koji nalaže promjenu strukture globalne proizvodnje i potrošnje koja ne narušava eko standarde, pri čemu se valja držati njegovih triju načela: ekonomske, ekološke te sociokulturne održivosti. Zaštitom okoliša tako se osigurava cjelovito očuvanje kakvoće okoliša, bioraznolikosti te racionalno korištenje prirodnih dobara i energije na najpovoljniji način za okoliš. S obzirom na to da živimo u vremenu kada je zaštita okoliša od velikog značaja za opstanak čovječanstva zbog onečišćenja, potrebno je voditi računa i o očuvanju okoliša u turizmu, posebice u hotelijerstvu. Koliki značaj imaju eko certifikati u turizmu te kako privlače sve veći broj turista, a samim time i veću količinu prihoda, najbolje se može vidjeti na primjerima hotela s EMAS oznakom, zatim EU ECOLABEL, GREEN KEY i BLUE FLAG, certifikat koji se dodjeljuje za očuvanje morske obale. U turističkom je sektoru tako moguće certificirati destinaciju, turistički prijevoz, smještajne kapacitete, što uključuje hotele, resorte, kampove, hostele, sobe, zatim poslovanje (npr. eko turizam) i mobilnost, odnosno poslovna i privatna putovanja te ostalo. Brojne zemlje rade upravo na tome da se njihove turističke destinacije okrenu k eko turizmu, održivom turizmu, sve u cilju zaštite okoliša te smanjenja emisije CO_2. Hoteli koji su okrenuti k održivom turizmu mogu poslovati tijekom cijele godine, a zeleni eko hoteli vrlo su pogodni za zdravstveni turizam. Upravo takve vrste hotela okoliš čuvaju racionalnim raspolaganjem električnom energijom, koristeći pritom prekidače za štednju energije odnosno RFID kartice te racionalnim raspolaganjem vodom, reciklirajući pritom otpad proizveden u hotelu.
Ključne riječi: eko certifikati, održivi razvoj, održivi turizam, turizam, zaštita okoliša

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Adaptation of the existing tourist infrastructure to climate change

Ivana SEČANJ, Paula BUCIĆ, Helena SELIĆ

Ires ekologija d.o.o., Prilaz baruna Filipovića 21, Zagreb, Croatia

Abstract
Tourist infrastructure is exposed to climatic changes, and it is necessary to determine climatic hazards at the location. Only by including climate change in development, a timely reaction to the effects is possible. The goal is to determine which climate changes the infrastructure is exposed and sensitive to and to analyze its vulnerability. Main architectural projects (15) in different locations within Croatia were analyzed. In the projects, the effects of climate change were taken into account and how their adaptation was made. A vulnerability analysis was made for projects, in accordance with the Technical Guidelines for preparing infrastructure for climate change 2021-2027. Adaptation to climate change was not mentioned in the projects and from the primary effects, only extreme temperatures were taken into account. Secondary effects were completely ignored. By correlating the results of the vulnerability assessment and the derived state, the shares of adapted infrastructure to climate change were obtained. Adaptation to climate change should be thought about at the beginning of project development so that infrastructure projects are prepared for a climate-resistant future. In the case of existing infrastructure, climate change should not be ignored because the costs of action are far lower than the costs of inaction.
Keywords: tourism infrastructure, adaptation to climate change, vulnerability of infrastructure

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Prilagođenost postojeće turističke infrastrukture klimatskim promjenama

Ivana SEČANJ, Paula BUCIĆ, Helena SELIĆ

Ires ekologija d.o.o., Prilaz baruna Filipovića 21, Zagreb, Hrvatska

Sažetak
Turistička infrastruktura je izložena klimatskim promjenama te je iz tog razloga potrebno utvrditi klimatske nepogode na lokaciji. Uključivanjem klimatskih promjena u razvoj turističke infrastrukture omogućuje se pravovremena reakcija na sve efekte klimatskih promjena. Cilj je utvrditi kojim klimatskim promjenama je infrastruktura izložena i na što je osjetljiva, a kako bi se analizirala njezina ranjivost. Analizirano je 15 glavnih arhitektonskih projekata na različitim lokacijama unutar Hrvatske. U projektima su traženi efekti klimatskih promjena uzetih u obzir i na koji način je napravljena njihova prilagodba. Također, napravljena je analiza ranjivosti za svaki projekt, sukladno Tehničkim smjernicama za pripremu infrastrukture za klimatske promjene 2021.-2027. U glavne arhitektonske projekte prilagodba na klimatske promjene nije spomenuta. Od primarnih efekti na klimatske promjene većinom je uzeto u obzir povećanje ekstremnih temperatura, dok su sekundarni efekti u potpunosti zanemareni. Korelacijom rezultata procjene ranjivosti projekata i izvedenog stanja dobiveni su udjeli turističke infrastrukture koja je prilagođena na klimatske promjene. Prilagodba na klimatske promjene je proces o kojem treba razmišljati u samim početcima razvoja projekta kako bi infrastrukturni projekti bili pripremljeni na klimatski otpornu budućnost. U slučaju već postojeće infrastrukture klimatske promjene se ne smiju zanemariti jer su troškovi djelovanja daleko niži od troškova nedjelovanja.
Ključne riječi: turistička infrastruktura, prilagodba na klimatske promjene, ranjivost infrastrukture

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Plastic pollution concern in the context of circular tourism

Simona-Roxana ULMAN, Florin-Constantin MIHAI

"Alexandru Ioan Cuza" University of Iasi, Department of Exact Sciences and Natural Sciences, Institute of Interdisciplinary Research, CERNESIM Center, Alexandru Lăpușneanu Street no. 26, Iași, Romania

Abstract
The different studies found in the literature emphasize incipient knowledge about the circular tourism concept, seen as a complex adaptive and reconfiguring system, following the logic of a circular economy for creating a virtuous circle that provides goods and services without losing limited natural resources. The circularity from the organizational level depends on the existent macro-environment and also on management environmental concerns that offer (or not) the proper framework for applying the circular principles into daily practice. Accordingly, we proposed a step-by-step approach for understanding the plastic pollution concern as closely linked to circularity and sustainability concerns in the tourism sector. More specifically, the main aim of this paper is to provide a perspective of what circularity means in the context of an accommodation unit, with a focus on plastic use, as one stringent issue of environmental sustainability dimension. This could prove useful in the process of supporting the implementation of pro-environmental policies and good practices aimed at promoting circular tourism while decreasing the level of plastic pollution. Moreover, it becomes relevant also in the discussions regarding the interaction between plastics and freshwater pollution in circumstances in which the environmental effects of tourism might not be neglected.
Keywords: plastic pollution concern, circularity concern, sustainability concern, circular tourism

Sustainable Tourism / *Održivi turizam*
Oral presentation / *Usmeno priopćenje*

Exploring the evaluation framework of tourism decarbonization

Mira ZOVKO

Ministry of Tourism and Sport, Šubićeva 28/III, Zagreb, Hrvatska

Abstract
The global and EU climate public policies have stimulated serious changes in accelerating the decarbonization of the tourism industry. A turning point has been reached, as can be seen from the number of governmental and non-governmental activities that mainstream tourism companies and destinations to set tangible climate goals. The European Union is currently focused on a regulatory framework related to the decarbonization of all economic sectors. In order to monitor the progress of the regulation implemented, an evaluation framework is necessary. The carbon neutrality of the tourism industry is rooted in the EU Green Deal and has relatively fewer documents compared to other industrial sectors. This emphasizes the specificity of tourism's decarbonization road map, especially due to its complexity in terms of its players and activities. Bearing in mind the upcoming changes in regulatory obligations relevant to the tourism industry and the necessity of measuring the success of targeted policy instruments, this research explores policy, data and indicators availability in order to propose effective feedback loops for the evaluation of policy performance. For that purpose, this paper suggests an evaluation framework for measuring and reporting on progress toward a net-zero future for the tourism industry.
Keywords: tourism, climate policy, decarbonization, evaluation framework, indicators

Sustainable Tourism / *Održivi turizam*
Poster presentation / *Postersko priopćenje*

ICT approach to green tourism

Ivana ŽGANJAR

University of Zagreb, Faculty of Graphic Arts, Getaldićeva 2, Zagreb, Croatia

Abstract
Based on the fact that in the Republic of Croatia, tourism represents one of the most important economic branches, whose comprehensiveness reflects on the entire country and includes multidisciplinary organization, it is important to monitor its impact on the environment. The development documents of Croatian tourism support the ecological approach to sustainable green tourism and emphasize the quality of media campaign development in tourism that needs to be achieved by encouraging digitization, by transforming the tourism media campaign based on printed and multimedia graphic materials with the aim of conveying a message to consumers. In accordance with global trends, and in terms of information and communication technology new tourists who are physically and intellectually active, organize their own trips online. The positive effect of information affects the experience of environmentally responsible choices; therefore the research work is focused on the analysis of Croatian tourist websites, with the aim of determining the information and communication message that contributes to the development of green sustainable Croatian tourism. The scientific research results of the graphic design of media content aimed at the ecological development of green tourism represent guidelines for sustainable development and environmental protection.
Keywords: sustainable green tourism, ICT, Croatian tourist websites, tourism media campaign

Water, Wastewater Treatment and Reuse

Prerada vode, pročišćavanje i recikliranje otpadnih vode

Water, Wastewater Treatment and Reuse / *Prerada vode, pročišćavanje i recikliranje otpadnih voda*
Poster presentation / *Postersko priopćenje*

Enhancing leachate treatment from landfills: A response surface methodology and central composite design approach to coagulation-flocculation optimization

Roukaya BOUYAKHSASS[1], Salah SOUABI[1], Safaa KHATTABI RIFI[1], Abdeslam TALEB[1], Aysegul PALA[2,3], Abdelaziz MADINZI[1]

[1] University Hassan II, Faculty of Science and Technology, Laboratory of Process Engineering and Environment, Mohammedia, Morocco
[2] Dokuz Eylul University, Environment Research and Development Center (CEVMER), Tinaztepe Campus, İzmir, Turkey
[3] Dokuz Eylul University, Faculty of Engineering, Environmental Engineering Department, Tinaztepe Campus, İzmir, Turkey

Abstract
Leachate is a complex mixture of organic and inorganic contaminants, including heavy metals, pathogens, and other toxic substances, that can pose significant risks to the environment and public health if left untreated. Therefore, leachate treatment is essential to protect the environment from contamination and prevent potential hazards to living organisms. This study aimed to improve the process of treating leachate from the Mohammedia-Benslimane landfill (Morocco) using coagulation-flocculation. The response surface methodology and central composite design were used to determine the optimal levels of pH, coagulant dose, flocculant dose, and agitation time. The results showed that the optimal conditions for treatment were a pH of 6.87, a coagulant dose of 7.89 g/L, a flocculant dose of 12 ml/L, and an agitation time of 22.8 minutes. These conditions reduced turbidity by 90.38%, COD by 85.50%, and absorbance at 254 nm by 55.53%. Overall, the model obtained is significant, with a p-value < 0.0001 for the three responses studied and R^2 values of 0.97, 0.96, and 0.94 for turbidity, COD, and UV_{254}, respectively. The findings of this study highlight the importance of using the response surface method in conjunction with the central composite design as an effective tool for optimizing coagulation-flocculation in landfill leachate treatment. This approach can potentially improve the efficiency and effectiveness of leachate treatment, which is essential for mitigating environmental contamination and safeguarding public health.
Keywords: landfill leachate, optimization, coagulation-flocculation, response surface methodology, central composite design

Water, Wastewater Treatment and Reuse / *Prerada vode, pročišćavanje i recikliranje otpadnih voda*
Oral presentation / *Usmeno priopćenje*

Ecosystem-based approaches for resilient waste infrastructures

Urša BRODNIK, Anja PUGELJ

LIMNOS Company for Applied Ecology, Ltd, Požarnice 41, Brezovica pri Ljubljani, Slovenia

Abstract:
Nature-based solutions (NBS) can be applied to increase the resilience of waste infrastructures (landfills) that are often sources of local pollution. Climate change impacts them by extreme events and the NB approach can alleviate this problem. Based on the use of blue-green solutions at a landfill site in Spain to increase its resilience and climate adaptation capacity, additional bio-technosoils layers were implemented in 2022. Hence, landfill landslides and pollution are avoided by soil stabilization (locally made material) that increases retention and infiltration capacity. To store and treat the landfill leachate and the temporarily contaminated run-off water, a combination of innovative treatment wetlands is used and the treated water will be reused to irrigate the landfill and to mitigate and cope with the effects of high temperatures preventing fires or explosions in a landfill. External treatment of polluted run-off waters is hence avoided, enabling not only water reuse and a controlled discharge but also significant cost savings. New innovative treatment wetlands applied are to be: floating treatment wetland (FTW), aerated vertical wetlands with geopolymers (GP - ATW) and electroactive biofilm-based treatment wetland (EAB – TW). FTW installed in 2023 is a buoyant structure where macrophytes are grown. Plants' roots provide an active settling medium and surface area for essential attachment and food for microbial populations needed for the removal of pollutants.
Keywords: landfill climate proofing; treatment wetlands; bio-technosoils

Demineralized water production process in the HEP Proizvodnja plant, EL-TO Zagreb plant

Anamarija DELLAVIA, Sanja SAPUNAR, Ivančica SOMODI

HEP Production, Plant EL-TO Zagreb, Ulica grada Vukovara 37, Zagreb, Croatia

Abstract
The EL-TO Zagreb plant has its own water demineralization plant that works on the principle of ion exchange, with ion resin in the fluidizing layer and counter-current regeneration of ion resins. The process takes place automatically from the water entering the cartridge filter to the exit of the mixed exchanger which is monitored from one place. The production capacity consists of three lines of 3x150 m3/h with max. 450 m3/h. The technological process, or the water demineralization process, runs automatically from the time the water enters the cartridge filter until the water exits the mixed exchanger. The entire production process is monitored from one place. Water from a well or water from the city water network is taken as raw water. The quality of demineralized water is presented in the following table:

Description	*Unit of measure*	*Total*
Silicon dioxide SiO_2	mg/L	< 0,02
El. Conductivity	µS/cm	< 0,2
DOC	mg/L	< 0,2

Keywords: raw water, ionic resins

Proces proizvodnje demineralizirane vode u postrojenju HEP Proizvodnja, Pogon EL-TO Zagreb

Anamarija DELLAVIA, Sanja SAPUNAR, Ivančica SOMODI

HEP Production, Plant EL-TO Zagreb, Ulica grada Vukovara 37, Zagreb, Hrvatska

Sažetak

Pogon EL-TO Zagreb ima svoje postrojenje za demineralizaciju vode koje radi na principu ionskih izmjena, s ionskom smolom u fluidizirajućem sloju i s protustrujnom regeneracijom ionskih smola. Proces se odvija automatski od ulaska vode u patronski filtar do izlaska vode iz miješanog izmjenjivača koji se nadzire s jednog mjesta. Proizvodni kapacitet sastoji se od tri linije od 3x150 m^3/h sa max. 450 m^3/h. Tehnološki proces odnosno proces demineralizacije vode teče automatski od ulaska vode u patronski filtar do izlaska vode iz miješanog izmjenjivača. Cijeli proizvodni proces nadziran je sa jednog mjesta. Voda iz bunara ili voda iz gradskog vodovoda uzima se kao sirova voda. Kakvoća demineralizirane vode prikazana je u tablici:

Opis	*Jedinica mjere*	*Iznos*
Silicijev dioksid SiO_2	mg/L	< 0,02
El. vodljivost	µS/cm	< 0,2
DOC	mg/L	< 0,2

Ključne riječi: sirova voda, ionske smole

The concept of circular economy in wastewater management

Darko DREV, Mario KRZYK

University of Ljubljana, Faculty of Civil and Geodetic Engineering, Jamova cesta 2, Ljubljana, Slovenia

Abstract

The existing concept of wastewater management and treatment meets the requirements of Directive 91/271/EEC on urban wastewater treatment. In 1991, the main objective was that treated water should not contain excessive amounts of organic carbon (C), nitrogen (N) and phosphorus (P). At that time, the reuse of treated water was not considered. It is not surprising that attempts were made to remove as much C as possible in the form of CO_2. Denitrification attempts to remove as much N as possible in the form of N_2 and to incorporate P into the sludge. This also ignores the fact that treated water can be a very valuable resource. In areas, especially with developed agriculture, where water from wastewater treatment plants pollutes the environment, a suitable method could solve water shortages in summer, reduce CO_2 emissions to the air, and reduce the need for artificial fertilizers. The most important requirement for any use of treated wastewater is adequate microbiological purification. For some examples of wastewater treatment plants along the Slovenian Adriatic coast, the characteristics of effluent are analyzed and the possibilities of reusing water from wastewater treatment plants are evaluated.

Keywords: wastewater, wastewater treatment, pollution, water reuse

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Biological treatment of fuel oil washing water by sequential batch reactor

Zineb ETTALOUI[1], Salah SOUABI[1], Safae Rifi KHATTABI[1], Aysegul PALA[2,3], Chaymea HADDAJI[1], Abdeslam TALEB[1]

[1] Hassan II University, Faculty of Sciences and Technologies Mohammedia, Laboratory of Process Engineering and Environment, Casablanca, Morocco
[2] Dokuz Eylul University, Environment Research and Development Center (CEVMER), Tinaztepe Campus, İzmir, Turkey
[3] Dokuz Eylul University, Faculty of Engineering, Environmental Engineering Department, Tinaztepe Campus, İzmir, Turkey

Abstract
Industrial Pollution discharges from washing fuel oils pose severe problems for the environment, particularly for the marine environment receiving these discharges. The washing water of the fuel oil is loaded with pollutants. Therefore, this wastewater should not be rejected without a specific treatment before discharge into the marine environment because this represents a severe environmental threat. Industrial effluents have several standard limits. This work uses a laboratory scale to evaluate the biological treatment performance of wastewater (90 m^3/h) rich in organic matter with low biodegradability using a sequential batch reactor (SBR). The test using SBR was carried out for 25 days on a continuous cycle of 24 hours (30 min of filling, 17 h of aeration, 4 h of anoxia, 2 h of settling, and 30 min of emptying). The feasibility of alternative sources of microorganisms from municipal wastewater performance of the batch sequencing reactor was evaluated using turbidity, total suspended solids, chemical oxygen demand (COD), biological oxygen demand (BOD), ammonium, nitrate, and phenol as indicators. The results obtained showed that the COD/BOD ratio and the pollutant load vary from one campaign to another. The removal efficiency of COD, BOD, TSS (Total suspended solids), ammonium, nitrate, and phenol vary from 81%, 91%, 72%, 100%, 52%, and 63%. Thus, SBR-type treatment could be an interesting way to reduce pollution due to its simplicity, less space occupation, low energy consumption, and not require highly qualified personnel.
Keywords: pollution, washing water, treatment, sequential batch reactor

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Oral presentation / *Usmeno priopćenje*

The use of microalgae and cyanobacteria for purification of wastewater from aquaculture

Ana GAVRILOVIĆ[1], Mirna HABUDA-STANIĆ[2], Miloš PELIĆ[3], Dragana LJUBOJEVIĆ PELIĆ[3], Jurica JUG-DUJAKOVIĆ[4]

[1] University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia
[2] University of Josip Juraj Strossmayer in Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[3] Scientific Veterinary Institute Novi Sad, Department of Food Safety, Novi Sad, Serbia
[4] Sustainable Aquaculture Systems Inc., 715 Pittstown Road, Frenchtown, United States of America

Abstract

Sustainable development of aquaculture depends currently on two main factors: global warming and resource consumption (energy, fresh water, and feed). The accelerated growth of this industry has led to the development of three critical constraints: the demand for aquaculture feed, the requirement of high volume of freshwater, and the high concentration of wastewater that must be safely disposed of. Wastewater from inland fish farms contains high levels of dissolved inorganic nitrogen and phosphorus. Mainly responsible for these high levels of nutrients are the products of fish metabolism and uneaten food. During the last 50 years, significant efforts have been made to remove various nutrients from this wastewater. Currently, there is a wide variety of biological and chemical methods that are satisfactorily used in nutrient removal: biological processes for nitrogen removal such as nitrification and denitrification, and chemical processes such as chemical precipitation for phosphorus removal although this process is a less environmentally friendly technique because it leads to the creation of sludge that further pollutes the environment. The use of microorganisms is considered one of the most prominent technologies with the most significant contribution to environmental protection. By applying algal technologies in wastewater from land-based fisheries, it is possible to remove concentrations of nitrates, phosphates and other present nutrients to obtain economically viable products for the national aquaculture sector, such as food rich in proteins and fats, biofertilizers and biofuels. To date, the use of different strains of microalgae and cyanobacteria for the removal of nutrients on inland fisheries wastewater has been tested at laboratory and demonstration scales in different countries such as Belgium, China, Denmark, Spain, South Africa, and Poland.

Keywords: biological treatment, nutrient removal, wastewater from aquaculture

Denitritation dephosphatation under anoxic conditions

Dijana GRGAS[1], Mirna HABUDA-STANIĆ[2], Vlado CRNEK[1], Tea ŠTEFANAC[1], Tibela LANDEKA DRAGIČEVIĆ[1]

[1] University of Zagreb, Faculty of Food Technology and Biotechnology, Pierotti Street 6, Zagreb, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia

Abstract
The prevention of the eutrophication of waterbodies caused by excessive nutrient discharge is challenging for environmental biotechnological scientists. Biological nutrient removal processes, such as denitritation dephosphatation, are economical, environmentally sustainable and effective alternatives for wastewater treatment. The performance of activated sludge acclimatized to high nitrite concentration for denitrifying dephosphatation was evaluated. Denitrifying phosphorus accumulating organisms (DPAOs) have the ability for simultaneous N removal and P uptake. The experiments of denitritation dephosphatation were performed under anoxic conditions with acetate as the sole carbon source in lab-scale reactors in batch mode.
Keywords: denitrifying dephosphatation, acetate, nitrite, anoxic conditions

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Oral presentation / *Usmeno priopćenje*

Arsenic in drinking water of the town of Osijek – from problem to solution

Mirna HABUDA-STANIĆ[1], **Željka ROMIĆ**[2]

[1] University of Josip Juraj Strossmayer in Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[2] Vodovod-Osijek d.o.o., Poljski put 1, Osijek, Croatia

Abstract
The occurrence of inorganic arsenic in the groundwaters of Eastern Croatia is a consequence of the geological composition, i.e. the occurrence of arsenic in some soil layers. Since the eighties of the last century, the population town of Osijek obtained water from the well-field Vinogradi placed around ten kilometers from Osijek. At the beginning of the water catchment, and during the following two decades, arsenic presence in Osijek groundwater, with an average concentration up to 20 times higher than the maximum concentration permitted by regulations, was rarely mentioned information. In the early 2000s, the problem of arsenic in groundwater and drinking water of the town of Osijek came into the spotlight, especially after Croatia initiated EU entrance and accepted the new, significantly lower concentration arsenic limit established by the European Directive. In this paper, the history of drinking water treatment history in the town of Osijek is described which finally resulted in Croatian arsenic removal technology, i.e. reduction of arsenic concentration from an average of 200 µg/L to 1 µg/L.
Keywords: drinking water, removal arsenic, coagulation, ozonization, filtration

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Strategic planning of wastewater treatment pathways contributing its reuse

Djurdja KERKEZ, Milena BEČELIĆ-TOMIN, Vesna PEŠIĆ, Dejan KRČMAR, Dragana TOMAŠEVIĆ PILIPOVIĆ, Anita LEOVAC MAĆERAK, Aleksandra KULIĆ MANDIĆ

University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Trg Dositeja Obradovica 3, Novi Sad, Serbia

Abstract

The Green Agenda for the Western Balkans, through its pillars, addresses the initiatives to support the region in developing circular economy (CE) strategies and fighting pollution of air, water and soil. According to this wastewater can potentially contribute to the nexus of water, energy and material recovery, with regard to the circular-economy design. Many challenges but also opportunities rise when considering reclamation and reuse of wastewater to increase water resources, with special attention paying particular attention to the risks for human health, recovery of nutrients, or highly added-value products (e.g., metals and biomolecules, etc.), valorization of sewage sludge, and/or recovery of energy. This adds new light onto wastewater treatment technologies and choosing the best pathway for resource recovery. A structured approach, based on multicriteria analysis is needed for selecting technologies for resource recovery from wastewater. Integrated resource recovery schemes focus on the best-performing resources for a given scenario, additional resources that can be captured, and potential process enhancements. To decide the final strategy, treatment methods using the original mass balance model are compared. This sort of strategic planning tool is necessary to accelerate the water sector's CE transition.

K**eywords:** wastewater management, circular economy, wastewater treatment and reuse

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Optimization of the coagulation process for olive oil mill wastewater using *Moringa Oleifera* as a natural coagulant

Safaa KHATTABI RIFI[1], Salah SOUABI[1], Loubna EL FELS[2], Anas DRIOUICH[3], Ilham NASSRI[4], Aysegul PALA[5,6], Mohamed HAFIDI[2,3], Abdelaziz MADINZI[1]

[1] University Hassan II, Faculty of Science & Technology, Laboratory of Process Engineering and Environment, Mohammedia, Morocco
[2] University Cadi Ayyad (UCA), Faculty of Sciences Semlalia, Laboratory of Microbial Biotechnologies, Agrosciences, and Environment Labeled Research Unit-CNRST N°4 Marrakech, Morocco
[3] Mohammed VI Polytechnic University, Agrobiosciences program, Benguerir Morocco
[4] Mohammed V University, Scientific Institute, Géo-biodiversity and Natural Patrimony Laboratory, Rabat, Morocco
[5] Dokuz Eylul University, Environment Research and Development Center (CEVMER), Tinaztepe Campus, İzmir, Turkey
[6] Dokuz Eylul University, Faculty of Engineering, Environmental Engineering Department, Tinaztepe Campus, İzmir, Turkey

Abstract
Oil Mill Wastewater (OMW) is a major environmental problem that needs effective treatment to reduce pollution. This study studied the treatment of OMW by coagulation using a natural coagulant based on the *Moringa oliefera* plant. To describe the relationship between TSS and nitrate removal efficiency, four independent variables were selected (*M. oliefera* concentration, pH, agitation speed, and agitation time), we used a composite-centered design (CCD) combined with the response surface methodology (RSM) to optimize the OMW treatment process. The results obtained showed that the established models were significant as a whole. Moreover, the models are characterized by very high values of the adjusted coefficient of determination (R^2Adj = 87% for TSS and R^2Adj = 90.8% for nitrates), confirming the excellent adjustment of the models. Therefore, with an *M. oliefera* concentration of about 65 g/L, a pH of 6, a stirring time of around 25 minutes, and a stirring speed of 35 rpm, the removal efficiencies of TSS and nitrates were of the order of 60%, and 78% respectively. Therefore, the proposed treatment process represents an efficient alternative to sustainable environmental technologies.
Keywords: olive mill wastewater, optimization, response surface methodology, *Moringa oleifera*, central composite plan

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Influence of hydraulic loading rate and C:N ratio on wastewater treatment in constructed wetlands inoculated with arbuscular mycorrhizal fungi

Kristina KRALJ

Czech University of Life Sciences Prague (CZU), Kamýcká 129, Praha – Suchdol, Czech Republic

Abstract
Constructed wetlands (CWs) are engineered wetland systems widely used to treat industrial and domestic wastewater and non-point water pollution from agricultural production. They are an environmentally friendly and cost-effective approach to wastewater treatment where performance can be influenced by a number of factors. The hydraulic loading rate (HLR) refers to the volume of wastewater that is applied to the wetland per unit of area per unit of time. HLR has an impact on the contact time between the wastewater and the wetland media, water saturation, oxygen availability, and consequently the pollutant removal efficiency. The availability of carbon and nitrogen in the wetland system can impact microbial activity, which in turn affects the degradation of pollutants. Arbuscular mycorrhizal fungi (AMF) have a newfound application in CWs where they contribute to nutrient uptake, plant growth, and overall system resilience. In this study, we assessed the effect of hydraulic loading rate and C:N ratio on nutrient removal efficiency, using 8 vertical flow constructed wetland reactors inoculated with *Rhizophagus irregularis*. Applied wastewater was simulated municipal sewage. Wastewater influent and effluent samples were analyzed in a laboratory. Results showed that all eight constructed wetland reactors had adequate nitrogen, carbon, and phosphorus removal efficiencies, even higher for certain nutrients than those reported in other research. This study provides useful information about CW system design.
Keywords: wastewater treatment, constructed wetlands, arbuscular mycorrhizal fungi, pollutant removal, sustainability

Utjecaj hidrauličkog opterećenja i omjera C:N na obradu otpadnih voda u konstruiranim močvarama inokuliranim s arbuskularnim mikoriznim gljivama

Kristina KRALJ

Czech University of Life Sciences Prague (CZU), Kamýcká 129, Praha – Suchdol, Czech Republic

Sažetak

Konstruirane močvare (KM) su dizajnirani močvarni sustavi koji se koriste za obradu industrijskih i komunalnih otpadnih voda te raspršenih zagađenja iz poljoprivredne proizvodnje. One su ekološki prihvatljiv i ekonomičan pristup obradi otpadnih voda, gdje performanse mogu biti utjecane brojnim čimbenicima. Hidrauličko opterećenje (HO) odnosi se na volumen otpadne vode koji se nanosi na močvarni sustav po jedinici površine i jedinici vremena. HO ima utjecaj na vrijeme kontakta između otpadne vode i medija u sustavu, zasićenost vodom, dostupnost kisika te, posljedično, učinkovitost uklanjanja onečišćujućih tvari. Omjer ugljika i dušika u močvarnom sustavu može utjecati na mikrobiološku aktivnost, što posljedično utječe na razgradnju onečišćujućih tvari. Arbuskularne mikorizne gljive (AMG) imaju novo otkrivenu primjenu u konstruiranim močvarama gdje doprinose asimilaciji hranjiva, rastu biljaka i ukupnoj otpornosti sustava. U provedenom istraživanju smo procijenili učinak hidrauličkog opterećenja i C:N omjera na učinkovitost uklanjanja hranjiva, koristeći 8 reaktora konstruirane vertikalno-protočne močvare inokulirane s *Rhizophagus irregularis*. U istraživanju je korištena simulirana komunalna otpadna voda. Uzorci influenta i efluenta otpadne vode su analizirani u laboratoriju. Rezultati su pokazali da su svih osam močvarnih reaktora imali adekvatne učinkovitosti uklanjanja dušika, ugljika i fosfora, čak i više za određene hranjive tvari nego što je pronađeno u drugim istraživanjima. Ovo istraživanje pruža korisne informacije o dizajnu sustava konstruirane močvare.

Ključne riječi: obrada otpadnih voda, konstruirane močvare, arbuskularne mikorizne gljive, uklanjanje onečišćenja, održivost

Eco-friendly water treatments

Barbara LENDIĆ[1], Mirna HABUDA-STANIĆ[1], Marija STJEPANOVIĆ[1], Tibela LANDEKA DRAGIČEVIĆ[2]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[1] University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia

Abstracts
Providing safe drinking water is considered to be one of the biggest challenges of today. Drinking water pollution is mainly caused by human activities and, therefore, metals, dyes, pesticide residues, fecal contaminants and other organic and inorganic compounds are often present in the water. Conventional water treatment methods require certain energy consumption and produce undesirable byproducts. In some conditions, they are not effective enough regarding the regulation requirements. Therefore, scientists and professionals trying to find new or improved conventional water treatments to obtain sustainability. These processes imply the use of low-cost materials in water treatment or efforts to reduce byproducts and waste generation. The following processes are considered environmentally friendly: adsorption by lignocellulose-based adsorbents, phytoremediation for chemical pollutants removal, usage of membrane filtrations and membrane bioreactors, advanced oxidation processes (AOPs), electrocoagulation, and numerous of their variations and modifications. These processes are based on the use of natural or recycled materials, i.e. waste utilization for the purpose of sustainability reached.
Keywords: drinking water treatment, wastewater treatment, adsorption, membrane filtration, AOPs

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Oral presentation / *Usmeno priopćenje*

Removal of glyphosate (GLP) herbicide from the surface water using polyaniline/$ZnWO_4$/WO_3 nanocomposite

Rukiye ÖZTEKİN, Delia Teresa SPONZA

Dokuz Eylül University, Engineering Faculty, Department of Environmental Engineering, Tınaztepe Campus, Buca, İzmir, Turkey

Abstract

Polyaniline–$ZnWO_4$/WO_3 nanocomposite was prepared to remove glyphosate (GLP) herbicide from the surface water. The properties of polyaniline/$ZnWO_4$/WO_3 nanocomposite were investigated using XRD, FTIR, FESEM, HRTEM, XPS analyses. The toxicity of nanocomposite and treated wastewater were investigated using Microthox and *Daphnia magna* acute toxicity tests. Increasing Polyaniline–$ZnWO_4$/WO_3 nanocomposite concentrations (0.1, 0.4, 0.6, 1.0 and 1.5 mg/L), different polyaniline/$ZnWO_4$/WO_3 mass ratios (1:1:3, 1:2:3, 3:1:1 and 3:2:1), different GLP herbicide concentrations (1, 2, 3 and 4 mg/L), increasing photooxidation time (2, 10, 15 and 20 min), increasing solar light power (20, 40, 60, 80 and 100 W/m^2). The acute toxicity analysis showed that the surface water was toxic and decreased toxicity after photocatalytic treatment. Polyaniline/ZnWO4/WO_3 nanocomposite exhibited slight toxicity after a concentration of 5 mg/L and 6 mg/L for Microthox and *Daphnia magna* acute toxicity, respectively. The nanocatalyst was reused 45 times with a yield of 98%. The maximum removal conditions for 3 mg/L GLP (99.90%) were 1 mg/L polyaniline/$ZnWO_4$/WO_3 nanocomposite with a polyaniline/$ZnWO_4$/WO_3 ratio of 1:2:3 after 15 min photooxidation time at 80 W/m^2 power. From 3 mg/L initial GLP concentration, 1.8 mg/L aminomethyl and 1.2 mg/L phosphonic acid were produced as photometabolites after 10 min photooxidation time. After 15 min these photometabolites break down to CO_2, H_2O and 0.05 mg/L PO_4-P. The crystalline monoclinic $ZnWO_4$ and WO_3 were detected from XRD analysis while polyaniline exhibited a characteristic broad peak at 28.91° with an amorphous nature. FTIR spectra showed that pure $ZnWO_4$ has the Zn–O–W vibrational bands. For WO_3 nanostructures, the vibrational band at 740 cm^{-1} represents the W–O–W stretching vibrations while IR bands for polyaniline observed at 1574 and 1510 cm^{-1} can be ascribed to the C/-C vibrational mode of the quinoid and benzenoid rings. XPS analysis exhibited reactive oxygen species quantification ($HO^{\bullet}$ and $O_2^{-\bullet}$) suggesting a possible double electron transfer to N–C bond cleavage of GLP. The treated water can be used again as washing utilities.

Keywords: glyphosate (GLP) herbicide, acute toxicity tests, photocatalytic oxidation process, nanocomposite

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Oral presentation / *Usmeno priopćenje*

Bacteria enriched from marine organisms with the potential for the removal of some pharmaceutical compounds from wastewater

Tânia PALMA[1,2], Julia VALENTINE[1,2], Alba MORENO[1], Maria Clara COSTA[1,2*], Jorge CARLIER[1]

[1] University of Algarve, Centro de Ciências da Mar, Campus de Gambelas, Building 7, Faro, Portugal
[2] University of Algarve, Faculdade de Ciências e Tecnologias, Campus de Gambelas, Building 8, Faro, Portugal

Abstract
The work presented is being performed in the framework of the project "BIOEXTREMDEGRAD" and aimed to select bacteria enriched from marine microorganisms with the potential to degrade pharmaceuticals frequently detected in municipal sewage for further bioaugmentation in granular wastewater treatment systems. For this purpose the following steps were done: (1) enrichment of microbial consortiums in liquid medium and isolation of strains in solid medium with these pollutants added as the only carbon sources, (2) strains plating in LB growth medium to select morphological types of colonies followed by taxonomic classifications based on the 16S rRNA gene and (3) confirmation of strains' degrading capacity in liquid medium. Eight bacteria with the ability to grow in the presence of paracetamol as the sole carbon source were isolated from cultures recovered from *Hymedesmia versicolor* and *Filograna implexa* macro-organisms collected in marine caves of Algarve coast (Portugal). The isolates were assigned to *Paenibacillus, Micrococcus and Microbacterium genera*. In a liquid medium, the isolate assigned to the *Micrococcus yunnanensis* strain TJPT4 presented the best performance for paracetamol removal (93 ± 4%) and was also able to degrade the produced metabolites. Moreover, this strain showed the ability to remove fluoxetine (82 ± 1%), mainly by adsorption, and 17α-ethinylestradiol (67 ± 1%).
Keywords: biodegradation, paracetamol, fluoxetine, 17α-ethinylestradiol, marine organisms

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From waste to riches: Microscale phenomena enabling phosphorus recovery from wastewaters

Sanja RADOVIC[1], Sabolc PAP[2], Daria ILIC[1,3], Maja TURK SEKULIC[1]

[1] University of Novi Sad, Faculty of Technical Sciences, Department of Environmental Engineering and Occupational Safety and Health, Trg Dositeja Obradovica 6, Novi Sad, Serbia
[2] Environmental Research Institute, UHI North Highland, University of the Highlands and Islands, Thurso, Caithness, Scotland, KW14 7JD, United Kingdom
[3] BioSense Institute, Dr Zorana Đinđića 1, Novi Sad, Serbia

Abstract

Phosphorus is an irreplaceable part of modern agriculture, as well as a scarce and non-renewable resource that must be recovered from phosphorus-rich waste streams. This work evaluates the phosphate (PO_4-P) removal ability of magnetic biochar (FeBCH) produced from sunflower seed hulls (SSH) and impregnated with $FeSO_4$. PO_4-P removal ability of the pristine material (SSH), SSH biochar without impregnation, impregnated SSH without pyrolysis and FeBCH were compared. Due to its highest removal efficiency (<90%) and magnetic properties, FeBCH was used for further experiments. The effect of different operating parameters such as FeBCH dosage (1-8 g/L), pH value (2-10), initial PO_4-P concentration (0.1-100 mg/L) and contact time (5 min to 24 h), on PO_4-P removal, were investigated. Over 90% removal was achieved at pH 6, for an initial PO_4-P concentration of 20 mg/L and an adsorbent dosage of 4 g/L, after 7 h. Almost complete removal was reached after 24 hours. Additionally, 0.5 M NaOH solution effectively desorbed 96.5% of previously adsorbed PO_4-P, which indicated that the saturated FeBCH could be potentially repurposed and used as a soil amendment. Although results showed that SSH can be used as a biochar precursor, further investigation is needed on FeBCH properties and their toxicity in different environments.

Keywords: agricultural biomass, circular economy, wastewater treatment, magnetic adsorbents

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Poster presentation / *Postersko priopćenje*

Removal of chromium and two solvents (dichloromethane, tetrachloroethane) from leather industry wastewater using nanofiltration and reverse osmosis membranes

Delia Teresa SPONZA, Rukiye ÖZTEKİN

Dokuz Eylül University, Engineering Faculty, Department of Environmental Engineering, Tınaztepe Campus, Buca, İzmir, Turkey

Abstract
In this study, for removal of the leather industry pollutants and recoveries of chromium, dichloromethane and tetrachloroethane were investigated in two nanofiltrations (NF270 and NF90 membranes) and two reverse osmosis (BW30 and SW30) membranes. The membrane surface properties were investigated by Fourier Transforms Infrared Spectroscopy Attenuated Total Reflectance (FTIR-ATR), and Emission Scanning Electronic Microscopy (SEM). The permeate of the SW30 reverse osmosis exhibited high removal varying between 98% and 99% for Na^{+}, K^{+}, Mg^{2+} and Ca^{2+}, COD, COD_{dis}, DOC and inert COD compared to the NF90 nanofiltration process. The reverse osmosis permeate conforms to Turkish Regulations regarding being discharged directly into the natural environment While the SW30 membrane proved to be the most effective for purification of the tannery effluent. From the retentate/concentrate of the SW30 reverse osmosis 45 mg/L chromium, 60 mg/L dichloromethane and 26 mg/L tetrachloroethane were resused.
Keywords: chromium, dichloromethane, leather industry wastewater, nanofiltration membranes, reverse osmosis membranes, tetrachloroethane

Water, Wastewater Treatment and Reuse / *Prerada vode, pročišćavanje i recikliranje otpadnih voda*
Poster presentation / *Postersko priopćenje*

Adsorptive removal of phosphate with waste wool derivatives: A preliminary research

Marija STJEPANOVIĆ[1], Mirna HABUDA-STANIĆ[1], Cinzia TONETTI[2], Natalija VELIĆ[1], Maria Laura TUMMINO [2]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[2] CNR-STIIMA (National Research Council of Italy - Institute of Intelligent Industrial Technologies and Systems for Advanced Manufacturing), Corso G. Pella 16, Biella, Italy

Abstract
The textile industry is a pillar of the manufacturing sector worldwide, but it still represents a significantly polluting production sector since it is energy-, water- and natural resources-intensive. Herein, we recovered waste wool that does not meet the technical requirements to be used for yarns and fabrics to prepare materials for wastewater remediation. The wool underwent an alkaline treatment, eventually saturated with $FeCl_3$ and then left at RT or heated at 180 °C to induce crosslinking/stabilization. The materials were characterized by SEM, TGA, DSC, FT-IR and water uptake tests. The main findings concern the impact of alkaline treatment on morphology and crystalline structure; additionally, the samples with iron displayed a behavior attributable to a crosslinking effect operated by Fe^{3+}. Preliminary batch adsorption experiments were performed with five samples: bare wool (S1), S_Wool_NaOH (S2), S_Wool_NaOH_180 (S3), S_Wool_Fe_NaOH (S4) and S_Wool_Fe_NaOH_180 (S5). Samples 1, 2 and 3 showed to be inefficient in phosphate removal, so further batch experiments were carried out only for S4 and S5. Investigated samples showed similar adsorbed amounts of 16.653 and 16.902 mg/g, respectively, at the initial phosphate concentration of 20 mg/L. A high removal percentage was obtained in a wide pH spectrum – from 3 to 10. Results suggest that the proposed Fe-added adsorbents have the potential for phosphate removal from wastewater.
Keywords: phosphate, adsorption, waste wool, sustainability

Urban wastewater treatment in the Republic of Croatia

Marija ŠPERAC, Dino OBRADOVIĆ

Josip Juraj Strossmayer University of Osijek, Faculty of Civil Engineering and Architecture Osijek, Vladimira Preloga 3, Osijek, Croatia

Abstract

In the Republic of Croatia, about 80% of the total amount of urban wastewater is treated before being released into the environment. This amount of treated urban wastewater includes the application of different treatment levels (some have only the previous level, some only primary, the largest part is wastewater treatment plants (WWTPs) with the previous level, primary and secondary treatment level, while some have all levels including tertiary). Depending on the size of the settlement, wastewater is treated in conventional wastewater treatment plants, but also in alternative plants such as constructed wetlands and bio lagoons. Wastewater treatment creates a surplus of activated or biological sludge (from secondary treatment) and chemical sludges (from primary and tertiary treatment) whose disposal poses a significant problem both in Croatia and wider. By joining the European Union, the Republic of Croatia assumed the rights and obligations applicable to the European Union. Regarding the full implementation of the Council Directive on Urban Wastewater Treatment, the Republic of Croatia was granted a transitional period until December 31, 2023. In order to ensure the treatment of wastewater, in addition to the treatment plants, it is necessary to have an adequate overall sewerage system and to connect the population to it. In the Republic of Croatia, 58% of the population is connected to the sewerage system. The sludge management from wastewater treatment plants should be aligned with the principles of the Circular Economy Action Plan, namely: prevention of waste generation, reduction of waste generation, producer responsibility for own waste, as well as further use of waste. The continuous decline in population, especially in smaller environments, enables the use of different, more environmentally friendly waste water drainage and treatment systems. A comparative overview of the state of urban wastewater treatment in the Republic of Croatia and certain EU countries will be given.

Keywords: circular economy, sludge, wastewater drainage system, wastewater treatment plant

Water, Wastewater Treatment and Reuse / *Prerada vode, pročišćavanje i recikliranje otpadnih voda*
Oral presentation / *Usmeno priopćenje*

Pročišćavanje komunalnih otpadnih voda u Republici Hrvatskoj

Marija ŠPERAC, Dino OBRADOVIĆ

Sveučilište Josipa Jurja Strossmayera u Osijeku, Građevinski i arhitektonski fakultet Osijek, Vladimira Preloga 3, Osijek, Hrvatska

Sažetak

Od ukupne količine komunalnih otpadnih voda u Republici Hrvatskoj oko 80 % se pročišćava prije ispuštanja u okoliš. Ova količina pročišćene komunalne otpadne vode uključuje primjenu različitih stupnjeva pročišćavanja (neki imaju samo prethodni stupanj, neki samo I., najveći dio je uređaja za pročišćavanje otpadnih voda (UPOV-a) s pret., I. i II. stupnjem, dok neki imaju sve stupnjeve do III.). Ovisno o veličini naselja, otpadne vode se pročišćavaju u konvencionalnim uređajima za pročišćavanje otpadnih voda, ali i u alternativnim uređajima kao što su umjetne močvare i bio lagune. Pročišćavanjem otpadnih voda nastaje višak aktivnog mulja ili biološkog mulja (iz II. stupnja pročišćavanja) te kemijskih muljeva (iz I. stupnja i III. stupnja pročišćavanja) čije zbrinjavanje predstavlja značajan problem kako u Hrvatskoj tako i na široj razini. Ulaskom u Europsku uniju Republika Hrvatska je preuzela prava i obveze koje se primjenjuju u Europskoj uniji. Vezano za potpunu primjenu Direktive Vijeća o pročišćavanju komunalnih otpadnih voda, Republika Hrvatska je dobila prijelazno razdoblje do 31. prosinca 2023. godine. Za osiguranje pročišćavanja otpadnih voda osim uređaja za pročišćavanje potrebno je imati i adekvatan cjelokupni sustav odvodnje kao i priključenost stanovništva na isti. U RH 58 % stanovništva je priključeno na sustav odvodnje. Upravljanje muljevima s uređaja za pročišćavanje otpadnih voda treba uskladiti s načelima akcijskog plana za kružno gospodarstvo, a to su: prevencija nastanka otpada, smanjenje količine nastanka otpada, odgovornost proizvođača za vlastiti otpad, kao i daljnja korisna uporaba otpada. Kontinuirani pad broja stanovnika, naročito u manjim sredinama, omogućava primjenu različitih sustava odvodnje i pročišćavanja otpadnih voda koji su za okoliš prihvatljiviji. U radu će se dati usporedni pregled stanja pročišćavanja komunalnih otpadnih voda u Republici Hrvatskoj te u odabranim članicama Europske unije.

Ključne riječi: kružno gospodarstvo, mulj, sustav odvodnje otpadnih voda, uređaj za pročišćavanje otpadnih voda

Water, Wastewater Treatment and Reuse / *Prerada vode, pročišćavanje i recikliranje otpadnih voda*
Poster presentation / *Postersko priopćenje*

Construction project of the integrated drainage system of the Zadar - Petrčane agglomeration - extension of the UPOV Centar

Branka VIDUKA

Odvodnja d.o.o. Zadar, Hrvatskog sabora 2 d, Zadar, Hrvatska

Abstract
Water and communal infrastructure improvement project of the Zadar-Petrčane agglomeration was launched for the purpose of harmonization with EU Directives (98/83 / EC and 91/271 / EEC) relating to the drainage and treatment of municipal wastewater and bathing sea quality. The project aims to develop a system of wastewater collection and treatment with the aim of contributing to the improvement of the state of the sea and water and increasing the connection of the population to public sewerage and treatment systems. The aim of this project is to reduce the discharge of partially treated and untreated wastewater into the Adriatic coastal area and to protect water resources.
The main activities of the project include:
- reconstructions, rehabilitations and upgrades in the Zadar agglomeration which include 68.24 km of gravity collectors, 4.64 km of pressure lines, 9 pumping stations and 4770 preparations for home connections
-construction of drainage system in the Petrčane agglomeration, which includes the construction of 22.38 km of gravity collectors, 6.51 km of pressure lines, 8 pumping stations and 800 preparations for home connections
- inevitable reconstructions of the water supply system on the routes of construction of the drainage system upgrade of the wastewater treatment plant Center
-purchase of equipment for maintenance of drainage systems.
The construction of the drainage system will enable the construction of 5570 new household connections and adequate wastewater treatment for an additional 12,500 ES.
Keywords: wastewater, drainage, wastewater treatment

Water, Wastewater Treatment and Reuse / *Prerada vode, pročišćavanje i recikliranje otpadnih voda*
Poster presentation / *Postersko priopćenje*

Projekt izgradnje integriranog sustava odvodnje aglomeracije Zadar-Petrčane - dogradnja UPOV-a Centar

Branka VIDUKA

Odvodnja d.o.o. Zadar, Hrvatskog sabora 2 d, Zadar, Hrvatska

Sažetak
Projekt poboljšanja vodno-komunalne infrastrukture aglomeracije Zadar-Petrčane pokrenut je u svrhu usklađivanja s Direktivama EU (98/83/EZ i 91/271/EEZ) koje se odnose na odvodnju i pročišćavanje komunalnih otpadnih voda te kakvoću mora za kupanje. Projektom se želi postići razvoj sustava prikupljanja i obrade otpadnih voda s ciljem doprinosa poboljšanja stanja mora i voda te povećanja priključenosti stanovništva na sustave javne odvodnje i pročišćavanja. Cilj ovog projekta je smanjenje ispuštanja djelomično pročišćenih i nepročišćenih otpadnih voda u priobalno područje Jadranskog mora i zaštita vodnih resursa. Glavne aktivnosti projekta obuhvaćaju:
- rekonstrukcije, sanacije i dogradnje u aglomeraciji Zadar koje uključuju 68,24 km gravitacijskih kolektora, 4,64 km tlačnih vodova, 9 crpnih stanica i 4770 priprema za kućne priključke
-izgradnje sustava odvodnje u aglomeraciji Petrčane koja uključuje izgradnju 22,38 km gravitacijskih kolektora, 6,51 km tlačnih vodova, 8 crpnih stanica i 800 priprema za kućne priključke
-neizbježne rekonstrukcije sustava vodoopskrbe na trasama izgradnje sustava odvodnje
-dogradnja uređaja za pročišćavanje otpadnih voda Centar
-nabava opreme za održavanje sustava odvodnje.
Izgradnjom sustava odvodnje će se omogućiti izvedba novih 5570 priključaka kućanstva i adekvatno pročišćavanje otpadnih voda za dodatnih 12 500 ES.
Ključne riječi: otpadne vode, odvodnja, pročišćavanje otpadnih voda

Waste Management
Gospodarenje otpadom

Food waste in hotels - Methods applied to tackle the problem

Vesna CETIN KRNJEVIĆ[1], Maša GOLUBIČIĆ[1], Jelena ŠOBAT[2]

[1] Environmental Protection and Energy Efficiency Fund, Radnička cesta 80, Zagreb, Croatia
[2] Ministry of Tourism and Sport, Prisavlje 14, Zagreb, Croatia

Abstract
Food waste prevention, from the tourism sector perspective, comes at the end of the food consumption value chain and has environmental, social, and financial impacts. As the value chain progresses, there is a cumulative effect on the value of the food that gets thrown away, i.e. discarded food. As a result, discarding of food still fit for consumption has a more significant environmental impact and affects the costs generated by the resulting waste. Environmental management plans, certificates, and norms in tourism create the framework under which food waste prevention measures in hotels can be introduced. The Strategy for Food Waste Prevention in Hotels, implemented through a pilot project entitled Reduce food waste, includes measurements, setting goals, activities aimed at reducing the negative environmental impact, and cutting down on the costs of discarding food. Based on the recommendations proposed under the project, food waste volume was reduced in the range of 11–30% on average, and financial savings regarding food waste were also achieved. Activities to raise the awareness of guests were an integral part of the strategy applied in this project.
Keywords: hotels, environment, food waste, financial saving, sustainable tourism

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Otpad od hrane u hotelima - metode primijenjene za rješavanje problema

Vesna CETIN KRNJEVIĆ[1], Maša GOLUBIČIĆ[1], Jelena ŠOBAT[2]

[1] Fond za zaštitu okoliša i energetsku učinkovitost, Radnička cesta 80, Zagreb, Hrvatska
[2] Ministarstvo turizma i sporta, Prisavlje 14, Zagreb, Hrvatska

Sažetak
Sprječavanje nastanka otpada od hrane s pozicije turističkog sektora na kraju vrijednosnog lanca potrošnje hrane ima okolišni, društveni i financijski aspekt. Kako vrijednosni lanac napreduje, dolazi do kumulativnog učinka na vrijednost izgubljene odnosno bačene hrane. Kao rezultat toga, bacanje jestive hrane u fazi konzumacije ima veći utjecaj na okoliš i troškove koje generira proizvedeni otpad. Planovi upravljanja okolišem, certifikati i standardi u turizmu stvaraju okvire kroz koje se mogu uvesti mjere sprječavanja nastanka otpada od hrane u hotelima. Strategija za sprječavanje nastanka otpada od hrane u hotelu postavljena u pilot projektu Smanji otpad od hrane uključuje mjerenje, postavljanje ciljeva i djelovanje u svrhu smanjenja negativnog utjecaja na okoliš i smanjenja troškova bacanja hrane. Predloženim preporukama iz projekta količine otpada od hrane smanjene su u prosjeku od 11 -30 %, te su procijenjene financijske uštede povezane s otpadom od hrane. Podizanje svijesti gostiju hotela o problemu bacanja hrane dio je strategije koja je primijenjena u pilot projektu.
Ključne riječi: hoteli, okoliš, otpad od hrane, financijska ušteda, održivi turizam

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Results of measurement of food waste quantities in Croatian hotels

Vesna CETIN KRNJEVIĆ[1], Maša GOLUBIČIĆ[1], Gordana VEŠLIGAJ[2], Eda PUNTARIĆ[2], Ana MOJSOVIĆ ĆUIĆ[3]

[1] Environmental Protection and Energy Efficiency Fund, Radnička cesta 80, Zagreb, Croatia
[2] Ministry of Economy and Sustainable Development, Radnička cesta 80/7, Zagreb, Croatia
[3] University of Applied Health Sciences, Mlinarska cesta 38, Zagreb, Croatia

Abstract
Statistical research on food waste management in Croatia conducted in 2021 showed that the business sector generated 70,034 tonnes of food waste per year, with the hospitality sector accounting for 22% of the waste. To identify the types and quantities of food waste in the hotel sector, measurements were carried out in seven hotels in the Republic of Croatia. Food waste quantities generated in hotels over a period of seven days were measured using the methodology laid down in Annex III to Commission Delegated Decision (EU) 2019/1597, according to the origin of waste; during food preparation and serving, and after food consumption (leftovers). Two measurement methods were used, and the data on the ten categories of food waste were recorded in the logbook developed by the Ministry of Economy and Sustainable Development of the Republic of Croatia (MESD). As part of the first method, food waste resulting from meal preparation and serving, and then after consumption was collected. Based on the total measured food waste, its quantity per individual meal (breakfast, lunch, dinner) was estimated. Compared to this method, the second method for collecting food waste in 10 containers for each waste category proved to be more challenging for implementation, but data collected in this way allowed a more precise interpretation of results.
Keywords: food waste, hotels, measurement methodology, source of waste

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Rezultati mjerenja količina otpada od hrane u hotelima Hrvatske

Vesna CETIN KRNJEVIĆ[1], Maša GOLUBIČIĆ[1], Gordana VEŠLIGAJ[2], Eda PUNTARIĆ[2], Ana MOJSOVIĆ ĆUIĆ[3]

[1] Fond za zaštitu okoliša i energetsku učinkovitost, Radnička cesta 80, Zagreb, Hrvatska;
[2] Ministarstvo gospodarstva i održivog razvoja, Radnička cesta 80/7, Zagreb, Hrvatska
[3] Zdravstveno veleučilište, Mlinarska cesta 38, Zagreb, Hrvatska

Sažetak
Statističko istraživanje o otpadu od hrane u Hrvatskoj iz 2021. godine, pokazalo je da poslovni sektor proizvodi 70.034 tona otpada od hrane godišnje, od čega ugostiteljski sektor proizvodi 22 % otpada. Kako bi se identificirane vrste i količine otpada od hrane u hotelskom sektoru provedena su mjerenja u 7 hotela na području Republike Hrvatske. Izmjerene su količine otpada od hrane koje nastaju u hotelu tijekom sedam dana primjenom metodologije propisane u Prilogu III. Delegirane Odluke Komisije (EU) 2019/1597 i to prema izvorima nastanka: tijekom pripreme i posluživanja hrane te nakon konzumacije hrane (tzv. otpad od hrane s tanjura). Primijenjene su dvije metode mjerenja, a podatci o deset kategorija hrane koja je odbačena kao otpad evidentirani su u dnevniku koje je razvilo Ministarstvo gospodarstva i održivog razvoja Republike Hrvatske (MINGOR). Prvom metodom sakupljan je otpad od hrane tijekom pripreme i posluživanja te nakon konzumacije hrane. S obzirom na ukupno izmjerenu količinu otpadne hrane procijenjena je količina po obroku (doručak, ručak, večera). U odnosu na ovu metodu, druga metoda sakupljanja otpada od hrane pomoću 10 spremnika za svaku pojedinu kategoriju otpada pokazala se zahtjevnijom za provedbu, ali preciznijom u interpretaciji podataka.
Ključne riječi: otpad od hrane, hoteli, metodologija mjerenja, izvor nastanka otpada

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Waste management in hop growing

Barbara ČEH

Slovenian Institute of Hop Research and Brewing, Cesta Žalskega tabora 2, Žalec, Slovenia

Abstract
Hop plants are grown primarily for their cones, which are used in the brewing industry. During harvest, the aboveground biomass is removed from the field and brought to the harvesting machine, leaving stems and leaves as a by-product next to the harvest hall. The hop industry generates an average of 15 tonnes of waste hop biomass from each hectare of a harvested hop field, totaling 400,000 tonnes in the European Union. This biomass is an ideal candidate for composting, as it can provide nutrients and organic matter to agricultural fields, reducing the need for chemical fertilizers and allowing the nutrients to cycle on the farm. Hop biomass can be composted on-site, either in industrial plants or on farms. On-farm composting is a more cost-effective option for farmers, provided it is managed properly. An alternative and noteworthy approach involves utilizing this plant waste material as a viable source of phenolic compounds. Although the leaves contain a lower total phenolic content in comparison to the cones, with a range of 3-fold to 30-fold less, they remain a promising source due to their representation of plant waste material. The leaves of the hop plant can serve as an effective antioxidant source, however, they do not exhibit antimicrobial properties. On the other hand, numerous biodegradable and compostable products can be manufactured from hop plant waste biomass.
Keywords: waste management; composting; antioxidant and antimicrobial activity

Waste Management / *Gospodarenje otpadom*
Poster presentation / *Postersko priopćenje*

Waste management in Tržnica d.o.o. Osijek

Ivana DAVIDOVIĆ

Tržnica d.o.o. Osijek, Trg Ljudevita Gaja 5, Osijek, Croatia

Abstract
Waste is a global problem today, and the organized collection and disposal of waste has become one of the basic social responsibilities. Biowaste is considered to be biodegradable material created during food preparation in households, restaurants, or similar service activities during the cultivation of gardens, parks, and other green areas. It can be transformed into compost through the composting process, which can also be applied to land in order to enrich soil nutrients and ventilation. The collection and composting of biowaste is an important element in the process of preventing the generation of waste. The category of biowaste also includes waste paper and cardboard, which must be collected in special containers. Tržnica d.o.o. Osijek is a company that for sixty years has been performing the communal and market activities of managing space for the sale of fruit, vegetables, flowers and craft products at five locations in the city of Osijek, and at the time of climate change and the energy crisis, Tržnica d.o.o. Osijek strives to implement measures that will contribute to its own self-sustainability and climate neutrality. One of these measures is the management of bio-waste that is generated daily by the operation of the market. Therefore, in October 2021, Tržnica d.o.o. Osijek signed a contract with Unikom d.o.o. in order to approach the sorting and disposal of biowaste, plastic and paper. This paper presents and compares the amounts of waste types (municipal waste, biowaste, paper, textiles, plastic) generated every day at Tržnica d.o.o. Osijek during 2019 and 2022. Financial savings and other benefits achieved through the implementation of the collection and disposal of the mentioned types of waste will also be presented.
Keywords: waste management, green market, Osijek, biowaste

Waste Management / *Gospodarenje otpadom*
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Gospodarenje otpadom u tvrtki Tržnica d.o.o. Osijek

Ivana DAVIDOVIĆ

Tržnica d.o.o. Osijek, Trg Ljudevita Gaja 5, Osijek, Hrvatska

Sažetak

Otpad je globalni problem današnjice, a organizirano prikupljanje i zbrinjavanje otpada postalo je jedno od temeljnih društvenih odgovornosti. Biootpadom se smatra biološki razgradiv materijal ili nusproizvod nastao pripremom hrane u kućanstvima, restorana ili sličnim uslužnim djelatnostima, ili pri obradi vrtova, parkova, i drugih zelenih površina koji se procesom kompostiranja može prevesti u kompost kojeg se, nadalje, može aplicirati na zemljišta u cilju obogaćivanja hranjivosti i prozračnosti tla. Prikupljanje i kompostiranje biootpada čini važnu stavku u procesima sprječavanja nastanka otpada. U kategoriju biootpada ubraja se i otpadni papir i karton koje je nužno prikupljati u posebne spremnike. Tržnica d.o.o. Osijek tvrtka je koja već šezdeset godina obavlja komunalnu i tržišnu djelatnost upravljanja prostorom za prodaju voća, povrća, cvijeća i obrtničkih proizvoda na pet lokacija u gradu Osijeku, a u vrijeme klimatskih promjena te energetske krize, Tržnica d.o.o. Osijek nastoji provoditi mjere kojima će doprijeti vlastitoj samoodrživosti te klimatskoj neutralnosti. Jedna od tih mjera je gospodarenje biootpadom koji svakodnevno nastaje radom tržnice. Stoga je u listopadu 2021. godine, Tržnica d.o.o. Osijek potpisala Ugovor s tvrtkom Unikom d.o.o. kako bi se pristupilo razvrstavanju i zbrinjavanju biootpada, plastike i papira. U ovom radu bit će prikazane i uspoređene količine pojedinih vrsta otpada (komunalni otpad, biootpad, papir, tekstil, plastika) nastale radom Tržnice d.o.o. Osijek tijekom 2019. i 2022. godine. Također će bit prikazane i financijske uštede te druge dobrobiti postignute provedbom prikupljanja i zbrinjavanja navedenih vrsta otpada.

Ključne riječi: gospodarenje otpadom, zelena tržnica, Osijek, bioopad

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Alternative green wall materials: A new trend in spray drying encapsulation of polyphenols

Nikolina GAĆINA

Polytechnic of Šibenik, Trg A. Hebranga 11, Šibenik, Croatia

Abstract
Spray drying is still the most significant method for polyphenols encapsulation which offers numerous advantages such as facilitating the handling of labile liquid polyphenols, improving their solubility and enhancing stability, degradation protection, controlling or delaying the release, and masking unappealing tastes or odors. The selection of the most suitable wall material is one of the most challenging tasks. Over the past decade, there has been a growing trend toward using new types of wall materials for polyphenols encapsulation by spray drying, either as additional compounds or as complete substitutes for traditional wall materials. This review aims to present the properties and applications of such alternative green wall materials. The term 'alternative green' refers to the origin of materials derived from by-products and waste.
Keywords: alternative green wall materials; polyphenols encapsulation; spray drying

Waste Management / *Gospodarenje otpadom*
Poster presentation / *Postersko priopćenje*

Possibilities of utilizing the by-products of fish processing

Ana GAVRILOVIĆ[1], Mirna HABUDA-STANIĆ[2], Jurica JUG-DUJAKOVIĆ[3]

[1] University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia
[2] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[2] Sustainable Aquaculture Systems Inc., 715 Pittstown Road, Frenchtown, United States of America

Abstract
The increase in production, and necessarily the processing and preparation of aquaculture products for the market, inevitably leads to an increase in the number of by-products, which in some cases can reach 70% of the raw material mass. Processing includes waste or by-products, which remain after the processing of aquatic organisms: heads, guts, skin, bones, scales, shells of crabs and shellfish, etc. Until recently, most of them were thrown away or tried to be disposed of as worthless waste. The development and implementation of complex processing technologies have attracted the attention of scientists, since by-products are recognized as a significant source of biologically valuable substances and can be considered as secondary raw materials for the production of various marketable products. More importantly, the cost of disposal or discard can be reduced, while the pollution caused by those leftovers can be prevented. The remaining proteins in fish processing residues are easily digestible and can be used to produce hydrolysates containing various peptides and amino acids. Furthermore, collagen, gelatin, as well as hydrolyzed collagen can be produced from collagen materials such as bone, shell, or skin, etc. In addition to fish proteins and oils, other valuable components, including enzymes, nucleic acids, minerals and other bioactive compounds such as is chondroitin sulfate (CS), etc. can be recovered. Recovered fish oil is rich in n-3 fatty acids such as icosatetraenoic acid (IPA) and docosahexaenoic acid (DHA), phospholipids, squalene, fat-soluble vitamins, etc. Despite the above, further research to explore new uses of by-products is necessary for the well-being of the environment and people.
Keywords: fish processing, by-products, biologically valuable substances, collagen, n-3 fatty acids

Waste Management / *Gospodarenje otpadom*
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Utilization of agricultural by-products – contribution to sustainability

Mirna HABUDA-STANIĆ[1], Eva FALCH[2], Antonija KRISTEK JANKOVIĆ[3], Mario ŠILJEG[4], Tibela LANDEKA DRAGIČEVIĆ[5], Brigita POPOVIĆ[6]

[1] Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje kuhača 18, Osijek, Croatia
[2] Norwegian University of Science and Technology (NTNU), Department of Biotechnology and Food Science, Kalvskinnet, Sverresgt 10-12, Trondheim, Norway
[3] Saponia d.d., Ul. Matije Gupca 2, Osijek, Croatia
[4] Ministry of Economy and Sustainable Development, Ulica grada Vukovara 78, Zagreb, Croatia
[5] University of Zagreb, Faculty of Food Technology and Biotechnology, Pierotti Street 6, Zagreb, Croatia
[6] Josip Juraj Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia

Abstract
In the year 2022, the population reached the number of 8 billion people on our planet Earth. That moment reminded us, once again, of the unstoppable growth of the world population and the future societal issues that will cause among which agriculture and food production are the most important ones which will cause the shortage of fertile soils, irrigation problems, and production and storage problems. At the same time, the human population will also face increasing global amounts of various organic residuals such as agriculture and food processing by-products, crop debris, livestock wastes, various types of industrial organic waste, logging residues, etc. which will demand appropriate disposal in accordance with more and more restrictive environmental regulations. This review presents the results of the latest studies conducted with the aim to investigate and develop sustainable utilization of agricultural and food production by-products.
Keywords: agricultural by-products, utilization, liquid, solid, sustainability

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Composting - an efficient method for environmentally clean and economical disposal of fish waste

Jurica JUG-DUJAKOVIĆ[1], Ante EREŠ[2], Mirna HABUDA-STANIĆ[3], Miloš PELIĆ[4], Dragana LJUBOJEVIĆ PELIĆ[4], Ana GAVRILOVIĆ[5]

[1] Sustainable Aquaculture Systems Inc., 715 Pittstown Road, Frenchtown, United States of America
[2] Independent researcher, Crveni Grm 166, Ljubuski, Bosnia and Herzegovina
[3] University of Josip Juraj Strossmayer in Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, Osijek, Croatia
[4] University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, Zagreb, Croatia
[5] Scientific Veterinary Institute Novi Sad, Department of Food Safety, Novi Sad, Serbia

Abstract
One of the basic ecological problems at fish farms and fish processing plants is the disposal of dead fish and fish waste. The fish body consists mainly of protein and contains a high percentage of water. This leads to rapid spoilage, the generation of unpleasant odors, development of insect larvae and pathogenic organisms. Such material becomes a potential contaminant of water and soil, so it should be quickly removed or processed. Composting is an efficient method for ecologically clean and economical disposal of solid organic waste. It is a controlled natural aerobic process in which heat, bacteria and fungi, together with carbon (wood shavings, leaves, grass), nitrogen (fish waste), oxygen and moisture dissolve the fish waste and turn it into a stable product - compost. It consists of stacking layers of fish waste and plant material and their frequent overturning to allow contact with air and occasional addition of water. At the elevated temperature created by bacterial decomposition, a mixture of organic material and microorganisms is created, which is a natural fertilizer for organic plant production. A handful of the final product contains billions of living microorganisms that occupy about 50% of the total compost volume, that is, a complex natural biosynthesized combination of nutrients and microorganisms that work symbiotically with plants. In most commercial composting plants, the material is placed on the bed in the form of long, narrow piles that are periodically turned over. In addition to compost production technology, the paper describes various techniques for the construction and management of composting areas.
Keywords: fish waste, composting, microorganisms

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Kompostiranje - učinkovita metoda za ekološki čisto i ekonomično zbrinjavanje ribljeg otpada

Jurica JUG-DUJAKOVIĆ[1], Ante EREŠ[2], Mirna HABUDA-STANIĆ[3], Miloš PELIĆ[4], Dragana LJUBOJEVIĆ PELIĆ[4], Ana GAVRILOVIĆ[5]

[1] Sustainable Aquaculture Systems Inc., 715 Pittstown Road, Frenchtown, Sjedinjene Američke Države
[2] Samosatni istraživač, Crveni Grm 166, Ljubuski, Bosna i Hercegovina
[3] Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek, Franje Kuhača 18, Osijek, Hrvatska
[4] Znanstveni institut za veterinarstvo "Novi Sad", Odjel za sigurnost hrane, Rumenački put 20, Novi Sad, Srbija
[5] Sveučilište u Zagrebu, Agronomski fakultet, Svetošimunska cesta 25, Zagreb, Hrvatska

Sažetak
Jedan od osnovnih ekoloških problema na ribljim farmama i pogonima za preradu ribe je odlaganje mrtvih riba i ribljih otpadaka. Riblji organizam se sastoji uglavnom od proteina te sadrži visok udio vode. To dovodi do brzog kvarenja, stvaranja neugodnih mirisa, razvoja ličinki insekata i patogenih organizama. Takav materijal postaje potencijalni zagađivač vode i tla te ga je nužno brzo ukloniti ili preraditi. Kompostiranje je učinkovita metoda za ekološki čisto i ekonomično rješavanje krutog organskog otpada. To je kontroliran prirodan aerobni proces u kojem toplina, bakterije i gljivice, zajedno s ugljikom (drvne strugotine, lišće, trava), dušikom (riblji otpadci), kisikom i vlagom razgrađuju riblje ostatke i pretvaraju ih u stabilan proizvod – kompost. Kompostiranje se provodi na način da se slojevi ribljeg otpada i biljnog materijala naizmjenično slažu te povremeno zalijevaju vodom i okreću kako bi se omogućio kontakt sa zrakom. Pri povišenoj temperaturi koja nastaje bakterijskom razgradnjom stvara se mješavina organskog materijala i mikroorganizama koja predstavlja prirodno gnojivo za organsku proizvodnju biljaka. Konačni proizvod sadrži milijarde živih mikroorganizama koji zauzimaju oko 50 % ukupnog kompostnog volumena, a sam kompost je kompleksna prirodna biosintetizirana kombinacija nutrienata i mikroorganizama koji djeluju simbiotički s biljkama. U većini komercijalnih pogona za proizvodnju komposta materijal se stavlja na podlogu u obliku dugih uskih hrpa koje se povremeno preokreću. U radu su, uz tehnologiju proizvodnje komposta, opisane i različite tehnike za gradnju i gospodarenje prostorom za kompostiranje.
Ključne riječi: riblji otpad, kompostiranje, mikroorganizmi

Waste Management / *Gospodarenje otpadom*
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Spatial revitalization of the Prudinec - Jakuševac landfill after the rehabilitation

Lana KRIŠTO[1], Elizabeta TOMAŠIĆ[2], Ana ORLOVIĆ ŠPELIĆ[3]

[1] Mundo Melius ltd, Ivana Banjavčića 22, Zagreb, Croatia
[2] Geotehnički fakultet, Hallerova aleja 7, Varaždin, Croatia
[3] IPZ UNIPROJEKT TERRA ltd, Voćarska street, Zagreb, Croatia

Abstract
Growing global production leads to the continuous generation of waste, most of which still ends its life cycle in landfills. Despite the efforts of reuse and recycling the waste the existing old landfills remain a major challenge for the future. Most landfills can be identified as unsanitary and can be referred to as existing or former landfills, meaning mounds or fields of abandoned garbage and degraded inert waste masses with little or no subsequent maintenance. The term 'landfill' refers to legally organized waste disposal sites created in a controlled manner, according to modern environmentally responsible standards. After the landfills are closed, a problem arises in the form of the abandonment of these spaces without assigning a social or spatial purpose, and they become ˝black zones˝ of cities. By revitalizing the landfill area to which has been assigned some useful public purpose, valuable spatial potential is created for additional content that is lacking in every urban entity due to dense construction. Through this article, three world examples will be presented, which represent a positive way of approaching the issue of rehabilitation and revitalization of waste disposal sites, creating added value to the environment as well as the content they offer to citizens. The consideration of the given examples is aimed at selecting the best solution for the revitalization of degraded spatial entities that would be applicable after the rehabilitation of the Prudinec Jakuševac landfill.
Keywords: landfill, spatial revitalization, Jakuševac, circular economy, environmental protection

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Revitalizacija prostora odlagališta otpada Prudinec - Jakuševac nakon provedene sanacije

Lana KRIŠTO[1], Elizabeta TOMAŠIĆ[2], Ana ORLOVIĆ ŠPELIĆ[3]

[1] Mundo Melius d.o.o., Ulica Ivana Banjavčića 22, Zagreb, Hrvatska
[2] Geotehnički fakultet, Hallerova aleja 7, Varaždin, Hrvatska
[3] IPZ UNIPROJEKT TERRA d.o.o., Voćarska cesta 68, Zagreb, Hrvatska

Sažetak
Rastuća globalna proizvodnja dovodi do kontinuiranog stvaranja otpada, čiji veći dio još uvijek završava svoj životni ciklus na odlagalištima. Unatoč naporima ponovne uporabe i recikliranja otpada, postojeća stara odlagališta ostaju veliki izazov za budućnost. Većina odlagališta može se identificirati kao nesanitarna i može ih se označiti kao postojeća ili bivša odlagališta, što znači brda ili polja napuštenog smeća i degradiranih inertnih otpadnih masa bez ikakvog ili s malo naknadnog održavanja. Pojam 'odlagalište' odnosi se na legalno organizirana odlagališta otpada stvorena na kontrolirani način, prema suvremenim ekološki odgovornim standardima. Nakon zatvaranja odlagališta, javlja se problem u obliku napuštanja tih prostora bez dodjeljivanja društvene ili prostorne namjene te oni postaju ˝crne zone˝ gradova. Sanacijom područja odlagališta, kojem je dodijeljena neka korisna javna namjena, stvara se vrijedan potencijalni prostor za dodatne sadržaje koji zbog guste izgradnje nedostaju svakoj urbanoj cjelini. Kroz ovaj članak prikazat će se tri svjetska primjera koja predstavljaju pozitivan način pristupanja problematici sanacije i prenamjene odlagališta otpada, stvarajući dodanu vrijednost okolišu kao i sadržaju kojeg nude građanima. Razmatranje danih primjera za cilj ima odabir najboljeg rješenja revitalizacije degradiranih prostornih cjelina koje bi bilo primjenjivo nakon sanacije postojećeg odlagališta otpada Prudinec - Jakuševac.
Ključne riječi: odlagalište, prenamjena prostorna, Jakuševac, kružna ekonomija, zaštita okoliša

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Characterization of Taal Volcanic ash as potential raw material for the construction industry

Michael LAGMAY, Admer Rey DABLIO, Ruth DAMIAN, Elyson Keith ENCARNACION, EMMA Tayag, Liwayway PIQUERO, Noel Angelo KALACAS, John Joshua SERGOTE, Mark Anthony PRINCIPE, Joel JANE

Industrial Technology Development Institute, Department of Science and Technology, Standards and Testing Division, Saliksik Street, DOST Compound, Bicutan, Taguig City, Philippines

Abstract
The phreatomagmatic eruption of Taal Volcano in Batangas, Philippines, in January 2020 resulted in a massive ash plume covering a large portion of nearby provinces and Metro Manila. This caused damages and disruptions in the agricultural sector, health, lifelines, aviation, and environment. The problem of the management of the huge amount of collected tephra environmental waste prompts the initiative of converting it into a useful material. The study characterized and subsequently evaluated the quality of the collected tephra as potential raw material for the construction industry based on the Philippine National Standard (PNS) 07:2018 to ensure structural integrity and people's safety. Four ashfall samples from strategic locations identified by the Philippine Institute of Volcanology and Seismology (PHIVOLCS) were obtained and analyzed for the identified chemical parameters using different analytical techniques. The results suggest it has the potential to be a raw material for the construction of ground-level structures. However, there is a need for further treatment to reduce the concentration of some constituents. The material passed the standard specifications for SiO_2, MgO, SO_3, and water-soluble and acid-soluble Cl^-. Meanwhile, the results for Al_2O_3, Fe_2O_3, total alkali, and loss on ignition exceeded the PNS 07:2018 threshold limits.

Keywords: volcanic ash, construction materials, chemical analysis, oxides, waste management

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Use of brewers' spent grains as emerging protein and fiber source in ćupter production

Anita LALIĆ[1], Andrea KARLOVIĆ[1], Jelka PLEADIN[2]

[1] Faculty of Agriculture and Technology, Faculty of Mostar, Biskupa Čule bb, Mostar, Bosnia and Herzegovina
[2] Croatian Veterinary Institute, Savska cesta 143, Zagreb, Croatia

Abstract
The literature record on the ćupter is extremely limited. However, research about its nutritive value and preparation is emerging, which warrants establishing a baseline annotation for ćupter to be labeled by EU Quality Schemes for Agricultural Products with one of the following labels: Protected Designation of Origin, Protected Geographical Indication, and Traditional Guaranteed Specialty. Brewers' spent grains incorporation in the manufacture of different food products increases fiber and protein content. The aim of this study was to examine do a partial or almost complete replacement of semolina with brewers' spent grains has a positive impact on the nutritive value of ćupter and whether this is correlated with the level of brewers' spent grains added as an ingredient. Six samples were prepared out of which 3 were with white grape must and 3 with red one. A control sample was without brewers' spent grain addition. Collected data showed a significant increase in fiber, carbohydrates, fat and protein levels in samples 5 and 6. For fiber and protein levels, this increase was >30%. In addition, data showed statistically significant differences in fiber, carbohydrates, fat and protein levels of white and red grape must prepared ćupters.
Keywords: ćupter, brewers spent grain, protein, fiber, traditional products

Waste Management / *Gospodarenje otpadom*
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The impact of microplastic fibers in municipal sludge on biogas production

Nina LEKŠE[1], Tjaša GRIESSLER BULC[2], Andreja ŽGAJNAR GOTVAJN[1]

[1] University of Ljubljana, Faculty of Chemistry and Chemical Technology, Večna pot 113, Ljubljana, Slovenia
[2] University of Ljubljana, Faculty of Health Sciences, Zdravstvena pot 5, Ljubljana, Slovenia

Abstract
Wastewater treatment plants (WWTPs) contribute to the release of microplastics (MPs) into the environment. The removal efficiency of MPs in WWTPs could reach up to 99.9%, but the highest amount of MPs is retained in the sludge. Anaerobic digestion, as one of the most promising processes of waste sludge management, can help to reduce its volume and odor and lead to the formation of biogas, mainly consisting of CH_4 and CO_2. It could also help to reduce the operating costs of WWTPs if methane is utilized to meet the energy self-efficiency of the treatment system. OxiTop® method was used to determine the impact of added MPs fibers on biogas production. Particles < 1 mm of polyester (PES), polyamide (PA) and polyacryl were added in concentrations of 0.05 and 0.1 g/L to waste aerobic sludge and biogas production in terms of increased pressure was measured for 7 days. After the addition of NaOH, CO_2 was removed and the amount of valuable CH_4 in the formed biogas was determined. Results showed that the lowest added concentrations of MPs (0.05 g/L) promote methane production, while the presence of 0.1 g/L of MPs decreased it regardless MPs type. The presence of polyacryl in the waste sludge of 0.1 g/L had the most inhibitory effect on methane production (up to 27% reduction) while PA at 0.05 g/L increased it significantly (up to 25%).
Keywords: anaerobic digestion, methane production, microplastics, polyester, polyamide, polyacryl

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Wastes and worm culture

Ayşegül PALA[1,2], Yeliz GÖZEN[3]

[1] Dokuz Eylul University, Environment Research and Development Center (CEVMER), Tinaztepe Campus, İzmir, Turkey
[2] Dokuz Eylul University, Faculty of Engineering, Environmental Engineering Department, Tinaztepe Campus, İzmir, Turkey
[3] Salihli Municipality, Atatürk Ahallesi, Kurudere Caddesi No. 1, Manisa, Turkey

Abstract
The world ecosystem has faced global pollution due to rapid urbanization and uncontrolled population growth so now we are looking for a multi-dimensional solution to environmental problems. This study, it is aimed to convert harmless industrial and organic household waste into a useful organic compound using vermiculture. Within these processes, there is a separate place of worm manure obtained by the activity of special soil worms. The aim of this study is to take organic wastes that are not evaluated and considered to have no economic value into the recovery cycle, as well as to obtain a product that is biologically active, which makes important contributions to soil productivity and can be used commercially. Red worms were preferred because they are at the forefront with their resistance to adverse weather conditions and ability to give high ovulation and a productive number of offspring that hatch in ideal conditions. Experiments were conducted in the municipal geothermal heated greenhouse intended for flowers and trees production. The geothermal heated greenhouse allows the ambient temperature to be kept at a certain level, especially during the winter months. A bath made of PVC material with a width of 1.5 m and a length of 3.00 m was used as a worm production container. It was first studied that about 50,000 red worms are fed regularly every 10 days. Worms were given 70% beef manure, 20% vegetable-fruit waste in the district market and 10% dried leaf mixture. Irrigation is done every 3 days by a spraying method to ensure the rate of biological activity. The obtained fertilizer can be used in the greenhouse of the municipality and in the park gardens. The study aims to develop social responsibility and provide training for young generations so they can recognize culture as a potential and efficient solution for urban organic waste.
Keywords: red worms, waste management, organic agriculture

Waste Management / *Gospodarenje otpadom*
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Sustainable environmental management of a wood processing industry

Ayşegül PALA[1,2], Gülçin TÜRKER KORUCUOĞLU[3]

[1] Dokuz Eylul University, Environment Research and Development Center (CEVMER), Tinaztepe Campus, İzmir, Turkey
[2] Dokuz Eylul University, Faculty of Engineering, Environmental Engineering Department, Tinaztepe Campus, İzmir, Turkey
[3] Dokuz Eylül University, Graduate School of Natural and Applied Sciences, M.Sc. in Environmental Engineering, İzmir, Turkey

Abstract
The furniture industry sector is a branch of industry that provides end-use products in many areas such as home, office, vehicle, and garden, which are related to human living spaces and provide intermediate products to many sectors. The number of companies engaged in fabricated production in the furniture industry is increasing, the main production activities are carried out in a wide range of production activities such has a negative effect on the environment. This study investigates the environmental impacts of the production processes in an exemplary furniture factory producing panel furniture, sofa and seating group furniture from wood material in a closed working area of 40774 m^2 with a total number of 571 employees, with a wood board processing capacity of 7,200,000 m^2/year. In the first part of the study, the primary pollutants that harm the environment in the basic production processes of the sample furniture factory were determined. Flue gas and dust emission measurement results, wastewater analysis results, the effects of solid waste types and amounts on the environment are mentioned. With the separation of wastes generated in furniture production processes at the source, the pollution load has also been reduced. In cases where wastes cannot be prevented or reduced in quantity, recycling opportunities have been captured in order to recycle the wastes or to obtain new usable products so that they can be re-evaluated. In the second part of the study, a special computer software application was performed for sustainable environmental management in the facility. Thus, a sustainable assessment tool was designed to standardize how the facility measures and evaluates its environmental performance each year.
Keywords: wood processing industry, environmental management, waste management, sustainability, environmental impact

Waste Management / *Gospodarenje otpadom*
Poster presentation / *Postersko priopćenje*

Sustainability analysis using annual environmental pollution indicators at an electrostatic powder painting and metal coating factory

Ayşegül PALA[1,2], Gülçin PEHLİVAN ÖZ[2]

[1] Dokuz Eylul University, Environment Research and Development Center (CEVMER), Tinaztepe Campus, İzmir, Turkey
[2] Dokuz Eylul University, Faculty of Engineering, Environmental Engineering Department, Tinaztepe Campus, İzmir, Turkey

Abstract
This study examined the environmental effects of a factory-producing heated towel rack with electrostatic powder painting and metal coating. The production capacity of the factory is 255 units per hour. The number of employees of the factory is 450 people. The water consumption data of the factory has been created. The water consumption to be used for a product was calculated as 0.068 m^3. Generated wastewaters were analyzed and the following annual averages have been obtained: pH: 7.88, suspended solids: 62.77 mg/L, Chemical Oxygen Demand: 199.67 mg/L, oil and grease: 32.06 mg/L, sulfate: 312.37 mg/L. Studies were also carried out on wastes produced from the factory. The types and quantities of waste to be generated in the process were determined. The waste classification was determined according to their sources. The annual amount of hazardous waste was calculated as 300,731 kg and non-hazardous waste was calculated as 813,995 kg. Temporary storage areas were built for the generated waste at the factory before it was sent to recycling or disposal places which is certificated by the Turkish ministry. 36 emission sources have been identified at the factory. Classification of the plant emission sources was made, the gases to be released from the sources were determined and emission measurements were made. These emission measurement results are as follows: CO: 0.771 kg/hour, NO_2: 0.382 kg/hour, NO: 0.242 kg/hour, SO_2: 0.001 kg/hour, VOC: 0.4022 kg/hour. The amount of electricity consumed per unit produced has been calculated as 13.43 kWh/piece. The amount of natural gas consumed per unit of production was calculated as 1.94 m^3/piece. The selected factory has been examined in terms of National Environmental Legislation and a database created by using annual environmental pollution indicators. A sustainability analysis was carried out for the selected factory.
Keywords: electrostatic powder painting, metal coating, environmental legislation, environmental management, sustainability

Waste Management / *Gospodarenje otpadom*
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The influence of drying on nutritional, microbiological and sensory value of Japanese persimmon consumed in Herzegovina

Josipa PRIMORAC[1], Jelka PLEADIN[2], Andrea HUMSKI[2], Nada VAHČIĆ[3], Anita LALIĆ[1], Višnja VASILJ[1]

[1] University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule bb, Mostar, Bosnia and Herzegovina
[2] Croatian Veterinary Institute, Savska cesta 143, P.O. Box 883, Zagreb, Croatia
[3] University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia

Abstract
The Japanese persimmon has been spread from Asian countries to Herzegovina, where it is mostly consumed fresh. In this paper, differences in nutritional, microbiological and sensory values of persimmons consumed in one of the Herzegovinian regions, witnessed upon drying at 70 °C/ 12 h, 85 °C/ 10.5 h and 100 °C/ 5.5 h were examined, together with their impact on fruit texture, mass, and composition. The increase in sugar content is especially emphasized, indicating that dried Japanese persimmon could be a healthy snack. For all samples significant increase in microorganism representation was not observed. Persimmons dried in dehydrators had the best-preserved nutritional properties and were best rated from the sensorial standpoint. The sample dried at 100 °C was damaged.
Keywords: Japanese persimmon, drying, dehydration, sensory, microbiology

Comparison of the quantity of recycled plastic waste in the EU and Croatia

Anita PTIČEK SIROČIĆ, Dragana DOGANČIĆ, Silvija ANCELJ

University of Zagreb, Faculty of Geotechnical Engineering, Hallerova aleja 7, Varaždin, Croatia

Abstract
The growing trend in the use of plastics simultaneously increases the accumulation of ubiquitous waste plastics in landfills and in the environment, which represents a global aesthetic as well as an ecological problem. For this reason, different waste disposal procedures are implemented. In the hierarchy of different waste disposal procedures, there is recycling or waste recovery. The recovery of plastic waste can be mechanical, chemical, or energetic, and the resulting products can be reused for useful purposes. Such a way of disposing of waste plastics is currently the most cost-effective solution, and it tries to avoid dumping waste in landfills, i.e., to reduce the amount of waste. Over the past two decades, the problem of waste has shifted increasingly from disposal methods to prevention and recycling. The member states of the European Union are committed to implementing and harmonizing current legal measures related to plastic items that are prescribed by European directives, and the ultimate goal is a circular economy model that will use plastics in a more sustainable way and reduce waste generation to a minimum.
Keywords: plastics, recycling of plastic waste, disposal of plastic waste

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Integration of underutilized ashes into material cycles

Nina ŠTIRMER, Ivana CAREVIĆ, Marijana SERDAR, Eva ZIMPRICH, Sonja CERKOVIĆ

University of Zagreb, Faculty of Civil Engineering, Fra Andrije Kačića Miošića 26, Zagreb, Croatia

Abstract
Wood biomass ashes (WBA) and sewage sludge ashes (SSA) represent an environmental and economic problem for energy producers and wastewater treatment plants because they are considered as waste. Currently, these ashes are underutilized and mostly sent to landfills, which incurs significant disposal costs. It is expected that the cost of landfilling ash will increase in the future. The goal of the Horizon project AshCycle is to provide tools to reduce waste generation by developing new utilization possibilities and better integration of Industial-Urban Symbiosis (I-US). As a participant of the AshCycle project, the Faculty of Civil Engineering of the University of Zagreb has collected different WBA and SSA from the local power plants and wastewater treatment plants. After detailed characterization and categorization of the ashes, the possibility of using ashes for the following purposes is investigated: partial replacement of cement or aggregate in ordinary Portland cement concrete, alkali-activated materials and production of clay bricks. A combination of life cycle analysis (LCA) and geographic information system (GIS) will be used to assess the environmental impacts associated with the I-US. In addition, a cloud-based digital tool will be developed that embeds advanced artificial intelligence and machine learning algorithms in a way that can be used by ash producers to evaluate the quality and optimal utilization potential of their ashes.
Keywords: wood biomass ash, sewage sludge ash, cement composites, alkali-activated materials

Waste Management / *Gospodarenje otpadom*
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From waste to fuel: An overview of refuse-derived fuel production in Croatia

Luka TRAVEN[1,2]

[1] University of Rijeka, Faculty of Medicine, Department of Environmental Medicine, Braće Branchetta 20/1, Rijeka, Croatia
[2] Teaching Institute of Public Health of the Primorsko-goranska County, Krešimirova 52a, Rijeka, Croatia

Abstract
The presentation will aim to provide a detailed description of the biological and mechanical treatment processes involved in the production of refuse-derived fuel (RDF) in waste management centers (WMC) in Croatia. The focus of the presentation will be on the current practices used for the treatment of municipal solid waste and the quality of the RDF produced. In addition, a classification scheme will be presented that is used to categorize RDF to better understand the characteristics and potential uses of the fuel produced. The presentation will also address the major drawbacks of the waste management centers in Croatia, such as inefficiencies and limitations, and provide tentative recommendations for optimizing the current system. To provide a comprehensive overview of the waste management situation in Croatia, the presentation will also discuss national and EU recycling targets and provide a critical overview of the country's waste management strategy. The presentation will be evidence-based and data-driven, providing an accurate picture of the current situation and the challenges and opportunities facing waste management centers in Croatia. The presentation will be of great interest to the scientific community, professionals working in the field, and other stakeholders involved in waste management.
Keywords: production of refuse-derived fuel, waste management, Croatia

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Role of laboratories in waste management

Teuta TOMPIĆ, Dunja TURK

Bioinstitut d.o.o., R. Steinera 7, Čakovec, Croatia

Abstract
Croatian Waste Management Law (NN 84/21) prescribes measures for protecting the environment and human health by preventing or reducing the generation of waste, reducing the adverse impacts of waste generation and management by reducing overall impacts of resource use and improving the efficiency of such use and increasing recycling and reuse of recycled materials, which is necessary to implement a circular economy and ensure the long-term competitiveness of the Republic of Croatia and the European Union. This paper presents the role of the laboratory in waste management, which is crucial for the proper direction of different waste types for disposal or recovery. The regulations prescribe how to properly categorize waste, assign its classification number and check the characteristic dangerous properties that determine further waste treatment. A basic characterization is made for waste that is intended for permanent disposal, while waste that is intended to be used as secondary raw material goes under the process of ceasing waste status. During these procedures, it is necessary to carry out certain laboratory tests. A legal entity can perform sampling and analysis of waste, by-products, waste recovery outcomes and determination of hazardous properties of waste if it is accredited according to the HRN EN ISO/IEC 17025 standard for the appropriate sampling and testing method.
Keywords: waste, laboratory, categorization, characterization, by-product

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Uloga laboratorija u gospodarenju otpadom

Teuta TOMPIĆ, Dunja TURK

Bioinstitut d.o.o., R. Steinera 7, Čakovec, Hrvatska

Sažetak
Zakonom o gospodarenju otpadom (NN 84/21) propisuju se mjere u svrhu zaštite okoliša i ljudskog zdravlja sprječavanjem ili smanjenjem nastanka otpada, smanjenjem negativnih učinaka nastanka otpada te gospodarenja otpadom, smanjenjem ukupnih učinaka uporabe sirovina i poboljšanjem učinkovitosti uporabe sirovina te povećanjem recikliranja i ponovnog korištenja reciklata, što je nužno za prelazak na kružno gospodarstvo i osiguranje dugoročne konkurentnosti Republike Hrvatske i Europske Unije. Ovim radom želimo se osvrnuti na ulogu laboratorija u gospodarenju otpadom koja je vrlo važna za pravilno usmjeravanje tokova različitih vrsta otpada u svrhu zbrinjavanja ili oporabe. Regulativom je propisano kako pravilno provesti kategorizaciju otpada, dodijeliti mu svojstveni ključni broj i provjeriti karakteristična opasna svojstva o čemu ovisi postupak obrade otpada. Također, za otpad koji se želi trajno odložiti izrađuje se osnovna karakterizacija, a otpad koji se želi upotrijebiti kao sirovina ulazi u postupak ukidanja statusa otpada. Prilikom svih tih postupaka potrebno je provesti određena laboratorijska ispitivanja, a pravna osoba može obavljati uzorkovanje i ispitivanje otpada, nusproizvoda, rezultata oporabe otpada i određivanje opasnih svojstava otpada ako je akreditirana prema normi HRN EN ISO/IEC 17025 za odgovarajuću metodu uzorkovanja i ispitivanja.
Klučne riječi: otpad, laboratorij, kategorizacija, karakterizacija, nusproizvod

Waste Management / *Gospodarenje otpadom*
Poster presentation / *Postersko priopćenje*

Trawling and marine litter in Croatia - challenges and opportunities in waste management

Pero TUTMAN

Institute of Oceanography and Fisheries, Šetalište Ivana Meštrovića 63, Split, Croatia

Abstract
Fishery can significantly contribute to reducing the amount of marine litter (ML) through "Fishing for Litter" (FfL) activities by collecting ML during trawling and disposing of it in the waste management system. This activity is an effective way of involving the fishery in the ML removal from the seabed, known in the western EU countries. It has two main goals; reducing ML in the sea, and raising the level of ecological awareness. Furthermore, it can contribute to the amount of waste input from land, as well as determining its source. In Croatia, it has been carried out since 2014 on about 40 trawlers; on average, one collects 5-10 kg/day, which is about 2-3 T/year, or a total of 200 T/year. Plastic is the most represented with 80-90% in total; the most common are shopping bags, foils for collective wrapping and bottles. If this activity were carried out more widely in the Adriatic, significant amounts of ML could be removed, which would reduce environmental impacts and economic costs for the fishing industry and other sectors. Given that we do not have data on the amount of ML on the seabed, as well as the amount of its intake, these efforts are important. The lack of legislation dealing with ML management is a challenge to further action.
Keywords: trawlers, plastic, Adriatic sea, legislative regulation, waste disposal

Waste Management / *Gospodarenje otpadom*
Poster presentation / *Postersko priopćenje*

Koćarski ribolov i morski otpad u Hrvatskoj – izazovi i prilike u gospodarenju otpadom

Pero TUTMAN

Institut za oceanografiju i ribarstvo, Šetalište Ivana Meštrovića 63, Split, Hrvatska

Sažetak

Ribarstvo može značajno doprinijeti smanjivanju količina morskog otpada putem „Fishing for Litter" (FfL) aktivnosti (hrv. Koćarski Ribolov i Morski otpAd,-KRMA), odnosno prikupljanjem otpada koji se zatekne u mrežama tijekom koćarskog ribolova i njegovim zbrinjavanjem u sustavu gospodarenja otpadom. Ova je aktivnost učinkovit način uključivanja ribarskog sektora u uklanjanje otpada s morskog dna, poznata u zapadnim zemljama EU. Ima dva glavna cilja; smanjivanje otpada u moru, te podizanje razine ekološke svijesti o ovom problemu. Nadalje, može doprinijeti praćenju količina otpada koji dospijeva s kopna, kao i određivanju njegovog izvora. U Hrvatskoj se provodi od 2014. na 40-ak koćarica; u prosjeku jedna prikupi 5-10 kg dnevno, što godišnje može činiti oko 2-3 T, odnosno ukupno 200 T/godišnje. Plastika je najzastupljenija s 80-90 % ukupnog sastava; najučestalije su vrećice za kupovinu, ostaci folija za skupno zamatanje, te boce. Kada bi se ova aktivnost provodila šire na Jadranu, mogle bi se ukloniti značajne količine otpada iz mora, čime bi se smanjili utjecaji na okoliš i gospodarski troškovi ribarskoj industriji i drugim sektorima. Obzirom da ne raspolažemo podacima o količinama otpada na morskom dnu, kao i količinama njegovog unosa, ovakva su nastojanja važna. Nedostatak zakonodavne regulative koja se bavi gospodarenjem morskog otpada predstavlja izazov daljnjem djelovanju.

Ključne riječi: koćarice, plastika, Jadransko more, zakonodavna regulativa, zbrinjavanje otpada

Active gas recovery system at closed municipal waste landfill - real necessity or source of problems?

Željko VARGA[1], Valentina HABDIJA ŽIGMAN[1], Rade SKOČIĆ[2]

[1] Maxicon d.o.o., Kružna 22, Zagreb, Croatia
[2] PanGeo Projekt d.o.o., Marijana Haberlea 6, Zagreb, Croatia

Abstract
The resolution or inability to resolve the problem of landfill gas recovery during the remediation of a closed municipal waste landfill represents a current and exceptional problem. The competent Ministry bodies impose the obligation to implement an active gas recovery system and state it as the only acceptable solution, justifying their decision with a rigid interpretation of the provisions of the new Waste Disposal Regulation (NN 4/23), which transposes the obligations prescribed by the Waste Landfill Directive 1999/31/EC and its related amendments (EU) 2018/850. The source of the problem lies in the fact that previous analyses of the state of closed landfills by designers and environmental protection experts are not taken into account, nor are the results of the environmental impact assessment procedures (PUO/OPUO) based on these analyses. This raises doubts about the possibility of implementing remediation of closed landfills with EU funds, which represent a necessary source of co-financing for local government units in implementing remediation projects. The problem of a rigid interpretation of the Directive and the exclusion of the results of already conducted environmental protection procedures is currently significantly affecting the possibility of applying through the National Recovery and Resilience Plan, reducing the implementation of already prepared projects to a significantly low level. This paper presents an extended interpretation of Directive 1999/31/EC, considering the provisions of other important Directives, and examples from EU practice, and ultimately discusses the actual technical feasibility and justification of implementing an active gas recovery system in relation to other legal obligations and the results of long-term monitoring of environmental conditions in closed landfills.
Keywords: closed municipal waste landfill, active gas recovery, problems, missed opportunities, impact assessment

Waste Management / *Gospodarenje otpadom*
Oral presentation / *Usmeno priopćenje*

Sustav aktivnog otplinjavanja na zatvorenom odlagalištu komunalnog otpada – stvarna potreba ili izvor problema?

Željko VARGA[1], Valentina HABDIJA ŽIGMAN[1], Rade SKOČIĆ[2]

[1] Maxicon d.o.o., Kružna 22, Zagreb, Hrvatska
[2] PanGeo Projekt d.o.o., Marijana Haberlea 6, Zagreb, Hrvatska

Sažetak
Rješavanje odnosno nemogućnost rješavanja problema otplinjavanja odlagališnog plina prilikom sanacije zatvorenog odlagališta komunalnog otpada, predstavlja aktualan i izniman problem. Tijela resornog Ministarstva nameću obavezu izvedbe aktivnog sustava otplinjavanja i navode ga kao jedino prihvatljivo rješenje te svoju odluku obrazlažu krutim tumačenjem odredbi novog Pravilnika o odlagalištima otpada (NN 4/23), a koji prenosi obaveze propisane Direktivom o odlagalištima otpada 1999/31/EZ i pripadajućim izmjenama (EU) 2018/850. Izvor problema očituje se u činjenici što se u obzir ne uzimaju već ranije izvršene analize stanja zatvorenih odlagališta od strane projektanata i stručnjaka u poslovima zaštite okoliša te na temelju tih analiza dobiveni rezultati provedenih postupaka procjene utjecaja zahvata na okoliš (PUO/OPUO). Na ovaj način u pitanje se dovodi mogućnost provedbe sanacija zatvorenih odlagališta sredstvima EU, a koja predstavljaju neophodan izvor sufinanciranja JLS-ova u provedbi projekata sanacija. Problem krutog tumačenja Direktive i isključivanje rezultata već provedenih postupaka zaštite okoliša, trenutno se znakovito odražava na mogućnost prijave kroz Nacionalni plan oporavka i otpornosti, odnosno provedbu već pripremljenih projekata svodi na značajno nisku razinu. Rad prikazuje proširenu interpretaciju Direktive 1999/31/EZ sagledavanjem odredbi ostalih bitnih Direktiva, primjere iz prakse EU te u konačnici raspravlja stvarnu tehničku mogućnost i opravdanost izvedbe aktivnog sustava otplinjavanja odlagališta u odnosu na ostale zakonske obaveze te rezultate dugogodišnjeg praćenja stanja okoliša na zatvorenim odlagalištima.
Ključne riječi: zatvoreno odlagalište komunalnog otpada, aktivno otplinjavanje, problemi, propuštene prilike, procjena utjecaja

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Groundwater chemistry as a consequence of geological conditions of aquifer development- a Case study of Dalj Wellfield

Željko DUIĆ[1], Jasna ZIMA[2], Ivica PAVIČIĆ[1]

[1] University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Zagreb, Croatia
[2] Vodovod-Osijek d.o.o., Poljski put 1, Osijek, Croatia

Abstract
The lowland areas of Eastern Slavonia consist of thick Quaternary deposits, which represent the last act of deposition in the geotectonic depression, the so-called Drava depression. Of these deposits, only the youngest, Holocene and Upper Pleistocene deposits come to the surface in the form of fluvial, baric and eolian facies. In general, it can be stated that the Quaternary deposits are overall very heterogeneous, but it is noticeable that they belong to the same sedimentary cycle. The Dalj wellfield is located about 500 m south of the Dalj settlement. The captured aquifer consists of fine- to medium-grained unitary sand. It is located at a depth of 56-86 m. The basic feature of groundwater chemistry is the prevalence of reductive conditions as a result of the deposition of water-bearing sediments in a shallowly flooded and occasionally waterlogged environment. It is interesting to note that in the overall profile of the Quaternary deposits recorded, the differences in the granulometric composition of the individual sand layers through the same borehole are less pronounced, while the differences due to their location in space are more pronounced. The above suggests that a stable depositional system was maintained and that the thickness and even the presence of individual layers are conditioned by the character and intensity of vertical movements.
Keywords: quaternary deposits, heterogeneous, reductive conditions

Water Management / *Upravljanje vodama*
Oral presentation / *Usmeno priopćenje*

Kemizam podzemne vode kao posljedica geoloških uvjeta razvitka vodonosnika-primjer crpilišta Dalj

Željko DUIĆ[1], Jasna ZIMA[2], Ivica PAVIČIĆ[1]

[1] Sveučilištu u Zagrebu, Rudarsko-geološko-naftni fakultet, Zagreb, Hrvatska
[2] Vodovod-Osijek d.o.o., Poljski put 1, Osijek, Hrvatska

Sažetak
Nizinske predjele istočne Slavonije izgrađuju debele kvartarne naslage koje su završni čin taloženja u geotektonskoj depresiji nazvanoj dravska depresija. Od njih se na površini pojavljuju samo one najmlađe, holocenske i gornjo-pleistocenske naslage u obliku fluvijalnog, barskog i eolskog facijesa. Općenito se može zaključiti da su kvartarne naslage u cjelini vrlo heterogene, ali je uočljiva njihova pripadnost istom sedimentacijskom ciklusu. Crpilište Dalj predstavlja zdenački zahvat podzemnih voda, a nalazi se oko 500 m južno od naselja Dalj. Zahvaćeni vodonosnik izgrađen je od sitno do srednjezrnog jednoličnog pijeska. Zaliježe na dubini od 56-86 m. Za kemizam podzemne vode osnovno je obilježje prevladavanje reduktivnih uvjeta kao posljedica taloženja vodonosnih naslaga u plitkoj zavodnjenoj i povremeno zamočvarenoj sredini. Zanimljivo je, da u ukupnom profilu snimljenih kvartarnih naslaga, slabije su izražene razlike u granulometrijskom sastavu pojedinih slojeva pijeska kroz istu bušotinu, a izrazitije se uočavaju razlike kao posljedica njihovoga položaja u prostoru. Navedeno upućuje na zaključak da se održavao stabilan sustav taloženja, a da je debljina, pa i nazočnost pojedinih slojeva uvjetovana karakterom i intenzitetom vertikalnih pokreta.
Ključne riječi: kvartarne naslage, heterogenost, reduktivni uvjeti

Water Management / *Upravljanje vodama*
Poster presentation / *Postersko priopćenje*

(Un)certainty of linear trends in hydrology

Magdalena DROŽĐAN[1], Ivana PINTARIĆ[1], Bojan ĐURIN[1], Petra SUŠILOVIĆ[2], Mirna RAIČ[2]

[1] University North, Department of Civil Engineering, Jurja Križanića 31b, Varaždin, Croatia
[2] University of Mostar, Faculty of Civil Engineering, Architecture and Geodesy, Matice hrvatske bb, Mostar, Bosnia and Herzegovina

Abstract
In most cases, the analysis of hydrological data is due to the definition of a linear trend and the corresponding interpretation. Even though such an analysis is not complex, the uncertainty of this common method, which is often used in hydrology, is questioned due to the small values of the coefficient of determination *R*. Incorrectly conclusion leads to weak estimates in the design of hydro-technical facilities. Increasingly complex climate changes also contribute to this situation. The paper will present a methodology that aims to determine the homogeneity and isotropy of the analyzed data, which aims to determine the level of uncertainty of the obtained linear trends. For this purpose, Innovative Polygon Trend Analysis, i.e., the IPTA method, will be applied. The IPTA method will be applied to the example of the river Bednja in Croatia.
Keywords: Linear trend, homogeneity, isotropy, IPTA, River Bednja

Water Management / *Upravljanje vodama*
Poster presentation / *Postersko priopćenje*

Velocity and flow profiles of the rivers - Mutual relationships and impacts on the environment

Magdalena DROŽĐAN[1], Ivana PINTARIĆ[1], Bojan ĐURIN[1], Petra SUŠILOVIĆ[2], Quoc BAO PHAM[3]

[1] University North, Department of Civil Engineering, Jurja Križanića 31b, Varaždin, Croatia
[2] University of Mostar, Faculty of Civil Engineering, Architecture and Geodesy, Matice hrvatske bb, Mostar, Bosnia and Herzegovina
[3] University of Silesia in Katowice, Faculty of Natural Sciences, Institute of Earth Sciences, Będzińska Street 60, Sosnowiec, Poland

Abstract
The paper analyzes a change in the velocity of water flow per cross-section of the watercourse and the connection to the flow. Regulatory interventions in watercourses, primarily extensions and deepening of the troughs, river embankments, water entrance of different channels, etc., affect the flow of watercourses, especially the environment. Considering climate change, which in this particular case is related to the appearance of precipitation, torrential flows, and water waves, that is, the appearance of floods, it can be seen that it is a complex hydrological and environmental problem. The relationship between speeds and flow will be shown in the Mirna River in Croatia, which is in karst medium. The impact of changes in the velocity and flow of the environment will be analyzed concerning the constructed regulatory objects. Solutions will be proposed to reduce the impact of climate change and anthropogenic environmental impacts.
Keywords: velocity, flow, rivers, environment, karst

Water Management / *Upravljanje vodama*
Oral presentation / *Usmeno priopćenje*

Hydrological and geodetic aspects of determining relationships between precipitation and evaporation from the surface of the lakes

Bojan ĐURIN[1], Ana FRNTIĆ[1], Vlado CETL[2], Sanja ŠAMANOVIĆ[2]

[1] University North, Department of Civil Engineering, Jurja Križanića 31b, Varaždin, Croatia
[2] University North, Department of Geodesy and Geomatics, Jurja Križanića 31b, Varaždin, Croatia

Abstract
Precipitation and evaporation represent elements of water balance sheets in the lake, that is, the accumulation in general. The study in the paper consists of hydrological and geodetic analysis, defining functional dependence between precipitation and evaporation. The hydrological analysis includes an analysis of the precipitation that falls to the surface of the lake and an analysis of evaporation from the lake's water surface, located in the alluvia medium. It also includes the determination of the flow of the Plitvica River, which enters and exits the analyzed lake, resulting from the redirection of the river for the operation of the water flow, which rotated the grain mill. An ultrasound measuring device for measuring flow was used. The geodetic analysis covers measuring the lake surface with a drone and using GPS. The analyses used and the results obtained can be applied to analyze the water balance of other lakes and the dimensioning of accumulation in alluvial media, that is, a loss assessment during water infiltration underground.
Keywords: precipitation, evaporation, flow tracker, drone, GPS

Water Management / *Upravljanje vodama*
Oral presentation / *Usmeno priopćenje*

Challenges and possibilities of restauration of degraded freshwater ecosystems in Croatia

Ivan VUČKOVIĆ[1], Mladen PLANTAK[1], Jelena FRESSL[1], Marta SREBOČAN[1], Tomislav ŠALAMON[1], Koni ČARGONJA REICHER[1], Ivan TUKŠA[1], Alan KEREKOVIĆ[1], Višnja BUKVIĆ[2]

[1] Elektroprojekt Consulting Engineers Ltd., Civil and Architectural Engineering Department, Section of Ecology, Alexandera von Humboldta St. 4, Zagreb, Croatia
[2] Herzegovina University, Faculty of Social Sciences dr. Milenko Brkić, Kraljice Mira 3A, Bijakovići, Međugorje, Bosnia and Herzegovina

Abstract
The development of human society and the occupation of space have led to the degradation of freshwater ecosystems, especially watercourses. River channels, river banks and floodplains represent unique habitats of numerous species whose life cycles depend on natural hydrological phenomena. The restoration of watercourses focuses on the degraded parts of watercourses the basic ecological characteristics of which had been changed as a result of human activities. Closure of watercourses by the construction of water structures causes significant hydrological and morphological changes in the transfer of substances and energy through riverine ecosystems, causes the reduction of natural flow, and has a particularly unfavorable effect on the migration of fish species and biological conditions. Ecosystem restoration could change such a condition, which entails preventing future and stopping existing pressures while restoring destroyed habitats and ecosystem functions. Restored freshwater ecosystems are those aquatic habitats in which high to good water status has been achieved, watercourses with no barriers, with longitudinal connectivity achieved through functional fishways, optimal flow and biological minimum of water, and wetland habitats that are maintained by natural flooding thus enabling life of their inhabitants. This paper will give examples of European practice of the restoration of freshwater ecosystems, as well as the possibility of its application in Croatia.
Keywords: freshwater ecosystems, anthropogenic pressures, watercourse restoration

Water Management / *Upravljanje vodama*
Oral presentation / *Usmeno priopćenje*

Izazovi i mogućnost restauracije degradiranih slatkovodnih ekosustava u Hrvatskoj

Ivan VUČKOVIĆ[1], Mladen PLANTAK[1], Jelena FRESSL[1], Marta SREBOČAN[1], Tomislav ŠALAMON[1], Koni ČARGONJA REICHER[1], Ivan TUKŠA[1], Alan KEREKOVIĆ[1], Višnja BUKVIĆ[2]

[1] Elektroprojekt d.d., Građevinsko-arhitektonski biro, Odjel ekologije, Alexandera von Humboldta 4, Zagreb, Hrvatska
[2] Sveučilište Hercegovina, Fakultet društvenih znanosti dr. Milenka Brkića, Kraljice Mira 3A, Bijakovići, Međugorje, Bosna i Hercegovina

Sažetak
Razvoj ljudskog društva i zauzimanje prostora dovelo je do degradacije slatkovodnih ekosustava, posebno vodotoka. Korita rijeka, riječne obale i poplavna područja predstavljaju jedinstvena staništa brojnih vrsta čiji životni ciklusi ovise o prirodnim hidrološkim pojavama. U restauraciji vodotoka daje se naglasak na one degradirane dijelove vodotoka kojima su uslijed ljudskih aktivnosti promijenjena osnovna ekološka obilježja. Pregradnja vodotoka hidrotehničkim građevinama može uzrokovati značajne hidrološke i morfološke promjene prijenosa tvari i energije kroz riječne ekosustave, može utjecati na smanjenje prirodnog protoka, a posebno može nepovoljno djelovati na migraciju ribljih vrsta i biološke uvjete. Promjena takvog stanja moguća je restauracijom ekosustava koja podrazumijeva sprečavanje budućih i zaustavljanje postojećih pritisaka te obnovu uništenih staništa i funkcija ekosustava. Restaurirani slatkovodni ekosustavi su ona vodna staništa u kojima je postignuto povoljno stanje voda, vodotoci bez pregrada, longitudinalna povezanost preko funkcionalnih ribljih staza, optimalni protok i biološki minimum vode, močvarne livade koje se održavaju prirodnim plavljenjem a time će se omogućiti život njihovih stanovnika. U ovom radu dat će se primjeri restauracije slatkovodnih ekosustava iz prakse u Europi, kao i mogućnost primjene u Hrvatskoj.
Ključne riječi: slatkovodni ekosustavi, antropogeni pritisci, restauracija vodotoka

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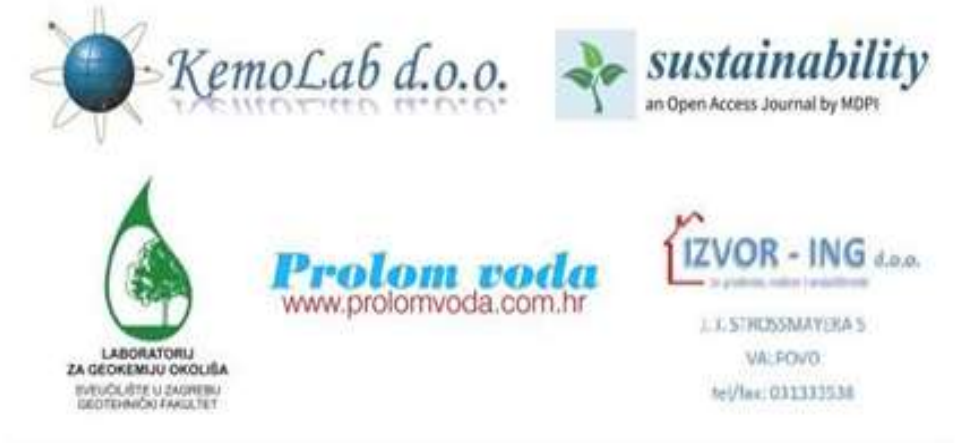

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çevmer

HAPIH
Hrvatska agencija za poljoprivredu i hranu

FSB

NTNU FOOD FORUM

Odjel za fiziku
fizika.unios.hr

PRAVOS

SVEUČILIŠTE U SPLITU
POMORSKI FAKULTET

MEDRI

Coimbra Health School
Polytechnic of Coimbra

mathos

Sveučilište J. J. Strossmayera u Osijeku
FAKULTET ZA DENTALNU MEDICINU I ZDRAVSTVO

Sveučilište u Zagrebu
Fakultet kemijskog inženjerstva i tehnologije

Sveučilište u Zagrebu
GEOTEHNIČKI FAKULTET

KTF
UNIVERSITY OF SPLIT
FACULTY OF CHEMISTRY AND TECHNOLOGY

FERIT
FAKULTET ELEKTROTEHNIKE, RAČUNARSTVA I INFORMACIJSKIH TEHNOLOGIJA OSIJEK

Univerza v Ljubljani
Fakulteta za kemijo in kemijsko tehnologijo

EFOS

Univerza v Ljubljani
Zdravstvena fakulteta

Pécsi Tudományegyetem
Műszaki és Informatikai Kar

Fakultet za odgojne i obrazovne znanosti
OBRAZUJEMO (ZA) BUDUĆNOST

VELEUČILIŠTE VELIKA GORICA

ZELENA PRAVNA KLINIKA

Hrvatska Komora Zdravstvenih Radn

HDKI
HRVATSKO DRUŠTVO KEMIJSKIH INŽENJERA I TEHNOLOGA

GRAĐEVINSKI FAKULTET
FACULTY OF CIVIL ENGINEERING

Sveučilište u Zagrebu
Učiteljski fakultet

UNIVERZITET METROPOLITAN BEOGRAD
FUTURA

NASTAVNI ZAVOD ZA JAVNO ZDRAVSTVO OSJEČKO - BARANJSKE ŽUPANIJE

ŽRA

KRKA
Nacionalni park
National Park

KOPAČKI RIT
Park prirode
Nature Park

NATURA 5

TURISTIČKA ZAJEDNICA OSJEČKO-BARANJSKE ŽUPANIJE

GEOSTUD

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