Water for All — *International Scientific and Professional Conference*

Voda za sve — *Međunarodni znanstveno-stručni skup*

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Osijek-Baranja County

„Vodovod-Osijek“

Nature Park “Kopački rit”

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2nd International and 6th Croatian Scientific and Professional Conference

WATER FOR ALL

18 March 2016
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BOOK OF ABSTRACTS

Water for All — *International Scientific and Professional Conference*

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Sveučilište Josipa Jurja Strossmayera u Osijeku
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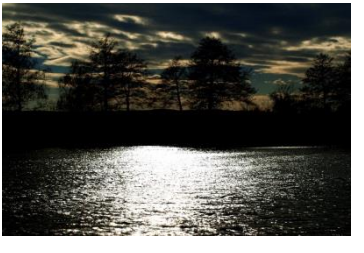
Zavod za javno zdravstvo Osječko-baranjske županije





II. međunarodni i VI. hrvatski znanstveno-stručni skup

VODA ZA SVE

18. ožujka 2016.
Osijek
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KNJIGA SAŽETAKA

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USMENA PRIOPĆENJA
ORAL PRESENTATIONS

Contents

Contents

Contents

Contents

Contents

Usmena priopćenja / *Oral presentations*

IDENTIFIKACIJA NAJZNAČAJNIJIH RIJEKA VELIKE VRIJEDNOSTI ZA OČUVANJE U HRVATSKOJ KORIŠTENJEM EKOREGIONALNOG PRISTUPA I SMJERNICA OKVIRNE DIREKTIVE O VODAMA

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Slatkovodni ekosustavi su globalno među najugroženijima te su stoga jedan od ciljeva očuvanja svjetske organizacije za zaštitu prirode World Wide Fund for Nature's (WWF). Kako bi strateški procijenili i identificirali rijeke i riječne segmente od velike važnosti za očuvanje u Hrvatskoj upotrijebili smo sljedeću metodologiju: ekoregionalni pristup s glavnim ciljem predstavljanja svih sastavnica bioraznolikosti pojedine ekoregije u kombinaciji s određivanjem ekološkog stanja rijeka u skladu sa EU Okvirnom direktivom o vodama. Nakon utvrđivanja tipologije rijeka određene su glavne jedinice analize - Ocjenjivani riječni segmenti (ORS). Ekološko stanje svakog ORS-a određeno je kombinacijom pet kriterija: hidrologija, morfologija korita, kvaliteta vode, riparijska zona i korištenje zemljišta. Ekološko stanje svakog ORS-a dobiveno je zbrajanjem ocjena svih kriterija, a podaci o rasprostranjenosti ugroženih i endemskih riba te prisutnost zaštićenih područja korišteni su za prioritizaciju ORS-a u odličnom ili dobrom stanju. Ukupno smo analizirali 82 rijeke, ukupne dužine toka 4522 km. Ukupna dužina toka odabranih rijeka od najveće važnosti iznosi 1607 km (35%), a dodatni ORS-i, koji obuhvaćaju ukupno 998 km (22%) toka odabrani su kako bi se osigurala reprezentativnost svih riječnih tipova u svakoj ekoregiji. Rezultate ove analize WWF koristi u zagovaranju strateškog pristupa u postizanju održivog korištenja rijeka i prikladnog očuvanja slatkovodne biološke raznolikosti u Hrvatskoj.

IDENTIFICATION OF THE MOST OUTSTANDING RIVERS OF HIGH CONSERVATION VALUE IN CROATIA USING ECOREGIONAL CONSERVATION APPROACH AND WATER FRAMEWORK DIRECTIVE METHODOLOGY

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Freshwaters are globally among the most endangered ecosystems and one of the World Wide Fund for Nature's (WWF) main conservation target. In order to strategically assess and identify the most outstanding rivers and river reaches of high conservation value in Croatia we used following methodology: a combination of ecoregional conservation approach and assessment of river reach condition in accordance with the EU Water Framework Directive. Main units of analysis, the Evaluated River Reaches (ERRs), were identified after all river types were distinguished. The condition of each ERR was assessed using a combination of five criteria: hydrology, channel morphology, riparian vegetation, water quality and land use. The final condition of ERR was scored by summing scores for the five criteria. Distribution of endangered freshwater fish species and protected areas was used for prioritizing the ERRs in high and good condition. Altogether 82 rivers and 4522 km of river length were analyzed. The total length of very high priority ERRs was 1607 km (35%), while additional ERRs comprising 998 km (22%) of river length were included to assure representation of all river types in each ecoregion. This work is used by WWF to advocate sustainable use of rivers and appropriate conservation of freshwater biodiversity in Croatia.

STANJE BIOLOŠKE RAZNOLIKOSTI RIJEKE SAVE KROZ USPOREDNU ANALIZU UTVRĐENIH VRSTA NATURA 2000 REPUBLIKE HRVATSKE I BOSNE I HERCEGOVINE

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Rijeka Sava je jedan od najvažnijih riječnih ekosustava u regiji, koji se odlikuje kompleksnom i specifičnom biološkom raznolikošću. Zbog iznimnog značaja i potrebe očuvanja njenih staništa i vrsta, ova rijeka je cijelom dužinom toka uvrštena u Natura 2000 za Republiku Hrvatsku, sukladno Direktivi o staništima (engl. *Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora*) i Direktivi o pticama (engl. *Council Directive 79/409/EEC; 2009/147/EC on the Conservation of Wild Birds)*. Tijekom 2015. godine isporučen je nacrt Natura 2000 za Bosnu i Hercegovinu, koji tretira isto područje te ga uključuje u prijedlog ekološke mreže. Radom želimo pokazati potrebu za daljnjim biološkim istraživanjima rijeke Save s obje obale te iskazati potrebu unificiranja podataka kako bi pravo stanje biološke raznolikosti dali potrebiti značaj.

THE STATE OF BIODIVERSITY OF THE SAVA RIVER THROUGH COMPARATIVE ANALYSIS NATURA 2000 SPECIES IN CROATIA AND BOSNIA AND HERZEGOVINA

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The Sava River is one of the most important ecosystems in the region, which is characterized by a complex and unique biodiversity. Due to the great importance and the need to preserve its habitats and species, this river, with its whole flow, is included in the Natura 2000 sites for Republic of Croatia, in accordance with the Habitats Directive (Council Directive 92/43/EEC) and the Birds Directive (Council Directive 79/409/EEC, 2009/147/EC). During the 2015 the proposal of Natura 2000 sites for Bosnia and Herzegovina has been drafted including the Sava River. By this paper we want to point out the need for continuous biological studies and research of this river in the Republic of Croatia and Bosnia and Herzegovina and to point out the need of providing the unified data in order to give required and belonging meaning to the actual state of the biodiversity.

STRATEGIJA ZA ZAŠTITU VODNIH RESURSA S KONCEPTOM ODRŽIVOG RAZVOJA I OPERATIVNI PROGRAM SA SMJERNICAMA ODVODNJE I PROČIŠĆAVANJA OTPADNIH VODA RAŠTRKANIH NASELJA GORNJEG MEĐIMURJA

Zdenko Tadić, Ana Pihler

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Dvojezična strategija i Operativni program sastavni su dio projekta „Dobra voda za vse“ (Projekt) koji se u okviru prekogranične suradnje Republika Slovenije i Hrvatske, odvija prema Operacionalnom programu Slovenija – Hrvatska 2007-2014.
Opći cilj Projekta je stvaranje uvjeta za održivi razvoj odvodnje i pročišćavanja otpadnih voda pograničnih područja, temeljen na očuvanju, zaštiti okoliša i smanjenju onečišćenja okoliša kroz zajedničko upravljanje otpadnim vodama.
Područje projekta obuhvaća područje Pomurja i Donjeg Podravja u Sloveniji te Međimurja u Hrvatskoj. Posebnost Projektnog područja je brdovitost i više manjih naselja raspršenih u prostoru za koja odvodnju nije moguće riješiti klasičnim sustavima odvodnje, pa je potrebno odabrati alternativna rješenja u načinima skupljanja, transporta, pročišćavanja i ispuštanja pročišćenih otpadnih voda.
Strategija analizira stanje na području projekta, s naglaskom na izvore vode, bavi se prisutnim aktivnostima i opterećenjima na vodna tijela te definira ciljeve i mjere potrebne za postizanje održivog upravljanja vodnim resursima.
Svrha Operativnog programa je osigurati pružanje učinkovite i održive usluge zbrinjavanja otpadnih voda za sve stanovnike Projektnog područja, smanjiti opterećenje nutrijentima površinskih i podzemnih voda primjenom jednostavnih i učinkovitih tehnoloških rješenja s niskim troškovima pogona i održavanja, te planerima, projektantima, zakonodavcima i korisnicima pružiti potrebne podatke i smjernice za realizaciju Projekta.

STRATEGY FOR THE PROTECTION OF WATER RESOURCES WITH CONCEPT OF SUSTAINABLE DEVELOPMENT AND OPERATIONAL PROGRAM WITH GUIDELINES FOR SEWAGE SYSTEM AND WASTEWATER TREATMENT FOR DISPERSED SETTLEMENTS IN GORNJE MEĐIMURJE

Zdenko Tadić, Ana Pihler

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Bilingual strategy and the Operational program is an integral part of the project "Dobra voda za vse" (the Project) which in the context of cross-border cooperation between Republic of Slovenia and Republic of Croatia, is under the Operational program Slovenia - Croatia 2007-2014.
The overall objective of the Project is to create conditions for sustainable development of sewage systems and waste water treatment in border regions, based on preservation and protection of the environment and reduction of environmental pollution through the joint management of wastewater in the area. The project covers area of Pomurje and Donje Podravje in Slovenia as well as Međimurje in Croatia. Distinction of the Project area worth mentioning is hilly terrain and a large number of small scattered settlements in the area for which the sewage system is not possible to solve with conventional sewage systems, so it is necessary to choose the solutions that fall within the domain of the alternative methods of collection, transport, treatment and discharge of treated wastewater.
The Strategy analyses the situation in the project area with emphasis on water resources and deals with the present activities and loads on water bodies, and defines the objectives and measures needed to achieve sustainable management of water resources.
The purpose of the Operational program is to ensure the provision of efficient and sustainable wastewater services for all residents of the project area, to reduce the load of nutrients on surface water and groundwater by using simple and effective technological solutions with low operational and maintenance costs, as well as providing planners, designers, regulators and customers the necessary data and guidelines for implementation of the project.

MONITORING VODE ZA LJUDSKU POTROŠNJU I BAZA PODATAKA

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U Hrvatskoj se od 2008. godine provodi Monitoring izvorišta vode za ljudsku potrošnju i Monitoring vode za ljudsku potrošnju iz razvodne mreže. Ministar nadležan za zdravlje na temelju prijedloga Hrvatskog zavoda za javno zdravstvo donosi Plan monitoringa. Izvršitelji su svi Županijski zavodi za javno zdravstvo, a Hrvatski zavod za javno zdravstvo koordinira provedbu i izrađuje godišnji i trogodišnji izvještaj kojeg dostavlja Ministru zdravlja, Ministru nadležnom za vodno gospodarstvo i Hrvatskim vodama. Monitorinzi do 2014. godine provodili su se po Pravilniku o zdravstvenoj ispravnosti vode za piće, a poslije 2014. godine po Zakonu o vodi za ljudsku potrošnju i njegovim podzakonskim aktima. Ogroman broj podataka i obveza izvještavanja Hrvatske kao članice Europske unije o kvaliteti vode za ljudsku potrošnju, ubrzali su stvaranje Baze podataka koja je formirana u suradnji Hrvatskih voda i Hrvatskog zavoda za javno zdravstvo, a njeni korisnici su i svi županijski zavodi za javno zdravstvo. U ovom radu dat će se kratak pregled glavnih karakteristika neprerađenih voda Hrvatske, a koje se koriste nakon obrade za ljudsku potrošnju, kao i glavnih karakteristika prerađene vode u Hrvatskoj. Također ćemo dati informaciju oko Baze podataka koja nastaje stalnim radom svih sudionika.

MONITORING OF THE WATER INTENDED FOR HUMAN CONSUMPTION AND NATIONAL DATABASE

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Monitoring of water sources (raw water) and monitoring of water intended for human consumption from the distribution network have been carrying out in Croatia since 2008. The minister responsible for the health brings a Plan of the Monitoring based on a proposal of the Croatian Institute of Public Health. County Public Health Institutes perform monitoring while the Croatian Institute of Public Health coordinates the implementation and prepares annual and three-year reports which are submitted to the Minister of Health, Minister responsible for water management and the Croatian Waters. The monitoring done by 2014 was carried out according to the Ordinance on drinking water safety, and after 2014 under the Law on water intended for human consumption and its bylaws. The enormous amount of data and reporting obligations, of Croatia as a member of the European Union, on the quality of water intended for human consumption accelerate the creation of database which was formed in cooperation of the Croatian Waters and the Croatian Institute of Public Health while its users are all county public health institutes. This paper will give a brief overview of the main characteristics of the raw water in Croatia, which are used for human consumption after treatment, as well as the main characteristics of the treated water. Information about Database which is growing by the continuous work of all interested parties will also be provided.

CRPILIŠTA U OSJEČKO-BARANJSKOJ ŽUPANIJI

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Marika Kralj, Hrvoje Sučić

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Razvitak vodoopskrbe predstavlja jedan od bitnih elemenata infrastrukturnog razvitka jedinica lokalne samouprave i Županije u cjelini. Razvijen vodoopskrbni sustav i dostupnost zdravstveno ispravne vode zaljudsku potrošnju na cijelom području, predstavljaju temeljnu pretpostavku gospodarskog razvitka. Zdravstveno ispravna i kvalitetna voda za ljudsku potrošnju osnova je dobrog ljudskog zdravlja. Opskrba zdravstveno ispravnom vodom za ljudsku potrošnju i odgovarajuća sanitacija, temelj su sprječavanja bolesti, koje se prenose onečišćenom vodom. Zbog toga se provode aktivnosti koje uključuju: mjere za smanjenje onečišćenja vode, kontrolu kakvoće vode za ljudsku potrošnju i razvitak infrastrukture. Kemijski, fizikalni i mikrobiološki pokazatelji koji definiraju kakvoću vode za ljudsku potrošnju ovise o kakvoći vode na izvorištu, uključujući vrstu obrade, metodu dezinfekcije, tehničko stanje objekta i razvodne mreže vodoopskrbnog sustava. Postojeća tehnička rješenja zahvata i obrade manjih javnih vodovod, ne zadovoljava u potpunosti, dok su manja crpilišta pojedinih ruralnih naselja individualni lokalni sustavi koji ne zadovoljavaju kriterije propisane zakonom. Gotovo sve zahvaćene vode za javne vodovode potrebno je obraditi prije distribucije u javni vodoopskrbni sustav. Osnova obrade ovih voda je uklanjanje željeza, mangana, arsena, organskih tvari, nitrata i amonijaka.Posebna poteškoća povezana je s pojavom povišenog arsena u podzemnoj vodi koji se postojećim uređajima za obradu vode ne uklanja dovoljno.

WATER SOURCE IN OSIJEK-BARANYA COUNTY

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Infrastructural growth of a County depends on a developed water supply system. Availability of a safe drinking water is a key element of stable economical development. Healthy correct and high quality drinking water is a basis of good human health. Supply of a safe drinking water and adequate sanitation is a necessity for preventing disease transmitted through contaminated water. The management of drinking water supply includes among others the monitoring of the quality state of water distribution, measures for preventing water contamination and infrastructure development. Chemical, physical and microbiological parameters which define the quality of drinking water are depending on factors including the quality of water supply, type of treatment, disinfenction, technical conditions of buildings and building materials, distribution network and water supply system.Existing tehnical solutions for treatment of smaller public water supply systems only partialy fulfill the criteria conferred by law. On the other hand some rural water supply systems don't fulfill them at all. Before distribution in public water supply system water must be treated. Basis of water treatment lies in removal of iron, manganese, arsenic, organic materials, nitrates and ammonia. High arsenic concentration in underground water presents special difficulty because of an insufficient removal by current water purification systems.

HIDRAULIČKE, ENERGETSKE I HIDROLOŠKE KARAKTERISTIKE ODRŽIVIH SUSTAVA NAVODNJAVANJA: PRIMJER NOGOMETNOG KLUBA "OBREŠ", SVETI ILIJA, HRVATSKA

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Problematika održivosti svakog modernog vodoopskrbnog sustava koji isporučuje vodu krajnjem korisniku podrazumijeva postizanje hidrauličke, energetske i hidrološke održivosti svih ulaznih i izlaznih pokazatelja toga sustava. Na primjeru budućeg projekta navodnjavanja lokalnog nogometnog kluba "Obreš" iz Svetog Ilije pored Varaždina prikazat će se nova, znanstveno inovativna i inženjerski primjenjiva metoda dimenzioniranja vodoopskrbnih sustava, a samim time i sustava navodnjavanja. Prikazani sustav navodnjavanja sastoji se od solarnog fotonaponskog sustava, crpki za vodu i od vodosprema, kao i od svih potrebnih cjevovoda te uređaja za navodnjavanje. Sustav navodnjavanja koristit će solarnu fotonaponsku energiju kao izvor električne energije za rad crpki. Crpke imaju funkciju precrpljivanja vode u vodospremu, koja služi kao spremnik vode za navodnjavanje nogometnog terena. Za potrebe navodnjavanja koristit će se podzemna voda u kombinaciji s kišnicom. Spomenuti izvori energije i vode, kao i spomenuta metodologija dimenzioniranja doprinose ostvarenju sustavne održivosti sustava za navodnjavanje. Budući da se izgradnjom ovakvog sustava zadovoljavaju određeni ekonomski, društveni, kao i ekološki kriteriji održivosti, potrebno je dati i smjernice za višekriterijsku analizu jednog ovakvog sustava.

HYDRAULIC, ENERGETIC AND HYDROLOGICAL CHARACTERISTICS OF SUSTAINABLE IRRIGATION SYSTEMS: AN EXAMPLE OF FOOTBALL CLUB "OBREŠ", SVETI ILIJA, CROATIA

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The issue of sustainability of any modern water supply system that supplies water to the end user implies achieving hydraulic, energetic and hydrological sustainability of all input and output parameters of the system. A new, scientifically innovative and, in terms of engineering, applicable method for dimensioning of water supply systems, and therefore the irrigation system, will be shown on the example of the future irrigation project of the local football club "Obreš" from Sveti Ilija near Varaždin. The presented irrigation system consists of a solar photovoltaic system, water pumps and water reservoirs, including all pipelines and machines for irrigation. The irrigation system will use solar photovoltaic energy as the source of electric energy for pump operation. The pumps have the function of re-pumping water into the water reservoir which serves as water storage for watering the football field. Groundwater in conjunction with rainwater will be used for this purpose. The previously mentioned sources of energy and water, as well as the sizing methodology, contribute to a systematic sustainability of the irrigation system. Given that the construction of such system meets certain economic, social and ecological sustainability criteria, it is necessary to give guidelines for the multi-criteria analysis of such system.

RJEŠAVANJE PROBLEMA POPLAVA U SLOVENIJI

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Slovenija je sve više u opasnosti od poplava. Zabrinuta javnost pita se kako država odgovara na poplave. Država Slovenija nalazi se na prekretnici poboljšanja zaštite od poplava. Ovaj problem je bio u posljednjih dvadeset i pet godina zanemaren. Provedba Europske Direktive o poplavama (2007/60/EC) provodi se u prenošenju europskih pravnih stečevina. Sada smo suočeni sa najtežim korakom u realizaciji projekata za poboljšanje zaštite od poplava.

U posljednjih nekoliko godina počeli smo provoditi takve aktivnosti na rijekama Savinji i Dravi. Iskustva u tim projektima; naročito dogovaranja između poljoprivrednog sektora i konzervatora prirode moraju činiti temelj za novo planiranje i reguliranje širim "zelenim" protočnim profilima riječnih korita i za sistemska određivanja primjerenih nadoknada za planirane površine za zadržavanje (npr. suhi rezervoari).

U ovom članku želim pokazati povijesni pregled poplava u odabranim, uglavnom urbaniziranim područjima Slovenije, zastoj rješavanja ovog problema u samostalnoj Sloveniji, direktivu o poplavama Europske unije, njezina implementacija u Sloveniji na projektima rijeke Savinje i Drave i aktualne projekte na područjima poplavne opasnosti.

SOLVING PROBLEMS OF FLOODS IN SLOVENIA

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Slovenia is increasingly at risk from flooding. Concerned public wonders how the state is responding to the floods. Slovenia is on a turning point of improving flood measures. This was a problem which was in the last 25 years very neglected. The implementation of European Floods Directive (2007/60/EC) has been transferred into Slovenian legislation. Now we are facing the most difficult step with the realization of projects for the improvement of flood protection.
In recent years we have started to implement such measures in the Savinja and Drava riverbasins. Experience in these projects; in particular with the agricultural sector and nature conservationists we must constitute the basis for a new planning and regulation of the wider "green" profiled riverbeds and a system of determining the appropriate compensation for planned retention areas (eg. dry dams).
In this article, I want to show the historical cross-section of the floods in Slovenia, the deadlock in solving this problem in the independent Slovenia, the flood directive of the European Union, its implementation in Slovenia and the projects on the rivers Savinja and Drava that are currently being implemented and the future plans of solving flood-prone areas.

VODA U POLJOPRIVREDI

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U ukupnoj potrošnji svježe slatke vode na globalnoj razini poljoprivreda koristi 70 %, industrija 22 % te domaćinstva 8 %. U stočarstvu se voda koristi za napajanje životinja, održavanje objekta, pranje uređaja i opreme (naročito aparata za mužnju). Na farmama treba osigurati kontinuiranu opskrbu svježe vode odgovarajuće kvalitete. Najveći potrošači vode su krave u laktaciji kojima je za napajanje, pranje sustava za mužnju i postupak hlađenja mlijeka potrebno osigurati i do 140 litara vode po grlu dnevno. Prema godišnjem izvješću Hrvatske poljoprivredne agencije za 2014. godinu u Hrvatskoj je bilo 176 169 krava što je potrošnja od ukupno 24 663 660 litre vode dnevno. U biljnoj proizvodnji, naročito u uzgoju povrća, troše se velike količine vode za 1 kg suhe tvari – transpiracijski koeficijent (500-800 za povrćarske kulture). U zaštiti bilja od štetnika, bolesti i korova troši se i do 1000 litara vode po hektaru. Voda u tlu za uzgoj biljaka može biti u suvišku (potrebna odvodnja) ili u nedostatku (potrebno navodnjavanje). U svijetu se navodnjava 17 % ukupno obradivih površina, u Europi oko 13 %, a u Hrvatskoj tek oko 1,2 % ukupno obradivih površina što nije dostatno obzirom na potrebu za navodnjavanjem i predviđenim planom od 6,5 % površina do 2020. godine.

WATER IN AGRICULTURE

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At global level, the overall consumption of freshwater ratios are 70% agricultural, 22% industrial and 8% domestic. Most water used in livestock farming is for animal drinking, washing animal housing and equipment (especially milking equipment). Farms should provide a continuous supply of fresh high quality water. The water needs of lactating cows, washing milking and milk cooling equipment require a larger portion of water supply of up to 140 liters per day per cow. According to the annual report of the Croatian Agricultural Agency for the year 2014, there were 176,169 cows in Croatia with the total daily water consumption of 24,663,660 liters. Crop production, especially vegetable farming, consume large amounts of water for 1 kg of dry matter - transpiration coefficient (500-800 for vegetables). For the crop protection from pests, diseases and weeds it is spent up to 1000 liters of water per ha. Water in the soil for crop production can be excess or insufficient, requiring drainage and irrigation, respectively. The irrigated area occupies worldwide about 17% of the total arable land, in Europe about 13% and in Croatia only about 1.2% of the total arable land, which is not enough given the need for irrigation and anticipated irrigation plan of 6.5% of the arable land by 2020.

ŽIVOT NA VODI, UZ VODU, S VODOM – SUŽIVOT LJUDI I RIJEKA U MEĐIMURJU

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U ovom radu istražuje se razina svakodnevnih interakcija između stanovništva Međimurja i rijeka u njihovu neposrednom okolišu. Tri tradicionalna obrta u Međimurju koja su usko povezana s Murom i Dravom – zlatarenje, mlinarstva i splavarenje – egzistirala su sve do druge polovice 20. stoljeća. Primjerice, u ekonomskom pogledu, zlatarenjem su se ponajviše bavili ljudi u području donjeg Međimurja kao dodatnom aktivnošću uz poljoprivredu, splavari su stupali u ugovorni odnos s industrijalcima, dok su mlinari posjedovali vlastite mlinove i s vremenom postajali obrtnici. Iako su u mnogim segmentima različite, ove tri aktivnosti povezuje rijeka kao temeljni preduvjet njihova rada. Terenskim istraživanjima provedenima kroz redovitu djelatnost Muzeja Međimurja u Čakovcu sakupljena su neprocjenjiva kazivanja mlinara, zlatara i splavara, kao i ljudi koji su svjedočili njihovom radu i načinu života. Istraživanje ove teme kritičkim iščitavanjem literature seže u rani novi vijek, odnosno u vrijeme kada su na području Međimurja po prvi put zabilježene navedene aktivnosti na rijekama. Koristeći oba spomenuta izvora podataka, koji čine temelj za primarni opis spomenutih aktivnosti, članak će se fokusirati na sljedeća pitanja: kakav je bio odnos stanovništva prema rijekama, odnosno jesu li se one smatrale opasnima ili ne? Na koji su način rijeke narativizirane u usmenoj predaji? Može li se na taj način sagledati odnos čovjeka prema okolišu? Kakva im je uloga danas namijenjena kroz prizmu sve većeg (neoromantičarskog) vrednovanja nematerijalne baštine? Sagledavajući istraživanu temu na spomenuti način, članak tematizira metodologiju istraživanja, vrednovanja i interpretiranja zlatarenja, mlinarstva i splavarenja u Međimurju.

LIFE ON THE WATER, BY THE WATER, WITH THE WATER – COEXSISTENCE OF MAN AND RIVERS IN THE MEĐIMURJE REGION

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This paper examines the level of everyday interactions between the population of the Međimurje region and the rivers in their immediate environment. Three traditional crafts of Međimurje which are closely associated with the rivers Mura and Drava – gold washing, milling and timber rafting – have continued until the second half of the 20th century. For example, in economic terms, people in the lower Međimurje have dealt with gold washing as an additional activity alongside agriculture; rafters were having a contractual relationship with the industrialists, while millers possessed their own mills and eventually became craftsmen. Although in many different segments, the link connecting these three activities is the river as a basic prerequisite for their work. Field research conducted through regular activities of the Museum of Međimurje in Čakovec obtained priceless testimonials of millers, gold washers and timber rafters, as well as people who shared their work and lifestyle. The study of this subject through critical reading of the literature dates back to the early modern period, i.e., to a time when the mentioned activities on rivers were for the first time recorded in the area of Međimurje. Using both of the above sources of data, which form the basis for the primary description of the mentioned activities, the article will be focused on the following questions: what was the attitude of the population towards the rivers, i.e., were they considered dangerous or not? How are rivers narrativized in oral tradition? Can we thus consider the attitude towards the environment? What is their role today through the prism of a growing (neoromantic) valuation of intangible heritage? By looking at the researched subject in this manner, the article discusses the methodology of research, evaluation and interpretation of gold washing, milling and lumber rafting in Međimurje.

VODA ZA SVE

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Voda je bezbojna tekućina koja tvori potoke, jezera, oceane i kišu širom svijeta. Najbitnije od svega voda je glavna sastavnica živih organizama. Zauzima 71 % površine Zemlje. Od vitalne je važnosti za sve oblike života. 95,5 % vode na Zemlji je u morima i oceanima, 1,7 % u podzemnoj vodi, a 1,7 % u ledenjacima i ledenoj kapi Antartike i Grenlanda. Samo 2,5 % vode je slatka voda, od toga 98,8 % od te vode je zarobljeno u ledu ili podzemnoj vodi.
Voda se na Zemlji kreće kontinuirano u ciklusu vode ili hidrološkom ciklusu kroz procese isparavanja, kondenzacije, precipitacije najčešće utječe u mora. To podrazumijeva stalnu izmjenu vode između atmosfere, vode iz tla, površinskih voda, podzemnih voda i biljaka.
Sigurna voda za piće je nasušno potrebna za ljude i sva živa bića iako nema ni kalorija niti nutrijenata. Zbog toga je održivi menadžment vode i njezinih prirodnih izvora jedan od najznačajnijih zadataka modernog društva. Na teritoriju Zagreba javni vodoopskrbni sustav orjentiran je na korištenje 7 podzemnih vodocrpilišta sa 36 zdenaca.

WATER FOR ALL

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Water is a transparent fluid which forms the world's streams, lakes, oceans and rain. Most important it is the major constituent of the fluids of organisms. Water covers 71% of the Earth's surface. It is vital for all known forms of life. On Earth, 96.5% of the planet's crust water is found in seas and oceans, 1.7% in groundwater and 1.7% in glaciers and the ice caps of Antarctica and Greenland. Only 2.5% of this water is freshwater, and 98.8% of that water is in ice and groundwater.
Water on Earth moves continually through the water cycle, or hydrologic cycle through the evaporation, condensation, precipitation and runoff, usually reaching the sea. It refers to the continuous exchange of water between the atmosphere, soil water, surface water, groundwater and plants.
Safe drinking water is essential to humans and other lifeforms even though it provides no calories or organic nutrients. So sustainable management of water as a natural resource is one of the most important tasks of modern society. In the territory of Zagreb, the public water supply is oriented exclusively to the use of groundwater from 7 different aquifers with 36 wells.

DETEKCIJA I KVANTIFIKACIJA MEMANTINA U VODI KAO POTENCIJALNO POSTOJANOG MIKROONEČIŠĆIVALA

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Memantin je farmaceutik koji se primjenjuje za ublažavanje simptoma Alzheimerove i Parkinsonove bolesti. Obzirom na trend povećanja prodaje farmaceutika na tržištu EU te rasta učestalosti neurodegenerativnih oboljenja, očekuje se značajan porast uporabe memantina te dospijevanje u okoliš putem sustava javne odvodnje.
Male koncentracijama farmaceutika u okolišu mogu nepovoljno utjecati na okoliš i zdravlje ljudi stoga su potrebne metode za njihovo praćenje.
Fizikalno-kemijska svojstva memantina ukazuju na potencijalnu postojanost u okolišu te ujedno otežavaju njegovo praćenje. Molekula memantina je praktički transparentna u UV/Vis području što otežava primjenu spektrofotometrijskih metoda. Moguća je primjena derivatizacije ili kompleksiranja s azo-bojilima, međutim time se povećava složenost pripreme uzorka. Primjena GC-a otežana je visokim talištem i vrelištem memantina te visokim *pKa* što iziskuje potrebu korištenja inertnih kolona.
Stoga je u ovome radu predstavljena LC-MS metoda koja omogućava relativno jednostavnu detekciju i kvantifikaciju memantina u vodi. Vodeni uzorak se zaluži, potom se memantin ekstrahira u etil acetatu. Otapalo se upari te se memantin otopi u vodenoj otopini HCl. Mobilna faza sastoji se od otopine acetonitrila i mravlje kiseline. Memantin se ionizira ESI-em pri 300 °C i 4 kV te detektira pri *m/z* od 180 uz napon kvadripola od 1 kV.

DETECTION AND QUANTIFICATION OF MEMANTINE IN WATER AS A POTENTIALLY PERSISTENT MICROPOLLUTANT

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Memantine is a pharmaceutical used for alleviating symptoms of Alzheimer's and Parkinson's disease. Due to rising sales of pharmaceuticals and incidence of neurodegenerative diseases, usage of memantine is expected to increase and therefore its presence in the environment.
Pharmaceuticals in low environmental concentrations can have a negative environmental and health impact, thus monitoring methods are necessary.
Physicochemical properties of memantine indicate that it is potentially environmentally persistent and difficult to detect and quantify. The molecule is transparent in UV/Vis range thereby making spectrophotometric methods difficult. Memantine can be derivatised or complexed with azo-dyes at the expense of method simplicity. Application of GC is difficult due to high melting and boiling points along with high *pKa*, therefore special inert columns are necessary.
In this work a relatively simple LC-MS method for detecting and quantifying memantine in water is presented. The aqueous sample is basified and memantine is extracted with ethyl acetate. The organic layer is boiled off and aqueous HCl is added. The mobile phase consists of aqueous acetonitrile and formic acid. Memantine is ionized by ESI at 300 °C and 4 kV and detected at *m*/*z* of 180 at 1 kV quadrupole voltage.

ODREĐIVANJE MINERALNIH ULJA U VODI METODOM PLINSKE KROMATOGRAFIJE

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Mineralna ulja su nusprodukti naftne industrije sastavljeni od dugolančanih i razgranatih alifatskih, alicikličkih, aromatskih ili alkil-supstituiranih aromatskih ugljikovodika. Ovim radom opisana je metoda određivanja mineralnih ulja tehnikom plinske kromatografije s plameno ionizacijskim detektorom (FID) u pitkim, površinskim, podzemnim i otpadnim vodama. Metoda se temelji na određivanju indeksa ugljikovodika koji je suma koncentracija uljnih komponenti ekstrahiranih ugljikovodičnim otapalom vrelišta između 36 °C i 69 °C i na kromatogramu imaju retencijsko vrijeme između *n*-dekana ($C_{10}H_{22}$) i *n*-tetrakontana ($C_{40}H_{82}$). Kvantifikacija mineralnih ulja provodi se temeljem integrirane površine svih pikova između dodanih markera *n*-dekana i *n*-tetrakontana pomoću vanjskog standarda koji je mješavina dvaju specificiranih tipova mineralnih ulja. Odgovaranje analitičke metode namijenjenoj svrsi dokazano je validacijskim protokolom od šest parametara (linearnost, ponovljivost injektiranja, ponovljivost pripreme uzorka, iskorištenje te granica detekcije i kvantifikacije). Postignuta donja granica kvantifikacije od 0,010 mg/l udovoljava zahtjevima svih trenutno važećih zakonskih akata kojima su propisane dopuštene koncentracije mineralnih ulja odnosno ugljikovodika u vodama. Dosadašnja sudjelovanja na vanjskim ispitivanjima osposobljenosti laboratorija za provedbu analitičke metode pokazala su zadovoljavajuće rezultate. Kao primjeri praktične primjene opisane analitičke metode prikazani su kromatogrami i kvantificirani rezultati određivanja mineralnih ulja u uzorcima pojedinih tipova voda različito opterećenih ugljikovodičnim onečišćenjem.

DETERMINATION OF MINERAL OIL IN WATER BY GAS CHROMATOGRAPHY

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A mineral oil is any petroleum industry by-product composed of long-chain or branched aliphatic, alicyclic, aromatic or alkyl-substituted aromatic hydrocarbons. This paper describes a method of mineral oil determination in drinking, surface, underground and wastewater, using gas chromatography with flame ionization detector (FID). The method is based on hydrocarbon oil index determination which is a sum of concentrations of compounds extractable with hydrocarbon solvent that has a boiling point between 36 °C and 69 °C and visible on chromatogram between retention times of *n*-decane ($C_{10}H_{22}$) and *n*-tetracontane ($C_{40}H_{82}$). The concentration of mineral oil is quantified based on integrated area of all peaks between *n*-decane and *n*-tetracontane against an external standard consisting of two specified mineral oils. Suitability of the method is proven through six validation parameters (linearity, injection repeatability, sample preparation repeatability, detection and quantification limit). Lower quantification limit of 0,010 mg/l corresponds to all legislative acts that define concentration limits for mineral oil or hydrocarbons in water. Proficiency tests gave satisfactory results and confirm qualification of the laboratory for performing the method. Some chromatograms and quantified results of mineral oil determination in various water type samples with diverse hydrocarbon contamination are given as examples of practical application of described method.

TEŠKI METALI U SEDIMENTU DRAVE PRIJE I NAKON KOLEKTORSKOG ISPUSTA

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Grad Osijek, kao središte industrije i poljoprivrede Slavonije i Baranje, vezan je svojim hidrotehničkim sustavom s rijekom Dravom, te je ona prijemnik nepročišćenih komunalnih, industrijskih i oborinskih otpadnih voda.
Odvodnja otpadnih voda grada i industrije Osijeka, odvijala se do 2000. godine putem Sjevernog kolektora, a dovršetkom izgradnje Južnog kolektora preusmjereno je ispuštanje otpadnih voda oba kolektora u Nemetin, gdje je i lokacija izgradnje budućeg uređaja. Cilj ovog rada bio je odrediti koncentracije teških metala prisutnih u sedimentu rijeke Drave i procijeniti utjecaj ispusta nepročišćene otpadne vode grada Osijeka i okolice u rijeku Dravu na akumulaciju teških metala u sedimentu.

HEAVY METALS IN SEDIMENTS OF RIVER DRAVA BEFORE AND AFTER DISCHARGE OF WASTE WATER

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The city of Osijek, as a center of industry and agriculture of Slavonia and Baranja, is related to its hydro-technical system with the Drava River, and it is the receiver of untreated municipal, industrial and storm sewage.
Sewerage and industry Osijek, was carried out by the year 2000 through the North collector, and the completion of construction of the Southern collector diverted the waste water discharge manifold both in Nemetin, where the location and construction of the future devices . The aim of this study was to determine the concentration of heavy metals in the sediment of the river Drava and assess the impact of discharges of untreated wastewater city of Osijek and its surroundings in the river Drava on the accumulation of heavy metals in the sediment.

PROČIŠĆAVANJE TEHNOLOŠKIH OTPADNIH VODA IZ PREHRAMBENE INDUSTRIJE NA PRIMJERU IZVEDENOG UPOV-a U MLJEKARI

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Tehnološke (industrijske) otpadne vode potrebno je prethodno pročistiti prije dolaska do zajedničkog komunalnog uređaja za pročišćavanje otpadnih voda. Potreba za prethodnim pročišćavanjem industrijskih otpadnih voda posljedica je njihovog posebnog sastava, kao i neujednačene dinamike ispuštanja. Smanjenje opterećenja, kao i njihovo ujednačavanje tijekom dana osobito je važno ako su otpadne vode jako opterećene organskim tvarima i ako nastaje velika količina otpadne vode u kratkom vremenu. Tehnološke otpadne vode nastaju tijekom različitih tehnoloških postupaka kao i pomoćnih operacija (hlađenje, transport sirovina, uklanjanje otpadaka i sl.), čija kakvoća ovisi o sirovinama koje se upotrebljavaju u proizvodnom procesu i dobivenom proizvodu. Prema vrsti zagađenja tehnološke otpadne vode dijele se na otpadne vode koje pretežno sadrže neorganske ili organske tvari, te biološki teže ili lakše razgradive. Za pročišćavanje potrebno je primijeniti sljedeće postupke: mehanički predtretman, fizikalno-kemijski tretman, biološki tretman te dehidracija mulja.

TREATMENT OF TECHNOLOGICAL WASTEWATER FROM FOOD INDUSTRY ON A REALIZED WWTP IN DAIRY INDUSTRY

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Technological (industrial) waste water needs to be pre-treated before coming to a common municipal waste water treatment plant. The need for prior purification of industrial waste water is a result of its special composition, and dynamics of uneven discharge. Load reduction, as well as its equalization during the day is particularly important where the effluent is heavily loaded with organic material and if there is a greater amount of waste water in a short time. Technological waste water are generated during various technological processes and auxiliary operations (cooling, transportation of raw materials, waste disposal, etc.), whose quality depends on the raw materials used in the production process and the resulting product. According to the type of pollution, industrial waste water are divided into waste water that mostly contain inorganic or organic matter, and biological harder or easier degradable. For the treatment it is necessary to apply the following procedures: mechanical pre-treatment, physical-chemical treatment, biological treatment and sludge dehydration.

OPTIMIRANJE KOAGULACIJSKE PREDOBRADE SIROVE BUNARSKE VODE BOGATE PRIRODNIM ORGANSKIM TVARIMA

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U ovom radu istražen je postupak optimiranja modificirane koagulacije pomoću faktorskog plana pokusa i metode odzivne površine na uzorcima sirove podzemne vode iz okolice Županje. Ispitan je utjecaj pH vrijednosti i doze željezovog klorida na sadržaj otopljenog organskog ugljika (engl. *dissolved organic carbon – DOC*) kao surogatne mjere za sadržaj prirodnih organskih tvari (engl. *natural organic matter – NOM*) u vodi. Učinkovitost uklanjanja NOM-a analizirana je pomoću programskog paketa *Design Expert*. Analiza dobivene odzivne površine ukazuje na postojanje područja maksimalnog uklanjanja DOC-a koje se nalazi u zoni inicijalne vrijednosti pH od oko 5,0 i pri višim ispitivanim dozama željezovog klorida.

OPTIMIZATION OF COAGULATION PRETREATMENT OF RAW GROUNDWATER RICH IN NATURAL ORGANIC MATTER

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A bench-scale study was conducted to evaluate the effectiveness of enhanced coagulation using full factorial design of experiment and response surface methodology. The jar tests were performed on raw groundwater samples from the surroundings of Županja, Croatia. The effect of initial pH and ferric chloride dose on dissolved organic carbon (DOC) removal, as a surrogate measure for natural organic matter (NOM), was investigated without the addition of a flocculant aid. The NOM removal efficiency was analyzed using Design Expert software. The analysis of response surface indicates the existence of the region of maximum DOC removal, which is located about the initial pH of 5.0 and at higher ferric chloride doses tested.

FOTOLITIČKA I FOTOKATALITIČKA RAZGRADNJA FARMACEUTIKA

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Farmaceutici su raznolika grupa organskih spojeva koji se koriste u liječenju i prevenciji bolesti kod ljudi i životinja. Međutim, imaju i potencijalni negativni učinak na ne-ciljane žive organizme s obzirom da su dizajnirani da budu biološki aktivni. Iako su u okolišu prisutni u vrlo niskim koncentracijama, napredak analitičkih metoda tijekom posljednjih desetljeća rezultirao je njihovom učestalom detekcijom u okolišu i posljedično tome podizanjem svijesti u znanstvenoj zajednici i društvu općenito o ovoj problematici.

Farmaceutici se unose u okoliš putem izlučevina, nepropisnim odlaganjem neupotrijebljenih farmaceutika ili farmaceutika kojima je istekao rok trajanja te primjenom u akvakulturi kao dodatci prehrani čime se direktno unose u vodu. Nepotpuno uklanjanje u postojećim postrojenjima utvrđeno je u brojnim istraživanjima ukazujući na potrebu njihove nadogradnje i implementacije naprednije tehnologije za obradu otpadnih voda.

U ovom radu pokazano je da fotokemijski napredni oksidacijski procesi – fotoliza i heterogena fotokataliza s TiO_2 kao fotokatalizatorom – imaju veliki potencijal za razgradnju farmaceutika do razine njihovog potpunog uklanjanja iz voda. Prikazani su i uspoređeni rezultati fotolitičke i fotokatalitičke razgradnje tri farmaceutika iz različitih grupa: sulfametazin, febantel i prazikvantel.

PHOTOLYTIC AND PHOTOCATALYTIC DEGRADATION OF PHARAMCEUTICALS

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Pharmaceuticals are highly diverse group of chemicals used in treatment and prevention of diseases in humans and animals. However, pharmaceuticals have the potential to negatively affect non-target living organisms, since they are designed to be biologically active. Although they are present in the environment in very low concentrations (ng/L), the advances of different analytical methodologies during the last decades have demonstrated the widespread occurrence of these compounds in the environment, leading to an arising social and scientific awareness.
Pharmaceuticals can enter the environment by human or animal excreta, disposal of unused pharmaceuticals or by direct application in aquaculture.Many studies showed that the main point of collection and subsequent release of pharmaceuticals into the environment are wastewater treatment plants (WWTPs), suggesting that their upgrade and implementation of advanced treatment technologies are required.
In this work it was shown that photochemical advanced oxidation processes – photolysis and heterogeneous photocatalysis using TiO_2 as photocataslyst– have a great potential for degradation of pharmaceuticals to the level of complete removal from the wastewater. Results of photolytic and photocatalytic degradation of three pharmaceuticals (sulfamethazin, febantel and praziquantel) from different groups were presented.

DEZINFEKCIJA U SUSTAVIMA JAVNE VODOOPSKRBE

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U Hrvatskoj je oko 80 % stanovništva priključeno na javnu vodoopskrbu, dok ostali dio koristi vodu iz individualnih izvora. Zdravstvena ispravnost i nadzor nad vodom za piće su regulirani, a obavljaju ga sanitarna inspekcija i ovlašteni laboratoriji. Obradom sirove vode iz izvora (vodozahvata) različitim postupcima za pročišćavanje, voda postaje pogodnom za piće. U praksi priprava vode za piće (kondicioniranje) najčešće obuhvaća taloženje, koagulaciju/flokulaciju, filtraciju i dezinfekciju, a potrebno ju je provoditi na način da tako pripremljena voda ne predstavlja opasnost po ljudsko zdravlje.
Osnovni tehnološki postupak u svakom sustavu kondicioniranja vode je dezinfekcija. Dezinfekcija se može obavljati različitim kemijskim sredstvima ili fizikalnim postupcima, a danas najzastupljenija metoda je - primjena klora. Budući da kloriranje vode osim pozitivnih, ima i negativne učinke po ljudsko zdravlje, postupak dezinfekcije potrebno je prilagođavati pojedinačnim sustavima uz moguće korištenje i kombiniranih postupaka dezinfekcije. Time bi se osigurao široki raspon djelovanja na patogene organizme uz što manji potrošak kemijskih sredstava te što manju produkciju štetnih dezinfekcijskih nusprodukata. Stoga se uobičajena hrvatska praksa primjene isključivo kemijske dezinfekcije, oslanjajući se uglavnom na sadržaj reziduala klora kao dokaza dezinfekcijskog učinka, treba postupno mijenjati prateći pozitivna iskustva europskih zemalja.

DISINFECTION OF PUBLIC WATER SUPPLY

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About 80% of the population in Croatia is connected to the public water supply, while the rest use water from individual sources. Health safety and sanitary control of drinking water are regulated and carried out by sanitary inspection and authorized laboratories. Through the treatment of raw water from the source (water intake) with various technological steps water becomes suitable for drinking purposes. In practice, the preparation of drinking water (conditioning) usually involves processes of coagulation/flocculation, sedimentation, filtration and disinfection, and they have to be implemented in a sequence that ensures the use of such treated water without any risk to human health.
The basic technological process in any system of drinking water conditioning is a process of disinfection. It can be performed by different chemical or physical processes, but today the most common method is the application of chlorine. Since the chlorination of water is characterized by positive and negative effects on human health, the disinfection procedure is necessary to adapt to the individual systems with possible use of the combined methods of disinfection. That could enable a wide range of effects on pathogenic organisms with the minimum consumption of chemicals and as low production of harmful disinfection byproducts as possible. Therefore, the common practice of applying solely chemical disinfection in Croatia, relying mainly on the content of residual chlorine as a proof of disinfection effect, should be gradually changed following the positive experience of European countries.

KINETIKA SORPCIJE IONSKOG BOJILA IZ VODENE OTOPINE NA LEBDEĆEM PEPELU BIOMASE

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U ovom radu ispitana je mogućnost primjene lebdećeg pepela biomase za uklanjanje ionskog, toksičnog i kancerogenog diazo bojila (kongo crvene) iz vodene otopine. Lebdeći pepeo biomase je nusprodukt dobiven izgaranjem miješane drvene biomase u kogeneracijskom postrojenju u Udbini, Hrvatska. U šaržnim uvjetima ispitano je uklanjanje bojila kongo crvene uporabom lebdećeg pepela biomase variranjem početne koncentracije bojila (10–80 mg/L) i vremena kontakta (0–240 min). Eksperimentalni kinetički podatci za tri početne koncentracije bojila kongo crvene (20, 40 i 60 mg/L) obrađeni su pomoću sljedećih kinetičkih modela: Lagergrenov model pseudo-prvog reda, Hoov model pseudo-drugog reda i Weber–Morris model unutarčestične difuzije. Utvrđeno je da sorpcija slijedi kinetički model pseudo-drugog reda.

SORPTION KINETICS OF IONIC DYE FROM AQUEOUS SOLUTION ON BIOMASS FLY ASH

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The objective of this work was to examine possible application of biomass fly ash for removal of ionic, toxic and cancerogenic diazo dye (Congo red) from aqueous solutions. Biomass fly ash is byproduct generated during mixed wood biomass combustion in 1 MW electric power facility in Udbina, Croatia. Batch sorption experiments were carried out to evaluate the influence of experimental parameters such as initial dye concentration (10–80 mg/L) and contact time (0–240 min) on the sorption process.
The kinetic experimental data at different initial Congo red concentrations (20, 40 and 60 mg/L) were fitted by Lagergren's pseudo-first order, Ho's pseudo-second-order and Weber–Morris intra-particle diffusion equations. Results of the kinetic studies showed that sorption of Congo red dye onto biomass fly ash was best described by the pseudo-second-order kinetic model.

POTENCIOMETRIJSKI SENZOR ZA TENZIDE BAZIRAN NA UGLJIKOVIM NANOČESTICAMA ZA MONITORING INDUSTRIJSKIH VODA

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U radu je karakteriziran novi, jednostavan, osjetljivi, točan i jeftin *solid state* senzor za tenzide, baziran na višestjenčanim ugljikovim nanočesticama i ionskom paru tenzida. Određene su slijedeće karakteristike senzora: odgovor, dinamički odgovor, interferencije, pH ovisnost i stabilnost. Senzor je korišten za određivanje završne točke potenciometrijske titracije niskih koncentracija anionskih tenzida u industrijskim vodama. Kao titrant uspješno su se koristile otopine cetrimonijevog bromida (CTAB), pri koncentracijama do $4x10^{-5}$ M. Rezultati su uspoređeni sa standardnom spektrofotometrijskom metodom Methylene Blue Active Substances (MBAS) i tenzidnom PVC elektrodom. Rezultati su pokazali zadovoljavajuće slaganje.

CARBON NANOTUBES BASED POTENTIOMETRIC SURFACTANT SENSOR FOR INDUSTRIAL EFFLUENTS DETERMINATION

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A new, simple, sensitive, accurate and inexpensive solid state surfactant sensor, based on multiwall carbon nanotubes and surfactant ion-pair, was characterized. Sensor characteristics were determinated – response, dynamic response, interferences, pH dependence and stability. The sensor was used for end-point detection during the potentiometric titrations of low levels of anionic surfactants in industrial effluents. Solutions of cetrimonium bromide (CTAB) at concentrations as low as $5x10^{-5}$ M were successfully used as a titrant. The results were compared with a standard spectrophotometric Methylene Blue Active Substances (MBAS) method, and a PVC based surfactant electrode. The results indicated a satisfactory correlation.

RAZVOJ EKOTURIZMA NA PODRUČJU DRAVE I DUNAVA

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Hrvatske vode su sa svojim partnerima putem IPA programa prekogranične suradnje 2007-2013 provele četiri projekta kojim su se obnovile i modernizirale krune nasipa vodnog područja donje Drave i Dunava. Projektima se obuhvatilo oko 50 km nasipa, a radovi su ukupne vrijednosti cca 3.000.000,00 EUR. Poseban naglasak stavljen je na ekološku obnovu i modernizaciju kruna nasipa koji se nalaze unutar područja Kopačkog Rita gdje su se radovi izveli za okoliš prihvatljivom metodom hladne reciklaže gdje se minimalno smanjuju tragovi na pejsažu prilikom izvođenja radova. Modernizirane krune usporavaju dnevnu potrošnju nasipa i osiguravaju bolju mobilnost sudionika u obrani od poplava. Predviđeni radovi na nasipu će produljiti trajnost i stabilnost nasipa, a održavanje će biti lakše i jeftinije, jer nasipi su prvenstveno namijenjeni obrani od poplava, a time i održavanje nasipa spada u kategoriju velike važnosti.
U navedenim projektima, osim važnih i potrebnih aktivnosti poboljšanja infrastrukture kroz modernizaciju kruna nasipa te razgranatost i povezivanje kapilarnih biciklističkih ruta, istaknuta je važnost razvoja cikloturizma na području velikih rijeka.
Nova infrastruktura bit će korištena za trčanje, šetnju, biciklizam te vožnju turističkog vlaka u organizaciji Parka prirode Kopački rit.

DRAVA&DANUBE ECOTOURISM GROWTH

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Hrvatske vode with project partners have implemented four projects in the frame of IPA Cross-Border Cooperation Programme 2007-2013, by which the crests of the Drava and Danube floodplain dikes have been restored and modernized. About 50 km of dike crests, with the total value of construction works of about 3.000.000,00 EUR, were encompassed by these projects. Particular emphasis refers to ecological restoration and modernization of the dike crest located within the area of Kopački Rit, where the work was carried out in an environmentally sound method of cold recycling, with reduced landscape changes during construction works. Modernized crests slow down daily wearing of dikes and ensure better mobility of participants during flood defense. The works on the dike will extend the durability and stability of it, and maintenance will be easier and cheaper, because dikes are primarily designed for flood control, thus their maintenance is of great importance. In these projects, in addition to the important and necessary actions to improve infrastructure through modernization of the dike crests and the enabling the widespread network and capillary bike routes connection, cycling tourism development in the areas of large rivers is very important. The new infrastructure will be used for running, walking, biking and riding the tourist train organized by Nature Park Kopački Rit.

STRUKTURA I RAZVOJ ZAJEDNICE TREPETLJIKAŠA PERIFITONA NA UMJETNOJ PODLOZI U SAKADAŠKOM JEZERU (POPLAVNO PODRUČJE KOPAČKOG RITA)

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Perifiton (obraštaj) je složena zajednica autotrofnih i heterotrofnih organizama te detritusa prisutna na različitim tipovima podloga u svim vodenim staništima, od oligotrofnih do distrofnih. U vodenim ekosustavima perifiton ima iznimno važnu ulogu u primarnoj proizvodnji i kruženju nutrijenata, izvrstan je pokazatelj promjena ekološkog stanja, važan je izvor hrane za različite skupine beskralježnjaka i ribe, te povećava raznolikost dostupnih staništa za vodene organizme. Perifiton se vrlo brzo počinje formirati na uronjenim podlogama, a praživotinje se ubrajaju među prve kolonizatore novih podloga. Trepetljikaši predstavljaju važnu komponentu perifitonskih zajednica kao jedni od glavnih konzumenata bakterija i algi u obraštaju, te učinkovito povezuju niže i više trofičke razine. U perifitonu umjetne podloge u Sakadaškom jezeru, tijekom istraživanja provedenog od travnja do prosinca 2009. godine, utvrđena je velika brojnost i raznolikost zajednice trepetljikaša. Najzastupljenije su bile skupine Peritrichida, Suctorida i Heterotrichida. Razvoj zajednice se odvijao u tri faze, uključujući inicijalnu kolonizaciju i prijelaznu fazu u kojima su dominirale pokretne pionirske bakteriovorne i algivorne vrste, te zrelu kasnu fazu karakteriziranu sjedilačkim filtratorima i predatorima. Abiotički čimbenici imali su veći utjecaj na zajednicu tijekom primarne kolonizacije, dok su dostupnost hrane i struktura perifitona bili značajni u kasnijim stadijima razvoja zajednice.

STRUCTURE AND DEVELOPMENT OF PERIPHYTIC CILIATE COMMUNITY ON ARTIFICIAL SUBSTRATA IN SAKADAŠ LAKE (FLOODPLAIN KOPAČKI RIT)

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Periphyton is a complex community of autotrophic and heterotrophic organisms, including detritus, present on different types of substrata in all aquatic environments, from oligotrophic to dystrophic. In aquatic ecosystems, periphyton plays immensely important role in primary production and nutrient cycling, it is an excellent indicator of ecological changes, it represents an important food source for different invertebrates and fish, and it increases habitat availability. Development of periphyton on immersed substrata is rapid, and Protozoa are among the first colonizers of newly exposed surfaces. Ciliates are important component of periphyton communities, since they represent one of the main consumers of bacteria and algae, and efficiently connect lower and higher trophic levels. In periphyton developed on artificial substrata exposed in the Sakadaš Lake from April to December 2009, a highly abundant and diverse ciliate community was found. Ciliates from the orders Peritrichida, Suctorida and Heterotrichida were the most abundant. Three phases during community development were determined. The motile pioneer bacterivorous-algivorous species dominated throughout the initial and intermediate phase, while the mature phase was characterized by sessile filtrators and predators. The primary colonization was mainly influenced by the abiotic factors, whereas food availability and periphyton structure were significant for the mature ciliate community.

Posterska priopćenja / *Poster presentations*

REMOVAL OF Ni(II) IONS FROM AQUEOUS SOLUTIONS BY NATURAL PEANUT HUSKS

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The rapid industrial development and urbanization have intensified environmental pollution and caused deterioration of eco-systems by accumulation of many pollutants, especially heavy metals. Most of the heavy metals are toxic and their ions are not biodegradable with the tendency to accumulate in the soil, water resources and the living organisms, hence they are significant environmental pollutants. Therefore, the treatment of the heavy metal ions and their elimination from water and wastewater is very important for environmental protection, and thus the public health. In this work, natural peanut husks, that represent an agcricultural waste, was investigated as potential sorbent for the removal of Ni(II) ions from aqueous solutions. The adsorption experiment was carried out at constant temperature and pH for different initial metal ion concentrations. Langmuir and Freundlich isotherm models were used to study the obtained equilibrium data. The maximal adsorption capacity of the peanut husks for Ni(II) was obtained and the percentage of removal was determined. The results reported that peanut husks has the potential to be used as low-cost agricultural by-product for removal of Ni(II) from contaminated waters.

THE POSSIBILITY OF EM TECHNOLOGY APPLICATION IN THE WASTEWATER TREATMENT

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The technology of effective microorganisms (EM technology) may have a number of applications, including agriculture, livestock, gardening and landscaping, composting, bioremediation, cleaning septic tanks, algal control, household uses and treatment of wastewater sewage. Organic materials within wastewater originate from plants, animals or synthetic organic compounds, and enter wastewater via a number of routes including human wastes, detergents, and industrial sources . In the current wastewater treatment process microorganisms play a significant role in the treatment of domestic sewage. Many different organisms live within the wastewater itself, assisting in the breakdown of certain organic pollutants. Microorganisms play a significant role in the decomposition of organic wastes, however, some microorganisms can cause health concerns to humans. This study examines the level of microbiological contamination of household waste water before and after treatment by effective mikroorganisms. The results of treatment demonstrated significant difference in presents and number of various microbiological species.

MODELING OF THE PROCESS OF REMOVAL OF ARSENITES AND ARSENATES FROM AQUEOUS SOLUTIONS IN A FIXED BED COLUMN SYSTEM

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Two commercially available adsorbents, white tuff from Strmosh region and a material with a commercial name Zeofit obtained from Kriva Palanka region, were investigated as possible raw materials for adsorption of arsenites and arsenates from aqueous solutions. These raw materials were modified through chemical insertion of iron within the basic material structure and ionic substitution of calcium and magnesium ions with sodium ions in order to improve the sorptive and ion-exchange properties of studied raw materials.
The experimental investigation was performed on an industrial scale pilot plant equipped with a fixed bed column. This system was specifically designed for the purpose of removal of arsenites and arsenates from model solutions. Investigated raw materials produced different results regarding the removal efficiency of the studied adsorption process. The white tuff material from the Strmos region produced adequate selectivity and sufficient adsorption capacity towards arsenic, while the Zeofit material from Kriva Palanka region generated lower adsorption capacity. On the other hand, the Zeofit material showed ion-exchange properties towards the macro elements present in the model solutions.
Drinking water from the water supply system in Skopje was used for preparation of the studied arsenic ions solutions.

UTJECAJ PADALINA NA POJAVNOST MIKOTOKSINA U HRVATSKIM ŽITARICAMA U PERIODU 2012-2015

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Posljednjih godina velika je pažnja posvećena mikotoksinima, odnosno sekundarnim produktima metabolizma plijesni koji su pokazali toksično djelovanje na ljude i druge životinje. Klimatske promjene jedan su od glavnih uzroka promjene pojavnosti mikotoksina diljem svijeta. Osim povećanja temperature zraka te količine CO_2, važnu ulogu za razvoj plijesni igra količina oborina. O količini, vrsti i intenzitetu oborina ovisi koji će se tip plijesni najviše razvijati, a time i mikotoksini. Manja količina oborina, odnosno suša, pogoduju razvoju plijesni iz roda Aspergillus koje su odgovorne za produkciju aflatoksina. U Hrvatskoj je 2012. i 2013. godine zabilježen porast količine aflatoksina u kukuruzu upravo iz razloga što je za vrijeme cvatnje kukuruza, kada je najveća osjetljivost i mogućnost kontaminacije plijesnima, količina oborina bila znatno ispod prosjeka. Dijelovi Hrvatske koji su najveći proizvođači bili su pogođeni ekstremnom sušom. S druge strane, velika vlažnost i povećana količina oborina za vrijeme cvatnje žitarica, kao i tijekom žetve, znatno utječe na razvoj plijesni roda Fusarium koje proizvode mikotoksine iz skupine trihotecena poput deoksinivalenola (DON), T-2 i HT-2 toksina, a uz njih i zearalenon, fumonozine i druge. Scenarij s povišenim količinama oborina dogodio se 2014. godine kada je zabilježen porast koncentracije DON-a u žitaricama.

EFFECT OF RAINFALL ON OCCURRENCE OF MYCOTOXINS IN CROATIA DURING 2012-2015

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Recent years have seen a lot of attention given to mycotoxins, secondary metabolites of molds with toxic effects in humans and other animals. Climate change is one of the main causes of changes in worldwide occurrence of mycotoxins. In addition to increases of temperature and CO_2 levels, rainfall is one of the main factors that affect mould growth. Timing, amount, type and intensity of rainfall influence which moulds will develop on crops, in turn deciding the composition of produced mycotoxins. Dry weather conditions favor growth of Aspergillus species, mainly responsible for aflatoxin production. Increased aflatoxin occurrence was observed in Croatia during 2012 and 2013 due to the below average rainfall during flowering of maize, a period when it is most susceptible to mold contamination. Croatian regions which are the greatest producers of maize were stricken by severe drought. Conversely, higher humidity and rainfall during flowering of cereals and harvesting season escalate occurrence of Fusarium species, known producers of trichothecene mycotoxins such as deoxynivalenol (DON), T-2 & HT-2 toxins, as well as zearalenone, fumonisins, etc. This scenario with increased rainfall and DON occurrence in cereals was recorded during 2014.

MONITORING KVALITETE PITKE VODE NA PODRUČJU OPĆINE ZAVIDOVIĆI – BiH

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Kvalitet vode za piće moguće je osigurati kombinacijom zaštite izvorišta, primjenom odgovarajuće tehnologije pripreme vode za piće i optimalnim upravljanjem sistemom snabdijevanja. Kvalitet usluge snabdijevanja pitkom vodom je od vitalnog značaja ne samo zbog snabdijevanje stanovništva pitkom vodom, neophodnom za život, nego i zbog činjenice da ovim putem može doći i do distribucije različitih štetnih i opasnih materija i mikroorganizama, što bi ugrozilo zdravlje stanovništva. Iz tog razloga, snabdijevanje stanovništva higijenski ispravnom (zdravstveno sigurnom) pitkom vodom je primarna obaveza svakog društvenog sistema.

Primarni cilj ovog rada je sagledavanje stanja snabdijevanja pitkom vodom na području općine Zavidovići, Bosna i Hercegovina (BiH), u periodu od 2012-2015.godine. U radu je dat opis snabdijevanja pitkom vodom općenito, opisana su izvorišta i njihove lokacije, stanje vodoobjekata i obezbjeđenje uvjeta za očuvanje kvalitete pitke vode. Osim toga, analizirani su rezultati fizikalno-hemijskih i mikrobioloških kontrola pitke vode, na izvorištu, te na odabranim potrošačkim mjestima u sistemu za snabdijevanje. Nakon provedenog monitoringa, date su mjere zaštite kvaliteta pitke vode u smislu osiguranja higijenske ispravnosti pitke vode u sistemu vodosnabdijevanja.

MONITORING THE QUALITY OF DRINKING WATER IN THE MUNICIPALITY ZAVIDOVICI – B&H

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The quality of drinking water can be provided by a combination of source protection, use of appropriate technology of drinking water treatment and optimum management of system. Service quality of drinking water is vital, not only for supplying the population with drinking water, essential for life, but also because in this way can lead to the distribution of harmful and hazardous substances and micro-organisms, which is harmful to health of population. For this reason, the supply of the population with safe drinking water is a primary obligation of every social system.
The primary objective of this study is to assess the state of drinking water supply in the municipality of Zavidovici, Bosnia and Herzegovina (BiH), in the period of 2012-2015. The paper gives a description of the drinking water supply in general, described the sources and their location, condition of facilities and the provision of conditions for the preservation of the quality of drinking water. In addition, analyzed the results of physico-chemical and microbiological control of drinking water at the source, and selected consumer places in the system for the supply. After conducting the monitoring, provides measures to protect drinking water quality in terms of security of hygienic quality of drinking water supply systems.

IDENTIFIKACIJA POTENCIJALNIH PROBLEMA PRILIKOM DEFINIRANJA MJERA SMANJENJA GUBITAKA U VODOOPSKRBNIM SUSTAVIMA

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Provedba mjera smanjenja gubitaka u vodoopskrbnim sustavima postala je jedna od glavnih aktivnosti isporučitelja vodnih usluga (IVU) u Republici Hrvatskoj (RH). Korištenjem europskih fondova (EF), omogućile su se investicije u programe smanjenja gubitaka sa visokim stupnjem sufinanciranja Europske unije. Za provedbu takvih programa potrebne su detaljne analize postojećeg stanja uz dijagnosticiranje problema na vodoopskrbnim sustavima te identifikaciju uzroka tih problema. Metode analize stanja pojedinog sustava te provedbe mjera smanjenja gubitaka, aktualizirane su posljednjih godina na svim stručnim skupovima sa ovom tematikom te su i u RH napisani mnogi radovi na tu temu.

Autor ovoga rada će se osvrnuti na fazu pripreme investicija te pokazati koji sve faktori utječu na konačno definiranje investicija. Ovim radom će se prikazati pojedini direktni i indirektni učinci pri provedbi mjera smanjenja gubitaka te pokazati potrebitost dodatnih ekonomskih analiza prilikom definiranja tih mjera. U radu će se na praktičnim primjerima pokazati da investicije u mjere smanjenja gubitaka trebaju biti održive u smislu povrata investicije odnosno trebaju utjecati na smanjenje, a ne povećanje operativnog troška IVU-a. Rad će na nekoliko praktičnih primjera pokazati tehno-ekonomske metode optimizacije investicija te ukazati na potencijalne probleme koji se pojavljuju nakon implementacije pojedinih mjera.

IDENTIFICATION OF POTENTIAL PROBLEMS DURING PRE-INVESTMENT ANALYSIS OF LEAKAGE REDUCTION IN WATER SUPPLY SYSTEMS

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Water leakage reduction in water supply systems became one of the main activities for water companies in Croatia. Availability of European Union funds opened possibility for investment in water leakage reduction programs with high level of EU co-financing. Implementation of these programs requires detailed analysis of the current situation with diagnosis of problems and its causes within water supply systems. Methods for analysis of water systems and leakage reduction measures implementation are actualized during recent years in all professional conferences on this topic in Croatia with many papers written on this subject.

The author of this paper will look at the pre-investment phase and show some of the factors affecting the final definition of investment. This paper will show certain direct and indirect effects of the implementation of measures in leakage reduction and show the necessity of additional economic analysis in defining those measures. The work will show on practical examples that those measures should be sustainable in terms of investment return respectively influencing decrease and not increase of the operating costs. The work will demonstrate some of the techno-economic methods of optimizing investment and point to potential problems that occur after the implementation of certain measures.

DEFLUORIZACIJA VODE AKTIVNIM UGLJENOM

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Povišene koncentracije fluorida u vodi za piće predstavljaju globalni zdravstveni problem budući da više od 250 milijuna ljudi diljem svijeta konzumira vodu u kojoj koncentracija fluorida prelazi 1,5 mg/L što je prema preporuci Svjetske zdravstvene organizacije te Pravilniku o parametrima sukladnosti i metodama analize vode za ljudsku potrošnju maksimalno dopuštena koncentracija fluorida u vodi za piće. Navedeni problem posebno je izražen u nerazvijenim zemljama, međutim ne zaobilazi ni industrijski razvijene zemlje.

Aktivni ugljen je najčešće korišten adsorbens za pročišćavanje voda zbog mogućnosti učinkovitog uklanjanja različitih organskih i anorganskih onečišćenja iz vode, a mnoga istraživanja pokazuju da se adsorpcijski kapaciteti pojednih aktivnih ugljena dodatno mogu povećati provedbom različitih modifikacija kojima se mijenja struktura aktivne površine čime se povećava njegov adsorpcijski kapacitet.

Cilj ovoga rada je detaljno prikazati mogućnost i učinkovitost upotrebe pojedinih vrsta aktivnog ugljena kao adsorbensa za uklanjanje povišenih koncentracija fluorida iz vode za piće.

DEFLUORIDATION OF WATER BY ACTIVATED CARBON

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Increased fluoride concentration in drinking water presents a global health problem since over 250 million people around the globe consumes drinking water with fluoride concentration higher than 1.5 mg/L, which is maximum permissible concentration of fluoride in drinking water according to World Health Organization and Croatian legislative on water for human consumption. This problem is present in undeveloped countries as well as in industrially developed countries.
Activated carbon is often used as adsorbent for water purification due to its effective removal of various organic and inorganic contaminants from water. Many studies shown that adsorption capacities of activated carbons are improved under certain modifications conducted in order to change its surface structure and to increase its adsorption capacities. The aim of this paper is to present the possibility and efficiencies of various activated carbon types as adsorbents for effective fluoride removal from drinking water.

TOKSIČNI ORGANSKI ONEČIŠĆIVAČI U VODI

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Onečišćenje voda jedan je od najvećih globalnih problema današnjice. Suočeni smo s velikim brojem novosintetiziranih organskih spojeva nastalih u različitim znanstvenim i industrijskim laboratorijima. Velik je broj sintetskih organskih spojeva za koje se zna da izazivaju toksične, karcinogene, mutagene i teratogene učinke. Još je veći broj spojeva, osobito onih koji nisu u svakodnevnoj uporabi, čiji učinci nisu poznati, a mnogi neće biti istraženi ako ne izazovu neki vidljiv i mjerljiv štetan učinak. U radu je dan pregled nekih od najtoksičnijih organskih spojeva koji mogu iz različitih izvora onečistiti vodu. Najpoznatiji organski toksikanti koji onečišćuju vodu porijeklom iz industrijskog otpada i prirodnog okoliša su organoklorovi spojevi kojima pripadaju organoklorovi pesticidi, poliklorirani bifenili te poliklorirani dibenzo-*p*-dioksini i poliklorirani benzofurani. Raspodjela i životni vijek organskih mikrozagađivala određeni su njihovim fizičko-kemijskim svojstvima. U radu su iznesene najveće dopuštene koncentracije pojedinih opasnih kemijskih tvari u kopnenim vodama i moru. Opisani su i mogući fizikalno-kemijski postupci koji se rabe za čišćenje podzemnih voda od navedenih organskih onečišćivača.

TOXIC ORGANIC POLLUTANTS IN WATER

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Water pollution is one of the biggest global problems today. We are faced with a large number of newly synthesized organic compounds generated in a variety of scientific and industrial laboratories. A large number of the known synthetic organic compounds cause toxic, carcinogenic, mutagenic and teratogenic effects. There is even a greater number of compounds, used on a daily basis with unknown effects, that will not be investigated unless they cause a visible and measurable effect. This paper presents an overview of some of the most toxic organic compounds which can contaminate water from different sources. The best known organic pollutants originating from industrial waste and the natural environment are organochlorine compounds which belong to organochlorine pesticides, polychlorinated biphenyls, and polychlorinated dibenzo-*p*-dioxins and polychlorinated benzofurans. Distribution and lifetime of organic micropollutants are determined by their physical-chemical properties. The paper presents the maximum permitted concentrations of certain hazardous chemicals in inland waters and the sea. Finally, possible physical and chemical processes used for cleaning the groundwater from the above mentioned contaminants are presented.

BROJ DOMAĆINSTAVA PRIKLJUČENIH NA JAVNI VODOOPSKRBNI SUSTAV NA PODRUČJU GRADA NOVA GRADIŠKA I PRIPADAJUĆIH SEOSKIH OPĆINA

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Voda je neophodna za ljudski život, ali nažalost veliki broj ljudi u svijetu još uvijek nema mogućnost opskrbe pitkom vodom. Dostupnost pitke vode i kvaliteta njene opskrbe jedan je od osnovnih uvjeta za zdravlje građana i ima važan utjecaj na ljudsko zdravlje zbog pojave bolesti koje su povezane s nedostatkom vode ili s opskrbom vode koja nije odgovarajuće kvalitete.
Cilj ovoga rada je prikazati broj domaćinstava priključenih na javni vodoopskrbni sustav na području grada Nova Gradiška i pripadajućih seoskih općina.
Podaci su dobiveni od pravnih osoba koji na novogradiškom području obavljaju djelatnost javne vodoopskrbe: Slavča d.o.o. Nova Gradiška i Regionalni vodovod Davor-Nova Gradiška d.o.o.
Podaci su uspoređeni s podacima za Republiku Hrvatsku i za Brodsko-posavsku županiju.
Procjenjuje se da je u Republici Hrvatskoj na javnu vodoopskrbu priključeno 87,7 % stanovništva, a u Brodsko-posavskoj županiji 75,6 % stanovništva.
Dobiveni rezultati pokazuju da je na novogradiškom području koje uključuje grad Novu Gradišku i 10 seoskih općina broj domaćinstava koji su priključeni na javnu vodoopskrbu ispod prosjeka Republike Hrvatske i ispod prosjeka Brodsko-posavske županije i iznosi 55,7 %.

THE NUMBER OF HOUSEHOLDS CONNECTED TO PUBLIC WATER SUPPLY SYSTEM IN NOVA GRADISKA AREA AND SURROUNDING DISTRICTS

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Water is essential for human life, but unfortunately a great number of people in the world still does not have the possibility of supply with drinking water. The availability of drinking water and quality of its supply is one of the basic conditions for the health of citizens and has a significant impact on human health due to the occurrence of diseases associated with a lack of water or with a water supply which is not of adequate quality.
The aim of this paper is to show the number of households connected to the public water supply system in the area of Nova Gradiska and the associated rural communities.
Data were obtained from legal entities that perform the activity of public water supply in the areea of Nova Gradiška: Slavča Ltd. Nova Gradiska and Regional water supply system Davor-Nova Gradiska Ltd.
The obtained data are compared with data for the Republic of Croatia and the Brod-Posavina County. It is estimated that 87.7% of the population in Croatia and 75.6% of the population in the Brod-Posavina County is connected to the public water supply
The results show that the number of households connected to the public water supply in the Novogradiška area (includes the town of Nova Gradiska and 10 rural municipalities) is below the Croatian average and below average Brod-Posavina County and amounts to 55.7%.

ICP-MS DETERMINATIONS OF THALLIUM AND URANIUM IN WATER AND URINE SAMPLES (EASTERN CROATIA)

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Drinking water in eastern Croatia contains high levels of elements such as arsenic manganese and iron. However, there is lack of data about concentrations of thallium and uranium, since the drinking water from five observed sites has never been chemically analysed in such detail. Using inductively coupled plasma mass spectrometry (ICP-MS) we analysed the concentrations of uranium and thallium in 71 samples from three villages (Vladislavci, Dalj and Čepin) and two towns (Osijek and Našice). The rules on the safety of drinking water in Croatia do not define standard values for thallium and uranium, however USEPA set 2 μg L^{-1} as the maximum contaminant level for thallium. Our results have shown that there is no danger for population in all five communities, since the thallium concentrations were very low ($1x10^{-4}$ – 6,8 $x10^{-3}$ μg L^{-1}). In all five communities the mean concentrations of uranium in drinking water was significantly lower than 30 μg L^{-1}, which is WHO guideline value for uranium in drinking water. Mean uranium concentrations in drinking water samples varied from 0,001 to 4,25 μg L^{-1}. Additionally, in our study thallium and uranium concentrations were determined in 391 urine samples. This study seems to have found relationship between concentrations of uranium in drinking water and uranium concentrations in urine samples only for Čepin area (r_s= 0,63, p<0,05).

ODRŽIVO GOSPODARENJE OTPADOM U POSTROJENJU ZA PROČIŠĆAVANJE OTPADNIH VODA

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Otpadne vode, koje nastaju svakodnevnim korištenjem vode u komunalnim zajednicama te industrijskim objektima, opterećene su različitim onečišćujućim tvarima. Izdvajanjem i uklanjanjem navedenih tvari u sustavima za pročišćavanje otpadnih voda (pročistačima) dobiva se pročišćena voda, kao i određena količina koncentriranog onečišćenja koje je bilo sadržano u onečišćenim otpadnim vodama. Takvo koncentrirano onečišćenje predstavlja otpad, s kojim se na mjestu njegovog nastanka mora postupati sukladno mjerodavnom Zakonu o održivom gospodarenju otpadom te pripadajućim propisima (uredbe i pravilnici), izrađenim na temelju istog zakona. Budući da se pročišćavanjem otpadne vode u pročistaču može izdvojiti više vrsta onečišćenja, koje je moguće kategorizirati kao različiti opasni i neopasni otpad, odgovorno gospodarenje istima, u smislu njihovog neškodljivog zbrinjavanja, mora biti provedeno na stručan i okolišno prihvatljiv način.

U radu se analizira održivo gospodarenje proizvedenim vrstama otpada u nekoliko primjera pročistača otpadnih voda, što obuhvaća postupke sakupljanja otpada na mjestu njegovog nastanka, razvrstavanje i privremeno skladištenje otpada, uzorkovanje i analizu otpada, vođenje evidencije o nastanku i tijeku otpada, predaju otpada ovlaštenim osobama na daljnje zbrinjavanje te prijavljivanje količina nastalog otpada nadležnim tijelima.

U zaključnom dijelu rada ukazano je na značaj poštivanja propisanih postupaka, čime se osigurava učinkovit i okolišno prihvatljiv način rada pročistača te propisno zbrinjavanje otpada koji je nastao tijekom pročišćavanja otpadnih voda.

SUSTAINABLE WASTE MANAGEMENT IN WASTEWATER TREATMENT PLANT

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Waste water, which are generated by daily water use in municipal communities and industrial buildings, loaded with the various pollutants. By separating and removing the mentioned substances in waste water treatment plants (purifiers) gets purified water, as well as a certain amount of concentrated pollution which are contained in contaminated wastewater. Such concentrated pollution is waste, with which at the place of its origin must comply with applicable laws on sustainable waste management, and pertinent regulations (regulations and ordinances), made on the basis of the same law. Since the purification of waste water in a purifier can extract many types of pollution, which can be categorized as different hazardous and non-hazardous waste, the responsible management of the same, in terms of their harmless disposal, must be conducted in a professional and environmentally acceptable manner.

The paper analyzes the sustainable management of waste streams produced in several examples of wastewater treatment plant, which includes procedures for collecting waste at the site of its creation, sorting and temporary storage of waste, sampling and analysis of waste, keeping records of the waste flow, delivery of waste to authorized persons on further disposal and reporting about the quantity of waste to the competent authorities.

In the final part of the paper points to the importance of respecting the prescribed procedures, ensuring efficient and environmentally acceptable work of purifier, and proper disposal of wastes produced during wastewater treatment.

KORIŠTENJE HIDROTEHNIČKIH MODELA U PREDVIĐANJU POPLAVA

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Cilj rada je modeliranjem korita rijeke Vuke pri samom ušću u rijeku Dunav u Vukovaru predvidjeti mogućnost pojave poplava uzimajući u obzir povratna razdoblja od 1, 2, 5, 10, 50 i 100 godina. Iako maksimalni vodostaji rijeke Dunav ne premašuju kote, uglavnom nizinskog, područja grada Vukovara, uzrokuju uspore u rijeci Vuki i njenom pritoku, Bobotskom kanalu. Na taj, indirektan način ugrožavaju okolno područje i smanjuju učinkovitost zaobalnih odvodnih sustava. Na digitalnom modelu terena korita rijeke Vuke i inundacijskog područja, u geoinformacijskom računalnom programu ArcGIS pomoću alatne trake HEC-GeoRAS, digitalizirano je postojeće korito rijeke Vuke te definirane granice potencijalnog plavnog područja i parametri hrapavosti okolnog terena. Unošenjem što više parametara stvarnog stanja korita rijeke Vuke, model postaje detaljniji i precizniji. Tako definiran model se unosi u računalni program HEC-RAS gdje se radi hidraulička analiza. Unosom mjerodavnih protoka i vodostaja, zaključuje se unos potrebnih parametara za proračun i analizu stacionarnog strujanja te simulaciju ponašanja sustava u zadanim uvjetima. Takav model stacionarnog strujanja se ponovno pokreće i analizira u računalnom programu ArcGIS gdje se pomoću programskog dodatka HEC-GeoRAS dobiju grafički prikazi pojave poplava za zadano područje. Takvim se modelom može vidjeti koje područje zahvaća pojedina poplava te na temelju poplavljene površine dati okvirna procjena štete ili, u boljem slučaju, predvidjeti mogućnost pojave poplave te pravovremenom sanacijom i regulacijom spriječiti nastanak iste.

USAGE OF HYDROTECHNICAL MODELS IN FLOOD PREDICTIONS

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The goal of this paper was to predict the possibility of floods of the downstrem reach of the Vuka river, right before the confluence in the Danube river, by modeling the river bed and the flow of the Vuka river with the return periods of 1, 2, 5, 10, 50 and 100 years. Although the maximum water levels of the Danube river do not excede the elevetaions of the mostly lowland area of the Vukovar city, they do cause the rise of water levels in the Vuka river and the tributary Bobota channel. By doing so, the water levels of the Danube river indirectly threaten the surrounding area and decrease the efficency of the hinterland drainage systems. In the geoinformation software ArcGis and its toolbar HEC-GeoRAS, the digital model of the surrounding area as well as the river bed of the Vuka river. Also, the borders of the potential inundation area as well as the roughness of the terraing have been defined. By inputing as much parameters of the real state of the river bed of the Vuka river, the model becomes more detailed and precise. Such model is exported into HEC-RAS software where the hydraulic analysis takes place. The relevant flows and water levels must be provided to the software to conclude the inputin task and to run the analysis of the stationary flow and to simulate the system behaviour in the designated conditions. The model of the stationary flow that is the result of the analysis and the simulation is once more exported as a GIS database and is opened in the ArcGIS software. In the software, by using the HEC-GeoRAS toolbar we analyze and display the graphical image of the potential flooding area. In the model, the flooding area can be determined as well as a general damage assesment, or in the better case, the probability of the flood can be given for any variation of the water levels combined with the flow of the Vuka river, as well as defining the measures which could be taken to ensure the prevention of the floods.

DINAMIKA BAKTERIOPLANKTONA PODZEMNIH VODA VODOCRPILIŠTA „VINOGRADI“ KOD OSIJEKA

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Mikroorganizmi su pouzdani bioindikatori uslijed svoje visoke osjetljivosti na promjene nastale u njihovoj životnoj sredini. Promjene u omjeru broja oligotrofnih bakterija, koje obitavaju u okolišu s niskom koncentracijom organskih tvari, i eutrofnih bakterija, koje obitavaju u okolišu s visokom koncentracijom organskih tvari, ukazuju na stanje nekog vodenog ekosustava. Jedan od značajnijih pokazatelja kakvoće vode, kao i njene zdravstvene ispravnosti su bakteriološke analize.
Stanovništvo grada Osijeka snabdijeva se vodom za piće s podzemnom vodom koja se crpi na vodocrpilištu Vinogradi, a potom prerađuje u pogonu tvrtke „Vodovod-Osijek“ d.o.o. kako bi u pogledu vrijednosti fizikalno-kemijskih i mikrobioloških parametara bila u skladu s odredbama Pravilnika o parametrima sukladnosti i metodama analize vode za ljudsku potrošnju (NN 125/2013). Vodocrpilište Vinogradi nalazi se zapadno od grada Osijeka i obuhvaća 18 bunara gdje se analiza kvalitete i zdravstvene ispravnosti vode kontinuirano provodi.
U ovom radu prikazani su rezultati uzorkovanja i analiza podzemnih voda s vodocrpilišta Vinogradi provedeno u razdoblju od 2013. do 2015. godine. Dobiveni rezultati analiza uspoređeni s rezultatima analiza podzemnih voda s vodocrpilišta Vinogradi provedenim u razdoblju od 1995. do 2010. godine, u petogodišnjim intervalima. Tijekom provedenog istraživanja u uzorcima podzemnih voda zabilježena je prisutnost većeg broja kolonija oligotrofnih bakterija (BKB-O), u odnosu na broj kolonija eutrofnih bakterija (BKB-E), što ukazuje na nisku koncentraciju organskih tvari u vodi. Tijekom godina se mijenjala dinamika razvoja kolonija oligotrofa i eutrofa, a 2000. godine u bunaru B-6 omjer BKB-O/BKB-E iznosio je samo 0,51. CFU vrijednosti oligotrofa i eutrofa nisu prelazile vrijednost od 100 CFU/ml, što ukazuje na dobru kakvoću ispitivanih uzroka, kao i zdravstvenu ispravnost vode u pogledu mikrobioloških pokazatelja kakvoće vode.

BACTERIOPLANKTON DYNAMICS OF GROUNDWATER FROM THE „VINOGRADI“ WELL FIELD NEAR TOWN OF OSIJEK

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Microorganisms are reliable indicators due to high sensitivity to changes in their environment. Changes in the ratio of the number of oligotrophic bacteria, which live in an environment with low concentration of organic substances, and eutrophic bacteria, which live in an environment with a high concentration of organic substances, indicate the status of an aquatic ecosystem. One of the most important indicators of water quality, as well as its health safety is bacteriological analysis. The population of the city of Osijek are supplied with drinking water obtained from the groundwater pumped from the well field Vinogradi, and then processed at a facility the company ‘’Vodovod-Osijek’’ d.o.o. in order to meet the requires of Regulations of parameters compliance and analysis methods of water for human consumption (Official Gazette 141/13). Water-well Vinogradi is located west of the city of Osijek and includes 18 wells. The quality of groundwater is determined continuously.

This paper presents the results of sampling and analysis of groundwater with water wells Vinogradi conducted in the period from 2013 to 2015. The results of analysis were compared with the results of the analysis of ground water in the period from 1995 to 2010, in five-year intervals. Results show the presence of multiple colony oligotrophic bacteria (BKB-O), compared with the number of colonies of bacteria eutrophic (BKB-E), indicates a presence of low concentration of organic substances in water. Over the years, the changing dynamics of the development of the colony oligotrophes and eutrophs, and in 2000 in the well B-6 ratio BKB-O/BKB-E was only 0.51. CFU values oligotrophes and eutrophes have not exceeded a value of 100 CFU/mL, indicating good quality, as well as the safety of the tested water in terms of microbiological indicators.

APPLICATION OF NATURAL ZEOLITE FOR SEPARATION OF Co(II) IONS FROM AQUEOUS SOLUTIONS: EGIULIBRIUM STUDY

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The contemporary trends in green separation processes impose the need for application of natural, low-cast and high-efficiency selective adsorbents within the processes for the treatment of drinking water supplies. Lately, nano-porous inorganic sorbents represent an ongoing trend for elimination of heavy metals from water resources. Natural zeolite (clynoptilolite) was used as a potential raw material for the purpose of removal of Co(II) ions from model solutions. The experimental results were obtained in a laboratory scale batch glass reactor with continuous stirring at 400 rpm. The effects of operational parameters such as the initial concentration of Co(II) ions in the aqueous solution, the mass of the nano-porous adsorbent and the contact time were studied to optimize the conditions for maximum removal of Co(II) ions. The process equilibrium was investigated at the following operating conditions: initial adsorbate concentration of Co(II) ions from 350 – 650 μg/l, mass of nano-porous sorbent from 0.1 – 0.5 mg, initial pH value from 4 – 8 and adsorption time from 1 – 300 min. The equilibrium study generated the maximal adsorption capacity of the system natural zeolite – Co(II) ions with different initial concentrations. MATLAB/Simulink process software was implemented to determine the adequate adsorption isotherm as well as to optimize the steady state of the investigated system. These results were used for further analysis of the kinetics of the studied process.

KVALITET VODE ZA PIĆE VODOVODNOG SISTEMA BIJELJINA

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Grad Bijeljina i okolna naselja vodom za piće se snabdijevaju sa izvorišta"Grmić", od 1961. godine. Očuvanje kvaliteta vode na izvorištu „Grmić", je od vitalnog interesa AD "Vodovod i kanalizacija" i opštine Bijeljina. Najveća prijetnja prvom vodonosnom sloju je ispiranje vještačkih hraniva i pesticida, koji se koriste na poljoprivrednim parcelama u zoni uže zaštite. Voda ovog Izvorišta zadovoljava zahtjevane kriterijume kvaliteta vode za piće. Jedini tretman kome podliježe voda ovog izvorišta je dezinfekcija gasnim hlorom, za koju se s pravom može reći da se sprovodi kao preventivna mjera i mjera zadovoljenja uslova Pravilnika. Međutim, povećanje koncentracije nitrata u vodi izvorišta „Grmić" je nešto što zabrinjava.

Cilj rada je da kroz primjenu dostupnih poda.taka laboratorijskog ispitivanja vode za piće i usporedbu izmjerenih koncentracija sa odredbama Pravilnika o zdravstvenoj ispravnosti vode za piće(Sl. Glasnik RS 75/15), prikaže kvalitet vode za piće vodovodnog sistema Bijeljina, uz poseban osvrt na sadržaj nitrata u uzorcima vode uzetih iz bunara na izvorištu.

U radu su statistički obrađeni podaci o rezultatima fizičko-hemijskih i mikrobioloških ispitivanja uzoraka vode za piće iz vodovodnog sistema, uzetih u periodu 2001.- 2015. godine od strane javno-zdravstvene ustanove i interne laboratorije.

THE QUALITY OF DRINKING WATER IN WATER SUPPLY SYSTEM OF BIJELJINA

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Bijeljina and the surrounding villages are getting drinking water from water source "Grmic"' since 1961.
The preservation of water quality on the water source "Grmic" is of vital interest to AD "Vodovod i kanalizacija" and the city of Bijeljina. The biggest threat to the first aquifer is the artificial fertilizers and pesticides used on farms in a zone of immediate protection. This water source fulfils the required criteria for drinking water. Chlorine gas is the only treatment beaing implemented on this water as preventive measure and this measure is in accordance with the conditions of Rule book. However, increased concentration of nitrates in the drinking water is something that worries.
The objective of this study is to show the quality of drinking water in water supply system of Bijeljina, with special reference to the content of nitrates in samples taken from the wells of the water source, by using available laboratory tests of drinking water and compering measured concentrations level with the regulations of Rule book for safe drinking water.
In this study we used statistically analyzed data concernig the results of physical, chemical and microbiological testing of samples of drinking water from the water system, taken by the public health institutions and internal laboratories in the period from 2001 to 2015.

PRIKAZ REZULTATA ANALIZIRANIH METALA NA POSTAJAMA NADZORNOG MONITORINGA POVRŠINSKIH VODA U BRODSKO-POSAVSKOJ I VUKOVARSKO-SRIJEMSKOJ ŽUPANIJI ZA 2014. GODINU

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Tijelo površinske vode može biti jezero, akumulacija, potok, rijeka ili kanal, prijelazna voda ili odsječak priobalne vode. Nadzor nad stanjem površinskih, uključujući priobalne vode, te podzemnih voda provodi se sustavnim praćenjem - monitoringom. Nadzornim monitoringom određuje se stanje voda unutar svakog sliva, odnosno dobivaju informacije o dugoročnim prirodnim promjenama i antropogenim utjecajima. Cilj rada je dati ocjenu stanja tijela površinske vode na temelju praćenja koncentracija metala. U radu su prikazane prosječne godišnje koncentracije metala u površinskim vodama na području Brodsko-posavske i Vukovarsko-srijemske županije u 2014. godini. Rezultati su dobiveni nadzornim monitoringom stanja površinskih voda kojega provode Hrvatske vode, te su uspoređivani sa dozvoljenim graničnim vrijednostima koncentracija koje propisuju Smjernice Svjetske zdravstvene organizacije i Direktiva 98/83/EC Europske unije. Okvirna direktiva o vodama kao krovna vodna direktiva Europske unije značajan naglasak stavlja na klasifikaciju voda s obzirom na ekološko stanje. Klasifikacija površinskih voda određuje se na temelju ekološkog stanja (relevantnih bioloških, fizikalno-kemijskih i hidromorfoloških elemenata kakvoće) i kemijskog stanja (na temelju prioritetnih i drugih onečišćujućih tvari).

ASSESSMENT OF SURFACE WATER IN BROD-POSAVINA AND VUKOVAR-SRIJEM COUNTY ACCORDING TO THE CONCENTRATION OF METALS IN 2014

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The surface water can be lake, stream, river or canal, a transitional water or a coastal water. Supervision of the surface waters, including coastal waters and groundwater is carried out by systematic observation - monitoring. The state of the water and information about long-term changes in nature and anthropogenic influences is determined by surveillance monitoring.
The aim of this paper is to evaluate the surface water on the basis of the concentration of metals. The paper shows the average annual concentrations of metals in surface waters in the Brod-Posavina and Vukovar-Srijem County in 2014.
The results were obtained by monitoring of surface water carried out by Croatian Waters. Results were compared with the the allowed concentration limits prescribed by the Guidelines of the World Health Organization and Directive 98/83 / EC of the European Union. The Water Directive, as the main Water Directive of the European Union, a significant emphasis puts on water classification based on ecological status. Classification of surface water is determined based on the ecological state (relevant biological, physico-chemical and hydromorphological quality elements) and chemical state (based on priority matters and pollutants).

USPOREDBA KVALITETE VODOVODNE VODE KNINSKOG I KRČKOG PODRUČJA

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Kvaliteta vode za piće i ljudsku potrošnju je pitanje od esencijalnog značaja sa javnozdravstvenog stajališta. Cilj ovog rada je usporediti kvalitetu vodovodne vode kninskog i krčkog područja. Kvaliteta vode određuje se na temelju više parametara, koji su propisani Pravilnikom. Uzorci za ispitivanje su uzeti u DV „Cvrčak" u Kninu i u hotelu „Dražica" na otoku Krku. Ispitivanja su provedena u HZZJZ Šibensko-kninske županije i Ponikve d.o.o. Krk. Na uzorcima su provedena fizikalna, kemijska i mikrobiološka ispitivanja. Rezultati ispitivanja pokazali su kako su uzorci krčke i kninske vodovodne vode sukladni navedenom Pravilniku. Na temelju dobivenih rezultata vidljivo je kako kninska vodovodna voda ima znatno višu količinu slobodnog klora u odnosu na krčku vodu, te znatno nižu količinu klorida i organske tvari, nižu temperaturu i nižu elektrovodljivost. Obzirom da se na ispitivanim lokalitetima nisu određivali svi isti parametri nije bilo moguće u potpunosti provesti usporedbu dobivenih rezultata.

COMPARISON OF QUALITY OF WATER KNIN AND THE ISLAND KRK

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Quality of drinking water for human consumption is essential from public health perspective. Aim of this paper is to compare quality of tap water in Knin and Krk area. Water quality is determined on several parameters, which are prescribed by Ordinace. Samples for analysis are taken in children kindergarten ″Cvrcak″ in Knin and in hotel ¨Drazica¨ on island Krk. Analysis were conducted in Croatian Instituite for Public Health of Sibenik-Knin County and Ponikve d.o.o. There was physical, chemical and microbiological analysis of samples. Results of analysis have shown that samples of Krk and Knin are in accordance to named Ordinace. Based on results it is observed that Knin tap water has significantly larger amount of free clorium compared to Krk area water, and significantly lower amount of chlorides and organic matter, lower temperature and lower electrical conductivity. Considering that in analyses localities not all parameters were determined it wasn't possible to completely conduct comparison of obtained data.

ADSORPTIVE REMOVAL OF MALACHITE GREEN FROM AQUEOUS SOLUTION USING LIGNOCELLULOSIC WASTE MATERIAL

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The ability of poplar sawdust, a lignocellulosic waste material, for the adsorption of cationic dye malachite green from aqueous solution was studied. Batch experiments were carried out at 25 °C and contact time of 300 min. The effects of the initial dye concentration (15, 25, 35 and 50 mg L^{-1}), adsorbent concentration (5, 10, 15 and 20 g L^{-1}), temperature (25 and 35 °C) and solution pH (2.5, 4.4 and 6.4) on dye removal were investigated. Adsorption efficiency (dye removal) higher than 90% was achieved in all runs. The percentage dye removal increased with increase in adsorbent concentration and decrease in the initial dye concentration. This was the most obvious within the first 30 min of contact time. The temperature had no significant effect on the percentage removal, while the decrease in pH caused the reduction of percentage removal of malachite green during the first 90 min of contact time. After 150 min of contact time the percentage dye removal difference was insignificant for all the experiments. The results demonstrate that poplar sawdust could be considered as effective, low-cost, environmentally friendly adsorbent for malachite green removal.

HIDROLOŠKI REŽIM ALUVIJALNIH POTOKA NA PODRUČJU MEĐIMURJA

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Prethodna istraživanja aluvijalnih tekućica na području Međimurja su nedostatna. Prva sustavna istraživanja hidrologije, fizikalno-kemijskih parametara vode i faunističkih obilježja provedena su u razdoblju od 2005. do 2010. godine . Prema dostupnim nesistematskim podatcima o mjerenjima protoka u istraživanom razdoblju uočena su velika variranja protoka tijekom pojedinih godina. Vidljivo je da su vrijednosti protoka, promatrajući prosječne mjesečne minimalne i maksimalne vrijednosti, te prosječne godišnje vrijednosti protoka, znatno veće za potok Bistrec u odnosu na drugi istraživani potok Boščak. Vidljivo je također da su srednji godišnji protoci te srednji mjesečni minimumi i maksimumi znatno veći na nizvodnom dijelu toka oba istraživana potoka. Istraživanje je napravljeno na temelju rezultata vlastitih istraživanja u Zoologijskom zavodu Biološkog odsjeka Prirodoslovno-matematičkog fakulteta Sveučilišta u Zagrebu.

HYDROLOGICAL REGIME OF THE ALLUVIAL STREAMS IN THE REGION OF MEĐIMURJE

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Previous research of the alluvial rivers in the region of Međimurje are sporadic and insufficient. The obtained research results of hydrological regime of the alluvial Streams of Bistrec and Boščak in the area of Međimurje are part of a complex scientific research in the period from 2005 to 2010 with the aim of determing the chemical and physicochemical elements that accompany biological elements. By calculating the average of the reference values of field measurements it is evident that the flow values by observing the average monthly minimal and maximal values of the average annual flow values are significantly higher for the Bistrec Stream when compared with the other investigated stream – the Stream of Boščak. It is also evident that the mean annual flow rates and the mean monthly minimal and maximal possible values are significantly higher in the downstream part of the flow of both of the studied streams. This research was done on the basis of the results of our own research that was done in the Institute of Zoology of the Departments of Biology of the Faculty of Science at the University of Zagreb.

ENVIRONMENTAL POLLUTION FROM INDUSTRIAL WASTE STREAMS THROUGH BIOMONITORING OF MERCURY, LEAD AND CADMIUM

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The biomonitoring of mercury, lead and cadmium in humans has been examined through analysis of 153 meconium samples of new-born children in the Split-Dalmatian County. Heavy metals content is related to pollution from industrial discharges, road traffic sources and landfills in the examined area. Mercury was found in 100% samples, lead was found in 89.4% and cadmium in 94.0% of analysed samples, indicating a high prevalence of the all metals in the environment. The content of each metal has been examined relative to the sociodemographic description and dietary habits of mothers. Statistical results have shown highest values for lead (<LOD-2423.64 ng/g), then mercury (3.04-394.69 ng/g) and cadmium (< LOD-26.58 ng/g). Concentrations of each metal are higher for living in the urban residences, more frequent consumption of vegetables and fish, and smoking habits. Results have shown that fish and sea food products are strongly related with mercury content, indicating high impact of long term discharge of industrial wastewaters containing mercury. Lead content is related to living close to the industrial basins, where cadmium is uniformly dispersed from pollution sources over a larger area and penetrates all parts of the environment.

NANOČESTICE FULERENA U OKOLIŠU: POTENCIJALNI RIZIK PRI OBRADI VODA?

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Povećana upotreba fulerena u različitim područjima industrije, poput elektronike, optike, poljoprivrede, prehrambene i farmaceutske industrije te medicine, ima za dugoročnu posljedicu njihovo povećano otpuštanje u okoliš. Pri tome, nanočestice fulerena ulaze u otpadne vode, bunare, ili direktno u rijeke, što može utjecati na procese obrade voda, ali i direktno na zdravlje ljudi i životinja. Stoga, postoji potreba za detaljnjim saznanjima o stabilnosti i biodostupnosti nanočestica fulerena u vodenim sustavima, a sve u svrhu procjene rizika i opasnosti vezanih uz njihov utjecaj na procese obrade voda. Upravo je cilj ovog pregleda zaokružiti trenutačne spoznaje o prisutnosti nanočestica fulerena u vodenim sustavima, njihove interakcije sa otopljenom organskom tvari, stabilnosti nanočestica u ovisnosti o pH i ionskoj jakosti vodene sredine, toksičnosti te biotransformaciji u okolišu. Gore navedeno, razmatrat će se obzirom na potencijalni utjecaj nanočestica fulerena na procese obrade kako pitke, tako i otpadnih voda.

ENVIRONMENTALLY RELEASED FULLERENE NANOPARTICLES: POTENTIAL RISK IN WATER TREATMENTS?

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Increased use of fullerenes in various industrial fields, such as electronic, cosmetic, agricultural, food, medical and pharmaceutical industry, raises their environmental burden. After usage fullerene nanoparticles are released into waste water system, drinking water wells, and/or river flows, thus affecting various water treatment processes, but also human and animal health. Therefore, knowledge on fullerene nanoparticles stability and bioavailability in water systems is needed to elucidate potential risks and hazards connected with water treatment processes. The present review will give state-of-the-art information on fullerene nanoparticle occurrence in water systems and environment, as well as current understanding of fullerene nanoparticle interaction with dissolved natural organic matter, pH and ionic strength dependent stability, toxicity, biological fate and biotransformation. These issues will be discussed to demystify the potential effects of fullerene nanoparticles on both drinking and waste water treatments.

INVESTIGATION OF DESORPTION MECHANISMS OF TRICHLOROBENZENES ON MULTIWALLED CARBON NANOTUBES

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Investigating adsorption reversibility can provide additional information on adsorption and desorption mechanisms. Adsorption-desorption hysteresis, the mismatch between the adsorption and desorption isotherms, was investigated for 1,2,3 and 1,2,4-trichlorobenzene on two different multiwalled carbon nanomaterials (MWCNTs): original MWCNTs (OMWCNT) and functionalized MWCNTs (FMWCNT). Hysteresis was quantified using the hysteresis index using parameters obtained from Freundlich's model for I, II and III desorption steps at three concentrations (q_e = 1,5; 11 and 18 mg/g). Generally, when the *HI* ~ 1, the adsorption isotherm should be the same as the desorption isotherm. In contrast, *HI* < 1 means the rate of desorption is less than the rate of adsorption, indicating hysteresis. The most pronounced adsorption-desorption hysteresis was observed for 1,2,4-trichlorobenzene on OMWCNT, wherein *HI* < 1 was obtained at all concentrations. Interestingly, this adsorbent showed a more pronounced hysteresis for 1,2,4-trichlorobenzene (*HI* = 0.75 to 0.15) than 1,2,3-trichlorobenzene (*HI* = 2.25 to 0.64), which may indicate that the bulkier 1,2,4-trichlorobenzene remains trapped after penetrating into the pores of the adsorbent. The pore diameter of the investigated adsorbent is about 3.60 nm, giving a pore volume of about 24400 $Å^3$, whereas the volume of one 1,2,4-trichlorobenzene molecule is 342 $Å^3$, indicating that "irreversible entrapment" could explain the observed adsorption-desorption hysteresis. At increasing adsorbate concentrations, the hysteresis indices declined, such that the increased concentration gradient caused the molecules to penetrate further into the pores of the CNT where they remain trapped.

SPOJEVI DUŠIKA U PODZEMNIM VODAMA ISTOČNE HRVATSKE

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Podzemne vode su glavni izvor vode za piće na području istočne Hrvatske. Nažalost, plitki izvori podzemne vode (dubine manje od 5 metara) su podložni različitim kontaminacijama, a naročito onima koje uzrokuju procjeđivanja oborinskih voda s površine te upotreba umjetnih gnojiva, upotreba životinjskih gnojiva, skladištenje stajskog gnojiva, obrada otpadnih voda, pojedine aktivnosti prehrambene industrijom, kao i procjeđivanja iz septičkih jama ili uslijed nepropisnog ispuštanja kanalizacijskih otpadnih voda.

U ovom radu prikazani su rezultati ispitivanja koncentracije dušikovih spojeva u podzemnim vodama istočne Hrvatske, a pri tome su određivane koncentracije nitrata, nitrita i iona amonijaka. Nitritni ioni i ioni amonijaka su relativno nepostojani u okolišu što objašnjava njihove zabilježene relativno niske koncentracije u analiziranim uzorcima podzemnih voda, a prisutnost amonijaka u vodi je najčešće indikator fekalnog onečišćenja prirodnih voda. Dušikovi spojevi se najčešće u podzemnim vodama nalaze u koncentracijama koje nisu štetne za čovjeka. No, iako se smatraju relativno netoksičnim spojem, nitrati u visokim koncentracijama mogu prouzročiti zdravstvene probleme dojenčadi u vidu pojave methemoglobinemije koja se manifestira smanjenom mogućnosti hemoglobina da veže i prenosi kisik u organizmu, a koja kod djece mlađe od šest mjeseci u ekstremnim slučajevima može uzrokovati i smrt.

U ovom radu su proučavane koncentracije spojeva dušika u neprerađenim podzemnim vodama koje se koriste za ljudsku vodoopskrbu istočne Hrvatske. Proučavanje je trajalo šest godina (2010.-2015.), a uzorci za analizu su uzimani s 40 lokacija.

NITROGEN COMPOUNDS IN GROUNDWATERS OF EASTERN CROATIA

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Groundwater are the main source of drinking water in Eastern Croatia. Shallow underground water sources (less than 5 meters) are prone to various contaminations caused by percolation of stormwater and usage of fertilizers, manure, wastewater treatment, food industry related activities, as well as percolation of septic tanks or improper discharge of sewage water.
In this paper, the results of analysis of nitrogen compounds in in groundwater of Eastern Croatia, are shown. Concentrations of nitrates, nitrites and ammonia are shown. High concentrations of ammonia can be related to fecal pollution of groundwater. Low concentrations of nitrite and ammonia ions in analyzed samples can be related to the fact that this compounds are relative unstable and are converted to other compounds.
While nitrogen compounds in groundwater are present in non-toxic concentrations, high nitrite concentrations can lead to health problems in infants related to methemoglobinemia (reduced ability of hemoglobin to bind and carry oxygen in the body), which can cause death in extreme cases.
This paper studies the concentrations of nitrogen compounds in raw groundwater used for public water supply of Eastern Croatia, and covers samples taken from 40 locations in 6 years period.

PILOT PROJEKT SMANJENJA POTROŠNJE VODE U SREDNJIM ŠKOLAMA GRADA OSIJEKA

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Iako je Zemlja „plavi planet“, i 2/3 planete zauzimaju vodene površine (mora i oceani), samo 2,4 % od ukupne mase je slatka voda. Od ukupne količine vode na Zemlji, samo 1 % je upotrebljivo za piće, te se koristi za piće, hlađenje, grijanje, industriju, sport i rekreaciju.
Vodoopskrba grada Osijeka se zasniva na izvorištu Vinogradi nedaleko od Osijeka. Izvorište se sastoji od 18 bunara i zahvati su relativno duboko u zemlji, te ne može doći do nestašice vode u ljetnim mjesecima. Potrošnja vode za 2014. godinu u gradu Osijeku je bila oko 166 l/stan/dan (norma fakturirane vode), tj. 319 l/stan/dan (norma zahvaćene vode), dok je ukupna dnevna isporučena količina vode bila oko 20 000 m^3.
Na području grada Osijeka ima 18 srednjih škola. Prosječna potrošnja vode Graditeljsko-geodetske škole protekle 3 godine iznosi 1094 m^3/godišnje. Graditeljsko-geodetska škola Osijek provest će pilot-projekt s ciljem smanjenja potrošnje vode ugradnjom tzv. perlatora. Cilj ovog projekta je dobiti podatke o uštedi vode kroz minimalna financijska ulaganja te provesti modeliranje uštede potrošnje vode na razini srednjih škola grada Osijeka. Ovaj model bi se mogao primijeniti na ostale ustanove u gradu Osijeku i šire s ciljem smanjenja potrošnje vode i ostvarivanja znatnih ušteda.

PILOT-PROJECT: REDUCTION OF WATER USAGE IN SECONDARY SCHOOLS OF CITY OF OSIJEK

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Even though the Earth is called „the Blue Planet" and 2/3 of the Planet is covered in water (seas and oceans), only 2,4% of total water mass is fresh water and 1% of total amount is drinkable and used for human consumption, cooling, heating, industry, sports and recreation.
Water supply for the city of Osijek is based on water source Vinogradi near Osijek. Being comprised of 18 wells deep underground this supply cannot dry out in summer months.
Water consumption for Osijek was 166 l/capita/day (billed water), i.e. 319 l/capita/day (extracted water) in 2014, while the total daily amount of water supplied was 20000 m^3.
The area of Osijek has 18 high schools. The average water consumption of School of Civil Engineering and Geodesy for the last 3 years was 1094 m^3/per annum. School of Civil Engineering and Geodesy will carry out a pilot project aimed at reducing the water consumption by installing water diffusers. The goal of this project is to obtain information on saving water consumption through minimal financial investment and to calculate possible savings in water consumption for all high schools in Osijek, according to the model of School of Civil Engineering and Geodesy. This model could be applied to other institutions in the city and its surroundings in order to reduce water consumption and to achieve significant savings.

ODREĐIVANJE KATIONA U PRIRODNIM VODAMA ELEKTROFOREZOM NA MIKROČIPU SA C^4D DETEKTOROM

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Kapilarna elektroforeza (CE) je vrlo učinkovita separacijska tehnika za kvantifikaciju različitih nabijenih specija. Elektroforeza na mikročipu (MCE) je minijaturizirana verzija CE.
Alkalijski metali rutinski se prate u različitim uzorcima vode, koji su važni u industriji voda za piće i otpadnih voda industrije.
MCE uređaj sa kapacitivno spregnutim, beskontaktnim, konduktometrijskim detektorom (C^4D) uspješno je primijenjen za analizu nekoliko alkalijskih kationa, pojedinačno i u smjesi. Istraživan je utjecaj sljedećih parametara na učinkovitost separacije: vrijeme injektiranja, napon injektiranja, vrijeme separacije i napon separacije. Ustanovljen je linearni odziv za svaki pojedini ispitivani kation, pojedinačno i smjesi pomoću linearne regresije. Metoda je primijenjena za određivanje alkalijskih kationa u prirodnoj vodi.

DETERMINATION OF CATIONS IN NATURAL WATERS USING ELECTROPHORESIS ON MICROCHIP WITH C^4D DETECTOR

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Capillary electrophoresis (CE) is a highly efficient separation technique for quantitation of different charged compounds. Electrophoresis on microchip (MCE) is a miniaturized version of the CE.
Alkali metals are routinely monitored in a variety of aqueous samples, which are important to several industries such as the drinking and waste water industries.
In this investigations a MCE device with capacitively coupled contactless conductivity detection (C^4D) was successfully applied for analysis of several alkali cations, individually and in mixture. The influence of the following parameters on the separation ability was investigated: injection time, injection voltage, separation time and separation voltage. The linear response region for each particular cation investigated, both single and in a mixture, was determined using linear regression. The method was applied for determination of alkali cations in natural water.

UTJECAJ AMBALAŽE NA KVALITETU PAKIRANE VODE

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Voda se pakira u primarnu i/ili sekundarnu ambalažu izrađenu od različitih ambalažnih materijala (staklo, plastika, višeslojni materijali). Ambalaža može utjecati na kvalitetu pakirane vode ukoliko dođe do fizičkog oštećenja ambalaže, permeacije kisika kroz ambalažu ili prodiranja svjetlosti. Nadalje, ambalažni materijali utječu na kvalitetu vode preko različitih migracijskih procesa kojima tvari iz ambalaže migriraju u zapakiranu vodu. Tu je potrebno spomenuti migraciju plastifikatora i različitih aditiva te migraciju monomera i oligomera male molekularne mase koji se stvaraju ili dodaju u procesu proizvodnje plastičnih masa. Utjecaj ambalaže na kvalitetu vode može se ispitivati analiziranjem koncentracije O_2 i CO_2, koncentracije metala, plastifikatora i aditiva, mikrobiološkim ispitivanjem, a matematičko modeliranje rezultata može dati realan uvid u utjecaj ambalaže na kvalitetu vode. U ovom radu cilj je bio opisati parametre koji mogu izazvati smanjenje kvalitete zapakirane vode te objasniti osobine ambalažnih materijala koje utječu na održavanje kvalitete zapakirane vode.

THE INFLUENCE OF THE PACKAGE ON THE QUALITY OF BOTTLED WATER

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Water is packed into a primary and / or secondary packaging made of different packaging materials (glass, plastic and multi-layer materials). The packaging can affect the quality of packaged (bottled) water if there is physical damage to the packaging, through the permeation of oxygen or the penetration of light. Furthermore, packaging materials can affect the quality of water through various migration processes since substances from the packaging can migrate into water. The migration of plasticizers, various additives, monomers and low molecular weight oligomers which are formed or added during the process of plastic material production, should be mentioned. The influence of packaging on the quality of water can be tested by analyzing O_2 and CO_2 concentration, the concentration of metals, plasticizers and additives, testing the microbial deterioration and mathematical modeling of results can provide a realistic insight into the influence of packaging on the quality of bottled water. In this work, the objective was to describe the parameters that can cause a decrease of quality of bottled water and to explain the characteristics of packaging materials that affect the maintenance of the quality of bottled water.

SEPARACIJA GVOŽĐA I MANGANA IZ PODZEMNE VODE NANOFILTRACIJOM BEZ PREDTRETMANA

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Gvožđe se u prirodnim vodama nalazi u četiri oblika Fe (II), Fe (III), organski vezan Fe(II) jon u kompleksu sa anjonima huminskih i fulvo kiselina, dok se mangan najčešće nalazi kao dvovalentan. Gvožđe i mangan se iz vodenih rastvora najčešće uklanjaju procesima biološke filtracije, oksidacije uz filtraciju, kao i jonskom izmenom, adsorpcijom i kombinacijom oksidacije sa ultrafiltracijom. U radu je iskorišćena osobina limunske kiseline (CA) da stvara kompleksna jedinjenja sa jonima Fe i Mn, tako da je CA precizno dozirana u sirovu bunarsku vodu koja je tretirana nanofiltracionim membranama. Stvoreni kompleksi Fe i Mn sa CA su doprineli odsustvu oksidacionih procesa i povećanoj efikasnosti uklanjanja gvožđa i mangana sa početnim koncentracijama od 1,79 mg/L i 0,67 mg/L, respektivno. U protoku bunarske vode je doziran rastvor CA koncentracije od 80 g/L u zapreminskim udelima od 4 %, 8 % i 12 %. Dobijeni rezultati pokazuju da se uz doziranje CA količine Fe i Mn u permeatu smanjuju dva do osam puta u odnosu na nanofiltraciju iste vode bez doziranja CA. Ova nova metoda separacije Fe i Mn direktnom nanofiltracijom ima niz konstruktivnih i ekonomskih prednosti nad konvencionalnom deferizacijom i demanganizacijom.

IRON AND MANGANESE SEPARATION FROM GROUNDWATER USING NANOFILTRATION WITHOUT PRETREATMENT

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Iron in natural waters is found as Fe (II), Fe (III), organically bonded Fe(II) ion and as complex with humic and fulvic acid anions while manganese is most often found as divalent. The most common processes that are used for iron and manganese removal from aquatic solutions are biological filtration, oxidation and filtration as well as ion exchange, adsorption and ultrafiltration combined with oxidation. The fact that citric acid (CA) creates complex compounds with Fe and Mn ions was used in this paper in the way that CA was precisely dosed into the raw well water before it was treated by nanofiltration. Created Fe and Mn complexes with CA contributed to lack of oxidation processes and increased Fe and Mn removal efficiency with initial concentrations of 1.79 mg/L and 0.67 mg/L, respectively. CA solution with concentration of 80 g/L was dosed into the raw well water flow in volume shares of 4%, 8% and 12%. Obtained results show that Fe and Mn amounts in permeate were reduced two to eight times with CA dosing with regard to the concentration in water that was only treated with nanofiltration. New developed method for Fe and Mn separation by nanofiltration without pretreatment has great constructive and economical advantages over conventional iron and manganese removal.

SEZONSKE PROMJENE BIOLOŠKE POTROŠNJE KISIKA TIJEKOM PROČIŠĆAVANJA OTPADNE VODE GRADA VINKOVACA

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Biokemijska potrošnja kisika (BPK) je parametar kojim se određuje masena koncentracija otopljenog kisika potrebna za biološku oksidiraju organske i/ili anorganske tvari u vodi. Kisik u vodi dolazi putem dvije reakcije i to procesom fotosinteze koju obavljaju autotrofne biljke te procesom otapanja kisika iz atmosfere. Količina otopljenog kisika iz atmosfere ovisi o parcijalnom tlaku i temperaturi. Porastom temperature u vodi smanjuje se količina kisika. Također na koncentraciju kisika u vodi utječu procesi truljenja organskih tvari. Postoje godišnje i dnevne oscilacija koncentracije kisika u vodi. Godišnje oscilacije koncentracije kisika ovise o parcijalnom tlaku i temperaturi vode u pojedinom periodu godine, dok dnevne oscilacije ovise o dijelu dana pri čemu je ključan čimbenik temperatura vode jer topljivost kisika značajno raste s opadanjem temperature vode. Sadržaj kisika je obično manji u odnosu na koncentraciju pri zasićenju uslijed potrošnje kisika za oksidaciju različitih organskih i anorganskih tvari u vodi. Koncentraciju kisika u vodi možemo odrediti kao kemijsku potrošnju kisika (KPK) i biološku potrošnju kisika. Biološka potrošnja kisika se najčešće izražava kao BPK_5, odnosno količina kisika potrebna za biokemijske procese tijekom 5 dana. Određivanje BPK vrijednosti se provodi tako da se odredi trenutna količina otopljenog kisika i količina otopljenog kisika preostala nakon nekog vremena, odnosno 5 dana na 20 °C. Dobivena razlika pokazuje količinu kisika potrebnu za odvijanje biokemijskih procesa. U ovom radu će biti prikazane promjene BPK_5 vrijednosti u pročišćenoj otpadnoj vodi grada Vinkovaca tijekom petogodišnjeg razdoblja (2010.-2015.), odnosno utjecaj pojedinog dijela godine na količinu kisika potrebnog da se razgradi biološki razgradiva organska tvar u vodi posredstvom aerobnih mikroorganizama izražene kao BPK_5 vrijednost.

SEASONAL VARIATION OF BIOLOGICAL OXYGEN DEMAND DURING WASTEWATER TREATMENT IN TOWN OF VINKOVCI

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Biochemical oxygen demand (BOD) is a parameter that determines the weight concentration of dissolved oxygen required to oxidize biological organic and/or inorganic substances in the water. Oxygen presence in water is a result of two reactions: photosynthesis process performed by plants and autotrophic organisms, and solubility of air in the water. The amount of dissolved oxygen in the water derived from atmosphere depends on the partial pressure and temperature. Increasing of water-body temperature can reduce the concentration of oxygen, as well as the presence of elevated amount of organic substances. The oxygen concentration in water-body can fluctuate in an annual and daily basis. Annual fluctuations depends on the air pressure and water temperature, while daily oscillations depends on the time of day since decreasing of water temperature casing increasing of oxygen concentration un water. The oxygen content is typically lower than the saturation concentration of oxygen consumption due to the oxidation of various organic and inorganic substances in the water. The concentration of oxygen in the water can be determined as chemical oxygen demand (COD) and biological oxygen demand (BOD). Biochemical Oxygen Demand is usually expressed as BOD_5, i.e. the amount of oxygen required for biochemical processes during 5 days. Determination BOD value implies the determination of current oxygen concertation and oxygen concentration in the same water sample stored for five days at 20 °C. This paper investigated the effect of seasonal variation onto BOD_5 value of the wastewater purified in wastewater-treatment plant in the town of Vinkovci during five-years- period (from 2010 to 2015).

PROCJENA RANJIVOSTI I RIZIKA PODZEMNIH VODA U ZAŠTITI VODE ZA LJUDSKU POTROŠNJU

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Gotovo 90 % vodoopskrbe u Hrvatskoj ostvaruje se iz zaliha podzemnih voda, stoga je važno mnogo pažnje posvetiti odgovarajućoj zaštiti tog prirodnog resursa. Multiparametarske metode procjene ranjivosti, opasnosti i rizika sve se više koriste u tu svrhu. Te su metode u svijetu dobro poznate. Neke su već ušle u zakonsku regulativu zaštite pitke vode sve većeg broja država, a u Hrvatskoj se zasad koriste kao dodatni alat kod definiranja zona sanitarne zaštite izvorišta pitke vode. U ovom radu bit(i) će prikazan postupak procjene ranjivosti, opasnosti i rizika u tri faze, kao što je predloženo u smjernicama projekta COST 620, a bit će iznijeti i prijedlozi prilagodbe i primjene postupaka na istraživanom području. Osim što se pokazala vrlo korisnom u pogledu pristupa zaštiti podzemne vode, prezentirana metodologija također se može koristiti kao podloga za prostorno planiranje. Njome se mogu izdvojiti dijelovi slivnog područja koji su zbog svojih prirodnih obilježja ranjiviji na ljudske utjecaje, te kao takvi zahtijevaju oprez, ali i oni manje ranjivi koji su pogodni za daljnji razvoj područja bez ugrožavanja kvalitete podzemne vode. Obrađivana metodologija također može ukazati na kritične točke koje bi trebale biti uvrštene u prioritetne sanacijske zahvate kako bi se smanjila mogućnost pogoršanja kakvoće podzemne vode.

GROUNDWATER VULNERABILITY AND RISK ASSESSMENT FOR PROTECTION OF WATER FOR HUMAN CONSUMPTION

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About 90% of water supply in Croatia is based on groundwater reserves so great attention must be given to its protection. Multiparametric methods for vulnerability, hazard and risk assessment can be used for this purpose. These methods are well known in the world. Some of them have already entered the groundwater protection legislation of increasing number of states and in Croatia are used as an additional tool for determining the sanitary protection zones of drinking water sources. This paper presents the procedure of vulnerability, hazard and risk assessment in three stages, as proposed in the guidelines of the project COST 620, as well as some proposals how to adapt the application on the study area. Besides being proved very useful in the aspect of groundwater protection, presented methodology can also be used as a background for land-use planning. It identifies parts of the catchment that are, due to its natural features, more vulnerable to human impact and as such require caution, but also the less vulnerable parts suitable for further development of the region without compromising the groundwater quality. Presented methodology can also indicate the critical points in catchment area that should be included in the priority remedial actions to reduce the possibility of deterioration in the quality of groundwater.

EFFECTS OF ANIONS ON ADSORPTION OF ARSENIC BY AMINO-FUNCTIONALIZED MULTI-WALLED CARBON NANOTUBES

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The adsorption of arsenic(III) ion from water on amine-functionalized multi-walled carbon nanotubes (MWCNTs-NH_2) was investigated in the presence of inorganic electrolyte anions (Cl^-, SO_4^{2-}, NO_3^-, PO_4^{3-}). The adsorbent MWCNTs-NH_2 is mesoporous based on the average pore diameter of 14.6 nm. pH_{PZC} was 8. All adsorption experiments were performed according to the batch method by continuous shaking for 48 h. The background solution was 0.01 M solution of Cl^-, SO_4^{2-}, NO_3^- and $H_2PO_4^-/HPO_4^{2-}$ ions in deionized water (single ion system). Initial concentration of heavy metal ions in suspension ranged from 50 to 3000 μg/L. The amount of MWCNTs-NH_2 ranged from 1-5 mg. The equilibrium adsorption data were modelled using Freundlich and Langmuir adsorption isotherms, where the it was showed that Langmuir better describe teh adsorption process. The results indicate that the adsorption affinity of MWCNTs-NH_2 for As(III) in the presence of all investigated ions were in range from 2.8 to 11 mg/g. Adsorption capacity in the presence of Cl^- was slightly improved, hence for all other investigated inorganic anions decreases in the following order $NO_3^- > SO_4^{2-} > PO_4^{3-}$.

KVALITETA VODE IZ PRIVATNIH ZDENACA U BRODSKO-POSAVSKOJ ŽUPANIJI OD 2011. DO 2015. GODINE

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Procjenjuje se da je na javnu vodoopskrbu u Hrvatskoj priključeno oko 87,7 %, a na lokalnu vodoopskrbu oko 3,2 % stanovništva. Ostali dio stanovništva opskrbljuje se vodom putem individualne vodoopskrbe (zdenci, cisterne, vodotoci).
Cilj rada je prikazati mikrobiološku i kemijsku kvalitetu vode iz privatnih zdenaca na području Brodsko-posavske županije u periodu od 2011. do 2015. godine.
U dostavljenim uzorcima vode analizirani su mikrobiološki parametri (ukupni broj bakterija na 22 °C i 37 °C, ukupni koliformi, *Escherichia coli* i enterokoki) te nitriti, nitrati i amonijak. Zdravstvena ispravnost uzoraka ocjenjena je sukladno Zakonu o vodi za ljudsku potrošnju (NN 56/13).
U petogodišnjem razdoblju analizirano je 1606 uzoraka vode iz privatnih zdenaca na mikrobiološke i 1239 uzoraka na kemijske parametre. Zbog mikrobioloških parametara nije odgovaralo 73,04 % uzoraka, a 26,55 % nije odgovaralo zbog kemijskih parametara.
Prolaskom vode kroz slojeve zemlje ona bi se trebala osloboditi mikroorganizama, ali se to katkad i ne dogodi, pogotovo u plićim slojevima. Ako su u vodi prisutni koliformni mikroorganizmi, velika je vjerojatnost da su prisutni i patogeni mikroorganizmi. Hidrične epidemije se šire i prenose kontaminiranom vodom. Danas su rijetka pojava, ali su ranijih desetljeća bile česte i za posljedicu imale visoku smrtnost.

WATER QUALITY OF PRIVATE WELLS IN BROD-POSAVINA COUNTY FROM 2011 TO 2015

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It is estimated that in Croatia, about 87.7% of the population is connected to the public water supply system and 3.2% is connected to the local water supply. The rest of the population is supplied with water from individual water supply (wells, cisterns, streams).
The aim of this paper is to show quality of private wells in the area of Brod-Posavina County from 2011 to 2015.
Microbiological parameters (total bacteria, total coliforms, *Escerichia coli* and enterococci) and nitrites, nitrates and ammonia were analyzed in the delivered water samples. Health quality of the samples was evaluated in accordance with the Regulations on drinking water safety (NN 56/13).
In the five-year period, 1606 water samples from private wells were analyzed on microbiological and 1239 on chemical parameters. 73.04% of samples failed because of microbiological parameters and 26.55% of samples failed because of chemical parameters.
The number of microorganisms in water should be reduced by passing water through the layers of soil but it sometimes does not happen, especially in shallow layers. If there are coliform microorganisms present in the water, it is very likely that there are pathogenic microorganisms present too. Waterborne diseases are transmitted by contaminated water. Today, they are rare, but in earlier decades they were frequent and resulted in a high mortality rate.

INVESTIGATION OF THE POSSIBILITY FOR APPLICATION OF NATURAL INORGANIC SORBENT (AKSIL) FOR HEAVY METALS REMOVAL FROM WATER RESOURCES

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Heavy metal pollution is a serious problem for the environment, and therefore it is very important to enable cost-effective heavy metal ions removal from contaminated water. Among viable options, natural inorganic materials are considered as possible sorbents for the heavy metal ions elimination. The aim of this work is to investigate the adsorption ability of aksil, natural mineral collected in the north east of the Republic of Macedonia in Kriva Palanka, to remove chromium (VI) ions from aqueous solutions. The adsorption experiment was performed at constant room temperature and initial Cr(VI) ions concentration at different pH of the solution. The equilibrium data were analyzed by Langmuir isotherm and maximal adsorption capacity was determined. The following experimental techniques were used for aksil characterization: XRD, TGA-DTA and FT-IR. The surface area of the sorbent was measured by BET method. The results confirm the possibility of applying the natural aksil as effective sorbent for heavy metals removal from water resources.

CREATING A MODEL FLOOD RISK ANALYSIS AND FLOOD WAVES AT THE BASIN OF THE STREAM GRADISCAK

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This paper presents the developing flood risk model and analysis of flood waves for Gradiscak stream. According to the type of flooding, Gradiscak is an erosion watercourse. It is located in the Medjimurje County and belongs to the catchment area of the river Mura. Due to its geometric elements, Gradiscak stream, at high water levels, spills out of its core natural riverbeds and floods the surrounding area.
At the beginning, using topographic maps (1: 5000) Catchment Boundary and Areas were determined. Data mining, did not find empirical measurement of meteorological and hydrological data. The values for maximum flow rates are calculated by D. Srebrenović. The calculated data was used for developing a model of flood lines (water face) for return period of 1, 5, 10, 25, 50 and 100 years, using Hydrologic Engineering Centers River Analysis System (HEC-RAS) ver. 5.0.
After calibration of the model, an experiment began that involved determining the flood line that is, reducing the flooded areas by construction retention.

EFFECT OF COMPETITIVE IONS ON THE ARSENIC REMOVAL FROM WATER BY NANOSTRUCTURED Fe-Mn BINARY OXIDE

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In order to develop an economical, reliable, and effective technique for removing both As(III) and As(V) simultaneously from arsenic contaminated drinking water, nanostructured Fe-Mn binary oxides were fabricated. This paper investigates the effects of phosphate (9.5-95 mg/L), sulphate (9.6-96 mg/L) and humic acid (HA; 4-12 mg DOC/L) on the removal of As(III) and As(V) by nanostructured Fe-Mn binary oxides. The presence of sulphate had a negligible effect on As(III) and As(V) removal. In contrast, phosphate reduced the uptake of As(III) and As(V) by 36 and 33%, respectively, depending on the applied Fe-Mn binary oxide. However, As(III) and As(V) removals were still above 80% in the presence of 47 mg PO_4^{3-}/L. Similar effects for these coexisting anions have been previously reported. As(III) and As(V) uptake was not affected by humic acid (up to 12 mg/L as DOC) (Fig. 1) indicating the Fe–Mn adsorbents are also effective for arsenic removal when humic acid is present.

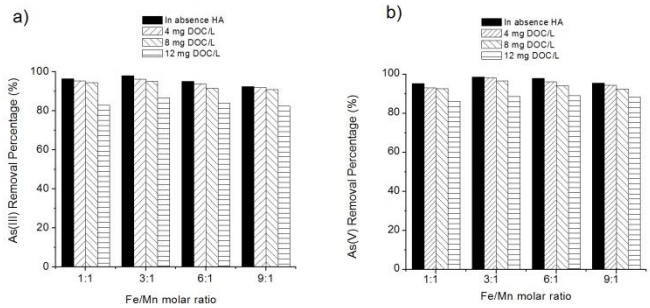

Fig. 1. *Effect of coexisting HA on a) As(III) and b) As(V) removal by Fe-Mn binary oxides with different Fe/Mn molar ratios. Initial As(III)/As(V) concentration 200 µg/L, adsorbent dose 0.5 g/L, pH 7.0 ± 0.2.*

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PIVSKI TROP I SJEMENKE GROŽĐA U OBRADI OTPADNIH VODA

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Zagađivanje vodnih resursa spojevima dušika kao što su nitrati, nitriti i amonijak, značajan je ekološki i zdravstveni problem. Stoga ih je važno ukloniti, osobito iz otpadnih voda, kako bi se zaštitio okoliš. Najčešća metoda uklanjanja nitrata je ionskom izmjenom i uključuje korištenje raznih tipova ionskih masa. Zadnjih desetljeća, pored komercijalnih ionskih izmjenjivača, mnoge studije ispitivale su mogućnost uklanjanja nitrata adsorpcijom na prirodne adsorbense animalnog ili biljnog podrijetla.

U ovom istraživanju ispitao se učinak uklanjanja nitrata, odnosno adsorpcije nitrata iz otpadnih voda mliječne industrije na modificirani pivski trop i sjemenke grožđa. Dobiveni adsorpcijski kapaciteti izraženi su preko adsorpcijskih ravnotežnih modela (Freundlichove i Langmuirove adsorpcijske izoterme). Rezidualna koncentracija nitrata nakon adsorpcije određena je spektrofotometrijski s 2,6-dimetilfenolom. Dobivene vrijednosti pokazala su dobro slaganje s Freundlichovim modelom adsorpcijske izoterme (pivski trop i sjemenke grožđa).

Rezultati istraživanja bi mogli voditi k razvoju novih i jeftinijih adsorpcijskih materijala za učinkovito uklanjanje nitrata iz otpadnih voda.

BREWERS' SPENT GRAIN AND GRAPE SEED IN WASTEWATER TREATMENT

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Pollution of water resources by nitrogenous compounds, such as nitrate, nitrite and ammonium presents significant environmental and health problem. Therefore, it is important to remove them, especially from wastewater treatment effluents in order to contribute to healthier environment. The most common method for nitrate removal is ion exchange that implies usage of various resin types. Besides resins, during last decades many studies investigated the possibility of nitrate removal by adsorption on natural adsorbents of vegetative and animal or mineral origin.

In this research, the removal i.e. adsorption of nitrate from *wastewater* generated from *dairy industry* onto modified brewers' spent grain and grape seed was investigated. Obtained adsorption capacities were expressed through adsorption equilibrium models (Freundlich's and Langmuir's adsorption isotherms). The residual concentration of nitrate after the adsorption was determined by spectrophotometric method with 2.6-dimethylphenol. The adsorption fitted well with the Freundlich model (brewers' spent grain and grape seed).

This study can contribute to the development of new low-cost adsorbent for efficient nitrate removal from wastewater.

KAKVOĆA VODA NA HIDROMELIORIRANIM POLJOPRIVREDNIM POVRŠINAMA

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Ispiranje organske tvari s poljoprivrednih površina utječe na kakvoću vode riječnih sustava. U ovom radu provedeno je istraživanje organske tvari u drenažnoj vodi, na melioracijskom pokusnom polju (45º33'52"N/16º31'33"E), na hidromelioriranom poljoprivredno područje u Hrvatskoj. U istraživanim uzorcima određeni su parametri: otopljeni i čestični organski ugljik (DOC i POC) kao i organske i anorganske reducirane vrste sumpora (RSS). Ukupni organski ugljik (TOC = POC + DOC) uključuje POC te njegova vrijednost ovisi i o količini suspendiranih organskih tvari. Koncentracije TOC kretale su se u rasponu od 1,17 do 13,44 mg C dm^{-3}, s prosječnom vrijednošću od 7,11 ± 3,71 mg C dm^{-3}. Frakcija POC u TOC je bila do 13 puta niža u odnosu na DOC frakciju u slučaju velike količine oborine. Najveća izmjerena koncentracija RSS je bila 0,4 μM. Otopljena organska frakcija nehlapljivih sumpornih spojeva bila je manja (do 36 %). Za usporedbu, u vodi anoksičnih sustava, RSS mogu biti prisutni u koncentraciji do nekoliko nM.

WATER QUALITY IN HYDROAMELIORATED AGRICULTURAL AREAS

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The soil-derived organic materials are of interest due the impact on the riverine systems. The high organic matter content in surface waters have negative effects on the water quality and water habitats. This study provides organic matter investigation in the drainage water of the experimental amelioration fields in the Sava river valley (45º33'52''N/16º31'33''E), the hydroameliorated agricultural area in Croatia. Dissolved and particulate organic carbon (DOC and POC) paralell with organic and inorganic reduced sulfur species (RSS) were measured in the investigated samples. Total organic carbon (TOC = POC + DOC) includes POC and is therefore affected by pronounced fluctuations in suspended solids in riverine systems. The average concentration of TOC was 7.11 ± 3,71 mg C dm^{-3} with a range from 1.17 to 13.44 mg C dm^{-3}. POC fraction of TOC was by a factor of 13 lower in comparison to the DOC fraction in the case of higher amount of precipitation. The RSS concentration was up to 0.4 μM. The dissolved non-volatile organic sulfur fraction was lower (up to 36%). For comparison, in anoxic fresh waterlake systems RSS can be measured in concentration of several nM.

ANAEROBNA OBRADA INDUSTRIJSKIH OTPADNIH VODA IZ PREHRAMBENE INDUSTRIJE: OPRAVDANOST I ISKUSTVA

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U radu je prikazana opravdanost primjene anaerobne obrade otpadnih voda iz prehrambene industrije na primjeru pivarske i mljekarske industrije. Otpadne vode prehrambene industrije većinom se ispuštaju u javni kanalizacijski sustav ili obrađuju aerobnim biološkim metodama. Porastom cijena energije i popularizacijom obnovljivih izvora, sve se više razmatra anaerobna obrada otpadnih voda prehrambene industrije, obzirom na visok sadržaj organskih tvari u njima. Te vode u pravilu imaju visoko organsko opterećenje (vrijednosti KPK otpadne vode pivarske industrije se kreću od 2.500-4.000 mg/L, a mljekarske industrije od 1.500-3.000 mg/L), koje je primjenom anaerobne obrade moguće sniziti do 90 %. Tako obrađene vode su, prema KPK vrijednostima, sličnije komunalnim otpadnim vodama te stoga i prihvatljivije za ispuštanje u javni kanalizacijski sustav. Uz snižavanje vrijednosti KPK, anaerobnom obradom proizvodi se bioplin, čijim je iskorištavanjem moguće supstituirati do 20 % prirodnog plina u proizvodnom procesu. Također, otpadnoj vodi moguće je dodavati i drugi tekući otpad (npr. kvasac, sirutka, tekući proizvodi s isteklim rokom trajanja), koji može dodatno povećati proizvodnju bioplina do 60 %, bez negativnih posljedica na provedbu procesa. Uzimajući u obzir snižavanje pristojbi na otpadne vode i smanjenje potrošnje prirodnog plina, period povrata investicije u ovakve sustave iznosi od 3 do 5 godina što njihovu primjenu čini ekonomski opravdanom.

ANAEROBIC TREATMENT OF INDUSTRIAL WASTE WATER FROM FOOD AND BEVERAGE INDUSTRY: FEASIBILITY AND EXPERIENCE

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In this paper the feasibility of anaerobic treatment of wastewater from brewery and dairy industry is presented. In most cases such wastewaters are discharged into the public sewer system or treated by aerobic biological methods. With increasing energy prices and popularization of renewable energy sources, the anaerobic treatment is increasingly being considered due to wastewaters high organic matter content. These wastewaters generally have high organic load (COD values between 2,500-4,000 mg/L and 1,500-3,000 mg/L for brewery and dairy wastewater respectively), which can be reduced up to 90% with the application of anaerobic treatment. According to COD values the treated wastewater are more similar to the municipal wastewater and are more suitable for discharge in the public sewer system. In addition to COD reduction, biogas produced during anaerobic treatment can substitute up to 20% of natural gas in the production process. Moreover, other liquid waste (e.g. yeast, whey and spoiled liquid products) can be added to the wastewater, which can further increase the biogas production up to 60%, without adverse effects to the anaerobic process. Considering the reduction in environmental taxation and natural gas use the payback period of such systems is 3 to 5 years, which makes such application feasible.

IONSKA KROMATOGRAFIJA U ANALIZI VODA

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Ionska kromatografija je tekućinska kromatografija odvajanja iona pomoću separacijske kolone i primarno se primjenjuje za određivanje smjese aniona i kationa, kako organskih tako i anorganskih. Ionsko-kromatografski proces odvajanja temelji se na ionskoj izmjeni na stacionarnoj fazi s aktivnim pozitivno ili negativno nabijenim funkcionalnim skupinama, na osnovi različitih afiniteta prema nepokretnoj fazi.

Tradicionalno se za eluaciju aniona koriste vodene otopine karbonatnih soli (najčešće $NaHCO_3$ i Na_2CO_3) u različitim omjerima, dok se kationi analiziraju prvenstveno primjenom kompleksirajućih agensa, kiselih eluensa kao što je dipikolinska kiselina. Detekcija (identifikacija i kvantifikacija) ispitivanih iona vrši se pogodnim detektorom, najčešće konduktometrijskim, u kombinaciji sa supresorom (anioni), čija je uloga smanjiti električnu vodljivost eluensa, odnosno povećati signal analita.

Ionska se kromatografija odlikuje visokom osjetljivošću, preciznošću, kratkim vremenom analize, mogućnošću istovremenog određivanja aniona i kationa, kao i malim volumenom uzorka potrebnim za analizu. Upravo su ovo razlozi zbog kojih je ionska kromatografija kao analitička tehnika zamijenila većinu „mokrih“ kemijskih tehnika određivanja ionskih vrsta u vodi za ljudsku potrošnju, površinskoj, podzemnoj te otpadnoj vodi.

ION CHROMATOGRAPHY IN WATER ANALYSIS

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Ion chromatography is a form of liquid chromatography that separates ions with the help of separation column and it is primarily used for determination of anions and cations, both organic and inorganic. Separation process is based on an ion exchange on stationary phase, that displays positively or negatively charged ionic functional groups, according to different affinity for the stationary phase.

Most commonly used eluents for anion elution are aqueous solutions of carbonate salts (mostly $NaHCO_3$ i Na_2CO_3) at various proportions, while cations are analysed using a complexing agent, an acid eluent, such as dipicolinic acid. Determination (identification and quantification) is carried out by suitable detector, in often cases a conductivity detector, combined with a suppressor (anions) whose main role is to suppress the conductivity of the eluent and also increase the analyte ion signal.

Ion chromatography is characterized by high sensitivity, precision, short time of analysis, the posibility of simultaneous determination of anions and cations, and a small volume of sample required for analysis. These are the reasons why ion chromatography as an analytical technique has replaced most of the „wet“ chemical techniques for determination of ion species in water for human consumption, surface, ground and waste water.

CHARACTERISATION OF NATURAL ORGANIC MATTER IN WATER COAGULATED WITH $FeCl_3$

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This study examines the impact of the $FeCl_3$ coagulation process on the concentration and characteristics of natural organic matter (NOM) in water. The study was conducted on groundwater from AP Vojvodina which has a high NOM content (5.18 ± 0.7 mg C/L DOC) of predominantly hydrophobic character (SUVA 3.98 ± 0.02 $Lm^{-1}mg^{-1}$). The dominant NOM fraction is hydrophobic fulvic acid, FAF (74%), while the hydrophilic fraction (acid - HPIA and non-acidic - HPINA) represents only 26%, in line with our previous results. The NOM present in water, especially the HPINA fraction, exhibits high reactivity with chlorine (THM formation potential, THMFP is 264 ± 30 mg/L). Coagulation of water at different $FeCl_3$ doses (90 and 120 mg/L) enabled 17% and 47% reduction of DOC content and 45% and 62% of THMFP, respectively. The DOC removal from water can be explained as a result of partial removal of the FAF faction, whose share in coagulated water decreases to 57% and 36%, depending on the coagulant dose (Fig. 1). The coagulation process resulted in a decrease in NOM fraction reactivity to formation of trihalomethanes (Fig. 2).

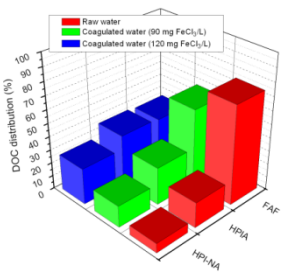

Fig. 1.

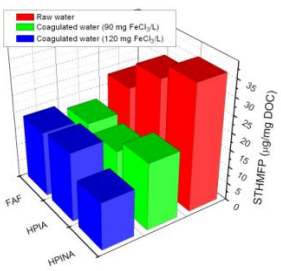

Fig. 2.

Fig. 1. Distribution of DOC in NOM fractions of the raw and coagulated water
Fig. 2. Specific THMFP in NOM fractions of the raw and coagulated water

Results indicate that during the treatment of water with predominantly hydrophobic organic matter, the conventional coagulation process by iron salts can provide a high degree of NOM removal, which is a trihalomethanes precursor (dominant disinfection by-products).

POVEZANOST KEMIJSKIH I MIKROBIOLOŠKIH POKAZATELJA U DEMINERALIZIRANOJ VODI

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Voda je nezamjenjiva u većini tehnoloških procesa. Za industrijske potrebe vodovodnu vodu potrebno je pripremiti (pročistiti od prisutnih otopljenih soli), kako bi se koristila kao tehnološka voda, kemijski čista voda ili demineralizirana voda.
Ovim istraživanjem se u uzorcima demineralizirane vode određivala pH vrijednost, elektrovodljivost kao i prisutnost aerobnih mezofilnih bakterija (AMB). Cilj ovoga istraživanja je bio utvrditi postoji li razlika u vrijednostima mjerenih kemijskih pokazatelja između uzoraka u kojima su izolirane AMB i onih u kojima ih nije bilo.
Analizirano je 100 uzoraka, koji su uzeti nakon pripreme vode, a pH vrijednost i elektrovodljivost su mjereni pomoću kalibriranih uređaja na mjestu uzorkovanja. AMB su određivane metodom kultivacije pri 37 °C u trajanju od 48h koristeći certificirane mikrobiološke podloge.
Kolmogorov-Smirnov test je pokazao normalnu raspodjelu rezultata, pa su se u daljnjoj statističkoj obradi koristile parametrijske metode. Od 100 analiziranih uzoraka u 72 je dokazana prisutnost AMB, pri čemu je medijan pH vrijednosti u uzorcima sa AMB iznosio 7,49 dok je u negativnim uzorcima iznosio 7,43. Medijan elektrovodljivosti u uzorcima s AMB je iznosio 0,5 μS/cm, odnosno u uzorcima bez AMB 0,4 μS/cm. Za usporedbu pH vrijednosti i elektrovodljivosti između pozitivnih i negativnih uzoraka se koristio T-test. Pri tom je za pH vrijednost t=-0868, a za elektrovodljivost t=-1,433.
Iz dobivenih rezultata nije određena statistički značajna razlika između pH vrijednosti i elektrovodljivosti u uzorcima bez i sa AMB.

RELATIONSHIP OF CHEMICAL AND MICROBIOLOGICAL PARAMETERS IN DEMINERALIZED WATER

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Water is indispensable in most industrial processes. For industrial applications, it is necessary to purify tap water (to remove present dissolved salts) for its use as process water, chemically pure water or demineralized water.
During this research in demineralized water samples pH, conductivity and presence aerobic mesophilic bacteria (AMB) were determined. The aim of this study was to determine the difference in values of measured chemical parameters between samples with isolated AMB and those without bacteria.
A total of 100 samples, which were taken after the preparation of the water were analyzed. The pH and conductivity were measured using calibrated devices at the point of sampling. AMB were determined by cultivation at 37 °C for 48 h using certified microbiological media.
Kolmogorov-Smirnov test showed normal distribution of results, and therefore in further statistical analysis were used parametric methods. Among 100 samples, the AMB has been detected in 72 samples, and the median pH value in the samples with the AMB was 7.49 while in the negative samples it was 7.43. The median conductivity in samples with AMB amounted to 0.5 μS/cm, and in samples without AMB it was 0.4 μS/cm. The T-test was used for the comparison of the pH and conductivity value among the positive and negative samples and obtained values were t = -0868 for the pH value and t=-1.433 for conductivity.
The obtained results showed that there is no statistically significant difference between pH and conductivity in the samples with and without AMB.

MONITORING POPULACIJE DABRA (*CASTOR FIBER* L.) U PARKU PRIRODE KOPAČKI RIT

Vlatko Rožac

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Monitoring populacije dabra (*Castor fiber* L.) u Parku prirode Kopački rit započet je 2007. godine. Prikupljani su podaci o dinamici populacije na temelju uspostava i korištenja obiteljskih teritorija. Krajem 2015., odnosno početkom 2016. godine, zabilježeno je minimalno 36 teritorija, dok je prvi teritorij zabilježen 2002. godine. Temeljem višegodišnjeg monitoringa može se zaključiti kako je dinamika populacije dabra (*Castor fiber* L.) u Parku prirode Kopački rit, nakon vrlo kratkog perioda naseljavanja novog staništa, ušla u fazu brzog rasta. S obzirom na veliku biomasu makrofitske vegetacije, koja je dabrovima primarni izvor hrane u vegetacijskom periodu, te dominantne šume bijele vrbe (*Salix alba* L.) u poplavnom području, koja je kao predstavnik mekih listača primarni izvor hrane izvan vegetacijskog perioda, Kopački rit predstavlja idealno i još uvijek neograničeno stanište za dabrove. Izostanak glavnog predatora vuka (*Canis lupus* L.), te do sada ne zabilježena predacija od strane čaglja (*Canis aureus* L.) i neantagonistički odnos s vidrom (*Lutra lutra* L.) dodatno daje uporište ovoj tvrdnji. Stoga je za očekivati daljnji brzi rast populacije dabra (*Castor fiber* L.). Pored toga, u 2015. godini zabilježen je prvi teritorij izvan poplavnog područja i to unutar mreže melioracijskih kanala pa je za očekivati i daljnje širenje u tom smjeru te skora kolizija s čovjekom, odnosno upad u poljoprivredne površine.

MONITORING OF THE EUROPEAN BEAVER (*CASTOR FIBER* L.) POPULATION IN KOPAČKI RIT NATURE PARK

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Monitoring of the European Beaver (*Castor fiber* L.) population in Kopački Rit Nature Park started in 2007. The collected data of the population dynamics were based on the beaver family territories foundation and usage. At the end of 2015, and at the beginning of 2016, at least 36 territories were recorded, whereas the first territory was recorded in 2002. After several years of monitoring, it could be concluded, that the European beaver (*Castor fiber* L.) population dynamics in Kopački Rit Nature Park, after a very short period of a new habitat colonization, reached the second fast growing phase. Considering a huge macrophyte biomass, which is a primary food source during the vegetation period, and dominant forests of the white willow (*Salix alba* L.) in the floodplain, which is a softwood species and because of that is the primary food source beyond the vegetation period, Kopački rit is ideal and still an infinite habitat for the European beavers. The lack of the main predator, being the grey wolf (*Canis lupus* L.), the unrecorded predation by the golden jackal (*Canis aureus* L.) and non-antagonistic relationship with the otter (*Lutra lutra* L.) supports that assertion. Besides that, the first territory outside the floodplain was recorded in 2015. It was founded inside a melioration channel network. Thus, further spreading of the beavers in that direction is expected soon, as well as a collision with humans and intrusion in the agriculture fields.

BIOSORPTION OF Mn (II) IONS FROM WATER RESOURCES BY USING AGRICULTURAL WASTE

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The contemporary eco-process engineering emphasizes the need of adequate and sophisticated methods for natural- and wastewater treatment, regardless of the source's geogenic or anthropogenic origin of pollution.
The process of biosorption of heavy metals Mn(II) from water resources through application of natural and modified biosorbent of domestic origin has been performed within this work as an alternative bioseparation technique.
The main goal of this article is to develop an adequate model for the process of separation of heavy metals using natural and modified sunflowers husks (agricultural waste).
The influence of several operation parameters on the heavy metal removal efficiency as well as on the adsorption capacity of applied biosorbent was investigated during the experimental work: initial adsorbate concentration, biosorption time and biosorbent quantity.

IZBOR MEMBRANSKIH FILTARA ZA MJERENJE OTOPLJENOG ORGANSKOG UGLJIKA

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U okviru ovoga rada provedena je analiza ponašanja pet različitih membranskih filtara prilikom njihove pripreme za filtraciju uzoraka za određivanje sadržaja otopljenog organskog ugljika (engl. *dissolved organic carbon – DOC*). Upotrijebljeni su membranski filtri nominalne veličine pora 0,45 μm koji se uobičajeno koriste za izdvajanje otopljenog organskog ugljika, dijela ukupnog organskog ugljika (engl. *total organic carbon – TOC*) koji ostaje u otopini nakon filtracije. Pokazano je s kojim će postupkom kondicioniranja membranskih filtara smetnje uzrokovane otpuštanjem organskog ugljika s membrana biti minimizirane i koji je od ispitivanih filtara najbolji za analizu otopljenog organskog ugljika. Provedena su dva tipa ispitivanja: pranje filtara i test namakanja. Tijekom ispitivanja sustavno su uzimani uzorci radi analize koncentracije otopljenog organskog ugljika u vodi i UV apsorbancije na valnoj duljini λ = 254 nm. Najbolje rezultate pokazao je filtar proizvođača Filter Bio, izrađen od polietersulfona prilikom primjene postupka pranja.

SELECTION OF FILTER MEMBRANES FOR DISSOLVED ORGANIC CARBON MEASUREMENT

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Five different membrane filters from the three manufacturers were evaluated for dissolved organic carbon (DOC) and ultraviolet (UV_{254}) absorbance measurements. The study was performed to investigate an appropriate method for minimizing interference of organic constituents for DOC determination in filtrated samples. Filters with nominal pore size of 0.45 μm were used to comply with the operational definition of DOC, which is defined as a part of the total organic carbon (TOC) remaining in solution after filtration through a 0.45 μm filter. Two different types of tests were conducted on the filters in order to determine the behavior of the filters with respect to leaching of organics, when subjected to different test conditions. The filtration test showed better results than the soak test and the polyethersulfone (PES) filter from manufacturer Filter Bio was the best option among all the tested filters.

KAKVOĆA VODE RIJEKE RADOBOLJE, BOSNA I HERCEGOVINA

Svjetlana Stanić-Koštroman, Dragan Škobić, Anita Dedić, Ana Šljivić, Nevenko Herceg

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U radu je prikazana procjena kakvoća vode rijeke Radobolje temeljem zajednica fitobentosa i makrozoobentosa te fizikalno-kemijskih pokazatelja. Istraživanjem su obuhvaćene četiri postaje duž longitudinalnog profila rijeke, od izvora do ušća. Na navedenim postajama obavljena su mjesečna uzorkovanja zajednica bentoskih organizama te terenska mjerenja fizikalno-kemijskih značajki vode. Za procjenu kakvoće vode korišteni su indeks saprobnosti (Pantle & Buck, 1995) i prošireni biotički indeks – EBI (Ghetti, 1986). Ukupno su zabilježene 93 svojte algi i 36 svojti makroskopskih beskralješnjaka. Primijenjeni biološki indeksi te izmjereni fizikalno-kemijski parametri kretali su se od oligosaprobnog stupnja saprobnosti, odnosno I. kategorije kakvoće vode za izvor Radobolje do betamezosaprobnog stupnja ili II. kategorije kakvoće vode na ušću ove rijeke u Neretvu.

WATER QUALITY OF THE RADOBOLJA RIVER, BOSNIA AND HERZEGOVINA

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This paper brings water quality assessment for the Radobolja River using phytobenthos and macrozoobenthos communities and physical and chemical parameters. Research included four sites along the longitudinal profile of the river, from the river spring to its mouth. Monthly sampling was done on these sites, on benthos communities, together with field measurements of physical and chemical parameters of the water. Saprobity index (Pantle & Buck, 1995) was used for the water quality assessment, together with extended biotic index - EBI (Ghetti, 1986). A total of 93 algae taxa and 36 taxa of macroscopic invertebrates was found. Applied biological indices and measured physical and chemical parameters ranged from oligosaprobic saprobity level, respectively the first category of water quality for spring site, to beta-mesosaprobic level or the second category of water quality at the mouth of the Radobolja River into the Neretva River.

CIJANOBAKTERIJE U POPLAVNOM PODRUČJU KOPAČKOG RITA

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Sveučilište Josipa Jurja Strossmayera u Osijeku, Odjel za biologiju, Cara Hadrijana 8/A, 31000 Osijek, Hrvatska

Riječna poplavna područja poznata su kao visoko produktivni ekološki sustavi, obično eutrofni i/ili hipertrofni, s učestalim razvojem gustih populacija cijanobakterija. Masovan razvoj cijanobakterija može uzrokovati brojne negativne posljedice na vodene ekološke sustave kao što su smanjena prozirnost vode i biološka raznolikost, pojačana primarna produkcija i nedostatak kisika u pridnenim slojevima vode. U Kopačkom je ritu utvrđeno više od 70 vrsta cijanobakterija, a najzastupljenije su *Cylindrospermopsis raciborskii*, *Aphanizomenon flos-aquae*, *Planktothrix agardhii*, *Trichormus catenula*, *Dolichospermum circinale*, *D. planctonicum*, *Limnothrix redekei*, *Pseudanabaena limnetica* i *Planktolyngbya limnetica*. Ove su vrste često prisutne tijekom cijele godine, a u ljetnim razdobljima mogu činiti više od 80 % ukupne biomase fitoplanktona. Visoka koncentracija hranjivih tvari i visoka temperatura vode su čimbenici koji pogoduju masovnom razvoju cijanobakterija, a razvoj i održavanje njihove visoke biomase usko su vezani uz vrijeme pojavljivanja, intenzitet i trajanje poplava.

CYANOBACTERIA IN KOPAČKI RIT FLOODPLAIN

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The river-floodplains are known as a highly productive ecosystems, usually eutrophic and/or hypertrophic, with frequent development of dense populations of cyanobacteria. High concentrations of cyanobacteria can cause a multiple negative effects on aquatic ecosystems such as reduced water transparency and biodiversity, enhanced primary production and the lack of oxygen in the bottom water layers. More than 70 species of cyanobacteria were found in Kopački Rit. The most common are *Cylindrospermopsis raciborskii*, *Aphanizomenon flos-aquae*, *Planktothrix agardhii*, *Trichormus catenula*, *Dolichospermum circinale*, *D. planctonicum*, *Limnothrix redekei*, *Pseudanabaena limnetica* and *Planktolyngbya limnetica*. These species are often present throughout the year, but in summer periods they can exceed 80% of the total phytoplankton biomass. The high nutrient concentrations and high water temperature are factors that favour mass development of cyanobacteria. The development and maintenance of high cyanobacterial biomass is closely related to the timing, intensity and duration of floods.

FIZIKALNO-KEMIJSKA KVALITETA PODZEMNIH VODA S VODOCRPILIŠTA VINOGRADI KOD OSIJEKA

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Podzemne vode su glavni izvor pitke vode za stanovništvo istočne Hrvatske. Grad Osijek se snabdijeva vodom za piće koja se dobiva preradom podzemne vode a koja se crpi na vodocrpilištu Vinogradi. Navedeno crpilište se nalazi zapadno od grada Osijeka i obuhvaća 18 bunara, a nadzor nad kvalitetom crpljene podzemne vode provodi se kontinuiranom analizom kvalitete i zdravstvene ispravnosti vode.

U ovom radu prikazane su vrijednosti koncentracije otopljenog kisika, utroška $KMnO_4$, željeza, mangana i amonijaka tijekom monitoringa podzemne vode vodocrpilišta Vinogradi i to u razdoblju od 2013. do 2015. godina. Dobiveni rezultati uspoređeni su s rezultatima monitoringa provedenim u razdoblju od 1995. do 2010. godine. Na kemijski sastav ispitivanih podzemnih voda značajno utječu karakteristični reduktivni uvjeti uslijed kojih je zabilježena pojava povećanih koncentracija željeza, mangana, amonijaka i pratećih elemenata, dok je koncentracija kisika u svim uzorcima bila manja od 1,5 mg/l. Navedena kakvoća podzemne vode vodocrpilišta Vinogradi zahtjeva primjenu adekvatne tehnologije kako bi voda koja se vodoopskrbnim sustavom distribuira bila u skladu s odredbama Pravilnika o parametrima sukladnosti i metodama analize vode za ljudsku potrošnju (NN 141/13). Rezultati ovog istraživanja ukazuju da tijekom vremena kvaliteta podzemne, neprerađene vode osječkog vodocrpilišta u fizikalno-kemijskom pogledu se značajno ne mijenja te je pod dominantnim utjecajem ambijentalnih uvjeta i geološkog sastava vodonosnog sloja iz kojeg je zahvaćena.

PHYSICO-CHEMICAL QUALITY OF GROUNDWATER FROM THE VINOGRADI WELL FIELD NEAR TOWN OF OSIJEK

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Groundwater is the main source of drinking water for the population of the eastern Croatia. The population of the town of Osijek are supplied with drinking water that is obtained by processing of underground water that is pumped from the well field Vinogradi. The mentioned pumping station is located west of the city of Osijek and includes 18 wells. The quality of used groundwaters are controlled regularly, almost on daily basis. In this research, the concentrations of dissolved oxygen, KMnO4 consumption, iron, manganese and ammonium were determined in groundwaters sampled from water well Vinogradi during the monitoring period between years 2013 and 2015. The obtained results were compared with the results of the monitoring conducted in the period from 1995 to 2010.

Obtained results shows that chemical composition of tested groundwater significantly depends on reductive conditions in its aquifers causing appearance of elevated concentrations of iron, manganese, ammonium and other accompanying elements, while the oxygen concentrations in all samples were less than 1.5 mg/l. Determined groundwaters qualities implies that application of appropriate drinking water technology is necessary in order to obtained safe drinking water which will be in accordance with the Regulations of parameters compliance and analysis methods of water for human consumption (Official Gazette 141/13). Results of this study also indicate that over time the quality of groundwater from water-well Vinogradi in terms of physic-chemical quality is dominated by environmental conditions and geological structure of the aquifers from which it is pumped.

ONEČIŠĆENJE MORA NA KUPALIŠTU SLATINA U OPATIJI U 2013. g.

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U Hrvatskoj, tradicionalno turistički orijentiranoj zemlji, pitanje sanitarne kakvoće mora na plažama od velikog je javno zdravstvenog interesa, prvenstveno zbog mogućnosti kontaminacije vode za kupanje komunalnim otpadnim vodama. Uredba o kakvoći mora za kupanje (Narodne novine 73/2008) usklađena je s europskom Direktivom o vodi za kupanje (2006/7/EC). Uredbom je propisan način uzorkovanja, vremensko razdoblje ispitivanja, kriteriji ocjenjivanja, postupanje u slučaju onečišćenja.
Unatoč značajnim ulaganjima u izgradnju sustava odvodnje i pročišćavanja komunalnih otpadnih voda, pojedine su plaže još uvijek pod stalnim ili povremenim utjecajem onečišćenja.
Liburnijsko područje, a posebno uže područje opatijskog priobalja, obiluje mnogobrojnim izvorima slatke/bočate vode, koja u obliku vrulja i priobalnih izvora utječe u more. Najizraženija zona istjecanja je na dionici između zapadnog ruba Slatine i hotela Admiral, ispred koje je, u više navrata prethodnih godina (a naročito tijekom ljeta 2013. g.), zabilježena nezadovoljavajuća kakvoća mora za kupanje.
U cilju detekcije uzroka takvih onečišćenja, uspostavljen je dodatni monitoring (ukupno 325 uzoraka) čiji su rezultati ukazali da za pojavu spomenutih onečišćenja ovoga puta nisu bile presudne oborine, već je onečišćenje mora bilo posljedica neispravnosti u funkcioniranju pojedinih dijelova kanalizacijske mreže.
Nakon provedenih mjera sanacije, more je na kritičnim lokacijama tijekom sezona 2014. i 2015. g. bilo izvrsne kakvoće.

POLLUTION OF THE SEA IN 2013 ON THE SLATINA BEACH IN OPATIJA

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In Croatia, as country being traditionally oriented toward tourism, the issue of the sanitary quality of seawater on the beaches represents a great public health interest, primarily because of the possibility of contamination of bathing water with municipal wastewaters. Legal regulation about the bathing seawater quality (Official Gazette 73/2008) is harmonized with the European Bathing Water Directive (2006/7/EC). Respective regulation defines sampling methodology, testing period, evaluation criteria, and procedures in the case of contamination.
Despite significant investment in the construction of drainage systems and treatment of municipal wastewaters, certain beaches are still under unceasing or periodic impact of pollution.
Liburnian area, and particularly, the narrow zone of Opatija's coastal area, is rich in freshwater / brackish water springs, which in the form of a submarine and coastal springs flow into the sea. The most visible are the leaks on the section between the western edge of Slatina and Hotel "Admiral", in front of which, on several occasions during the previous years (and especially during the summer of 2013), quality of bathing water has been verified as unsatisfactory.
In order to detect pollution patterns, additional monitoring had been established (total of 325 samples), whose results showed that the occurrence of respective pollution had not essentially been linked to the precipitations, yet the pollution was a consequence of faults in the functioning of certain parts of the sewerage network. After the corrective measures were taken, the sea at critical locations showed excellent quality throughout the seasons of 2014 and 2015.

MIKROBIOLOŠKE ANALIZE VODA

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U cilju zaštite ljudskog zdravlja i kontrole okolišnih uvjeta provode se ispitivanja svih vrsta voda na mikrobiološke parametre čime se osigurava zdravstvena ispravnost vode za ljudsku potrošnju, i kontrola ekološkog stanja i kvalitete ostalih vrsta voda. U akreditiranim laboratorijima mikrobiološke analize voda izvode se prema validiranim metodama opisanim ISO standardima i provjerenim metodama s dokazanom točnošću, a provode se na uzorcima vode za ljudsku potrošnju, prirodnim mineralnim, izvorskim i stolnim vodama, bazenskim, tehnološkim , otpadnim, površinskim i podzemnim vodama, ledu i vodi za kupanje. Metode se temelje na membranskoj filtraciji, MPN i minijaturnoj MPN tehnici, a rezultati analize mogu biti izraženi kao kvalitativni ili kvantitativni. Parametri koji se ispituju prilikom mikrobioloških analiza propisani su i definirani vodnom legislativom EU i Republike Hrvatske, ali mogu biti i dopunjeni dodatnim parametrima prema zahtjevu kupca. Najčešće ispitivani parametri uključuju ukupne koliforme (koliformne bakterije), *Escherichia coli*, crijevne enterokoke, *Clostridium perfringens* (uključujući spore), *Pseudomonas aeruginosa*, broj kolonija kod 37 °C i 22 °C, sulfitreducirajuće klostridije i spore, fekalne koliforme, *Salmonella spp*. i *Legionella*. Spomenuti mikrobiološki parametri svrstavaju se u patogene ili oportunističke patogene, a njihova prisutnost u vodi ili povećan broj mogu uzrokovati infekcije i utjecati na zdravlje ljudi i životinja.

MICROBIOLOGICAL ANALYSIS OF WATER

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Microbiological analysis of water is conducted in order to protect human health and control environmental conditions by regular testing of water for human consumption and controlling ecological status and quality of other types of water. In accredited laboratory microbiological analyses are performed according to the methods described by ISO standards or by verified methods with proven accuracy. Analysis can be carried out on samples of water for human consumption, natural mineral, spring and table waters, processed, surface and groundwater, ice and recreational (bathing water). These methods are based on membrane filtration, MPN and miniature MPN technique. The parameters that are tested during the microbiological analysis are prescribed and defined by water legislation of EU and the Republic of Croatia but analysis can be modified with additional parameters according to customer demands. The most common microbiological parameters include total coliforms (coliforms), *Escherichia coli*, *Enterococcus*, *Clostridium perfringens* (including spores), *Pseudomonas aeruginosa*, number of culturable microorganisms on 37 °C and 22 °C, sulfite-reducing clostridia and spores, fecal coliforms, *Salmonella spp*. and *Legionella*. Mentioned microbiological parameters are classified as pathogens or opportunistic pathogens and their presence in water or an increased number can cause an infection and impact on human and animal health.

Kazalo / *Author index*

Author index

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