DIFENEW 2019

1st Student Work Meeting

University of Novi Sad,
Faculty of Technical Sciences,
Department of Environmental Engineering
and Occupational Safety and Health
3rd December 2019

University of Novi Sad

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SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA
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ABSTRACT BOOK

The First DIFENEW Student Work Meeting

DIFENEW SWM 2019

Faculty of Technical Sciences,
University of Novi Sad,
3rd December, 2019
Novi Sad, Serbia

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Department of Environmental Engineering and Occupational Safety and Health, Faculty of Technical Sciences, University of Novi Sad, Serbia

Institute of Analytical Chemistry, Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava, Slovakia

The 1st DIFENEW SWM 2019,

is the part of dissemination activities within the Serbian-Slovak Joint Research Project "Development and Implementation of Field and Laboratory Methodologies for Environmental Evaluation of wetlands - DIFENEW" for the period 2019-2020, supported by:

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and

Slovak Research and Development Agency.

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WELCOME ADDRESS OF THE EDITOR:

On behalf of the Organizing, Scientific and Program Committee, it is my pleasure to welcome you all to the 1st DIFENEW Student Work Meeting (SWM) 2019, which takes place in Novi Sad, Serbia on December 3rd.

The First DIFENEW SWM is organized by the Department of Environmental Engineering and Occupational Safety and Health, Faculty of Technical Sciences, University of Novi Sad, Serbia and Institute of Analytical Chemistry, Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava, Slovakia as part of dissemination activities of Serbian-Slovak Joint Research Project "*Development and Implementation of Field and Laboratory Methodologies for Environmental Evaluation of wetlands - DIFENEW*". Project is supported by Ministry of Education, Science and Technological Development of Serbia and Slovak Research and Development Agency.

The SWM Organization Committee includes members of the Department of Environmental Engineering and Occupational Safety and Health, Faculty of Technical Sciences, University of Novi Sad, Serbia.

The Scientific and Program Committee consists of National and International professors.

We have prepared an exciting program and PhD students have been invited to share their valuable knowledge and experience.

The main goal of DIFENEW SWM is to provide an opportunity for all participants to exchange research interests, ideas, and experiences in Environmental research field.

We would like to thank all the authors, co-authors and their mentors for participating in the 1st DIFENEW Student Work Meeting.

We wish you successful 1st DIFENEW SWM.

Novi Sad,
December, 2019

EDITOR
Dr. Maja Petrović, assistant professor

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ABSTRACT
BOOK

DEVELOPMENT AND IMPLEMENTATION OF FIELD AND LABORATORY METHODOLOGIES FOR ENVIRONMENTAL EVALUATION OF WETLANDS – PROJECT OVERVIEW

Živančev N.[1], *Novaković M.*[1], *Sremački M.*[1],
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Abstract:

The Project aims at developing methods for integrated monitoring of key existing risks and systems and environmental and biodiversity protection. One of the most important challenges during the Project is addressing the problems in Pannonia Region and agricultural landscapes characterized by the high percent of arable land and increased pressure on natural systems. These degraded and impaired ecosystems have less adaptability and tolerance to changes in environmental conditions. Environmental management's main idea is to safeguard and improve state of the environment and to sustain economic and social benefits from the ecosystems. The most common problem is water pollution from anthropogenic and agricultural sources. Consequences of poor water quality are usually the loss of biodiversity in wetlands, but can also lead to an inedequate quality of surface water for irrigation use. The main objective of the Project is sharing scientific infrastructure to characterize organic pollutants present in wetlands ecosystem in Vojvodina region, with focus on characterization of pollution of groundwaters, surface water and leachate. Specific objectives of the Project are to develop Environmental Monitoring Plan which will incorporate cost-effective and time-bound analytical techniques, to develop and implement modern analytical techniques for screening analysis, to perform analysis of physicochemical parameters in water and to define Guidelines for future monitoring programs of agricultural areas. In order to research the influence of seasonal variations and to collect data needed for the design of future monitoring programs, sampling campaigns include four seasons (spring, summer, autumn and winter). The obtained samples will be treated by modern and conventional sample treatment procedures (SBSE, LLE) followed by analysis with advanced separation techniques (GCxGC-HRTOFMS). Equally important objective of the Project is development of cooperation and transfer of knowledge between Slovakia and Serbia, as well as to young generation of early stage researchers.

Keywords: wetlands; ecosystem biodiversity; organic pollutants; leachate.

Acknowledgement:

This work was supported by Ministry of Education, Science and Technological Development Serbia under contract 337-00-107/2019-09/16 and by Slovak Research and Development Agency under contract SK-SRB-18-0020.

THE QUALITY CONTROL OF AQUATIC MEDIA IN PROTECTED NATURAL AREA IN SERBIA AND CROATIA

Obrovski B.[1], *Milovanović D.*[1], *Mihajlović I.*[1],
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Abstract:

The main objective of IPA CBC Croatia-Serbia Project which is the basis for bilateral cooperation between Republic of Serbia and Republic of Slovakia is to implement integrated cross-border analytical monitoring of key physicochemical parameters, as well as protection of the green environment and biodiversity. The Lake Zobnatica, Serbia and the Wetlands of Tompojevci, Croatia, protected natural areas, are surrounded by agricultural land, and are selected as representative regions for the research field of the Project SENS Wetlands. The key physicochemical parameters that were analyzed are pH, electroconductivity, dissolved oxygen, chemical oxygen demand (COD), biological oxygen demand (BOD5), total organic carbon (TOC), anions - nitrites (NO2-(aq)) and nitrates (NO3-(aq)), orthophosphates (PO43-(aq)) and ammonium nitrogen cation (NH4+-N (aq)), total nitrogen, sulphates (SO42-(aq)), chlorides (Cl-(aq)), fluorides (F-(aq)), total chlorine and cations of metals (nickel (Ni2+(aq)), iron (Fe2/3+(aq)), zinc (Zn2+ (aq)), chromium (Cr6+(aq)), copper (Cu2+(aq)). In addition to standard analytical methods, a fiber optic sensor (FOS) was used to examination groundwater quality. Physicochemical parameters measured with the sensor were: anions - nitrites (NO2-(aq)) and nitrates (NO3-(aq)), orthophosphates (PO43-(aq)) and ammonium nitrogen cation (NH4+-N (aq)), sulphates (SO42-(aq)), chlorides (Cl-(aq)), fluorides (F-(aq)), total chlorine and cations of metals (nickel (Ni2+(aq)), iron (Fe2/3+(aq)), zinc (Zn2+ (aq)), chromium (Cr6+(aq)), copper (Cu2+(aq)). The results obtained by the sensor are compared with the results obtained by standard analytical methods to confirm the efficiency of the device.

Keywords: Surface water; groundwater; FOS; protected area.

Acknowledgment:

The research study has been financially supported by Interreg IPA CBC Croatia-Serbia Project „Active SEnsor monitoring Network and environmental evaluation for protection and wiSe use of WETLANDS and other surface waters“ and by Ministry of Education, Science and Technological Development Serbia under contract 337-00-107/2019-09/16 and by Slovak Research and Development Agency under contract SK-SRB-18-0020.

THE DEVELOPMENT IN SAMPLE TREATMENT METHODS USED OF PRECONCENTRATION OF ORGANIC COMPOUNDS PRESENT ON ULTRATRACE CONCENTRATION LEVELS

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Abstract:

The characteristic feature of all environmental samples is low concentration of organic pollutants present in such samples. This is even more highlighted for environmental samples coming from highland and natural protected areas. Thus, methods used for extraction of organic compounds from such samples must be effective for broad spectrum of chemical compounds. At the same time, it is crucial to achieve the low limits of detection as well as clean mass spectra to avoid false/positive or false/negative identification. Conventional and commercially available techniques, e.g. SPE, LLE are usually used for sample preparation. However, application of these methods usually does not achieve the necessary sensitivity and selectivity. A partial solution is to avoid dilution of sample extract and use solventless techniques such as SPME or SBSE. SPME is excellent method for analysis of volatiles but the construction of sampling device as well as anchoring of sorbent do not allow extensive use for aquatic samples in direct immersion mode. On the contrary, SBSE is inert in contact with water samples but is limited in sorbent properties. The analysis of analytes present at low and ultra-low concentration levels emphasizes to use of novel sample treatment methods such as passive sampling. During passive sampling, the analytes of interest are continuously extracted into the sampler and accumulated therein. This sampling procedure is advantageous in terms of the ease of monitoring a wide variety of organic compounds, in reducing the volumes of solvents used, and in reducing overall costs. Another sampling method so called large volume sampling allows enlarge volume of sample used in SPE extraction from 1 liter to significantly larger volumes up to 25 liters. The pros and cons of the most frequently used sample treatment methods for their application in screening and monitoring of organic pollutants in aquatic samples from protected natural areas will be discussed in detail.

Keywords: Surface water; sample treatment, environmental monitoring; natural protected area.

Acknowledgment:

This work was supported by Ministry of Education, Science and Technological Development Serbia under contract 337-00-107/2019-09/16 and by Slovak Research and Development Agency under contract SK-SRB-18-0020.

THE SPECIFIC REQUIREMENTS ON ANALYTICAL METHODS USED IN MONITORING OF AQUATIC ENIVRONMENT IN PROTECTED NATURAL AREAS

Khvalbota L.[1], *Vyviurska O.*[1], *Machyňáková A.*[1], *Petrović M.*[2], *Špánik I.*[1]

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Abstract:

Natural protected areas are usually considered as clean environment. However, it does not mean that it is protected against any form of pollution. The major source of pollution in this case is transport of organic pollutants through air, followed by their adsorption in snow matrix and consequent release into lakes and waters in protected areas. In addition, many pollutants are stored in the cryosphere and are now being released rapidly with climate warming. Exposure to these pollutants in aquatic ecosystems may adversely affect the activity, growth, metabolism, and reproduction of aquatic organisms. Released organic pollutants in protected areas are usually present at very low concentration levels, but it was shown that even the ng/L levels can negatively affect the living organisms in environment. Nowadays, analysis of aquatic sources in protected areas is mostly limited to target pollutants, mostly PAHs, halogenated organic compounds, PCBs, PBDEs, flame retardants etc. For the determination of organic compounds in samples from protected areas, gas and liquid chromatography methods are commonly used in combination with SIM or SRM mass spectrometry in order to achieve the highest selectivity and sensitivity for target analysis. On the contrary, studies focusing on non-target screening and identification of unknown organic pollutants present in environmental samples from protected environment are scarce. Due to the low concentration of analytes, small mass fragments in the spectrum may absent and obtained spectrum may be contaminated with fragments of coeluting analytes. For this reason, standard identification by comparison with spectra in libraries is often inadequate. Accurate mass of molecular ions and fragments greatly facilitate the correct identification and understanding of the structure of the unknown compound. That is a reason why the high-resolution mass spectrometry becomes an essential part of the non-target screening. Advantages and disadvantages of various methods used will be discussed in detail.

Keywords: Surface water; environmental monitoring; natural protected area.

Acknowledgment:

This work was supported by Ministry of Education, Science and Technological Development Serbia under contract 337-00-107/2019-09/16 and by Slovak Research and Development Agency under contract SK-SRB-18-0020.

ANALYSIS OF ORGANIC POLLUTANTS ADSORBED ON MICROPLASTICS SAMPLED FROM SURFACE WATER INTAKE

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Abstract:

Presence of plastic debris in marine and freshwater ecosystems is increasingly reported worldwide. However, only a few studies have been focused on examining the presence and impact of microplastics in water treatments. Based on the available information, microplastics can be detected in different water matrices, which in even minimal concentrations can cause a significant environmental problem. The presence and behavior of microplastics in water treatments require additional research in terms of quantification and characterization of microplastics, especially when it comes to smaller sized plastics (<10 μm). Due to their physic-chemical properties, microplastics were found able to accumulate different organic and inorganic contaminants. Therefore, the aim of this study was to investigate which groups of organic pollutants have the adsorption affinity towered two types of plastic sampled from the surface water intake. Based on the obtained results, it was determined that significant number of organic pollutants were adsorbed on selected microplastics. It was also determined that a number of detected organic pollutants, such as 2-ethylhexanol, phthalates, 1-hexadecanol, benzophenone, acetophenone and phenols, were indicators of anthropogenic pollution.

Keywords: Microplastics, drinking water treatment, wastewater treatment, effluent, groundwater, surface water.

DEVELOPMENT OF A LANDFILL METHANE RISK ASSESSMENT FRAMEWORK

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Abstract:

Landfilling as the most common type of waste disposal in low income countries causes various environmental issues due to gas emission among which air pollution is the most significant one. The most common reason why little attention was paid to this aspect of landfill impact is the lack of appropriate data. The aim of this research is establishment of the landfill gas risk assessment framework (LFG RAF) for landfill prioritization according to the significance of methane effect. Due to the lack of financial resources, this kind of prioritization is important in order to establish the priorities for undertaking the necessary control and remedial measures in developing countries like Serbia. The proposed LFG RAF includes three groups of processes: identification and evaluation of criteria; data collecting and processing and landfill ranking. As the LFG RAF was established by multi-criteria decision making methods (MCDM) application, a starting point of the overall methane risk assessment was the identification of landfills' key features (criteria and sub-criteria) relevant to the impact that methane has on air quality and surrounding environment. The identified criteria were then evaluated by significance in order to evaluate their weights using analytical hierarchy processes (AHP). A categorization model of landfills according to their influence on air quality through real values of landfill characteristics was also proposed. The final step involved data processing by compromise programming (CP) approach that lead to their final ranking according the impact on air quality. The defined methodology was successfully tested for landfills in South Backa District located in the the Province of Vojvodina. The obtained results indicated the need for further development of presented model in order to determine the importance of criteria in further research.

Keywords: Landfill; methane; risk assessment.

APPLICATION OF INNOVATIVE COLORIMETRIC SENSOR METHOD FOR ANALYSIS THE QUALITY OF AQUATIC MEDIA

Obrovski B.[1], Mihajlović I.[1], Bajić J.[2], Vojinović Miloradov M.[1], Šunjević M.[1], Rajs V.[2]

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Abstract:

Increasingly complex processes of environmental pollution require new methods and different approaches for measurement of contamination whit different pollutants. The research is focused on the development and application of colorimetric sensor method for monitoring the quality of surface and swimming pool waters. Colorimetric fiber optic sensor (KFOS) converts RGB (Red, Green, Blue) color model to HSV (Hue, Saturation, Value) and based on the color intensity of the sample determines the concentration for parameters of analyte interest in water sample. The device was developed and calibrated for measurement of anions orthophosphate, nitrite, sulfate, cation Cr6+(aq) and total chlorine in surface water samples and total chlorine and residual chlorine in swimming pool water samples. Obtained results by standard laboratory methods (UV-Vis spectrophotometer) are compared with results obtained by FOS in order to demonstrate effectiveness and applicability of the sensor. FOS has proven to be very appropriate for use in the laboratory under controlled conditions as low-cost solution to replace expensive standard equipment.

Keywords: Surface water; swimming pool, sensor; new method.

Acknowledgment:

The authors acknowledge for the funding provided by the Ministry of Education, Science and Technological Development of Republic of Serbia under project 'Development of methods, sensors and systems for monitoring quality of water, air and soil', number III43008.

IDENTIFICATION AND DETERMINATION OF MICROPLASTICS IN LANDFILL LEACHATE

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Abstract:

Microplastics are plastic particles smaller than 5 mm, which can be intentionally made as small particles or formed by shredding large pieces of plastic into the environment. The sources of microplastics are numerous, ranging from industry, transport, households, through landfills and plastic recycling facilities, to personal care products, and unfortunately it ends up in environmental media (water, air, soil). Current research in the world is based on determining the presence and concentration of microplastics in flowing and stagnant waters (rivers, lakes, seas and oceans), and the results show that, despite the fact that there is a regulated plastic management system in most developed countries, microplastics is finding its way to the environment, and ultimately to the human population through food and drinking water. In the Republic of Serbia, there are few studies addressing the presence, quantity and impact of microplastics on the living world, and there are no significant results to confirm that plastic products are managed improperly throughout the life cycle. Namely, the current practice of managing plastic products after they become waste involves landfilling, both in landfills and sanitary landfills, but unfortunately, plastic ends up in all environmental media due to an inadequate waste management system. Within my PhD thesis, the presence and quantities of microplastics in landfill leachate from sanitary and non-sanitary landfill sites will be determined. Based on the preliminary results, the research will include the optimization of the sampling method, human risk assessment as well as determination of the bisphenol A in landfill leachate samples in order to conduct the environmental risk assessment.

Keywords: Landfill; microplastics; landfill leachate.

APPLICATION OF NEW NANOSTRUCTURED PHOTOCATALYSTS IN THE DEGRADATION OF SELECTED PHARMACEUTICALS IN THE AQUATIC MEDIUM

Novaković M.[1], Štrbac D.[1], Petrović M.[1], Štrbac G.[2], Mihajlović I.[1]

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Abstract:

Pharmaceutical compounds, as well as their biologically active metabolites, are continuously introduced into the aquatic environment via a variety of routes, primarily through untreated or inadequately treated wastewater. Long-term exposure to low concentrations of pharmaceutical pollutants can lead to adverse effects on natural ecosystems. The aim of the doctoral thesis is the implementation of newly developed nanomaterials (ZnO/SnO_2, ZnO/TiO_2 and ZnO/In_2O_3) in the elimination of a dominant group of emerging pharmaceuticals present in municipal wastewater. Within the scope of the doctoral dissertation, a group of pharmaceuticals whose degradation was examined consists of four non-steroidal anti-inflammatory drugs (NSAIDs): naproxen, diclofenac, ibuprofen and ketoprofen. In the research, a detailed analysis of the interaction between selected micropollutants and nanostructured photocatalysts was given in order to propose a technological solution for the treatment of water medium contaminated with pharmaceuticals. Advanced oxidation processes (AOPs), characterized by the generation of in-situ reactive species, primarily hydroxyl radicals, have been recognized as one of the effective technologies for the removal of organic pollutants from various wastewater. The research was conducted at the laboratory level with a series of experimental procedures which included the effect of catalyst loading; pH value of aqueous solution; irradiation time; initial concentration of pharmaceuticals and water matrix constituents. Kinetic of the photocatalytic process was monitored at different time intervals covering the exposure between 5-60 minutes and analyzed by the HPLC system. Satisfactory degradation of diclofenac and ketoprofen was achieved after 30 minutes of UV exposure, which is not the case for naproxen and ibuprofen. In addition, ecotoxicology tests are provided in order to examine the biocompatibility of photocatalytic treatment after UV exposure of selected pharmaceuticals and their degradation products. New nanodimensional mixtures used in heterogeneous photocatalysis can be applied as an innovative tertiary technique in real systems of wastewater treatment plants.

Keywords: nanomaterials; nanostructured photocatalyst; pharmaceutical compounds; waste water.

Acknowledgements:

This study has been financially supported by the Department for Environmental Protection, City of Novi Sad (Project no. VI-501-2 /2018-18в-6) and Projects of Ministry of Education, Science and Technological Development, Republic of Serbia (Project III46009 and Project TR34014).

REMOVAL OF ORGANIC POLLUTANTS IN FLOW SYSTEMS USING ACTIVATED CARBON FROM BIOMASS

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Abstract:

In recent years, the continued development of industry and agriculture with an increase in the number of vehicles directly effects on the introduction of organic pollutants in the environmental compartments causing serious environmental pollution. Great efforts have been made to introduce new and more efficient treatment processes for the removal of pollutants. Among them, adsorption with activated carbon (AC) is currently being studied to be implemented in wastewater and air treatment plants. Activated carbon has many precedences such as various types of biomass, low cost, recyclability and the ability to turn waste into usable material when used for environmental purposes. Contamination of water resources by hazardous chemicals and endocrine disrupting compounds (EDCs) is widespread and it is a topic of special environmental relevance. According to the World Health Organization, urban air pollution causes nearly seven million premature deaths per year throughout the world. The goal of current research is to develop a method where hazelnut shells will be used as raw materials for the synthesis of AC. Crushed hazelnut shells will be repeatedly washed with distilled water to remove dust particles and impurities, dried at 105 °C for 48 h and sieved to obtain particle size under 0.3 mm. Chemical activation of the shells will be performed with NaOH and H_3PO_4 solution in a mass ratio of 2:1. The mixture must be maintained at room temperature for 24 h and then evaporated at 110°C for 48 h. AC will be used for the removal of one organic synthetic compound from aqueous solution and formaldehyde removal from the air. Flow systems are defined through fixed-bed column and removal efficiency will be analyzed on HPLC and gas chromatography systems.

Keywords: Organic pollutants; biomass; activated carbon; hazelnut shells.

Acknowledgements:

This research was financially supported by the Project III 46009, „Improvement and development of hygienic and technological procedures in the production of food stuffs of animal origin in order to obtain quality and safe products that are competitive on the world market“ by Ministry of Education, Science and Technological development of the Republic of Serbia.

PARTICULATE MATTER (PM 10 AND PM 2,5) EMISSION FROM CONSTRUCTION SITES AND MITIGATION MODELS

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Abstract:

In the process of urbanization during construction and anthropogenic activities Particulate Matter (PM) is emitted in the surrounding environment. Particulate Matter emitted from construction sites is commonly recognized as dust and consists from PM10, PM2,5 and PM1 (particulate size smaller than 10 μm, 2,5 μm and 1 μm respectively). International and national legislative has regulated, defined and standardized monitoring and acceptable levels of PM in ambient air. Although PM 10 and PM2,5 particulates are recognized and monitored on representative locations in all countries of European Union, construction sites are neglected and lack in monitoring. PM emission from construction sites is well known and accepted fact; however studies and researches are scarce and complex.

Aim of the research is to develop real model for assessment of PM emission from construction sites and to evaluate effects on surrounding environment. Direct emission from construction sites was monitored with modern optical sensor OPC-N2 (developed by Alphasense) which provides real time data on five selected locations. Received monitoring data from five selected locations will be used to verify functionality of developed emission assessment model (EAM). Development of functional EAM additionally allows pinpointing crucial hazard segments in architectural building construction processes and allows development of novel mitigation models. Novel models can be applied as prevention measure during design processes and directly on construction sites as secondary measure.

Keywords: Particulate Matter; sensor monitoring; construction sites; mitigation models.

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IDENTIFICATION OF SPECIFIC POLLUTANTS AND DEVELOPMENT OF PRIORITIZATION METHODOLOGY IN ORDER TO IMPROVE PROTECTION MECHANISM OF SURFACE WATER AND WASTEWATER

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Abstract:

Contamination of surface water by organic and inorganic compounds represents one of the key environmental problems that humanity is facing today. Emerging substances are dominantly industrial chemicals that can be detected in surface water of large river basins, groundwater, lakes and other water bodies. Priority substances pose serious risk for aquatic environment. Priority hazardous substances are toxic, persistant with bioaccumulative tendencies, and pose increased risk for human health and environment. Annex X of the Water Framework Directive defines 45 priority substances and imposes the need to identify "specific synthetic and nonsynthetic pollutants" for all EU member states. In order to determine chemical status, in accordance with the Article 16 of the Water Framework Directive, it is necessary to apply prioritization process.

Quantitative Structure-Activity Relationship approach has been applied for assessment of toxicity for selected organic pollutants. In comparison with classic methods, QSAR is ecologically, economically and timely more efficiant solution. QSAR approach relies on prediction of concentrations that have critical effects, based on physico-chemical properties, known toxicity parameters and particular molecular descriptors, by using regression analysis. Detection and quantification of specific pollutants in surface water and wastewater samples on the selected sites around Novi Sad, by applying screening and target analysis, will be conducted within this PhD thesis. In addition, new prioritization methodology will be apllied, which will result, for the first time, in the list of specific substances in accordance with the Annex VIII of the WFD. Organic pollutants will be classified in 6 categories depending on the available information on concentration levels and toxicity, followed by the prioritization procedure within each category. The final list will rank all relevant organic pollutants according to the hazard indicator, relevance and detection frequency. Statisitical methods will serve to determine emission sources of pollutants with the highest occurance frequency.

Keywords: Surface water; Emerging substances; WFD; QSAR; protected area.

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