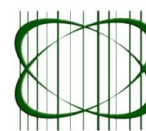




ASSOCIATION OF
CHEMISTRY AND THE
ENVIRONMENT



20th European Meeting on Environmental Chemistry



**2-5 December 2019
Lodz, Poland**



Book Of Abstract

WELCOME

On the behalf of the organizing committee, it is my great pleasure to welcome you to Lodz in Poland for the **20th European Meeting on Environmental Chemistry (EMEC20)**

The conference is organized by the Faculty of Chemistry from the Lodz University of Technology (TUL), on behalf of the Association of Chemistry and the Environment (ACE). The **EMEC20** conference is organized under honorary auspices of the Mayor of the City of Lodz and His Magnificence Rector of the Lodz University of Technology.

The **EMEC** conference covers a broad range of topics within the field of environmental chemistry, and interdisciplinary presentations are very welcome. The meetings always attract high quality science presentations and invited talks from internationally renowned researchers working in environmental chemistry and related fields.

The main objectives of **EMEC20** are to bring together scientists working in the fields of environmental chemistry & environmental monitoring, to report the most advanced research progresses in these areas and to pave the way for the future collaboration, research and challenges.

We think that **EMEC20** will be an useful occasion to enjoy science, network and meet old friends or new colleagues, to get new ideas for your scientific work, to establish new cooperation, start new projects in Lodz - the city of unique and amazing history and culture.

I wish you very pleasant moments together and I hope this will be a fruitful and successful scientific event.

Prof. Malgorzata Iwona Szyrkowska
Chair of the EMEC20

ASSOCIATION OF CHEMISTRY AND THE ENVIRONMENT

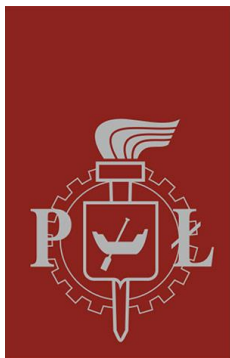


The Association of Chemistry and the Environment (ACE) is a non-profit-making scientific association founded in October 2000 by a group of European scientists. The main goal of this organization is to promote global contacts between scientists in academia and research institutes, the commercial sector and social representatives within governmental and regulatory bodies to address environmental problems and to promote education in this area.

The Association strongly welcomes scientists from diverse fields such as atmosphere science, biology, geology, industrial chemistry, medicine, sociology, soil science, toxicology and water science to play an active role within the organisation.

<http://www.europeance.com>

LODZ UNIVERSITY OF TECHNOLOGY



Year of founding -**1945**

Lodz University of Technology is a well-established higher education institution with an evolved structure. Prospective student have nine faculties to choose from.

Faculty of Mechanical Engineering

Faculty of Electrical, Electronic, Computer and Control Engineering

Faculty of Chemistry

Faculty of Material Technologies and Textile Design

Faculty of Biotechnology and Food Sciences

Faculty of Civil Engineering, Architecture and Environmental Engineering

Faculty of Technical Physics, Information Technology and Applied

Mathematics

Faculty of Management and Production Engineering

Faculty of Process and Environmental Engineering

Total number of staff **2 705**

Number of academic staff **1 234**

Number of professors **221**

Number of students

(first-cycle programmes,
second-cycle programmes) **16 726**

Number of Ph.D. students

(third-cycle programmes) **612**

Number of fields of study **53**

Number of graduates in 2018 year **3 518**

<https://www.p.lodz.pl/en>

THE FACULTY OF CHEMISTRY



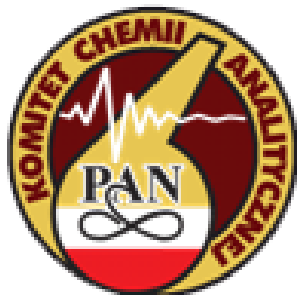
The Faculty of Chemistry is one of the three oldest faculties of the Technical University of Lodz. Established in 1945, it is internationally regarded as an important research centre with considerable scientific and educational output. The Faculty offers BSc, MSc and PhD courses in Chemical Technology, Chemistry, Environmental Protection, Material Engineering, and in the interdisciplinary field of Nanotechnology. These courses have been authorized by the State Accreditation Committee for the next 6 years. The Faculty of Chemistry employs about 130 staff, including 44 full professors and scholars with post-doctoral degrees.

The curriculum is largely interdisciplinary in all areas, which ensures that our graduates are specialists who know how to successfully combine their chemical, engineering and technological knowledge. Moreover, students are taught the basics of marketing, business strategy, and finances. They are also offered English courses (B2 level) to be able to understand academic papers in English. Thanks to this, our graduates pursue successful careers in a wide range of industries, in the education sector, as well as with the public administration and with scientific and research institutions in Poland and abroad. Nearly 6,000 BSc and MSc students have graduated from the Faculty of Chemistry since 1945. Currently, nearly 1,500 students are enrolled in our courses.

Our laboratories are equipped with state-of-the-art apparatus and our scholars collaborate extensively with Polish and foreign research and educational institutions. This ensures world-class research and provides our doctoral students with a wide range of opportunities to obtain internships and participate in conferences. Every year, nearly 20 doctoral students are awarded a PhD degree in the field of chemistry or chemical technology. The Faculty is also authorized to confer post-doctoral degrees.

<https://chemia.p.lodz.pl/en/>

POLISH ACADEMY OF SCIENCES COMMITTEE OF ANALYTICAL CHEMISTRY



Scope and history

1. to initiate, organize and coordinate basic applied research in the field of analytical chemistry in various branches of science and technology
2. to stimulate development of chemical and physicochemical methods for detection and separation of organic and inorganic chemical substances in various matrices
3. to implement procedures of chemical metrology and quality assurance of analytical results
4. to promote achievements in analytical chemistry
5. to represent Polish analytical chemistry in the international organizations

Short history

The story of the committee starts in 1955 when on September 15th the group of Polish analytical chemists from Warsaw lead to the appointment of the Analytical Subcommittee within the Committee of Chemistry of the Department III of Polish Academy of Sciences. Since the range of activities taken by the subcommittee went far beyond competencies and general interest of the Committee of Chemistry, on February 25th 1975 it was decided to upgrade it to The Committee of Analytical Chemistry of the Department III of Polish Academy of Sciences. Prof. dr Kemula was the first chairman of the committee, whereas Prof Minczewski was a deputy and dr Rubel was a secretary. Since then more then 300 people from academia and industry were involved in works of the Committee. The chairman position was held by the following colleagues: Prof. W. Kemula (until 1980), Prof. J. Minczewski (1980-1992), Prof. A. Hulanicki (1992-2006), Prof. J. Namieśnik (2006-2016), Prof. B. Buszewski (since 2016).

http://kcha.pan.pl/index.php?option=com_content&view=article&id=151&Itemid=155&lang=en

POLISH CHEMICAL SOCIETY



Polish Chemical Society, active for over 100 years, besides gathering researchers working in chemistry is also an institution of public benefit, whose main aim is to support development of chemistry and popularization of this area of science.

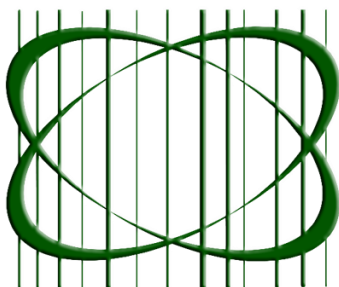
The activities of PCS include: organization of seminars, conferences and scientific meetings, organization of public presentations, lectures and courses, publication of scientific journals and other specialistic papers related to the profile of activity of the Society, participation in international consortia publishing scientific papers, substantive support of the Olympic Games in Chemistry, establishing libraries and library collections, cooperation with scientific organizations for students, cooperation with research institutions and chemical industrial companies.

Polish Chemical Society is authorized to: bestow awards and distinctions for scientific achievements in chemistry and related areas, promote chemistry on the state and social fora, express opinions on issues important for development of chemical sciences and education in chemistry.

Polish Chemical Society together with the City of Warsaw runs the Maria Skłodowska-Curie Museum in the house in which she was born in 1867.

<https://ptchem.pl/en>

SPECTRAL ANALYSIS TEAM



http://kcha.pan.pl/index.php?option=com_content&view=article&id=246:zespol-analizy-spektralnej&catid=40&Itemid=150&lang=en

SHORT HISTORY OF EMEC

The European Meeting on Environmental Chemistry (EMEC) is organised annually on behalf of the Association for Chemistry and the Environment (**ACE**). It is held in early December and always attracts high quality science presentations from internationally-renowned researchers in environmental chemistry and related fields.

Meetings Number	Year	Place
1 st	2000	Nancy, France
2 nd	2001	Dijon, France
3 rd	2002	Geneva, Switzerland
4 th	2003	Plymouth, U.K.
5 th	2004	Bari, Italy
6 th	2005	Belgrade, Serbia and Montenegro
7 th	2006	Brno, Czech Republic
8 th	2007	Inverness, Scotland
9 th	2008	Girona, Spain
10 th	2009	Limoges, France
11 th	2010	Portoroz, Slovenia
Chemistry and Climate Workshop	2011	Tromsø, Norway
12 th	2011	Clermont Ferrand, France
13 th	2012	Moscow, Russia
14 th	2013	Budva, Montenegro
15 th	2014	Brno, Czech Republic
16 th	2015	Turino, Italy
17 th	2016	Inverness, U.K.
18 th	2017	Porto, Portugal
19 th	2018	Clermont-Ferrand, France
20 th	2019	Lodz, Poland



In memories

This conference is dedicated to the memory of three Polish Professors, who accepted the invitation to be the members of the Scientific Committee **EMEC20** but passed away before a conference started. We have no doubt that their life and scientific achievements will inspire many generations of future scientists all around the world.



Prof. Adam GROCHOWALSKI

Kraków, Poland

Born 1954, Kraków, Poland

Died 2019, Kraków, Poland



Studies in chemistry at the Faculty of Chemical Engineering and Technology of Cracow University of Technology.

PhD in 1990 at Jagiellonian University in Kraków.

Professor of technical sciences since 2016.

- V-ce Head for Science at the Institute of Inorganic Chemistry and Technology at Cracow University of Technology (1992-2003)
- Manager of the Department of Analytical Chemistry at Cracow University of Technology (since 2003)
- Manager of Laboratory for Trace Organic Analyses at Cracow University of Technology (since 1996)
- Expert of the United National Environment Programme
- Member of the Committee on Chromatographic Analysis of the Polish Academy of Sciences
- Member of the European Committee for Standardization
- Member of the National Centre for Emission Management at the Institute of Environmental Protection - National Research Institute
- Prof. Andrzej Waksmundzki Medal Award for outstanding achievements in chromatography and related techniques, 2000/2001

Major research interests included studies in the field of trace determination of toxic organic compounds, mainly dioxins, PCBs and polybrominated diphenyl ethers with the use of separation techniques.

Author and co-author of 11 book chapters, over 88 full length articles in professional journals and over 100 lectures and communications published in conference proceedings. Supervisor or co-supervisor of 5 PhD theses (completed).



Prof. Jacek NAMIEŚNIK

Gdańsk, Poland

Born 1949, Mogilno, Poland

Died 2019, Gdańsk, Poland



Studies in chemistry at Faculty of Chemistry of the Gdańsk University of Technology.

PhD in 1978.

Professor of analytical chemistry since 1996.

- Head of Analytical Chemistry Department (since 1995)
- Dean of Faculty of Chemistry (1996-2002, 2005-2012)
- Rector of Gdansk University of Technology (2016-2019)
- Member of the Committee on Analytical Chemistry of the Polish Academy of Sciences (1994-2019)
- Chairman of the Committee on Analytical Chemistry of the Polish Academy of Sciences (2007-2015)
- Member of State Commission on scientific degrees and titles (2007-2016)
- Member of the European Academy of Sciences, class IV: natural sciences (2017-2019)
- Doctor *honoris causa* of the Gdansk University of Medicine (2015)
- Doctor *honoris causa* of the Military University of Technology in Warsaw (2015)

Major research interests included elaboration of new analytical procedures for determination of trace and ultratrace constituents in samples characterized by complex composition of the matrix, design and testing of specific (fit for purpose) analytical units and measuring devices, production of new types of matrix-free reference materials.

Author and editor of 8 books, author and co-author of 766 papers published in international journals and over 400 lectures and communications published in conference proceedings, 19 patents and patents applications. Supervisor or co-supervisor of 66 PhD theses (completed).



Prof. Tadeusz PARYJCZAK

Łódź, Poland

Born 1932, Łopatyn, Poland

Died 2019, Łódź, Poland



Studies in chemistry at Faculty of Chemistry of the Lodz University of Technology.

PhD in 1963.

Professor of chemistry since 1985.

- Head of the Institute of General and Ecological Chemistry (1975-2002)
- Dean of Faculty of Chemistry (1975-1981, 1984-1990, 1993-1999)
- Member of the Committee of Chemistry of the Polish Academy of Sciences (1987-1997)
- Member of the State Committee for Scientific Research, Section of Chemistry, Chemical Technology and Chemical Engineering and Environmental Protection (1991-2003)
- Chairman of the Section of Chemistry, Chemical Technology and Chemical Engineering and Environmental Protection in the State Committee for Scientific Research (2000-2003)
- Member of State Commission on scientific degrees and titles (1991-2003)
- Member of the Science Council at the Ministry of Science and Higher Education (2003-2008)
- Doctor *honoris causa* of the Szczecin University of Technology (2001)
- Doctor *honoris causa* of the the Lodz University of Technology (2006)

Major research interests included the processes of adsorption and catalysis using methods derived from gas chromatography, with particular emphasis on the physical and chemical properties of metallic catalysts applied to supports, including thermo-programmed techniques (TPD, TPR, TPO, TPSR). He has achievements in the field of green chemistry and environment protection.

Author and co-author of 4 books, over 400 papers and chapters, over 400 conference lectures and communications, 18 patents. Supervisor of 32 PhD theses (completed).

COMMITTEES

Honorary Patronage

- Mayor of the City of Lodz
Hanna **ZDANOWSKA**



- Rector Magnificus of the Lodz University of Technology
Professor Sławomir **WIAK**



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Ewa **BULSKA**, University of Warsaw, Poland

Bogusław **BUSZEWSKI**, Nicolaus Copernicus University in Torun, Poland

Katarzyna **CHOJNACKA**, Wrocław University of Science and Technology,
Poland

Sławomir **GARBOŚ**, National Institute of Public Health - National Institute of
Hygiene, Warsaw, Poland

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Piotr **KONIECZKA**, Gdansk University of Technology, Poland

Albert **LEBEDEV**, Moscow State University, Russia

Marian **OLAZABAL**, University of the Basque Country, Spain

Nuno **RATOLA**, University of Porto, Portugal

Kurt **ROSENTRATER**, Distillers Grains Technology Council, USA

Sławomira **SKRZYPEK**, University of Lodz, Poland

Irena **STANECZKO-BARANOWSKA**, Silesian University of Technology,
Poland

Małgorzata Iwona **SZYŃKOWSKA**, Lodz University of Technology, Poland

Wojciech **WOLF**, Lodz University of Technology, Poland

Ireneusz **ZBICIŃSKI**, Lodz University of Technology, Poland

Organizing Committee

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of Technology, Poland

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Magdalena **GAJEK**, Lodz University of Technology, Poland

Sławomir **GARBOŚ**, National Institute of Public Health - National Institute of
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Angelina **ROSIK**, Lodz University of Technology, Poland

Lesław **SIEROŃ**, Lodz University of Technology, Poland

Elżbieta **SKIBA**, Lodz University of Technology, Poland

Izabela **WITOŃSKA**, Lodz University of Technology, Poland

	Monday 2 Dec	Tuesday 3 Dec		Wednesday 4 Dec	Thursday 5 Dec
7.30		Registration 7.30-8.30			
8.30		Opening Ceremony 8.30-9.00		Registration 8.30-9.00	
9.00		Bogusław Buszewski 9.00-9.40		Seppo Hellsten 9.00-9.40	Kurt Rosentrater 9.00-9.40
9.40		P. Stepnowski 9.40-10.05		E. Bulska 9.40-10.05	L. Mojović 9.40-10.05
10.05		Coffee Break/Poster Session 10.05-10.35			Coffee Break ACE General Assembly 10.05-10.35
10.35		Session A O. Đuragić 10.35-11.00	Session B W.M. Wolf 10.35-11.00	Young Session B. Kubičková 10.35-11.00	J. Igras 10.35-11.00
11.00		N. Zarič	F. Dal Bello	M. Stec	B. Godlewska-Żytkiewicz 11.00-11.25
11.15		M. Bavcon Kralj	P. Trebše	Ž. Arciszewska	
11.30		M. Passananti	J. Kašlik	H. Zind	B. Krasnodębska-Ostręga 11.25-11.50
11.45		F. Prosenc	S. Pap	O. Matviichuk	
12.00		Coffee Break/Poster Session 12.00-12.30			Coffee Break 11.50-12.30
12.30		T. Miličević	M. Brumovský	P. Suková	K. Czarny
12.45		M. Kašanin-Grubin	J. Oborná	M. Madej	A-M. Delort
13.00		D.M. Mazur	J. Schwarzbauer	B. Kaur	A. Krejčova
13.15		A.T. Lebedev	I. Komorowicz	A. Kravchenko	K. Taran
13.30		Lunch 13.30-14.30			
14.30		EC1 Tour 14.30-18.00			Sponsor Presentation G. Przeliorz 14.30-14.45
14.45					J. Salvé
15.00					P. Cheng
15.15					F. Rocha
15.30					Y. Arbid
15.45					Coffee Break/ Poster Session 15.45-16.00
16.00					A. Marion
16.15					P. Irizar
16.30	Registration 16.30-17.00				B. Rogalewicz
16.45					M. Przydacz
17.00					Sponsor Presentation J. Grodowski 17.00-17.10
17.15	Welcome Reception 17.00-19.00				Coffee Break/ Poster Session 17.10-17.30
17.30					T. Soleymani Angili
17.45					D. Polikarpova
18.00					N.P.F. Gonçalves
18.15					
18.30					
19.00		Poster Session 18.00-20.00			
20.00				Gala Dinner 20.00	

PLENARY SPEAKERS



Prof. Bogusław BUSZEWSKI

Professor of Analytical Chemistry
Nicolaus Copernicus University in Torun, Poland

lecture on Tuesday entitled: *"A new concept in metabolism study of toxins in environmental and biological samples"*

Professor Bogusław Buszewski is the head of the Chair of Environmental Chemistry & Bioanalytics at the Faculty of Chemistry, Nicolaus Copernicus University. He is also the president of the Central European Group for Separation Sciences and the chairmen of the Committee of Analytical Chemistry of Polish Academy of Sciences. Former, he was the president of the Polish Chemical Society and European Society for Separation Science. He was awarded by numerous national and international organizations. His main scientific interests are concerned with separation science including theoretical and practical aspects in chromatography and related techniques, adsorption, sample preparation, bioanalytics and bioanalysis (metabolomics, proteomics, biomarkers), nanotechnology and chemometrics. He is authored or co-authored 15 books, patents and more than 567 scientific papers (over 11.000 citations, h = 51) and member of the editorial boards of 26 national and international journals in field of analytical chemistry and separation sciences.



Dr. Seppo HELLSTEN

Head of unit of Restoration Assessment at the Finnish Environment Institute (SYKE) in Oulu, Finland

lecture on Wednesday entitled: *"Management and restoration of surface water bodies receiving mine waters - lessons learned from Talvivaara mine impacts in northern part of Finland"*

Dr. Seppo Hellsten until 2013 was professor and leading the unit Monitoring and assessment of SYKE in charge of monitoring of freshwaters of Finland. Dr. Seppo Hellsten has a long term experience in both monitoring, management and research of the of lakes and rivers. Recently he has headed a large Interreg III B Baltic Sea Region projects WATERSKETCH and Baltic Sea Region project WATERPRAXIS with the main aim to improve possibilities and tools to create sustainable River Basin Plan. He has been researcher and principal researcher in several EU Framework projects (REBECCA, WISER, REFORM, MARS) with specific topic of ecological assessment. Currently he is co-heading the largest integrated LIFE Nature project FRESHABIT in Europe and BIOWATER - Centre of Excellence in Nordic bioeconomy with specific focus on assessment and monitoring. He has been member of several EU official working groups such as Pilot river basins, Heavily modified water bodies and Environmental flows.



Dr. Kurt ROSENTRATER

Dr. Kurt Rosentrater - Associate Professor, Iowa State University. Executive Director of the Distillers Grains Technology Council, USA

lecture on Thursday entitled: *"Using life cycle assessment to better understand environmental impacts of bioprocessing systems"*

Dr. Kurt Rosentrater is the Executive Director of the Distillers Grains Technology Council. He is also an Associate Professor in the Departments of Agricultural and Biosystems Engineering, and Food Science and Human Nutrition at Iowa State University. He is actively pursuing a research program to improve the sustainability of biofuel, grain, feed, food, and agricultural-based systems. He is developing sustainable, economical co-products and value-added products, such as enhanced feeds, foods, biofuels, bioplastics, biocomposites, industrial intermediates, and ingredients. A key component to these efforts is life cycle assessment and techno-economic analysis in order to understand and improve environmental impacts as well as reduce costs. He has published 114 international scientific articles/reports and more than 100 Finnish scientific articles and professional report, H-index = 28; Citations = 2649; 66 refereed publications.

INVITED SPEAKERS



Prof. Piotr STEPNOWSKI - since the beginning of his academic career, Prof. Piotr Stepnowski has been affiliated with the University of Gdańsk, Poland, where he has headed the Department of Environmental Analysis since 2006

"Analytical challenges in fate assessment of pharmaceuticals in the environment"

Prof. Piotr Stepnowski scientific interests include research on mechanisms of distribution and chemical transformations of environmental pollutants and methods of their analysis, as well as toxicological assessment of the effects of their occurrence. He has published over 200 original and review scientific papers. He is the editor of 8 scientific monographs and 3 academic textbooks as well as 15 chapters in prestigious international publishing houses. He gave over 50 lectures. His works have been quoted over 5000 times and the current Hirsch index is 44. He completed long-term scientific internships at the University of Lund, the Marine Research Centre in La Spezia and the University of Bremen. He was also a participant of a polar scientific expedition of the Institute of Oceanology PAS on board r/v "Oceania". He has promoted 14 doctors. He was the initiator and first director of the Institute of Environmental Protection and Human Health of the University of Gdańsk. In 2012-2016, he was the Dean of the Faculty of Chemistry of the University of Gdańsk. Since 2016, he has been the Vice-Rector for Science at the University of Gdańsk. His most important non-scientific interests include fine arts, architecture and music, including active wood sculpture and guitar playing, as well as his constant fascination with Italian Renaissance painting and architecture.



Prof. Olivera ĐURAGIĆ - a former General Manager at the Institute of Food Technology (2015-2019) and senior research associate with a Ph.D. in Food Engineering at the Faculty of Technology, the University of Novi Sad in Serbia

"Plant-based by-products: environmental hazard or valuable feed ingredient?"

Dr. Duragić has over 26 years of experience in scientific work on fields such as feed quality and safety, technology of animal feed production, the processing of raw materials and finished compound feeds, the working accuracy of process (homogeneity of compound feeds, cross-contamination and carry over), the utilization of agricultural and food by-products as well as on the implementation of feed safety quality system in feed mills (HACCP) and the development and implementation of trainings in formal and informal education and related training materials and publications.

The vast experience in this area of expertise comes not only from the years spent as a researcher in the Feed Technology Department but also from the active participation in international projects such as FEED TO FOOD, FOODSEG, INNO-FOOD-SEE, AP4INNO, DANUINTEG. She is a member of several international associations and networks (Food cluster initiative, Bacfoodnet, Foodsegnet) and USDA Cochran fellowship grantee in the "Food Safety" program in 2014. She published more than 180 scientific and technical papers and participated in a great number of international conferences.



Prof. Wojciech WOLF is a Head Environmental and Coordination Chemistry Group at the Institute of General and Ecological Chemistry, Łódź University of Technology, Poland

"Environmental and chemical aspects of plant stress induced by heavy metals"

His major research interests originated from the crystal structure analysis. Recently, he is also involved in environmental chemical analysis aimed at heavy metal pollution and protection of soil and water. Special emphasis is directed toward the additive interactions of plant stress factors and the way their affect plant photosynthesis. Professor Wolf is also involved in applied projects directed towards reduction of waste load in sewage from power stations and development of electrodes for the molten carbonate fuel cells. He has published over 80 original research papers and is co-author of five patents. His works have been cited 750 times, the H factor is 16. He completed long-term internships at Oxford University, the Free University of Berlin and the SERC Synchrotron Research Laboratory at Daresbury (UK). He was a deputy dean (2005-2008) of the Chemical Faculty and a vice-rector (2008-2012) of the Łódź University of Technology. In 2009-2018 he was elected a vice president of the European University Foundation. Since 2014 he is an honorary consul of Grand Duchy of Luxembourg in Łódź and a vice president of the Łódź Scientific Society.



Prof. Ewa BULSKA - is working at the Faculty of Chemistry, University of Warsaw, Poland. Since 2005, Head of the Metrology in Chemistry Centre at the University of Warsaw. Since 2013, Director of Biological and Chemical Research Centre at the University of Warsaw, Poland

"Towards food safety via bio-stimulated increasing nutritional value of selected plants"

Member of Committee of Analytical Chemistry of Polish Academy of Sciences (KChA PAN) and the Chair of the Analytical Spectrometry Working Group of KChA PAN; member of Polish Chemical Society; member of Board of POLLAB; member of Executive Committee of EUROLAB. She is an author or co-author of over 190 scientific publications, few book chapters and several review papers in the field of analytical chemistry: inorganic and bioinorganic trace analysis; environmental, clinical and food samples; archeometry; atomic spectrometry (AAS, OES, MS); atom formation process in graphite furnace and in plasmas; mechanism of matrix interferences; hydride generation with AAS, ICP and MIP OES; investigation of speciation with GC MIP-OES, HPLC ICP-MS or solid sorbents; flow and flow injection system for AAS, OES and MS; use of EPMA, SIMS, XANES and LA ICP-MS for the investigation of surface and sub-surface domain of various solids (graphite, archeological samples, foods); isotopic dilution in ICP-MS; chemical isotope effects of Ga, In and Ge; metrology in chemistry. She contribute to the book "Inorganic Trace Analytics Trace Element Analysis and Speciation", ed. H. Matusiewicz and E. Bulska (De Gruyter, 2018), She is an author of monography "Metrology in Chemistry" (Springer, 2018).

Her achievement was recognised with a number of awards, in between with the prestige Bunsen-Kirchhoff Award, given by German Chemical Society (2004), Wiktor Kemula Award, given by Polish Chemical Society (2012), IUPAC'2015 Distinguished Women in Chemistry Award given by IUPAC (2015) and Jerzy Fijałkowski Award, given by Analytical Spectrometry Working Group of KChA PAN (2016).



Dr. Barbara KUBÍČKOVÁ - RECETOX, Masaryk University, Brno, Czech Republic

"Natural toxins in the freshwater environment - occurrence, fate and health implications"

Work experience:

Since 2017: RECETOX, Masaryk University, Brno, Czech Republic Marie Skłodowska-Curie Actions Early Stage Researcher, Ph.D. student of Environmental Health Sciences. Project: "Health risks of natural toxins in surface waters".

05-07.2019: Helmholtz Centre for Environmental Research (UFZ), Leipzig, Germany Visiting researcher

04-12.2016: RECETOX, Masaryk University, Brno, Czech Republic ERASMUS+ internship

09-12.2015: Department of Microbiology, University Greifswald, Germany Research assistant. Project: "Functional genomics and systems-level analysis of septicaemic E. coli pathogens"

04-08.2015: Department of Microbiology, University Greifswald, Germany Research assistant. Project: "Protein S-bacillithiolations and real-time redox imaging of the bacillithiol redox potential in Staphylococcus aureus"

2010-2011: SOS SOS Children's Village - Grimmen, Germany Volunteer.

Education:

Ernst-Moritz-Arndt University - Greifswald, Germany M. Sc. Molecular Biology & Physiology, Major: Cell Physiology Thesis: Effects of cyanobacterial toxins on cultured immortalized human airway epithelial cells. Supervisor: Prof. Dr. Jan-Peter Hildebrandt, Supervisor-specialist: Assoc. Prof. Pavel Babica, Ph.D.

Ernst-Moritz-Arndt University - Greifswald, Germany B. Sc. Biology, Major: Microbiology Thesis: "Characterization of hepatitis E virus specific monoclonal antibodies" Supervisor: Prof. Dr. Katrin Riedel, Supervisor-specialist: Dr. Rainer G. Ulrich.



Prof. Ljiljana MOJOVIĆ - Professor of „Biochemical Engineering”, University of Belgrade, Faculty of Technology and Metallurgy, Department of Biochemical Engineering and Biotechnology, Belgrade, Serbia

"Bioprocessing agro-industrial residues into value added products"

Dr. Ljiljana V. Mojović, is Full Professor at The University of Belgrade, Serbia. Her basic education is technical and biochemical - in the field of biochemical engineering and biotechnology. Her main research interests are various biotechnological processes and microbial fermentations employed in environmental protection, waste water treatment, utilization of renewable biomass for food, feed and biofuel production. She participated in a number of research and industrial projects, and authored or co-authored 7 books and 105 international scientific articles (h index=22, citation=1411 according to Scopus on 11.11.2019).



Prof. Janusz IGRAS PhD. Eng. is the General Director of the Łukasiewicz Research Network - New Chemical Syntheses Institute in Puławy, Poland

"Smart fertilizers - reality or researcher's fantasy?"

Prof. Igras from 1990 to 2011 worked in the Institute of Soil Science and Plant Cultivation - State Research Institute in Puławy. For many years he was a member of the Central Council of Science and Higher Education and the president of the Scientific Board of Puławy Competence Center at Grupa Azoty Puławy. Currently, he is a member of the Scientific Council at Jerzy Haber Institute of Catalysis and Surface Chemistry Polish Academy of Sciences. Prof. Janusz Igras is a recognized expert in the field of fertilizers and fertilization and his research is also focused on chemistry and agriculture.



Prof. Beata GODLEWSKA-ŻYŁKIEWICZ is the head of the Chair of Analytical and Inorganic Chemistry at the Faculty of Chemistry, University of Białystok (UwB), and the vice chairmen of the Committee of Analytical Chemistry of Polish Academy of Sciences

"Nanomaterials - environmental risks and speciation analysis of metal nanoparticles in environmental samples"

In the past, prof. Beata Godlewska-Żyłkiewicz was the vice Rector for Research and International Relations, and the Dean of the Faculty of Biology and Chemistry of the University of Białystok. Her scientific interest is mainly focused on developing methods for analysis of technologically critical elements (TCE), including platinum group elements as well as speciation analysis of metals, metalloids, and nanoparticles in environmental samples. Her research brings a holistic approach to different dimensions of metals analysis, e.g. problems of stability of metallic forms, novel separation methods, elimination of interferences, and quality assurance of analytical results. Moreover, she performs studies on the impact of NPs on the environment, and on bioavailability of metals from soils and waters by plants and microorganisms. She is a co-author of 120 scientific papers, almost 80 among these were published in internationally recognized journals.



Dr. Beata KRASNODEBSKA-OSTRĘGA is a leader of Research Group - Analytical chemistry in investigation and protection of the environment at Faculty of Chemistry, University of Warsaw, Warszawa, Poland

"Sampling and sample pretreatment as a critical point of environmental analysis of water - total and species analysis"

Dr. Beata Krasnodębska-Ostręga - her scientific interests are: environmental analysis; environmental monitoring (biomonitoring and sample banking); determination of traces of "heavy" metals (Pt, Pd, Tl, Zn, Cd, Cu, Ct, Pb) and metalloids (As) in environmental samples (water, soil, sediments, food, plant and animal tissues); phytoremediation processes; waste management; chemical/physical speciation and fractionation; preparation of new control materials; development of sampling procedures of water and solid samples; optimization of sample pretreatment step (sampling, milling, homogenization), digestion/mineralization

(microwave assisted) and UV/Vis digestion (chemically or catalytically accelerated), application of solid phase extraction and liquid chromatography in trace speciation analysis; application of ICP MS and voltammetric determination in total content and speciation analysis/fractionation (water, soil, sediment). Currently she is: Vice-Dean for Student Affairs (FCh UW) and Vice-chairman of the University Council of the Center for Environmental Studies and Sustainable Development of UW, and Member of the Spectral Analysis Team of the Analytical Chemistry Committee of the Polish Academy of Science.



Dr. Marcin KONKOL is currently a Scientific Director of the New Chemical Syntheses Institute in Puławy, which has changed its name into the Łukasiewicz Research Network, Poland

"Supercritical CO₂ extraction - green waste-free technology"

In 2005, he completed his PhD thesis in Chemical Sciences at the Martin Luther University in Halle-Wittenberg (Germany), and in 2017 he received a postdoctoral degree in the Technical Sciences at the West Pomeranian University of Technology in Szczecin. In the years 2006-2008 and 2008-2010 he worked at the Aachen University of Technology (RWTH Aachen) and the Sumitomo Petrochemicals Research Laboratory (Sodegaura, Japan), respectively. Since 2010, he has been employed in Łukasiewicz Research Network and in the years 2014-2018 he was also the Scientific Secretary of this Institute. Main interests include catalytic processes, extraction of plant material with supercritical CO₂ and chemical analysis.



Assoc. Prof. Rajmund MICHALSKI works at the Institute of Environmental Engineering, Polish Academy of Sciences in Zabrze, Poland

"Applications of ion chromatography for the determination of carboxylic acids in biomass combustion products"

Rajmund Michalski works in the Institute of Environmental Engineering, Polish Academy of Sciences in Zabrze (Poland) since 1988. His research concern mainly environmental and analytical chemistry, in particular: ion chromatography (sample preparation, columns, eluents, detectors, and applications) and utilization of hyphenated techniques (IC-ICP-MS, IC-MS) in species analysis (inorganic disinfection by-products, metal/metalloids ions). He is an author of dozen of books, manuscripts and over 270 publications on ion chromatography in environmental and food analysis published in international and popular-science journals.

Several times he was on foreign scholarships, including 1 year in Japan (Tohoku University, 2000-2001) and few months in Germany (Institute of Environmental Protection and Geology in Wiesbaden, 1999, 2002, 2010), as well as Universities in Cluj Napoca (Romania) and Bilbao (Spain). He is a member of Polish Association of Chemistry; Polish Academy of Sciences (Committee of Analytical Chemistry); Polish Committee of Standardization and Chairman of Scientific Committee of annual international conference "Ion Chromatography and Related Techniques". Since 2007 he is a representative of Polish Academy of Sciences in European Academies Science Advisory Council, Environmental Steering Panel (EASAC ESP), and since 2011 a member of National Committee for Cooperation with Advising Scientific Council of European Academies.

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The Prize is awarded to two teams of researchers:

1) Dr. Andre Geim and Dr. Rahul Nair (National Graphene Institute, University of Manchester, UK)

for developing novel graphene oxide membranes that promise to enable energy-efficient and high-volume water filtration and desalination.



Dr. Andre Geim



Dr. Rahul Nair

2) Dr. Günter Blöschl (TU Wien, Austria) and Dr. Murugesu Sivapalan (University of Illinois at Urbana-Champaign, USA)

for developing the new field of Sociohydrology, a ground-breaking paradigm for water management and a new validated approach for studying the dynamic interactions and bi-directional feedbacks between water systems and people.



Dr. Günter Blöschl

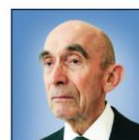


Dr. Murugesu Sivapalan

Surface Water Prize

Dr. Wilfried Brutsaert (Cornell University, USA)

for developing, demonstrating, and validating a new theory that can generate unprecedented estimates of evaporation from the natural landscape.



Dr. Wilfried Brutsaert

Groundwater Prize

Dr. Martinus Th. van Genuchten (Federal University of Rio de Janeiro, Brazil)

for the development and application of key theoretical and software tools that describe water flow and contaminant transport in the subsurface.



Dr. Martinus van Genuchten

Alternative Water Resources Prize

Dr. Omar Yaghi (University of California, Berkeley, USA) and Dr. Evelyn Wang (Massachusetts Institute of Technology, USA)

for creating a solar-powered device that uses an innovative porous metal-organic framework (MOF) to capture water from the atmosphere.



Dr. Omar Yaghi



Dr. Evelyn Wang

Water Management and Protection Prize

Dr. Jim W. Hall and Dr. Edoardo Borgomeo (Environmental Change Institute, Oxford University, UK)

for developing and applying a new risk-based framework to assess water security and plan water supply infrastructure in times of climate change.



Dr. Jim W. Hall



Dr. Edoardo Borgomeo

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1. All nominations are made online through an electronic application form that is available on the PSIPW website. All required documentation and submitted works are uploaded by way of the same form. Mail-in applications are not accepted.
2. In the event that a team of individuals are being nominated, all team members (up to five) must be named at the time of application and one member must be specified as their representative. Groups of people working on the same project may not be nominated separately. They must be nominated as a team with a single nomination form.
3. The nominee must be an individual or team of individuals. Organizations are not eligible to be nominated for the five prizes.
4. Nominations for the **Specialized Prizes** are by direct self-nomination. Nominations for the interdisciplinary **Creativity Prize** must be made by a university, institution, or government agency on behalf of the scientists and researchers. Individuals may not nominate themselves or others for the Creativity Prize.
5. The nominated body of work must have been completed no more than five (5) years prior to the nomination deadline for the current award.
6. Published research papers, published books, and registered patents may be submitted for consideration. Unpublished works and unregistered patents are ineligible for the prize.
7. No more than five (5) distinct works may be submitted. Multiple works should not be collected together and submitted as a single work.
8. Works will be reviewed and judged in English. A work published in another language must be submitted in the original language accompanied by a full translation or a translation of the parts of the work that are to be considered for the prize. If a partial English translation is provided, then only that portion of the work will be considered for assessment.
9. A nominee may only be nominated for one prize during an award period.
10. The work being nominated must not have previously been a recipient of any other international prize. (However, it may have been the recipient of local, national or regional prizes.)
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Award: Creativity Prize	Value: \$266,000
NomInators:	universities, university departments, research institutes, companies, water organizations and agencies
Candidates:	scientists and researchers
Eligible Works:	published research papers, published books and registered patents within the past 5 years
Award: Specialized Prizes	Value: \$133,000
NomInators:	self-nomination
Candidates:	scientists and researchers
Eligible Works:	published research papers, published books and registered patents within the past 5 years

Nominations for all prizes can be made online at the PSIPW website:

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PROGRAMME

➤ **Monday, December 2nd 2019: first day**

16:30 – 17:00 Registration

17:00 – 19:00 Welcome Reception at Izrael Poznański's Palace

➤ **Tuesday, December 3rd 2019: second day**

7.30 – 8.30 Registration

8.30 – 9.00 Opening Ceremony

Session 1 (Chairs: M.I. Szyrkowska, B. Jovancicevic)

9:00 – 9:40 Plenary lecture (PL1):

B. Buszewski ***"A new concept in metabolism study of toxins in environmental and biological samples"***

9:40 – 10:05 Invited lecture (IL1):

P. Stepnowski ***"Analytical challenges in fate assessment of pharmaceuticals in the environment"***

10:05 – 10:35 Coffee break/Poster session

Session 2A - aula A (Chairs: K. Chojnacka, N. Ratola)

10:35 – 11:00 Invited lecture (IL2):

O. Đuragić ***"Plant-based by-products: environmental hazard or valuable feed ingredient?"***

11:00 – 11:15 Oral presentation (OP1):

N. Zarić ***"Elemental composition of individual honeybees and their use as environmental bioindicators"***

11:15 – 11:30 Oral presentation (OP2):

M. Bavcon Kralj ***"Are common household preparations effective in removing pesticide residues from citrus fruits?"***

11:30 – 11:45 Oral presentation (OP3):

M. Passananti ***"Degradation of nanoplastics in water: impact on gaseous and aqueous phase organic carbon"***

11:45 – 12:00 Oral presentation (OP4):

F. Prosenc ***"Microplastics in soil and soil-like matrices: extraction, quantification and identification"***

Session 2B - aula B (Chairs: I. Staneczko-Baranowska, A.T. Lebedev)

10:35 – 11:00 Invited lecture (IL3):

W.M. Wolf ***"Environmental and chemical aspects of plant stress induced by heavy metals"***

11:00 – 11:15 Oral presentation (OP5):

F. Dal Bello ***“LC-MS analytical determination of gabapentin degradation by heterogenous photocatalysis and environment evaluation”***

11:15 – 11:30 Oral presentation (OP6):

P. Trebše ***“Photolytic and photocatalytic degradation of doxazosin in aqueous solution”***

11:30 – 11:45 Oral presentation (OP7):

J. Kašlík ***“Valorisation of Fe/Ca mining waste sludge: reactive nanocomposites for hazardous metals removal from contaminated mine water”***

11:45 – 12:00 Oral presentation (OP8):

S. Pap ***“From molecular to large-scale phosphorous recovery from wastewater using chitosan-calcite adsorbent”***

12:00 – 12:30 Coffee break/Poster session

Session 3A - aula A (Chairs: L. Mojović, W. Wolf)

12:30 – 12:45 Oral presentation (OP9):

T. Milićević ***“Non-destructive techniques (WD-XRF and magnetic measurements) for investigation of the pollution in different vineyards in Serbia”***

12:45 – 13:00 Oral presentation (OP10):

M. Kašanin-Grubin ***“Assessment of vulnerability of European forest soil in mountain regions to land use and climate change”***

13:00 – 13:15 Oral presentation (OP11):

D.M. Mazur ***“Organic pollutants in the snow of Franz Joseph Land. Expedition 2017”***

13:15 – 13:30 Oral presentation (OP12):

A.T. Lebedev ***“Complementary techniques in the environmental GC–MS analysis”***

Session 3B - aula B (Chairs: B. Godlewska-Żyłkiewicz, M. Olazabal)

12:30 – 12:45 Oral presentation (OP13):

M. Brumovský ***“Cr(VI) removal by sulfidated nanoscale zerovalent iron: from lab–scale testing to in situ remediation”***

12:45 – 13:00 Oral presentation (OP14):

J. Oborná ***“In situ remediation by commercial sulfidation iron nanoparticles (S-nZVI) on a site heavily polluted by chloroethenes”***

13:00 – 13:15 Oral presentation (OP15):

J. Schwarzbauer ***“Organic contaminant footprints in 2011 Tohoku-Oki tsunami deposits (Northern Japan)”***

13:15 – 13:30 Oral presentation (OP16):

I. Komorowicz ***“Study On Total Arsenic And Arsenic Species In Various Matrices: Water and Freshwater Fish Samples”***

13:30 – 14:30 Lunch

14:30 – 18:00 EC1 Tour

18:00 – 20:00 Poster session

➤ **Wednesday, December 4th 2019: third day**

8.30 – 9:00 Registration

Session 4 - aula A (Chairs: A-M. Delort, B. Buszewski)

9:00 – 9:40 Plenary lecture (PL2):

S. Hellsten ***"Management and restoration of surface water bodies receiving mine waters - lessons learned from Talvivaara mine impacts in northern part of Finland"***

9:40 – 10:05 Invited lecture (IL4):

E. Bulska ***"Towards food safety via bio-stimulated increasing nutritional value of selected plants"***

10:05 – 10:35 Coffee break/Poster session

YOUNG SESSION

Session 5 - aula A (Chairs: S. Hellsten, P. Konieczka)

10:35 – 11:00 Invited lecture (IL5):

B. Kubičková ***"Natural toxins in the freshwater environment - occurrence, fate and health implications"***

11:00 – 11:15 Oral presentation (OP17):

M. Stec ***"Occurrence and spatiotemporal variability of sunscreen agents along the polish part of the Baltic Sea coast"***

11:15 – 11:30 Oral presentation (OP18):

Ž. Arciszewska ***"Method development for determination of trace amounts of Pd in seawater by SPE-ICP-MS using thiol-functionalized MCM-41 materials"***

11:30 – 11:45 Oral presentation (OP19):

H. Zind ***"Distribution of selected pharmaceutical residues and their related degradation products in different aquatic compartments"***

11:45 – 12:00 Oral presentation (OP20):

O. Matviichuk ***"Evolution of antibiotics in two French rivers and incidence of antibiotic resistance in biofilms"***

12:00 – 12:30 Coffee break/Poster session

Session 6 - aula A (Chairs: J. Schwarzbauer, P. Trebše)

12:30 – 12:45 Oral presentation (OP21):

P. Suková ***"Elimination of pharmaceuticals from aquatic environment using enzymatic apparatus of wood decaying fungi"***

12:45 – 13:00 Oral presentation (OP22):

M. Madej ***"Voltammetric determination of antidepressant drug citalopram in water samples"***

13:00 – 13:15 Oral presentation (OP23):

B. Kaur ***"A comparative study of Losartan photodegradation: activated persulfate versus hydrogen peroxide"***

13:15 – 13:30 Oral presentation (OP24):

A. Kravchenko ***"Permanent coatings based on imidazolium cations in the separation of biological active analytes by capillary electrophoresis"***

13:30 – 14:30 Lunch

Session 7 - aula A (Chairs: B. Kubičková, S. Garboś)

14:30 – 14:45 Sponsor presentation (SP1):

G. Przeliorz ***"Instruments for environmental research in the offer of the COMEF company"***

14:45 – 15:00 Oral presentation (OP25):

J. Salvé ***"Chitosan-clay materials for drinking water production: stability improvement and reactivity towards dissolved organic matter"***

15:00 – 15:15 Oral presentation (OP26):

P. Cheng ***"Decatungstate, $W_{10}O_{32}^{4-}$, as a photocatalyst for the simultaneous oxidation of organic pollutants and reduction of Fe^{3+} and/or H_2O_2 "***

15:15 – 15:30 Oral presentation (OP27):

F. Rocha ***"Nutrient content, heavy metals, microorganisms and organic pollutants in Portuguese sewage sludge - a country level analysis"***

15:30 – 15:45 Oral presentation (OP28):

Y. Arbid ***"Development of an experimental system to measure air depollution performance of green roofs"***

15:45 – 16:00 Coffee break/Poster session

Session 8 - aula A (Chairs: N. Fiol, R. Michalski)

16:00 – 16:15 Oral presentation (OP29):

A. Marion ***"Nitrous acid (HONO) formation on corn leaves by reduction of nitrogen dioxide (NO_2)"***

16:15 – 16:30 Oral presentation (OP30):

P. Irizar ***"Design of epoxy-silica hybrids based on environment-friendly cycloaliphatic diol compounds for potential application as stone conservation materials"***

16:30 – 16:45 Oral presentation (OP31):

B. Rogalewicz ***"Impact of medical use on composition of two carbon dioxide absorbents used in anaesthesiology. Research on kinetics of carbon dioxide absorption under specific conditions"***

16:45 – 17:00 Oral presentation (OP32):

M. Przydacz ***“Does polymorphic form of TiO₂ influence the HMF hydrogenation course?”***

17:00 – 17:10 Sponsor presentation (SP2):

J. Grodowski ***“Instruments for environmental research in the offer of the Intertech Poland company”***

17:10 – 17:30 Coffee break/Poster session

Session 9 - aula A (Chairs: B. Krasnodębska-Ostręga, K. Rosentrater)

17:30 – 17:45 Oral presentation (OP33):

T. Soleymani-Angili ***“Environmental life cycle analysis of corn ethanol under different scenarios for the valorisation of whole stillage”***

17:45 – 18:00 Oral presentation (OP34):

D. Polikarpova ***“Nano-sized ion exchangers for electrophoretic separation of charged analytes”***

18:00 – 18:15 Oral presentation (OP35):

N.P.F. Gonçalves ***“Comparative study of persulfate and hydrogen peroxide activation by humic acid coated magnetic materials for BPA degradation: A life cycle assessment evaluation”***

20:00 – 24:00 Gala dinner at Browar Księży Młyn

➤ **Thursday, December 5th 2019: fourth day**

Session 10 - aula A (Chairs: D. Barałkiewicz, I. Zbiciński)

9:00 – 9:40 Plenary lecture (PL3):

K. Rosentrater ***“Using life cycle assessment to better understand environmental impacts of bioprocessing systems”***

9:40 – 10:05 Invited lecture (IL6):

L. Mojović ***“Bioprocessing agro-industrial residues into value added products”***

10:05 – 10:35 Coffee break/ACE General Assembly

Session 11 - aula A (Chairs: I. Witońska, A. Parczewski)

10:35 – 11:00 Invited lecture (IL7):

J. Igras ***“Smart fertilizers - reality or researcher’s fantasy?”***

11:00 – 11:25 Invited lecture (IL8):

B. Godlewska-Żyłkiewicz ***“Nanomaterials - environmental risks and speciation analysis of metal nanoparticles in environmental samples”***

11:25 – 11:50 Invited lecture (IL9):

B. Krasnodębska-Ostręga ***“Sampling and sample pretreatment as a critical point of environmental analysis of water - total and species analysis”***

11:50 – 12:30 Coffee break

Session 12 - aula A (Chairs: J. Kałużna-Czaplińska, O. Đuragić)

12:30 – 12:45 Oral presentation (OP36):

K. Czarny ***“Molecularly imprinted polymer film grafted from porous silica for efficient enrichment of steroid hormones in water samples”***

12:45 – 13:00 Oral presentation (OP37):

A.-M. Delort ***“Biodegradation of phenol and catechol by cloud microorganisms. Comparison with radical chemistry”***

13:00 – 13:15 Oral presentation (OP38):

A. Krejčova ***“Assessment of risks perception associated with the use of tattoo inks”***

13:15 – 13:30 Oral presentation (OP39):

K. Taran ***“An Innovative Dilemma Of Interplay Between Cancer ‘In Vivo’ Cells And Their Environment In Macro And The Atomic Scale”***

13:30 – 14:30 Lunch

Session 13 - aula A (Chairs: V. Beskoski, P. Mierczyński)

14:30 – 14:55 Invited lecture (IL10):

M. Konkol ***“Supercritical CO₂ extraction - green waste-free technology”***

14:55 – 15:20 Invited lecture (IL11):

R. Michalski ***“Applications of ion chromatography for the determination of carboxylic acids in biomass combustion products”***

15:20 – 16:00 Coffee break

Session 14 - aula A (Chairs: A. Czyłkowska, A. Astel)

16:00 – 16:15 Oral presentation (OP40):

J. Rogowski ***“Synthesis and characterization of SiC-based composites prepared from plant material”***

16:15 – 16:30 Oral presentation (OP41):

C. Escudero-Oñate ***“Removal of quaternary ammonium-based corrosion inhibitors from produced water and seawater: photodegradation and bioremoval”***

16:30 – 17:30 Award ceremony. Closing session

PLENARY LECTURES

B. Buszewski*, A. Rogowska, P. Pomastowski, R. Gadzała-Kopciuch

Department of Environmental Chemistry and Bioanalytics, Faculty of Chemistry, Nicolaus Copernicus University in Toruń, 7 Gagarin St., PL-87 100 Toruń, Poland

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Recently, the significant increase in interest on investigation of presence of low-molecular compounds (xenoestrogens) produced by filamentous fungi in food raw materials was observed. What has attracted particular attention was zearalenone (ZEA) as well as its metabolites (α -zearalenol - α -ZOL and β -zearalenol - β -ZOL) – a mycotoxin produced by mold fungi belonging to the *Fusarium* family, which show strong estrogenic activity. *Fusarium* species are found on many plants growing in the temperate climate zone, mainly on corn and numerous grains. The presence of such species on plants leads to contamination of food e.g. meat, bread, milk or eggs. In addition, produced by these species mycotoxin - zearalenone exhibit high stability during storage and does not degrade after exposure to high temperatures. The similarity of the zearalenone structure to natural estrogens allows to antagonize their activity, change their mechanism of synthesis and metabolism or interfere with the synthesis of receptor. Such a disturbance of the natural hormonal balance may contribute to the formation of hormone-dependent disease such as breast, prostate or cervical cancer. Moreover, α -ZOL exhibit higher estrogenic activity than parent ZEA [1]. Considering that the presence of zearalenone and its metabolites in food products is a huge threat to human and animal health and is a serious cause of economic problems, it is extremely important for modern science to develop new effective methods of neutralizing this toxin. Over the last years, researchers have tried to solve this problem - the most commonly used methods of detoxification of feed and food include physical and chemical methods. Although these methods in many cases

prove to be effective, they have many limitations associated primarily with high costs and the loss of essential nutrients from food. Therefore, there is an increased interest in the application of microbiological methods, which seem to be safer, more environmentally friendly and cheaper in comparison to traditional methods. The results we have confirmed of neutralization of zearalenone by lactic acid bacteria and diatoms, which is a new and promising tool for the microbiology neutralization of mycotoxins [1,2]. Another important research problem is to develop an effective methods for isolation and determination of this mycotoxin and its metabolites from various biological and environmental matrices. For this reason the repeated, qualitative and quantitative determination of these compounds by the combined separation techniques was the overriding objective of these studies. In our studies we conducted of the selective method of ZEA and its metabolites isolation from neoplastically changed human tissue by coupled separation techniques. Except the purely chromatographic applications molecularly imprinted polymers were also used as specific binding matrices for the solid phase extraction and cleanup of biological sample extracts.

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1. A. Król, P. Pomastowski, K. Rafińska, V. Railean-Plugaru, J. Walczak, B. Buszewski, *Anal Bioanal Chem.* 410 (2018) 943-952.
2. A. Rogowska, P. Pomastowski, K. Rafińska, V. Railean-Plugaru, M. Złoch, J. Walczak, B. Buszewski, *Toxicon* 169 (2019) 81-90.

Management and Restoration of Surface Water Bodies Receiving Mine Waters - Lessons Learned from Talvivaara Mine Impacts in Northern Part of Finland

PL2

S. Hellsten

Finnish Environment Institute (SYKE), Freshwater Centre, Restoration and Assessment unit, Oulu, Finland
seppo.hellsten@ymparisto.fi

Mining has increasing role in use of northern natural resources. Environmental effects of mining activities are usually well mapped in environmental impact assessment and permission. However, management of mine water discharges in their recipient surface water bodies is often the weakest link in assessment and mines with zero aquatic emissions are not feasible in northern climatic conditions. Talvivaara metal mining activities in northern part of Finland and especially the effects of gypsum pond leakage autumn 2012 raised public concern and urgent need to develop assessment methods for lakes and rivers.

The Management and restoration of surface water bodies receiving mine waters ("KaiHali") project was planned to fulfil the gaps in knowledge in the management of mine water discharges to surface waters [1]. The project also focused on modelling and restoration of water bodies taking into account properties specific to mine waters such as reactivity, high salt content and accumulation of contaminants in biota. Further specific properties such as background concentrations for metals in ecological quality standards and physical properties affecting on lake stratification patterns were taken into account.

Modelling of surface waters was developed by the VEMALA-watercourse modelling tool. Based on several case studies, the model worked well and helped evaluation of the effects of mining. Effects on lake stratification were estimated with MyLake-software. In addition, the project applied bioligand models (BLM) to characterize bioavailable concentrations of nickel, zinc and copper and produced toxicity data in local water quality conditions for improvement work of current BLM models. Mixture toxicity models of heavy metals were demonstrated for surface waters and sediment as an early warning assessment tools for mining affected water bodies.

Restoration of mine affected lakes should also include chemical modelling and pilot-level field experiments for removal of chemical stratification [2]. This basic information and modeling approach must be utilized in the planning phase of restoration. Self-purification capacity of contaminated sediments can be significant, but further feasibility studies are needed for method development.

Kaihali-project produced a toolbox and a set of background material for research institutes, companies, consultants and environmental authorities to promote assessment and modelling of mine affected lakes and rivers. Further biological assessment methods are developed for rivers receiving minewaters [3]. The project has enhanced the possibilities for research and development related to sustainable mining.

Acknowledgements

Project was funded by European Regional funds.

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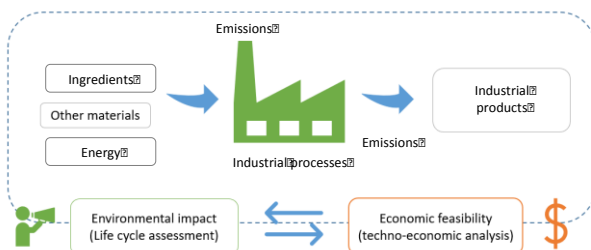
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Using Life Cycle Assessment to Better Understand Environmental Impacts of Bioprocessing Systems

PL3

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As new products and processes are developed, especially those based on biological products, scaled up, and commercialized, it is increasingly important to understand the environmental impacts of these new developments. Life Cycle Assessment (LCA) is an objective methodology that is increasingly used for this purpose.

This presentation will discuss a case study [1] which uses LCA as a tool for investigating bioprocessing options at an early stage of product development.

This example discusses the development of glycerol-based bioadhesives. Due to increasing environmental concerns about petroleum-based products, the replacement of petro-products has attracted much attention in recent years. The purpose was to evaluate the potential environmental impacts of glycerol-based structural bio-adhesive produced through the reversible addition-fragmentation chain transfer polymerization process. In this study, two pathways of glycerol production were considered in this cradle-to-gate life cycle assessment: bio-glycerol produced from biodiesel production plant and petroleum-based glycerol derived from petroleum refineries. Several impact categories were analyzed including global warming potential, acidification potential, eutrophication potential, and human health

effects (both cancer and non-cancer). The impact of different allocation methods (energy content, mass value, and economic value) were also explored in this study.

Our results showed that bio-glycerol based structural adhesive had a lower environmental impact in general compared to petro-glycerol based structural adhesive. Higher environmental impacts throughout the structural bio-adhesive life cycle were observed by adopting energy allocation method. The key factors that influence the global warming potential were electricity sources and the product yield.

This LCA study provides useful information for developing sustainable biomaterials and processes. It is recommended to further explore the potential approaches to reduce the carbon intensity and eutrophication potential in the RAFT polymerization process as it is identified as the hotspot in the structural bio-adhesive production process.

Overall, LCA is frequently being used to examine environmental impacts of many products and processes at early-stage process development. This approach can help decision makers at organizations optimize their development approach.

Acknowledgements

The author would like to thank the EMEC20 organizing committee for the invitation to present at this conference.

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INVITED LECTURES

P. Stepnowski

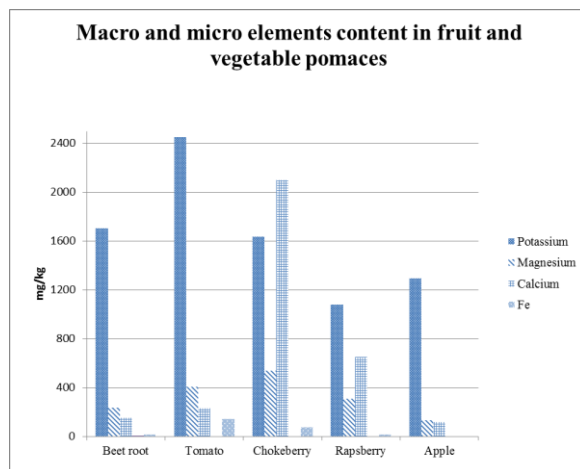
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Residues of pharmaceutical substances in the environment are increasingly being detected primarily in surface water and soils in almost all parts of the world. This is mainly due to the growing global consumption of pharmaceuticals in both human and veterinary medicine. The most frequently detected are antibiotics and over-the-counter, non-steroidal anti-inflammatory and analgesic drugs, estrogenic hormones, beta blockers, psychotropic or antiparasitic agents. Techniques of determination of such a wide and chemically diverse group of analytes, as well as examination of their pathways of transport, persistence and evaluation of the effectiveness of their degradation processes are one of the most serious

challenges of modern chemistry and environmental analytics. The presentation will present the most important achievements of our team in the field of preparation of environmental samples and improvement of final determinations of selected pharmaceuticals using available techniques (e.g. SPE, SPME, ASE, IEA, UAE, GC-MS, LC-MS/MS) as well as original solutions in the field of selective derivatisation of analytes and alternative extraction techniques using carbon nanotubes or ionic liquids as receiving phases. Additionally, the results of studies on the evaluation of sorption and kinetics of distribution of selected veterinary and anticancer drugs in different soil types will be presented.

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The main problem of the agro-food industry is the high amount of by-products which is generated during various stages of production. These by-products are usually leftovers from cereals, fruits and vegetables consisted of skins, peels, seeds, leaves and other inedible fractions. Those fractions are usually discarded due to their low nutritive value, presence of potentially toxic substances but also by inappropriate sensorial characteristics. Enormous amounts that are yearly generated could cause serious environmental problems due to high water activity that promotes microbial development. Some data shows that about one-third of worldwide food production (approximately 1.3 billion tons) is wasted. On the other side, we have almost 1 billion people who starving (FAO, 2015) and this problem will raise to 2050. when 10 billion populations are expected. Fruit by-products have become more and more popular both in human and animal nutrition, since they represent a remarkable source of functional compounds, such as dietary fibres, polyphenols and a rich source of antioxidants (Čolović et al., 2019, Mahawar et al., 2012). They remain after juice extraction from fruits and constitute approx. 20-25% of the fresh fruit weight. In this research, the chemical composition of pomace derived from chokeberry (Aronia), apple and raspberry as well as tomato and beetroot has been investigated. They contain a large amount of water (63.73 - 87.66%, wet basis) and total sugars (1.20 – 6.73%, wet basis) so its direct disposal into the soil could cause an environmental problem due to uncontrolled fermentation and degradation. On the other hand, pomace has the potential to be transformed into valuable feed ingredients since it is a

good source of macro and micro elements such as potassium, magnesium, and calcium which are very important for animal growth. Chokeberry and raspberry pomace are rich in magnesium and calcium content, while beetroot and tomato contain a high level of potassium.

As already said, by-products can be potentially unsafe for further usage in nutrition due to the presence of toxic substances. Therefore, we also investigated presence of organochlorine pesticides, heavy metals and microbial status in five pomace samples. According to obtained results, heavy metal contents (Hg, Pb, As and Cd) were far below the limits proposed by the EU regulation, as well as contents of organochlorine pesticides. Total counts of microorganisms were below 1000 cfu/g in all samples, except in tomato pomace (4000 cfu/g), while in chokeberry pomace it counted 480000 cfu/g. The reason for that might lay in the fact that chokeberry is usually not treated with any herbicides, fungicides or pesticides during cultivation. Total count of yeasts and moulds was also the highest in chokeberry pomace sample (110000cfu/g), while in other samples was below 1000 cfu/g (apple pomace and beetroot pomace), and even below 100g/cfu (tomato pomace and raspberry pomace). It is reasonable to expect that chokeberry pomace would have the shortest shelf life, which must be taken into account in animal feed production.

Acknowledgements

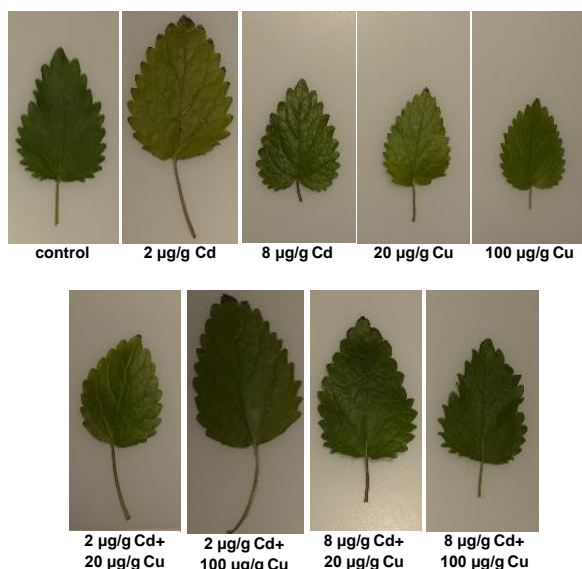
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Industrial production and agricultural activity often lead to transfer of diverse forms of heavy metals into the soil and plant environment. In particular, the increasing amount of metal nanoparticles as offered on the market, prompts the detailed studies on their environmental and health impact. The latter are being used in a number of processes like: drinking water treatment, toxic chemicals eliminations, reducing water uses, lower energy consumption and cleaner energy technologies. A special interest is given to interaction with living organisms with the unique position of plants which are the food source. Nanoparticles are starting to play an important role in agriculture with special emphasis directed towards novel efficient agrochemicals and fertilizers [1].

Heavy metal uptake by plants is a complex soil-plant process. It used to be affected by several factors such as plant species, their genotype, availability, and mobility of metals, soil properties, and biogeochemical processes combined with the microbial activity, at the rhizosphere level, which influence metal availability to plants [2]. Additionally, soils are rarely contaminated with a single metal but rather a mixture of diverse metals and their additive (mutual) interactions cannot be ruled out. Particular metals may have different plant uptake mechanisms and often compete with each other for the uptake. Finally, the influence of widely used agrochemicals should not be neglected [3]. Furthermore, humic acids

shows the well recognized ability to form stable complexes with heavy metals further reducing mobility and rising their retention in organic soils.

There are two major mechanisms for heavy metals uptake by plants i.e. the apoplastic and synplastic pathways. Both can influence the metabolic processes, which in aerobic organisms lead to the generation of reactive oxygen species (ROS). These plant stress products affect metabolism and quantum yield of the plant [4]. The latter can be conveniently assessed by the photosynthetic activity indicators as represented by chlorophyll content and gas exchange parameters. It is well recognized that in either the soil or the plant cell environment metals can exist in a number of chemical forms which may involve superoxide dismutases which neutralizes oxygen reactive species produced in the plant metabolism [5]. Conserved metal ions are important cofactors which secures the enzyme activity. Metal uptake by roots from soil is strongly dependent on the rhizosphere environment in which bacteria and fungi play the vital role. Additionally, the influence of humic acids cannot be ruled out. The latter show well recognized ability to form stable complexes with heavy metals affecting mobility and rising their retention in organic soils. Although, the mycorrhizal fungi may be responsible for nutrients and metal uptake, with zinc and copper being the mostly prone elements [6].

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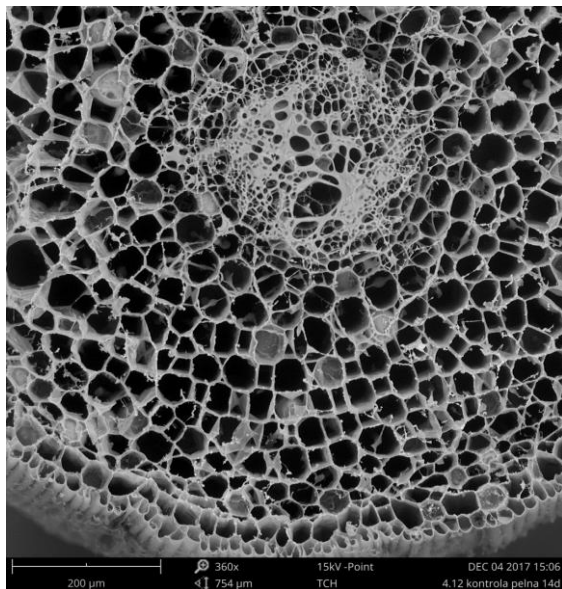
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Towards Food Safety via Bio-stimulated Increasing of Nutritional Value of Selected Plants

IL4

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The aim of the presentation is to discuss the process of bio-stimulation of various plants towards increasing their nutrition value, with the example of the selected onions and tomato varieties.

The aim of the project was to develop an on-field approach, under agro-friendly conditions, towards the increasing nutritional value (bio-stimulated) of selected performant onion and tomato varieties to be cultivated in areas with temperate climate. It should be stressed that in temperate climate, the average yield/ha of tomato is significantly lower than international standards. Multiple trials were developed to study physiological and agronomical performance under a wide range of growing conditions, with an improved eco-footprint. To increase the nutritional value of processed onion and tomato, new bio-stimulants which increase mineral bioavailability for humans, were developed. The procedure for enriched plants with various biologically active substances, produced in-situ by growing plants enriched with carefully selected bio-stimulants were developed firstly under laboratory scale conditions, that after proof-of-concept approach, was transferred to be used in field conditions.

Various analytical methods were used in order to monitor the bio-transformation as well as bio-transportation of selenium and its compounds over the investigated plant tissues. The ICP-MS was

used for the investigation of the total content of selenium either in the entire plant or in individual organs. Then HPLC-ICP-MS was used for the evaluation of the presence of various chemical species in extracts performed with the use of selected media (namely aqueous solution of buffer and enzymes), thus enabling the determination of the species of selected attributes. The LA-ICP-MS as well as microscopic observations were used for the allocation of the specific compartments of plant tissues. Finally, the synchrotron-based x-ray techniques (namely XANES) were used to perform in-vivo speciation studies).

On the basis of the above described investigation, the proper conditions for agro-friendly were developed towards increasing the naturally involved bio-stimulated processes increasing the nutritional values of selected plants being used in food industry.

Acknowledgements

The investigation was partly financed by the project "Increasing nutritional value (bio-stimulated) of selected performant tomato varieties to be cultivated in areas with temperate climate" founded by European Institute of Innovation and Technology (EIT), under EIT Food pan-European partnership (2017-2018).

The study was carried out at the Biological and Chemical Research Centre, University of Warsaw, established within the project co-financed by European Union from the European Regional Development Fund under the Operational Programme Innovative Economy (2007-2013).

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Natural Toxins in the Freshwater Environment - Occurrence, Fate and Health Implications

IL5

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Clean drinking water is crucial to human health and wellbeing. Global climate change leads to extended dry heat periods in summer and aggravates freshwater shortage - which may affect the supply of clean and safe drinking water. Especially surface water bodies, which are often used for drinking water extraction, are prone to contamination. While chemical pollutants and pharmaceuticals are already being targeted by environmental protection policies, natural toxins receive little attention in terms of environmental levels in freshwater, their health hazard and potential risk, as well as management strategies¹. Natural toxins are, amongst others, produced by terrestrial plants and aquatic cyanobacteria (blue-green algae) in large quantities – the latter being intensified due to poor wastewater treatment, nutrient emission from agricultural areas and global warming. The compounds are highly diverse in chemical structure and comprise, for instance, cyanogenic glucosides, non-ribosomal peptides, saponins and small alkaloids – groups with varying physico-chemical properties profiles^{2,3,4}. Furthermore, natural toxins are very toxic, covering all types of toxicity and different modes of action^{4,5}. In fact, some toxins substantially exceed the toxicity of agricultural chemicals like pesticides⁴. These problems are addressed by the NaToxAq project (<http://www.natoxaq.eu>), consisting of experts on *in silico* predictive modelling, chemical analysis, toxicology and risk assessment. We aim to improve

the understanding of the sources, occurrence, fate and health impact of natural toxins in freshwater environments as well as the efficiency of their removal by water treatments. We aim to inform the water supply sector and policy makers on the risks of natural toxins and their management strategies to assure provision of safe drinking water for future generations.

Acknowledgements

Many thanks to the NaToxAq consortium for contributing their research results and supporting investigations in the pioneer field of natural toxins in freshwater environments. This project received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 722493. The information and views set out in this presentation are those of the author and do not necessarily reflect the official opinion of partners of the NaToxAq project, the European Union's Research Executive Agency or their subsidies.

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Bioprocessing of agro-industrial residues into value added products**IL6****L. Mojović***Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia*

Biorefinery processes that would enable bioprocessing of wastes and residues from food and agro-industry into value added products have gained worldwide attention. In this study, a simultaneous production of LA and livestock feed by fermentation of a combined substrate based on molasses and potato stillage by immobilized *Lactobacillus paracasei* NRRL B-4564 was studied. The immobilization carriers used were lignocelulosic agricultural wastes such as sunflower seed hull (SSH), brewers' spent grain (BSG) and sugar beet pulp (SBP). The highest total LA concentration of around 400 g L⁻¹ with overall productivity of 1.27 g L⁻¹ h⁻¹ was achieved in repeated batch fermentation by SBP immobilized biocatalyst, followed by BSG and SSH immobilized cells. Chemical characterization of the fermented supports revealed that the fermentation improved the content of proteins and ash, and decreased the content of fibers in all three support materials, while an increase in *in vitro* dry matter digestibility and energy

values of SSH and BSG has been recorded thus making them more appropriate for animal feed. In addition, assessment of probiotic potential of the *L. paracasei* strain used demonstrated favorable probiotic profile, exhibiting high resistance to simulated ruminant digestive tract, significant antioxidant and antimicrobial activity. The proposed process could be an efficient strategy for valorization of agro-industrial residues as value-added ruminant feed sources, enabling simultaneous production of LA. This way combining different raw materials and integrating them into a biorefinery process could contribute to the concept of circular economy while significantly improving the overall profitability and productivity of all products.

Keywords: Lactic acid fermentation; Sunflower seed hull; Brewers' spent grain; Sugar beet pulp; Animal nutrition; Probiotics.

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Agriculture is characteristic of a large biodiversity and of diverse socioeconomic conditions. The intensity of plant production technology determines the efficiency of agricultural production to a large extent. One of the major element of cultivation technology is fertilization process. Depending on the production intensity, this factor can constitute from a few to approx. 40-60% of all the incurred expenditures. The use of nutrients contained in fertilizers by plants is also strongly diversified. The use of nitrogen can vary from 20 to 60%, whereas the use of phosphorous does not exceed 25% and 60% for potassium, depending on dosages of fertilizer and weather conditions of vegetation season [1]. For example, it is estimated that even 60% of nitrogen can be lost after being applied under unfavorable atmospheric conditions i.e. drought, high temperature, poor soil structure etc., This phenomenon contributes to great financial losses by increasing expenditures on fertilizers and decreasing the profits from the sale of crops. The rest of unused nutrients is scattered and it can impose the risk for both the quality of water and air. Nitrogen and phosphorous flowing from fields can have a negative effect on the quality of underground water and they can cause eutrophication of surface water. The new EU Directives (being prepared) regarding reductions of ammonia emissions from fertilizers, oblige fertilizer producers particularly producers of urea and urea-based fertilizers to lower nitrogen losses by at least 30 % during its use.

The smart fertilization system involves the entire spectrum of issues related to the development of:

1. economically efficient production technologies of new smart fertilizers coated with natural biodegradable compounds adjusted to nutritional requirements of plants,
2. dedicated machines for application of fertilizers and the precise application of fertilizers directly in roots of plants,
3. a modern, multi-layered IT software based on advanced algorithms, data-bases, methods of data-processing as a practical tool for farmers and other users of fertilization system.

The advanced technology involving the development of fertilizer composition and fertilizer granule coating which ensure slow release of fertilizers, innovative machines dedicated to their application and multi-layered IT system supporting fertilization is of a great importance for smart fertilization system [2]. Innovative fertilization methods cover also the precise fertilization into root of plants, ensuring higher absorption of nutrients and limiting emissions of nitrogen to the environment.

The concept of smart fertilization is developed to maximize the use of nutrients from fertilizers and to adjust the rate of fertilizer release from granule to growth rate of plants during vegetation season [3]. Next-generation fertilizers will have a positive impact on the reduction of greenhouse gases emissions per the unit of produced output as higher efficiency of application will be achieved for significantly lower fertilizer dosage.

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Nanomaterials - Environmental Risks and Speciation Analysis of Metal Nanoparticles in Environmental Samples

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Metal-based nanoparticles (MNPs) have attracted increasing attention in scientific, industrial and commercial applications. Gold nanoparticles are widely applied in electronics, sensors, solar cells, and catalysis, as well as in medicine for radiotherapy, cancer therapy or as drug carriers. Moreover, nanogold is often used as a component of food supplements and cosmetics. Titanium and zinc oxide nanopowders are used in sunscreens, creams, lotions, in anti-scratch coatings for lenses and glass surfaces, and as food additives. Nanoparticles of silver and lanthanum are used for disinfection purposes. Moreover, nanomaterials have been successfully applied for groundwater, water and soil remediation.

Due to increasing applications of nanomaterials in daily life their emission into environment has been recently observed. The toxicological impacts of MNPs on environment are not well documented. The MNPs can undergo processes of dissolution, agglomeration and aggregation. On the other hand, the ionic species of metals can be transformed into MNPs in the presence of redox components of environmental samples and biological organisms. As

the toxicity of various forms of metals is different, speciation analysis of nano and ionic forms of metal is essential when assessing the potential impact of nanoparticles on human health and the environment.

The major problem of nanomaterials is the nanoparticle analysis method. Novel materials vary by shape and size which are important factors in determining the toxicity. Lack of information and methods of characterizing nanomaterials make existing technology extremely difficult to detect the nanoparticles in various environmental compartments for environmental protection.

Analytical methods, developed in our laboratory for the simultaneous determination of speciation forms in different matrices (consumer products, biological and environmental samples) will be presented. The studies on interactions of gold and silver nanoparticles with living cells of green algae in surface water will be also shown.

Acknowledgements

This work was supported by the Polish National Science Centre (DEC-2014/15/B/ST4/04641).

Sampling and sample pretreatment as a critical point of environmental analysis of water - total and species analysis

IL9

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Trace analysis of natural samples is already a challenge, and speciation analysis at trace levels is even more difficult. Procedures applied for such analysis must ensure low limits of determination, high selectivity (when the concentration of other potentially interfering elements is much higher than the concentration of the analyte) and low uncertainty of the measurement (determination of several chemical/physical forms of the analytes). Methods applied for water monitoring should ensure that the act of sampling properly matches the aim and methodology, as well as sample pretreatment must guarantee the stability of the analyte. Sampling and any pretreatment of water result in changes of the oxidation states and chemical compounds formed by all elements [1]. Therefore, even the results obtained with the most reliable methods and procedures mean nothing if the sample does not represent the

investigated object. Any chemical (pH, oxygenation, solar light exposition, addition of any chemicals) or physical (pressure, drying, fragmentation) changes have an influence on the total content and fractionation of the analyte [2,3].

Usually determination of trace elements in water samples does not require any sample pretreatment before GFAAS, ASV or ICP MS analysis. The presence of high content of surfactants in polluted water interferes with the ability to obtain a reliable result. Therefore, application of an alternative procedure to digestion with hydrogen peroxide and nitric acid is expected [4].

For this reason the first steps of analytical procedures (sampling, transport, storage, conservation), especially in the case of procedures meant for trace analysis, have to be very carefully studied for potential changes they may cause in sample's properties [5].

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Supercritical CO₂ Extraction - Green Waste-Free Technology

IL10

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Since 1997 Łukasiewicz - Instytut Nowych Syntezy Chemicznych has been intensively developing the extraction of natural materials with supercritical CO₂ (scCO₂). Starting originally from hop cones and dried paprika pods the scope of extracted plants has widened significantly. INS is a leader in CO₂ supercritical extraction in Eastern and Central Europe and possesses unique plants for the supercritical extraction from the laboratory and pilot plants to industrial scale (toll manufacturing) that can operate at a wide range of process parameters (temperature, pressure). The universal installation, that was launched in 2011, possesses the processing capacity of 2000 t/y and consists of two extractors (volume 2.8 m³) that can operate up to 530 bar. INS offers the production of plant extracts for brewery, food, pharmaceutical and cosmetic industries.



In recent years, the supercritical fluid extraction (SFE) of natural plant materials, with the most commonly used solvent being carbon dioxide, has been gaining an increasing interest due to a number of undeniable advantages. In contrast to classical methods of the extraction of bioactive compounds from natural plant materials, such as maceration, distillation or Soxhlet extraction, supercritical fluid extraction is a green waste-free process. The SFE process eliminates the necessity of using large amounts of organic solvents, often toxic and harmful to environment. Moreover, due to relatively low critical parameters of CO₂ ($t_c = 31.1^\circ\text{C}$; $p_c = 7.38\text{ MPa}$) the extraction of thermally unstable compounds present in natural materials can be carried out without a risk of their thermal degradation, decomposition or oxidation. Furthermore, scCO₂ itself offers a lot of advantages over traditional solvents - it is easily

accessible, non-toxic, non-corrosive, non-flammable, non-explosive, cost-effective and can be completely removed from extracts. Moreover, scCO₂ is characterized by low viscosity and high diffusivity. Due to its hydrophobic and non-polar nature, lipophilic substances can easily dissolve in scCO₂.

ScCO₂-based technologies are applied in a broad range of industrial branches. The use of SFE in food industry involves i.a. hop cones extraction and decaffeination of coffee resulting in obtaining pure caffeine. Another promising application is material dyeing by the coloring plants extraction. Various plants are the source of natural dyes characterized by a wide range of colors, such as yellow (carotenoids, flavonoid glycosides; e.g. *Genista tinctoria*), red (alizarin, naphthoquinones; e.g. *Rubia tinctorum*), blue (peptide glycosides; e.g. *Indigofera species*) and green (chlorophylls, e.g. *Urtica dioica*) [1]. Recently, a lot of attention is also put to the biomass extraction from a number of fast growing trees as well as extraction of contaminants from environmental matrices and management of waste which may be improved by means of extraction with scCO₂. Among fast growing trees, the black locust, willow and poplar have gained a lot of interest as types of lignocellulose biomass with a high content of phenolic compounds and their derivatives [2].

Another field of SFE applications is valorization of food wastes, e.g. fruits (orange, pomegranate, pomelo) by-products such as peels and seeds in order to obtain valuable essential oils and fatty acids fractions. The researches on the utilization of SFE are also carried out in other processes such as deodorization of fats and oils, phospholipids (lecithin) separation and the extraction of aromas and flavors.

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Applications of Ion Chromatography for the Determination of Carboxylic Acids in Biomass Combustion Products

IL11

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In recent years, the production of energy from biomass to replace coal for electricity generation has been rapidly increasing. Critical to this trade is the classification of biomass as renewable energy and thus eligible for public subsidies. Classifying biomass as renewable has had major consequences [1]. However, much scientific study on the net effect of this trend suggests that it is having the opposite effect to that expected of renewable energy, by increasing atmospheric levels of carbon dioxide for substantial periods of time. Already in the 1960s, it was found that not only sulfur and nitrogen oxides, but also carbonyl compounds, in particular low molecular weight carboxylic acids originating, among others from biomass combustion [2] play an important role in the formation of acid rain. Acids such as formic, acetic and oxalic acids are the most common organic acids in the atmosphere. Their presence in wet deposition was found even in non-industrialized areas. Carboxylic acids can be determined by ion chromatography and related techniques that have many advantages, including: speed of analysis,

selectivity, low limits of detection and the possibility of full automatization [3]. Although the ion exchange remains a prevailing separation mode in ion chromatography, other related methods, such as ion-exclusion (IEC), ion-pairing chromatography (IPC), and reversed phase liquid chromatography (RPLC), can also be employed [4]. The advantages and limitation of carboxylic acids analysis as biomarkers of biomass combustion products by using ion chromatography with various detection methods will be presented.

Acknowledgements

This work was supported by the Institute of Environmental Engineering, Polish Academy of Sciences, Zabrze, Poland. The financial support is gratefully acknowledged.

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ORAL PRESENTATIONS

Elemental composition of individual honeybees and their use as environmental bioindicators**ORAL
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Honeybees have been proposed as good bioindicators. They reflect pollution that is present in all aspects of the environment'. Direct deposition of particulate matter from air on the hairy body of the bee or water through drinking are direct sources. Elements from soil are either taken by plants and transferred through their organs to flowers (pollen and nectar) or then consumed by bees or by resuspension of soil into the air and consequently its direct deposition on bees and on plant organs they visit [1]. Although honeybees are used for monitoring of metal pollution for a couple of decades, until now they have not been subjected to rigorous analytical procedures.

The aim of our study was to analyze individual bees (over 400) from 21 different hives in one apiary and assess correlations between element concentrations and honeybee mass, and to evaluate the differences in element concentrations of honeybees both in-hive and between-hives and how this can affect comparison of element concentrations in honeybees from different locations.

For Na, Mg, P, S, K, Fe, Cu, and Zn strong negative correlations were found between the mass of the bee and concentrations of the mentioned elements. Honeybees can carry nectar loads that are 35-80% of their mass, and metal concentrations in nectar are up to 10x lower than in bees. Therefore, these negative correlations might be explained by nectar foragers that were present in the sampled bees.

One apiary located in Mesić with 21 hives was used to test in-hive and between-hive differences. Highest in-hive variability was observed for Al, Li, V, As and Cd. The elements that had the smallest both in-hive as

well as between-hive variability were S, K, P, and Mg.

Between-hive variability was statistically significant for all the analyzed elements. These differences can influence comparison of element concentrations in bees from different locations when using statistical testes, such as Analysis of variance (ANOVA) or Kruskal–Wallis (K-W) H test. Depending on the hive used different conclusions could be drawn. One hive from Mesić had significantly lower concentrations of Al and U, while at the same time a different hive had higher concentration of the same elements in comparison to a different location, in this case the region with two thermal power plants (TPP) in the vicinity of the sampling apiary. Therefore, a larger number of hives needs to be samples at each location to provide an adequate dataset for reliable statistical analysis.

Acknowledgements

Nenad Zarić did the presented work as part of his postdoc study at the University of Graz. It was made possible through: Scholarship of the Scholarship Foundation of the Republic of Austria, Postdocs, Reference number: ICM-2018-11534 awarded by OeAD-GmbH. We also acknowledge the support of project No OI 176006, which is financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

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Are common household preparations effective in removing pesticide residues from citrus fruits?**ORAL
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The growing production of fruits and vegetables demand the daily use of pesticides on orchards and fields worldwide. A special group of fruits with peels that are generally inedible are citrus fruits. The amount that can penetrate the peel and poses no risk to human health is according to the European Food Safety Authority (EFSA) defined as the maximum residue level (MRL). However, there are very conflicting opinions about whether these standards are sufficient, when considering the hygiene measures of the citrus fruits, that are grown in different countries and transported for long distances [1].

Taking into account all circumstances the citrus fruits are used in soft and alcoholic drinks as such, with peel without special treatment.

During the last few decades, different studies including industrial processing techniques for pesticides' removal from citrus fruits have been published [2]. The aim of our research was the evaluation of simple fruit pretreatment methods including washing and soaking. The chemicals used for pesticides' removal were ordinary solutions used in individual households and small kitchen establishments (e.g. daily bars). The study was oriented toward removal of one polar active substance – imidacloprid and one nonpolar active substance – chlorpyrifos on two different types of citrus peels (oranges and limes).

Samples of citrus fruits were pre-analyzed before the experiment on pesticides content. Their peels were carefully rubbed with cleansing pads soaked in ethanol. Then the citrus peels were cut on small equal pieces (4 cm×5 cm), frozen, thawed and dried (no water traces) before spiking them with pesticide standards. Peels were filled in a container for ice cubes, which prevents spills of added standard pesticides' solution (250 µl of 400 mg/L of imidacloprid or chlorpyrifos standard solution). The container with peels was then placed in the oven (60° C for 25 min) and left to dry. After this procedure the peels were prepared for washing or soaking (10 min) with 10 mL of normal tap water, alcoholic vinegar (9% acetic acid), wine vinegar

(4% acetic acid), sodium hydrogen carbonate, citric acid and methanol (for total removal).

The washing and soaking solutions were analysed on HPLC-DAD.

The soaking method was expected to be more efficient than washing citrus fruits only by rinsing them, but between both methods there was any important difference. Imidacloprid, the model compound of polar active substances, was in most cases less than 30% removed from oranges and limes by rinsing or soaking process. On the other hand, chlorpyrifos, the non polar active substance was more than 75% removed by both methods from oranges but it was strongly retained on limes.

There were specific differences according to the solutions used and the peel type (limes vs. oranges). From the research it could be concluded, that there is no predictable or complete removal of pesticides from the fruits' peels by using only one ordinary solution found in every kitchen. Since the application of pesticides on the peels is mostly unknown (from polar to non polar active substances), the users should include a sequential washing procedure for an efficient removal (first alkaline, then acidic or vice versa). More attention should be taken into account when peels are immersed in spirits or other alcoholic drinks, since both compounds were the best removed by methanol.

Acknowledgements

This research was supported by the Slovenian Research Agency, research core funding No. P3 0388, Mechanisms of health protection (Mehanizmi varovanja zdravja) and international CEEPUS network.

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Degradation of nanoplastics in water: impact on gaseous and aqueous phase organic carbon

ORAL
3

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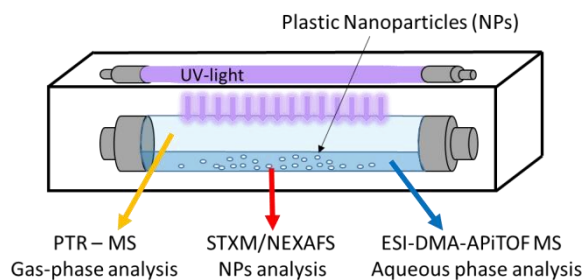
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Previous studies have shown the ubiquitous presence in the biosphere of microplastics (MPs), plastic fragments with size lower than 5 mm, due to years of improper disposal of plastic materials, mismanagement and negligent littering. Only recently, the presence of nanoplastics (NPs) in oceans and in atmospheric particulate matter has been demonstrated [1,2] and it is still unclear what their environmental impact could be. NPs have size lower than 1 μm and, due to their density, they are expected to float at the surface of the oceans and interact with both atmosphere and bulk water. Moreover, NPs can absorb sunlight and react with oxidants in the gas and in the liquid phase. Most studies focus on surface modification using different approaches, mainly based on infrared spectroscopy (FT-IR, ATR, ...) or on microscopy (AFM, SEM, ...). However, as far as we know, little information is reported concerning degradation and photodegradation products released in both aqueous and gaseous phase. It is worth noting that NPs and MPs degradation in the aquatic environment can release soluble compounds that could have an impact on DOM (dissolved organic matter).

At first, we investigated interaction between PS-NPs (polystyrene nanoparticles) and light or ozone, using commercially available NPs. The suspension in MilliQ water was a) irradiated with UVC lamps or b) exposed to an air flow containing 400 ppb of ozone. A significant uptake of ozone into the PS-NPs was observed, also for short-term exposure (19h). This result highlights that NPs at the water surface can interact with oxidants in the gas phase, such as ozone. PS-NPs were also analyzed by STXM/NEXAFS (scanning transmission X-ray microscopy coupled to near-edge X-ray absorption fine structure spectroscopy) in order to investigate chemical modifications [3]. Experiments a) and b) show

a general increase of oxygenated functionalities, confirming that PS-NPs dispersed in water react with both light and ozone. STXM/NEXAFS also revealed to what extent the conjugated bonds on PS-NPs decayed. Indeed, analysis of the overlying gas-phase composition evidenced the formation of benzaldehyde and butanal.

Since polystyrene represents less than 10% of the world plastic demand [4], the degradation of different NPs particles was investigated in aquatic environment. Commercially available NPs and MPs were dispersed in Milli-Q water and were exposed to UV light (355 nm) in the presence and in the absence of 1mM hydrogen peroxide. The buildup of degradation compounds induced by direct light absorption, reaction with photogenerated hydroxyl radicals or hydrogen peroxide, was studied by ESI-DMA-APiTOF MS (electrospray ionization - differential mobility analyser - atmospheric pressure interface time of flight mass spectrometry). For all the investigated NP polymers, degradation leads to formation of small organic molecules (formate and acetate) and of compounds with molecular mass up to 200 Da. We do not observe in the mass spectra higher weight (>200 Da) compounds derived by the breakup of large segment of the polymer chain. Therefore, these preliminary results suggest that polymer oxidation takes place little by little at the chain extremities but further investigations are needed to confirm this hypothesis.

Acknowledgements

This study was supported by the University of Helsinki (3 year research grants, n.75284135). The STXM/NEXAFS experiments were carried out at PolLux under the proposal n.20180904.

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Microplastics in Soil and Soil-like Matrices: Extraction, Quantification, and Identification

ORAL
4

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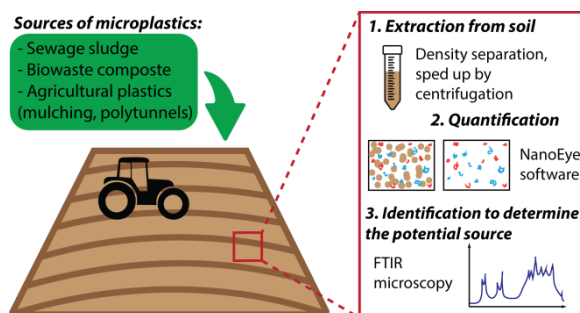
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Microplastics (MPs) are a persistent environmental pollutant with newly gained attention. It is known that MPs are widely present in the aquatic environment, however, their presence in the terrestrial environment is underrepresented in scientific literature and yet are likely to have as great, if not greater, impact on the terrestrial ecosystems [1]. The first step in understanding the impact, however, is to be able to reliably quantify the MPs present in soils. There is a lack of standardised methods for measuring and reporting soil-borne MPs. The majority of methods currently being employed are adapted from MPs extraction from sediments. However, soil and other soil-like matrices present additional problems, such as soil organic matter (SOM) content, which interferes with the extraction of MPs [2]. This study, therefore, aimed at addressing these problems and developing a robust reliable protocol for extraction and quantification of low-density polyethylene (LDPE).

Five protocols for MPs extraction were tested on artificially prepared samples, which were prepared by addition of different quantities (0.01%, 0.02%, 0.05%) of LDPE MP particles, ranging from 0.25 to 0.5 mm in size, to uncontaminated soil or a combination of uncontaminated soil + compost in different ratios (50:50, 80:20, 90:10). MPs were separated from the matrix by flotation, either allowing for overnight sedimentation or facilitated by centrifugation. Samples with high SOM were also subjected to wet peroxide oxidation (WPO) to decrease organic content [2]. Ultrasonication to separate the MPs potentially trapped in soil aggregates was added to the procedure prior to flotation. Post flotation and (or) WPO, the MPs were

isolated by filtration, then dried and transferred to a glass slide in a single layer for quantification. A picture of the MPs was taken with a stereomicroscope Olympus SZH10, before heating the samples at 160°C for 10 seconds, and after. After heating, the MPs on the glass slide melted and transformed from irregularly shaped white particles into circular, transparent particles. Before- and post-heating pictures were processed by NanoEye software that automatically recognises particles that changed shape, and quantifies them. Environmental samples, such as activated sludge, industrial compost mixed with soil, and soil, irrigated with wastewater, were processed with the same procedures for extraction and quantification. Additionally, the identification of MPs in environmental samples will be done with FTIR microscopy.

Recovery rates for 0.05% MP in artificially prepared samples ranged from 83 to 97% between different protocols, with no statistically significant difference between them. As MP content within soil decreased, so did recovery rates, with 68% recovered from samples containing 0.01% MPs. This may need to be compensated for in samples with low amounts of MPs, by using a predetermined loss factor to obtain realistic estimations of environmental MPs concentrations. NanoEye software proved to be a good option for automatic quantification, however, there are important prerequisites for successful image processing. The samples need to be spread in a single even layer and must remain stable during handling.

Acknowledgements

The authors acknowledge the projects: J2-8162, P3-0388, and Slovenia-Russia bilateral project, which were financially supported by the Slovenian Research Agency. F.P. acknowledges WFS National Scholarship awarded to her.

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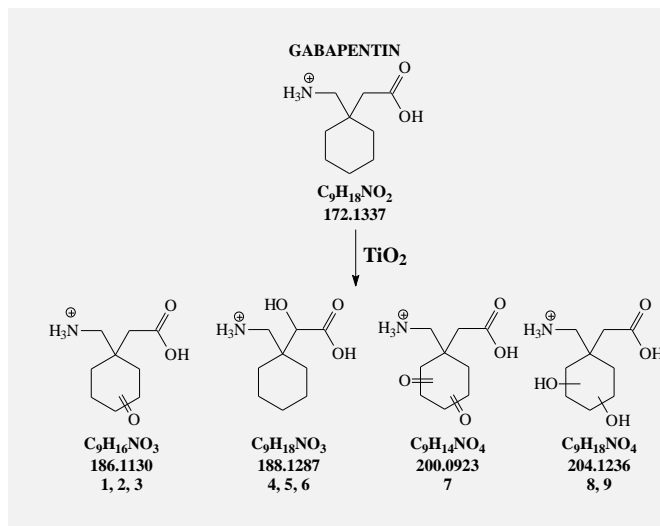
LC-MS Analytical Determination Of Gabapentin Degradation By Heterogeneous Photocatalysis And Environmental Evaluation

ORAL
5

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Pharmaceuticals in the environment are becoming a subject of global concern, with potential environmental consequences. As active substances, they can be commonly measured in surface water of rivers and lakes, at low, but potentially toxic concentrations for environments and humans.

Gabapentin is a drug used to treat epilepsy and peripheral neuropathic pain (long-lasting pain caused by nerve damage). It is an analogue of γ -aminobutyric acid (GABA) that acts with three cytosol enzymes involved in the metabolism of GABA and is able to increase its concentration in neuronal compartments and calcium channels of type L. The medicine is excreted by human metabolism as unchanged drug and eliminated from the systemic circulation by renal excretion. It has been reported the environmental stability of this drug as emerging pollutant.

In fact, the sewage system is an important key point to control environmental contamination, but treatment plants are unable to remove a substantial part of the pharmaceuticals efficiently. The treatment process takes place in wastewater treatment plants (WWTP). Pollutants in municipal wastewater (households and small industries) are removed or broken down. Normally, the wastewater treatment includes a combination of physical, chemical and biological processes designed to eliminate solid and organic compounds from wastewater.

An alternative to conventional wastewater treatment method is advanced oxidation processes (AOPs) based on the generation of highly reactive species (OH^\cdot) through photocatalysis [1]. The oxidation process could transform the organic compounds into

harmless ones, eventually leading to a complete mineralization [2].

After any treatment operation, traces of persistent organic pollutants (POPs), such as pharmaceuticals, still remain in water. The measured concentrations, normally mg/m^3 of water, are much lower than those capable of exerting acute toxic effects on humans, but the exposure is continuous and possible adverse effects on human health derive from chronic exposure [3].

In this scenario the aim of the project was the development of an analytical procedure based on high pressure liquid chromatography coupled to high resolution mass spectrometry (HPLC-HRMS) to determine gabapentin and its degradation products (DPs) in laboratory simulation with heterogeneous photodegradation mediated by titanium dioxide (TiO_2). Then the method was applied to determine gabapentin and DPs residues in some real WWTP.

The HPLC separation of DPs was achieved using a C18 column (Gemini NX-C18, 3 μm , 110 \AA , 150 \times 2 mm, Phenomenex) with heptafluorobutyric acid (ion pair chromatography) and acetonitrile as eluents in 23 minutes. Mass spectrometry analysis was performed using a LTQ orbitrap system with high resolving power in positive mode ionization. The resolution was set at 30k.

The heterogeneous photodegradation mediated by TiO_2 experiments showed a quite complete (97%) degradation of gabapentin in 60 minutes; after this time the molecule did not degrade anymore. Many DPs were arisen during TiO_2 photodegradation: we found nine new formed molecules and hypothesized their structural formulas through high resolving power mass spectrometry. This methodology was useful to study the fragmentation pathway of gabapentin, describing the neutral loss of the protonated ion.

The analytical method was then applied to real samples came from WWTP. Water samples were enriched with solid phase extraction (SPE).

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Over the last few decades environmental research has shifted attention from conventional pollutants such as PCBs and PAHs to new pollutants, compounds that are increasingly releasing into the environment and are a potential threat to ecosystem and public health.¹ This group of new pollutants includes diverse groups of pharmaceuticals and pharmaceutical active substances used in human and veterinary medicine (such as painkillers, antibiotics, hormones, anti-inflammatory drugs, lipid regulators, beta blockers, anti-cancer drugs) and personal care products. Continuous release of pharmaceuticals to the environment as complex mixtures can result in higher concentrations, long-term and negative effects on aquatic and terrestrial organisms. The conventional biological treatment processes used for water and wastewater treatment are not effective in degrading pharmaceuticals. Due to high stability of pharmaceuticals in water and not efficient conventional wastewater treatment processes² some pharmaceuticals can be found in surface waters, groundwater and also in drinking water.

Doxazosin, a selective alpha blocker, is widely used in medical therapy as an effective antihypertensive agent. It is very frequently prescribed drug and for this reason, environmental and ecotoxicological research is of great importance in terms of exposure and risk for both aquatic species and humans. In this study we focused on photolytic and TiO₂ photocatalytic degradation processes of doxazosin under different simulated sunlight conditions, which were evaluated in terms of disappearance rate, mineralisation rate and identification of degradation products.

TiO₂ photocatalytic and photolytic (without TiO₂) experiments were performed for 120 min in photoreactor equipped with polychromatic low-pressure mercury lamps (1.6 mW/cm² of UVA (300 - 400 nm)) as well as with UVC germicidal lamps (254 nm). In the case of photolytic experiments, doxazosin aqueous solution was irradiated for fixed periods of time in the presence and absence of oxygen, while photocatalytic degradation of doxazosin aqueous solution have been carried out under constant oxygen flow. All samples have been analysed with HPLC-DAD, TOC, ion

chromatography and toxicity with V. Fischery. Selected samples have been further concentrated for LC-MS analysis, which proved the formation of several degradation products. The detailed degradation pathway has been proposed and will be presented.

Under our experimental conditions, approx. 80% of doxazosin has been degraded in the case of photolytic experiment under 120 min of UVA light and 100% under UVC light. There was a slight difference between reaction rate in the case of presence and absence of oxygen.

The photocatalytic degradation of the doxazosin aqueous solution with immobilised TiO₂ after 120 min resulted in first-order degradation reaction. The observed rate constant was $k = 0.127 \pm 0.006 \text{ min}^{-1}$ with a half-life time of $t_{1/2} = 5.45 \pm 0.06 \text{ min}^{-1}$. The TOC measurements revealed substantial mineralisation rate and the ion chromatography measurements showed transformation of amine into nitrate.

When applying photolysis, the inhibition of luminescence increased roughly for 4%, meaning that the observed difference in luminescence inhibition is probably only due to the uncertainties of the measurements. In this case the toxicity could be accounted only by the parent compound. In contrary, it can be emphasised that the samples, after applying photocatalytic degradation with TiO₂, showed decreased toxicity in comparison to both, the parent compound and the samples, treated with photolysis.

Acknowledgements

This research was supported by the Slovenian Research Agency, research core funding No. P3 0388, Mechanisms of health protection (Mehanizmi varovanja zdravja) and bilateral collaboration between Slovenia and Russia.

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Valorisation of Fe/Ca Mining Waste Sludge: Reactive Nanocomposites for Hazardous Metals Removal from Contaminated Mine Water

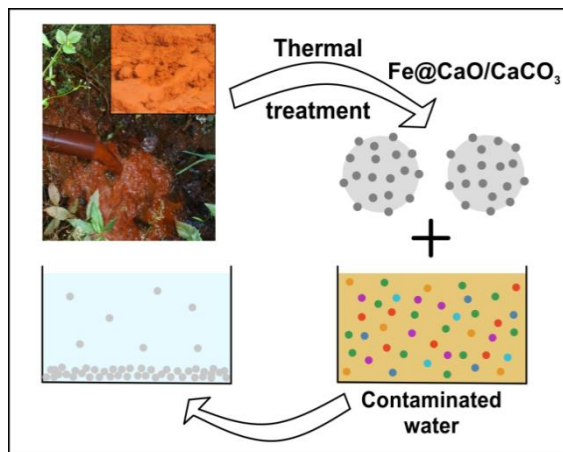
ORAL
7

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New nanocomposite materials based on CaCO_3/CaO supported nanoscale zerovalent iron were prepared from iron and calcium rich mining waste sludge. The thermal treatment in controlled reducing conditions led to preparation of series of nanocomposites with different composition of matrix and iron bearing phase. The two nanocomposite materials with matrices dominantly formed by CaCO_3 and CaO were selected for further detailed morphological, structural and phase characterization. Moreover, stability of prepared materials in water and the impact of nanocomposites on acidic environment conditions (pH and ORP) were monitored.

We suggest the application of the prepared materials for highly polluted waters due to the synergistic effect of reduction/sorption and pH and ORP adjustment. Therefore, the removal efficiency and assumed removal mechanisms for several hazardous metals (Al, Cd, Cr, Cu, Ni, Zn, and Pb)

from acidic mine water were evaluated. The $\text{Fe}@\text{CaCO}_3$ and $\text{Fe}@\text{CaO}$ nanocomposites removed 28.6, and 98.9% of the total initial pollutants concentration (51.95 mg/L). In comparison, the commercial nanoscale zerovalent iron NANO FER STAR (NANO IRON, Czech Republic) removed 83.7 % of the total initial pollutants concentration. The best total efficiency achieved by $\text{Fe}@\text{CaO}$ is caused mainly by pH increase to value 12.3 (the initial pH of tested water was 2.3), which resulted in chemical precipitation of metallic ions. The total removal efficiency was strongly influenced by content of the most abundant metal, i.e. Zn (the initial concentration 40.92 mg/L). Thus, although the total efficiency of $\text{Fe}@\text{CaCO}_3$ nanocomposite was the lowest, it exhibited the highest efficiency for Pb remediation.

The presented results show that the mining waste sludge could be valorised by simple one step thermal treatment. The prepared $\text{Fe}@\text{CaO}/\text{CaCO}_3$ nanocomposite could be suitable materials for remediation of waters polluted by several different contaminants.

Acknowledgements

The authors gratefully acknowledge the support by the Ministry of the Interior of the Czech Republic (VI20162019017). The authors also thank to Mariá Cecilia Pérez Reytez for assistance with SEM/EDS measurement.

From Molecular to Large-Scale Phosphorous Recovery from Wastewater Using Chitosan-Calcite Adsorbent

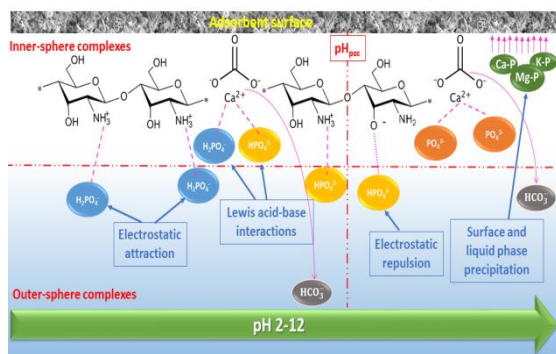
ORAL
8

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Phosphorus (P) recovery from wastewater will become increasingly vital in the future as terrestrial rock phosphate deposits are expended [1]. Effective management of P as a critical resource will require new techniques to recover P from wastewater, ideally in a form that can be used in agriculture as fertiliser [2].

In this study, batch and fixed-bed column conditions were tested using a KOH deacetylated chitosan-calcite based adsorbent (CCM) for P removal from aqueous solutions and wastewater effluent. The maximum P adsorption capacity was 24.14 mg P/g at 22°C. The adsorption was endothermic in nature and reached equilibrium after 120 min. The experimental data was best described using a Langmuir isotherm and a pseudo-second order kinetic model. The diffusion kinetic analysis highlighted the importance of both film and intraparticle mass-transport. Instrumental material characterisation suggested that the adsorption process involved interactions between P and functional groups (mostly -NH₃⁺) due to electrostatic interaction on the chitosan chain, or, involved ligand exchange with CO₃²⁻. Analysis of materials using X Ray Powder Diffraction (XRPD) and Thermogravimetric Analysis (TGA) indicated a microprecipitation-type mechanism may also occur through the formation of hydroxylapatite (Ca₅(PO₄)₃(OH)). A desorption study showed that the P-laden CCM derived from the crab carapace had the potential to be reused as a soil amendment to serve as a slow-release P fertiliser. The effect of different operating parameters were explored in

a fixed-bed column, and the experimental data fitted well to the Clark model. The dynamic study confirmed that both breakthrough time and exhaustion time increased with increasing bed depth, and with decreasing influent phosphorus concentration and flow rate. The CCM also showed excellent P recovery potential from wastewater effluent in dynamic conditions. Results indicated that real WWT effluent shortened the CCM breakthrough time by 49%. Besides a matrix effect, the higher initial P concentration in the wastewater also caused this notable decrease. Biofouling was not a very pronounced phenomenon with this CCM adsorbent. Additionally, ammonium and COD were reduced by the CCM (in the wastewater effluent), which suggests that the CCM has the potential to be used for ammonium and dissolved organic compound removal. Finally, a scale-up and cost analysis approach was used to calculate the price and parameters needed for a large-scale P recovery system using this adsorbent. The design parameters required for column diameter, area, and bed volume were 35 cm, 962 cm², and 37 cm³, respectively.

Scale-up and cost parameters are given - and the excellent performance of this adsorbent (versus other materials previously studied for P removal and recovery) with real secondary effluent indicates that this material could have significant potential within larger-scale applications.

Acknowledgements

This work was undertaken as part of the 'Phos4You' project (NWE 292) with financial support from the INTERREG V B Northwest Europe programme. Authors are also thankful to Cedric Mebarki and Veolia™ Water Technologies UK for their help in pilot plant design, supply and construction.

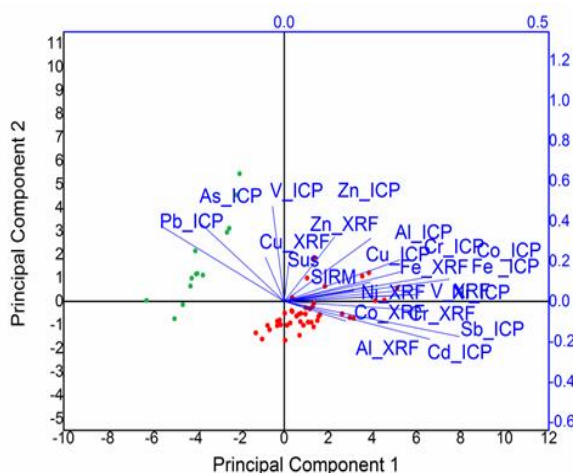
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Non-destructive techniques (WD-XRF and magnetic measurements) for investigation of the pollution in different vineyards in Serbia

ORAL
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Some analytical techniques such as X-ray fluorescence (XRF) spectrometry represents the non-destructive technique for determination of total element content of the various samples and application of magnetic measurements in environmental studies is based on the fundamental nature of magnetism and the presence of Fe. Both methods are cost-effective, easier and faster than destructive methods. Determination of concentrations of elements was assessed by the WD-XRF and content of magnetic particles assessed on the leaf surface of the grapevine and the surface soil layer in two vineyards (commercial and organic) in Serbia. The aim of this study was investigated could non-destructive WD-XRF with Uniquant software be appropriate as a screening method for total element content in the soil and leaf samples comparing to the ICP-OES and ICP-MS technique, with special attention to the plant material. Also, the aim was to assess can magnetic parameters (magnetic saturation isothermal remanent magnetization-SIRM and magnetic susceptibility- χ) be a proxy of the magnetic particle pollution and elements associated with magnetic particles.

WD-XRF with Uniquant software was appropriate for total element content screening for both soil and leaves, but for the leaves (plant material) where some of the elements are presented as tracers for more precisions application of this method the specific calibration on the matrix which is similar to the investigated sample. Pseudo-total element concentrations in the soil and total element

concentrations in the leaves obtained by ICP-OES and ICP-MS [1, 2] were additionally analyzed with the results obtained by non-destructive technique WD-XRF. Both total and (pseudo)total element concentrations obtained by non-destructive and destructive methods (for soil R ranged from 0.40 to 0.99, and for leaf R ranged from 0.40 to 0.85; $p < 0.05$) were equally evaluated in order to estimate the magnetic parameters as a proxy for potential magnetic PM pollution in the vineyard ambient.

The results of this study imply that both measured magnetic parameters (SIRM and χ) indicated pollution in the soil, but more suitable parameter for assessing the magnetic particles on the leaves was SIRM. The values of both magnetic parameters are significantly ($p < 0.01$) correlated in the same type of sample (soil-soil or leaf-leaf), but neither SIRM nor χ values are not correlated in different matrixes (soil-leaf). Among the vegetation season, there were significant ($p < 0.01$) differences between SIRM and χ values, which imply that there were differences between the grain size of magnetic particles.

Finally, the cost-effective and user-friendly techniques (WD-XRF, magnetic measurements - SIRM, susceptibility) could be recommended as appropriate for detecting the pollution hot spots in the vineyards.

Acknowledgements

The authors are grateful to the Ministry of Education and Science of the Republic of Serbia (Projects no. III43007 and 172001). The part of this research was supported by the ERASMUS + programme for student exchange supported by the European Commission.

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Assessment of Vulnerability of European Forest Soils in Mountain Regions to Land Use and Climate Change

ORAL
10

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Mountain regions occupy around one third of European land and forests cover 41% of the total mountain area. Rising atmospheric carbon dioxide concentrations, higher temperatures and changes in precipitation are likely to have significant effects on the vegetation period, growth, health and distribution of trees as well as on forest ecosystems. The increase in temperature is particularly large in many mountain regions, where loss of glacier mass, reduced snow cover, thawing of permafrost and changing precipitation patterns, have been observed and are expected to increase further. This could lead to an increase in the risk of floods, soil erosion and forest fires.

The aim of this study is to examine the erodibility of European beech forest soils in order to assess its vulnerability to predicted climate change. Total of 80 soil samples from 15 soil profiles (0-10 cm, 10-20 cm, 20-40 cm and 40-80 cm) were collected from beech forests of Spain, Czech Republic, Slovakia, Germany, Poland, Romania, Serbia, Italy, Bosnia and Herzegovina and Slovenia.

Factors which mostly influence soil dispersivity are Sodium Adsorption Ratio (SAR), electrical conductivity (EC), pH, content of organic carbon (C_{org}) and grain size distribution. EC and pH were measured by portable meters, and C_{org} by elemental analyser. Sodium adsorption ratio, SAR, is defined by the equation:

$$SAR = [Na] / ([Ca + Mg]/2)^{0.5}$$

where all concentrations are in mmol/litre.

Exchangeable cations were determined following the procedure given by Faulkner [1].

In order to determine morphological diagnosis of dispersive materials, dependency plots of following "site signatures" were examined: SAR/EC, pH/SAR, particle size/SAR, pH/EC. These plots were developed as morphological diagnosis tools for dispersive materials [1, 2]. The SAR/particle size relationship to characterize swelling and reduction potential of layer material; and the SAR/pH plot to characterize the buffering properties of material samples.

The use of the functional relationship between Electrical Conductivity (EC) and Sodium Adsorption Ratio (SAR) for description of potentially affected soils is very often used in literature to determine the dispersivity of soils [1]. This dependency diagram shows that investigated soils belong to the group of potentially dispersive materials (Fig. 1).

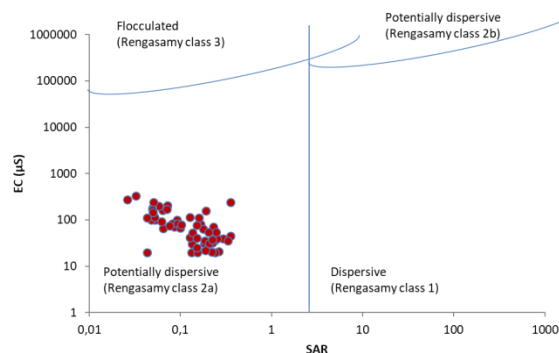


Fig. 1. Site signature SAR/EC for analysed European beech forest soils.

Negative relation of SAR/pH indicates that soils which have pH below 5 have higher dispersivity potential. The dependency diagram SAR/ C_{org} shows a threshold of C_{org} of 6% above which dispersivity of soil is lower.

Acknowledgements

This study is part of the COST action „Climate Smart Forestry in Mountain Regions“ CA15226. We acknowledge all participants in the soil sample collection. Laboratory analyses were financed by the Ministry of Science and Technological Development of the Republic of Serbia (Project number 176006).

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Arctic environment has been shown to be very sensitive to changes in the chemical composition of the air-snow interface and climate changing in general [1,2]. The reports published by the Arctic Monitoring and Assessment Program (AMAP) have summarized a large dataset regarding emerging contaminants, their terrestrial and temporal distributions, and their environmental effects. Despite accumulation of considerable amount of data any new information on the environmental situation in Arctic is very valuable. The present study throws light upon organic contaminants in the snow of the Franz Joseph Land.

The samples were collected within the Franz Joseph Land during 2017 research expedition. All snow samples were stored frozen during the expedition. The sample preparation procedure involved melting of the snow samples under room temperature followed by dichloromethane extraction according to US EPA 8270 method. Field blank was subjected to the same procedure. The extracts were combined and analysed using gas chromatography - high resolution mass spectrometry (GC-HRMS) with electron ionization (EI). All experiments were carried out using Pegasus GC-HRT instrument (LECO, USA). The identification of organic compounds was made using mass spectral library NIST14. Besides, all identification results were checked manually for avoiding the false-positive results.

Snow samples from Franz Joseph Land were relatively pure considering anthropogenic pollutants. The major organic constituents involve natural organic compounds (terpenes and terpenoids), some hydrocarbons (mainly alkanes and naphthenes), phthalates, and few widely used industrial products. The highest number of detected compounds was related to different oxygenated molecules, which could not be exactly classified. Though some of them were categorized as oxygenated alkanes with DBE=0, previously found in Novaya Zemlya Archipelago environment. Only

several US EPA priority pollutants were identified and quantified (phthalates). Hydrocarbons by themselves could appear in the Arctic due to long distance air transfer or due to increased number of cargo ships using Northern sea route. Phthalates are present almost in all environmental samples nowadays due to their wide use in plastics. Though they may not be categorized as persistent organic pollutants (POPs), detection of phthalates even in such remote areas as Arctic makes them of priority control. Despite the big amount of data related to the presence of chlorinated hydrocarbons, pesticides, fire retardants and other POPs in Arctic environment, which are usually used as environmental indicators, we have detected only one example of such compounds - tri(2-chloroethyl) phosphate. An interesting class of compounds detected in all samples corresponded to fatty acid amides, supporting our previous data obtained during study of Novaya Zemlya, where fatty amides were also found. Their origin may involve humic matter, biomass burning or some anthropogenic sources. An unexpected class of pollutants detected in snow samples was presented by N,N-dimethylcyclohexylamine and N,N-dimethylbenzylamine. Having a very large variety of industrial applications, these compounds were not a priori supposed to be met in the area of low household activity.

Acknowledgements

The research was done in terms of RSF 17-13-01112 project.

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It is becoming very daunting task to comprehensively monitor all environmentally significant compounds. Moreover, almost every day new anthropogenic compounds or their transformation products appear in the environment. The most reasonable analytical approach to address that is to perform preliminary non-targeted screening at the particular site to discover the most relevant xenobiotics for future targeted monitoring. However ordinary GC-MS analysis usually is not capable to reliably identify the unknowns and analysts should apply variety of techniques to resolve difficult tasks on hand. Here we demonstrate various spectacular examples when combination of HRMS, GCxGC, EI, PCI and ECNI was comprehensively applied.

Samples of rain water from France, Russia, and Chile, snow from Moscow and Russian Arctic islands, cloud water from France were analyzed in 2016-2019. Sample preparation in all the cases was in accordance to the EPA Method 8270. The high resolution time-of-flight mass spectrometer coupled to GCxGC was used for analysis. NIST libraries along with manual spectra interpretation were used for analytes assignment. Retention indices along the first and the second chromatographic columns were used as well. The instrument was equipped with the ion source capable of producing EI, positive CI and ECNI spectra without changing the hardware and GCxGC methods, which was significant for expanded coverage of analytes.

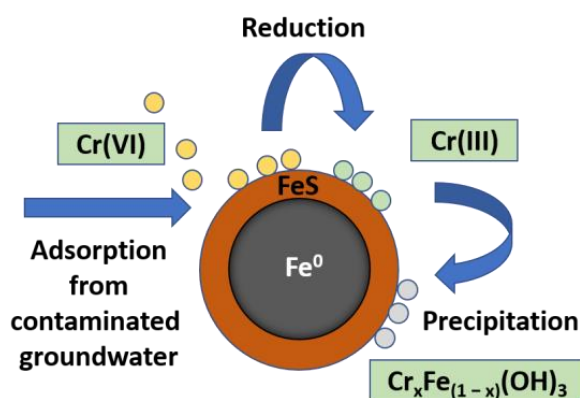
Environmental samples usually are very complex mixtures containing thousands of analytes. The most environmentally relevant compounds often present at trace levels and thus their identification is a challenge due to coelution with higher concentration compounds. The GCxGC as a very efficient method to separates compounds with similar chromatographic properties. The number of separated peaks in GCxGC results are usually 5-10

times higher than in one-dimensional GC. Several examples will demonstrate transformation of an unassignable mass spectrum in GC mode into 2-5 quality spectra easily assignable by using library. Retention indices along the secondary polar column allow identification and correctly assign constituents of the same nature. Accurate mass measurements allowed correct compounds assignment even when the library similarity match score is low. It is also very helpful in the presented challenging cases, when manual structural elucidation and reconstruction of mass chromatograms is necessary.

Chemical ionization being a soft method provides a chance to identify correctly certain compounds which do not have molecular ions in EI spectra. However without EI spectral information the identification is not completed. Dialkylphthalates are a good example. These priority pollutants are always environmentally relevant while their molecular ions are usually absent in EI spectra. CI spectra contain protonated molecule peak, while fragmentation information from EI data allowed assignment of both alkyl moieties. Important complementary information is also obtainable with ECNI data. Examples demonstrate improved detection of the halogenated compounds. ECNI sensitivity may be up to 100 000 times better than in EI mode for these compounds. Thus PCBs with 7-8 Cl atoms, which often remain undetectable in EI mode, were easily found using ECNI mode. Nitro-containing compounds are another example of several orders improved sensitivity, when using ECNI. Another interesting example demonstrate detection of all isomers of dinitrotoluenes and dinitrobenzenes in GCxGC-ECNI-HRMS experiments.

Cr(VI) removal by sulfidated nanoscale zerovalent iron: from lab-scale testing to *in situ* remediation**ORAL
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The use of chromium in many industrial processes, such as leather tanning, electroplating, steel manufacturing and wood preservation resulted in widespread groundwater and soil contamination by this metal. At these sites, Cr is typically present as Cr(VI) oxyanion species which are well soluble and mobile in the aquatic environment, and they are of serious concern due to their toxic, mutagenic and carcinogenic effects [1].

An efficient and frequently used remedial strategy for Cr(VI) consists of reduction to poorly soluble, non-toxic Cr(III) and simultaneous or subsequent immobilization into Cr(III)-bearing precipitates. Recently, the sulfidated nanoscale zero-valent iron (S-nZVI) particles attracted extensive attention for the *in situ* removal of metals, metalloids and organic contaminants due to their superior reactivity, easy and flexible *in situ* applicability, improved selectivity and environmentally benign transformation products [2]. At laboratory scale, S-nZVI has been shown to remove Cr(VI) more efficiently compared to pristine iron nanoparticles [3, 4].

Herein, we report on Cr(VI) removal performance of S-nZVI particles in laboratory-scale studies followed by a pilot *in situ* remediation of a site contaminated with Cr(VI). S-nZVI particles used within the presented study were either synthesized in the lab using a commercially available nanoscale zero-valent iron that was subsequently treated with aqueous solutions of sodium sulphide, or used as provided by the manufacturer.

The results of batch experiments showed that

sulfidation of zero-valent iron particles significantly increased both chromium sequestration rate and removal capacity. As Cr total concentration matched Cr(VI) concentration in the course of the experiments, the sequestration likely occurred at the solid-solution interface, where Cr(VI) was adsorbed, reduced to Cr(III) and subsequently immobilized into poorly-soluble mixed Fe(III)-Cr(III) hydroxides. The presence of Cr(III) on the surface of reacted particles was confirmed by XPS spectroscopy while no Cr(VI) was detected.

Commercially available S-nZVI particles were subsequently used for a pilot groundwater remediation at a former electroplating site. In total, 80 kg of particle suspension (20% w/w) were injected into 8 wells. Gradual decrease of Cr(VI) concentration in monitoring wells points to effectivity and longevity of S-nZVI remedial treatment. High-resolution transmission electron microscopy with EDX elemental mapping on particles recovered from the site confirmed the presence of Cr on the surface of S-nZVI particles. The formation of Fe(III)-Cr(III) hydroxides in the field was corroborated by XPS spectroscopy.

Acknowledgements

Financial support from the bilateral Czech Science Foundation/FWF grant project ModelFace (Czech No. 17-33779L, Austrian No. I3065) and the Technology Agency of the Czech Republic, Competence Centers (TE01020218) is gratefully acknowledged.

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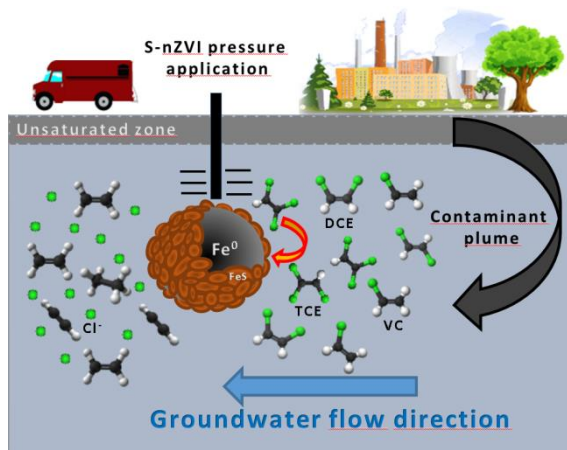
In Situ Remediation by Commercial Sulfidation Iron Nanoparticles (S-nZVI) on a Site Heavily Polluted by Chloroethenes

ORAL
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In situ remediation technique exploiting nanoparticles of metals or metal oxides, most frequently nanoscale-zero valent iron (nZVI) in the treatment of contaminated groundwater and soil are being increasingly used in the European continent and as well as in North America [1]. The first documented field trial, in 2000, involved of reduction of trichloroethylene (TCE) in groundwater using nZVI was in Trenton, New Jersey, USA [2]. The high reactivity of nZVI also proved to be its weakness due to the competitions with various natural reductant demand processes running not only in field applications [3]. Improvement of nZVI properties was a modification of these nanoparticles in the presence of reduced sulphur compounds [4]. The synergistic effect of sulfidation the nZVI particles on faster contaminant removal TCE than original nZVI, decrease iron corrosion in water and selectivity for reductive dechlorination of TCE was reported in many scientific papers [2-6]. However, *in situ* application of this new sulfidated nZVI (S-nZVI) is still a challenging task requiring a complete insight into hydrogeological condition at the locality, chemical composition of the groundwater, its flow velocity, contamination level and laboratory tests to characterise the reaction agent to be used, are important.

This pilot study aimed to verify the efficiency of S-nZVI in reductive dehalogenation of highly chlorinated ethenes in the field conditions. The chosen pilot site is located in the area of the

pharmaceutical company in the Czech Republic. The soil and groundwater are characterized by a high concentration of chlorinated hydrocarbons (CHCs), namely TCE reaching up to ten mg/L. The site was remediated using 150 kg of S-nZVI (NANO FER 25DS purchased from NANO IRON) which was applied in August 2018. The nanomaterial was injected in the form of an aqueous suspension (concentration approx. 3 g/L) employing the pressure injection into the permanent wells. The locality monitoring was running before and after remediation event by using advanced analytical techniques and as well as field-ready laboratory equipment.

Application of S-nZVI resulting in increasing pH and decreasing oxidation-reduction potential. Monitoring of the site has proved the decrease in average CHCs concentration and evolution of gaseous products (ethane, ethane, acetylene) of CHCs degradation. To the best our knowledge, this is the first S-nZVI field trial accompanied by complex detailed pre- and post-injection monitoring.

Acknowledgements

Financial support from the VI20162019017 of the Ministry of the Interior of the Czech Republic, Technology Agency of the Czech Republic “Competence Centres” (TE01020218) and Czech Science Foundation grant project ModelFace (No. 17-33779L) is gratefully acknowledged.

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Organic Contaminant Footprints in 2011 Tohoku-Oki Tsunami Deposits (Northern Japan)**ORAL
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The 2011 Tohoku-oki tsunami caused massive damages along coastal areas of Northern Japan [1]. In the Aomori Prefecture waves of 6-10 m inundating up to 550 m inland, were recorded. Sandy deposits, however, reach only ~250-350 m inland. These clearly identifiable sandy remains of up to 10 cm thickness were detected together with other tsunami indicators inundation (such as barrels, fishing nets, buoys, etc.) in the coastal forest at the small fishing port of Misawa. In tsunami studies these sand layers are used to identify the max. inundation of tsunamis and for a hazard assessment of coastal areas.

The tsunami inundating the coastal forest eroded subsequently the organic-rich topsoil, including loose plant material and wood. This organic-rich layer emerges as the tsunami sand thins out and was observed with a maximum thickness of 5 cm. Field observations show that trash and potential hazardous objects (such as with paint and chemicals filled barrels) were transported into the coastal defense forest, deposited in backwash direction; they have remained untouched eight years following the event. These objects and the waste destruction of infrastructure and industrial facilities lead to the release of pollutants in the nearfield environment. Swimmable plastic particles were transported inland and incorporated in the organic- and plant-rich tsunami deposit. Additionally, organic-geochemical anthropogenic markers and biomarkers suggest this layer to be of tsunami origin.

As the harbor suffered severe damages environmental pollutants, such as polycyclic aromatic hydrocarbons, pesticides and technical additives (e.g., fuels, fats, tarmac, plastics) were released during the 2011 Tohoku-oki tsunami and

distributed with the inflowing water-masses.

Concentration profiles of specific contaminants along cross sections are the base for interpreting the spatial distribution of pollution during the tsunami event. They point to a complex dispersion as the result of overlaying transport processes by inundation and backwash.

Environment specific natural biomarkers (such as *n*-alkanes, fatty acids, *n*-aldehydes and steroids) have been already used as indicator for tsunami deposits in Hawai or Greece [2,3]. Here they were detected within both, the sandy and organic-rich tsunami deposits, indicate on the one hand the marine origin of the event deposit but represent on the other hand all during run-up crossed and eroded facies. Further on, the extent of the inundation can be faced by these indicators pointing to a general approach also applicable for historic tsunamis, e.g. the Jogan tsunami in 869 (AD).

Acknowledgements

This project is financially supported by the German Research Foundation DFG (Project number 390538253).

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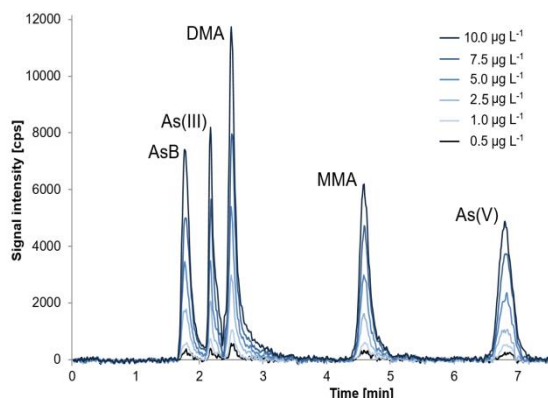
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Study On Total Arsenic And Arsenic Species In Various Matrices: Water and Freshwater Fish Samples

ORAL
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Studies on arsenic speciation in various matrices has been the subject of interest for many scientists over the years, especially when it was proved that determination of total concentration/content of element in sample does not provide sufficient information about its toxicity. For this reason, the influence of elements on environment and human organism may be estimated by performing speciation analysis.

Presence of arsenic in the environment, especially in groundwater used as a source of drinking water is an issue of great importance because of health consequences it can cause. Arsenic concentration determination in all types of water is essential for evaluation of possible environmental pollution [2]. When it comes to food, its consumption when contain arsenic may cause a significant increase in exposure to toxic arsenic species. Hence there is a need to perform arsenic speciation analysis in order to determine biotoxicity and bioaccumulation of this element.

The goal of research was to develop analytical procedures for total arsenic determination in water and freshwater fish samples using inductively coupled plasma mass spectrometry with dynamic reaction cell (ICP-DRC-MS) and speciation analysis of As(III), As(V), DMA, MMA and AsB in water and freshwater fish samples using high performance liquid chromatography coupled to ICP-DRC-MS (HPLC/ICP-DRC-MS) [3,4]. A lot of attention was focused on ensuring the reliability of the developed procedures, because only this allows to draw correct conclusions.

Development of mentioned procedures required the following steps: optimization of ICP-DRC-MS

working parameters; optimization of HPLC separation parameters; optimization of digestion procedure in case of fish samples and selection and optimization of extraction procedure in case of fish samples using microwave digestion system EthosOne; validation of procedures according to metrological approach using certified reference materials such as River Water SLRS-5, Tuna Fish Tissue BCR 627, Fish Muscle ERM-BB422.

All developed analytical procedures were applied to real water and freshwater fish samples. Among all the investigated types of water, surface water collected in the Lower Silesia Province contained the highest arsenic concentration reaching 3800 µg L⁻¹. Speciation studies revealed that the arsenic was in the form of As(V). In case of freshwater fish samples, our studies revealed that fish samples from Lower Silesia province contained significantly higher content of arsenic in comparison to fish collected in Wielkopolska province. AsB predominated in all samples, only trace amounts of As(V) were found in freshwater fish collected in Lower Silesia province.

The research was carried out using a liquid chromatograph (PerkinElmer Sciex, Canada) an ICP-MS spectrometer model ELAN DRC II with a dynamic reaction cell (PerkinElmer Sciex, Canada). Hamilton's anion exchange column PRP-X100 was used for arsenic species separation.

Acknowledgements

This research was supported by the National Science Center in Poland, project number 2017/25/B/ST4/00374.

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Occurrence and spatiotemporal variability of sunscreen agents along the Polish part of the Baltic Sea coast

ORAL
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Sunscreen agents are component of body care cosmetic used to protection against harmful impact of UV radiation which results in skin cancer. Common use of UV filters raises concern about their potentially dangerous impact on the environment and human health. In the course of numerous analyses hormonal activity (BP1, BP2, BP3, OC, EHMC, BMDBM, 4MBC, 3BC) of certain UV filters and their harmful impact on fertility and reproduction were proved.

This research is focused on the detection of benzophenone and camphor derivatives in beach sediments of four Polish beaches according to seasonality, vertical and horizontal transects.

Sand samples were analyzed for 5 UV-filters i.e. benzophenone-1 (BP1), benzophenone-2 (BP2), benzophenone-3 (BP3), 3-benzylidene camphor (3BC), 4-methylbenzylidene camphor (4MBC). Samples were collected seasonally (spring, summer, autumn) in 2017 along a transect perpendicular to the shoreline in Ustka, Czołpino, Darłowo and Rowy - sandy beaches situated in northern Poland. They differ in terms of the degree of anthropogenic impact. Four sampling sites were located along this transect: site S1 - 3 m offshore, at a depth of about 1 m underwater; site S2 - waterline; site S3 - halfway up the beach; S4 - among dunes, about 60-70 m away from the shore. The sand cores were collected from three sections in the field (0-5 cm, 5-10 cm, 10-15 cm).

Extraction of analytes from core sediments was achieved by ultrasonic extraction using MeOH. Details on the extraction method can be found in [1]. The separation and identification and quantification analytes were performed using high-performance liquid chromatography coupled with diode array detector.

The average concentration of UV-filters in core sediments collected along the Polish coastline is summarized in Table 1. The highest concentration was determined for BP2 with values over 1450 ng·kg⁻¹ on average, followed by 4MBC, BP1 and BP3. The presence of 3BC was not confirmed.

Table 1. Mean concentration (ng·kg⁻¹) and range of UV-filters determined in sand samples.

	N	Mean	Max.	Min.
BP1	10	52.7	74.2	16.0
BP2	129	296.2	1474.3	10.2
BP3	16	15.0	52.5	5.4
4MBC	19	78.3	133.0	26.4

The level of BP2 reported here is within the same range than those previously published by [2] and far less than the levels reported by [3-4] for beach sediments collected in Spain. Regarding the occurrence of BP2 in beach sediments according to seasonality as well as vertical transects and horizontal profiles substantial variability was observed. As an example, figure 1 shows the BP2 concentration in the top layer of beach sediments collected in Ustka according to the seasonality and distance from the shore.

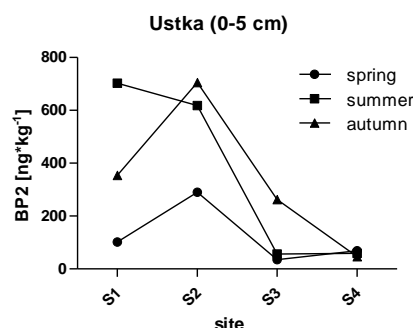


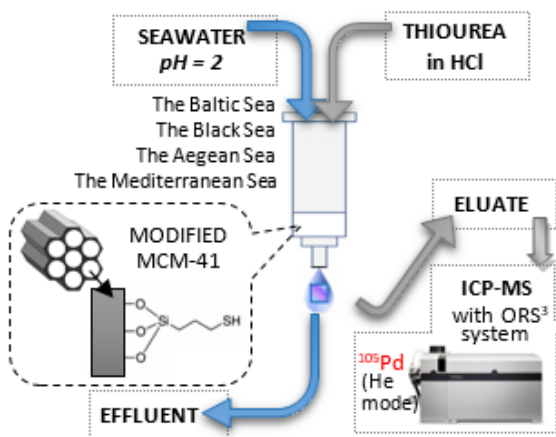
Fig. 1. Seasonal variability of BP2 concentration in top layer of beach sediments collected in Ustka.

As could be seen the highest BP2 concentration was determined on S1 and S2 (sites having permanent contact with sea water) in the peak of touristic season. Similar dependence was observed in Darłowo and Czołpino, however in the case of the last location which is a reference place the range of BP2 concentration was lower.

Summarizing, the occurrence of BP2 in beach sediments of Polish coast is similar to those observed in Spain. Some differences are observed between concentration of UV-filters in beach sediments collected from places of various touristic pressure. In general, the highest distance from the water line the lower concentration of sunscreen agents.

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Method development for determination of trace amounts of Pd in seawater by SPE-ICP-MS using thiol-functionalized MCM-41 materials
**ORAL
18**
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Palladium is widely used in various branches of industry and technology, especially in the production of automotive catalytic converters and electronic, chemical and metallurgical manufacturing. All these applications caused increase of palladium content in environmentally relevant matrices, as roadside dust, soil, surface water, seawater and marine organisms. Due to the toxic effect of Pd on living organisms and its high mobility, it becomes necessary to monitor the concentrations of Pd in various elements of the environment. However, direct determination of Pd in such samples is difficult due to its low concentration and complexity of the matrix of environmental samples. The spectrometric techniques used for determination of Pd, such as electrothermal atomic absorption spectrometry (ETAAS) and inductively coupled plasma mass spectrometry (ICP-MS) suffer from insufficient limit of detection and interferences of matrix origin. Therefore, procedures of matrix separation have to be applied prior to detection step.

Solid phase extraction (SPE) has been widely used for the preconcentration and separation of Pd

from various samples. The proper choice of sorbent in SPE is very important for obtaining high preconcentration factor of analyte and its good recovery. Recently, modified ordered mesoporous silica materials have been proposed as solid sorbents for the removal of metal ions from aqueous solutions.

The aim of this work was to study the applicability of MCM-41 materials modified with 3-mercaptopropyltrimethoxysilane for the preconcentration and separation of Pd from seawater prior to ICP-MS determination. For elimination of matrix interferences during determination of ^{105}Pd in seawater Triple Quad 8800 ICP-MS spectrometer with ORS³ system filled with helium as a collision gas was applied. Various parameters affecting the Pd separation on tested sorbents, such as sample pH, type, concentration and volume of the eluent have been optimized. The highest retention of Pd was obtained from solution of pH in the range of 1.0-5.5. For efficient elution of analyte $0.1 \text{ mol}\cdot\text{L}^{-1}$ thiourea in $1 \text{ mol}\cdot\text{L}^{-1}$ HCl was applied. The preconcentration factor of Pd on the modified MCM sorbents was equal 30. The recoveries of trace amounts of analyte from spiked seawater samples were in the range 82.7-91.8%. The developed SPE-ICP-MS method is characterized by low detection limit ($0.2 \text{ pg}\cdot\text{mL}^{-1}$), good selectivity in the presence of interfering elements and high concentration of chloride ions, as well as satisfactory accuracy. The application of ICP-MS together with efficient separation/ preconcentration of Pd on thiol-functionalized MCM-41 sorbents allows for interference free determination of analyte in seawater at $\text{pg}\cdot\text{mL}^{-1}$ level.

Distribution of selected pharmaceutical residues and their related degradation products in different aquatic compartments

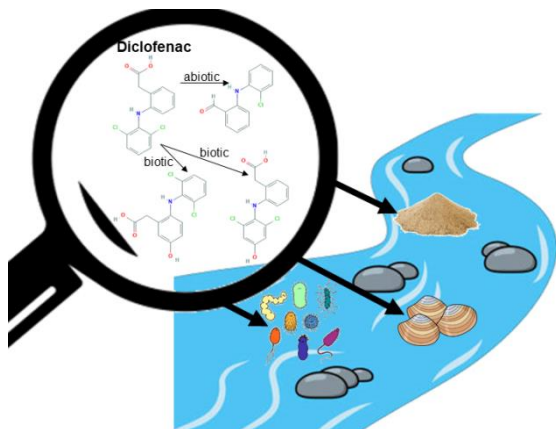
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The occurrence of pharmaceutical residues in aquatic environments has become a global issue of growing environmental concern. Despite their low concentrations ($\text{ng}\cdot\text{L}^{-1}$ to $\mu\text{g}\cdot\text{L}^{-1}$), continuous exposure to these contaminants seems to have toxic or disrupting effects on aquatic organisms [1,2]. Several studies [3-5] have shown the accumulation of these pollutants in different benthic compartments. However, little is known about the presence of their degradation products in the environment. The aim of this study is to determine the distribution of pharmaceutical residues and their related degradation products in river biofilms, sediments and clams (*Corbicula fluminea*).

Three sampling campaigns of six months each (one sample per month, between July 2017 and April 2019) were conducted on two French rivers (the Clain and the Vienne) to collect epilithic biofilms grown on initially clean rocks deposited in the rivers. Studied sites were chosen upstream of two mid-sized cities to avoid the influence of wastewater treatment plants (WWTPs) discharge. For each campaign, Polar Organic Chemical Integrative Samplers (POCIS) were deployed to provide an overview of the water contamination.

Another sampling campaign was conducted in September 2018 along the Vienne river to compare the contamination of biofilms, sediments and *Corbicula fluminea*. At each of the five studied sites, *in situ* benthic samples were collected in addition to two litres of river water.

Three pharmaceutical compounds (Amoxicillin, Diclofenac, and Carbamazepine) and nine of their degradation products were measured in all the

collected samples, using pressurized liquid extraction (PLE), followed by solid phase extraction (SPE) and analysis by ultra-performance liquid chromatography, coupled with triple quadrupole mass spectrometry (UPLC/TQ-MS) for the three biofilm campaigns, and with quadrupole time-of-flight mass spectrometry (UPLC/Q-TOF-MS) for the last campaign.

In the biofilm campaigns, the results highlight the wide presence of the studied degradation products and their parent compounds. Concentrations (ranging between 0.06 ng/g of biofilm and 1960.12 ng/g of biofilm) and detection frequencies (ranging between 33% and 100%) change depending on the studied river. Furthermore, concentrations of the degradation products are generally of the same order of magnitude as those of the parent molecules. The six-month evolution shows no direct correlation with rainy events or the rivers flow rates. In general, evolutions of degradation products seem to have a similar shape with their related parent compounds.

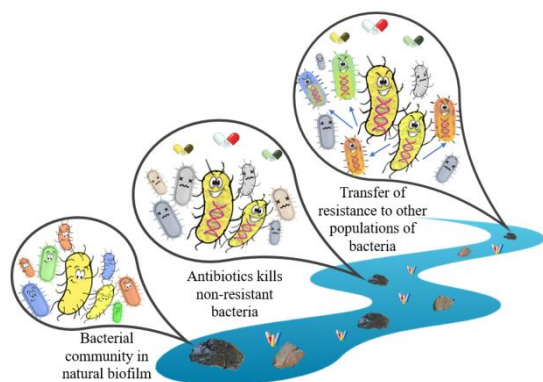
The first results of the comparison between biofilms and sediments or clams, tend to show that both parent compounds and degradation products can be found in the different compartments. The distribution of these compounds changes according to the studied compartment and the proximity with sources of contamination along the watershed.

Acknowledgements

The authors acknowledge financial support from the Walid Joumblatt Foundation for University Studies, the European Union (ERDF) and "Région Nouvelle Aquitaine".

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Evolution of antibiotics in two French rivers and incidence of antibiotic resistance in biofilms**ORAL
20****O. Matviichuk^{1,*}, M. Al Badany¹, H. Zind¹, J. Paranhos Rosa De Vargas^{1,2}, M. Gaschet³, C. Geffroy¹, L. Mondamert¹, C. Dagot³, J. Labanowski¹**¹*Institut de Chimie des Milieux et Matériaux de Poitiers, UMR CNRS 7285, University of Poitiers, France*²*Federal University of Santa Maria, Rio Grande do Sul, Brazil*³*INSERM, U1092, Limoges, France***olha.matviichuk@univ-poitiers.fr***Objectives**

The wide use of antibiotics make them environmental emerging contaminants. Despite their low concentrations, such a constant exposure to antibiotics resulted in their accumulation and presence of a wide diversity of resistance genes in different benthic compartments, like biofilms [1], which in turn led to an increase of mortality [2,3]. The present work aimed to study the time-evolution of antibiotic concentrations in river biofilms and of antibiotic resistance markers in microbial communities in relation with the seasonal variation of hydro-climatic parameters and/or of wastewater treatment plants discharge (WWTPs).

Methodology

Sampling campaigns of 6 months were conducted on two French rivers (the Clain and the Vienne) between July 2017 and April 2019 (one sample per month). In the Clain river 2 investigation points - upstream and downstream from the WWTP - and in the Vienne river only upstream point were chosen. Biofilms were grown on initially sterile rocks, which were placed in rivers. Then, twenty frequently used antibiotics were measured in all the collected samples, using ultra-performance liquid chromatography coupled with triple quadrupole mass spectrometry, in the same time, number of three classes of integrons (intl1,2,3) were quantified by using qPCR technic.

Key findings and conclusions

The results show that in Clain river eighteen to twenty compounds were detected upstream and all twenty downstream of WWTP. Similar

observations were obtained for the Vienne river - from nineteen to twenty compound. Besides, a large change in concentrations was obtained depending on the site, campaign and the compound. Moreover, the obtained concentrations of antibiotics significantly exceed the PNEC values for the resistance selection.

The data obtained suggest a “steady near-saturation process” of the biofilm. Indeed, the total amount of antibiotics remains stable between 1 month to 6 month of exposure in river, but the diversity of antibiotics changes over time. The accumulation of antibiotics occurs in all biofilms independently of the site exposition or the season. However, there was no direct correlation between hydro-climatic variables or WWTPs discharge flows, except in one case where concentrations of some antibiotics increased with precipitation. Likewise, no direct correlation was observed between antibiotics and Class 1, 2 or 3 integrons. Obtained results confirms the impact of WWTPs discharge on the aquatic environment but no direct model with river flowrate and/or WWTP plant discharge fluxes was found to fit the behaviour of antibiotic resistance in river biofilms.

Acknowledgements

The authors acknowledge financial support from the ANSES and “Région Nouvelle Aquitaine”.

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Elimination of Pharmaceuticals from Aquatic Environment Using Enzymatic Apparatus of Wood Decaying Fungi

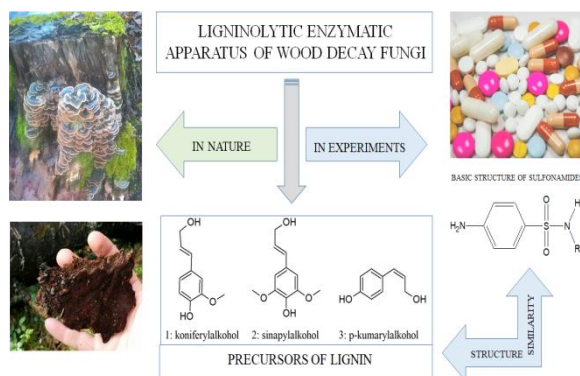
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The consumption of pharmaceuticals, especially antibiotics, worldwide is still constantly growing and environmental contamination by residues of these substances is widespread world-wide problem. This trend is associated not only with population growth, but especially with the development of civilization diseases, the availability of treatment, and also with increasing life expectancy and increasing life quality requirements. Unfortunately, antibiotics are often prescribed to patients when unnecessary or misused by patients [1]. For example in the Czech Republic, approximately 6.81 million packages of antibiotics were delivered to patients in 2017 [2].

Drug residues are excreted from the body either unchanged or in the form of various metabolites. Afterwards, these substances within municipal wastewater reach wastewater treatment plants (WWTP). It is known that the current conventionally used technological processes of treatment at mechanical-biological WWTPs are not sufficiently effective to eliminate these various pharmaceuticals. Due to this fact the quality of wastewater at the effluent from the WWTP may be significantly impaired. As a result, pharmaceuticals enter the aquatic environment and may have a negative effect on organisms living in water or/and can lead to contamination of other components of environment. The presence of pharmaceutical residues in the environment (even in low concentrations) and related risks are very discussed topics nowadays. The most significant risk associated with antibiotics is the possibility of bacterial resistance. The presence of macrolide antibiotics, as well as amoxicillin and ciprofloxacin on the “watch list” of European Commission, shows the importance of this issue [3].

In the environment, self-purification processes based on natural biotic and abiotic processes can be found. These principles could be used in the design of new technologies eliminating environmental pollution. A promising method for the removal of pharmaceuticals from the aquatic environment are technologies using the enzymatic apparatus of wood-decaying fungi. The unspecific oxidative ligninolytic enzymatic system of wood-decaying fungi (white rot) have the potential to participate in the transformation and mineralization of organic pollutants structurally similar to lignin precursor molecules [4,5]. The expected advantages of this technology are low operating costs and, above all, the fact that it is a natural bioremediation process. In addition, wood-decaying fungi are relatively durable, grow rapidly, and also adapt well to changing environmental conditions.

In our experiments we used mycelium of *Trametes Versicolor* cultivated by unique way on scaffold cubes. These cubes were printed on the 3D printer from material which contains proportion of wood matter. The efficiency of the enzymatic apparatus of wood-decaying fungus *T. versicolor* in the elimination of sulfonamide antibiotics has already been proven in previous research. Pharmaceuticals from other therapeutic groups (antidepressants, β -blockers, antiepileptics) were included in further experiments.

Acknowledgements

This work was supported by the specific research projects No. FCH-S-19-5971 and No. FAST/FCH-J-19-5862 from the Ministry of Education, Youth and Sports of the Czech Republic.

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According to Organisation for Economic Co-operation and Development (OECD) report from 2017 almost 8% of the European population use antidepressants regularly and moreover increasing consumption of this group of pharmaceuticals is observed every year. One of the consequences of this trend is continuous growth of environmental pollution caused by antidepressants and its metabolites [1].

Among most commonly prescribed antidepressants, particular environmental risk is posed by citalopram, which belongs to the group of selective serotonin reuptake inhibitors (SSRIs). Due to the relatively low degree of metabolism in the human body (about 75%) [2], and at the same time high persistence in the aquatic environment, this compound, even in trace amounts, tends to bioaccumulate and disrupt the basic life functions of various aquatic organisms, such as fish, snails or crustaceans [3,4]. These observations confirm that it is important to develop sensitive and accurate analytical methods to monitor the presence of citalopram in environmental waters.

The work presents a simple and sensitive method for the determination of citalopram by differential pulse voltammetry (DPV) using a glassy carbon electrode (GCE). Application of special procedure, based on providing additional polishing of working electrode between measurements (see Figure 1), allowed for an enhancement of the recorded analytical signal (peak current) and thus increased sensitivity.

During optimization step, a phosphate buffer (pH 8; 0.1 mol·L⁻¹) was chosen as the supporting electrolyte and DPV parameters were selected. For developed method basic analytical parameters, such as sensitivity, linear range and detection limit, were determined. The GCE exhibited fast linear response toward citalopram oxidation in concentration ranges of 0.05-10 μmol·L⁻¹ and 10-115 μmol·L⁻¹ with detection limit equal 0.036 μmol·L⁻¹. Additionally, the selectivity of method was tested by examining

the influence of various organic and inorganic compounds on the height of the recorded signal.

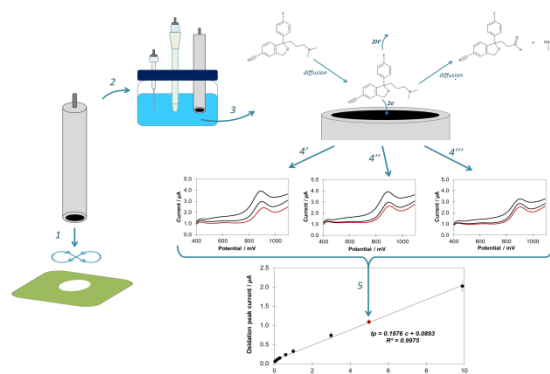


Fig. 1. The diagram of proposed analytical procedure.

The usefulness of developed method was confirmed by determination of citalopram in pharmaceutical formulations and spiked tap, river and waste water samples with good reproducibility and precision. Developed method stands out from the previously reported work due to its simplicity, short time of measurements and high sensitivity.

Acknowledgements

The study was supported by the EU Project POWR.03.02.00-00-I004/16.

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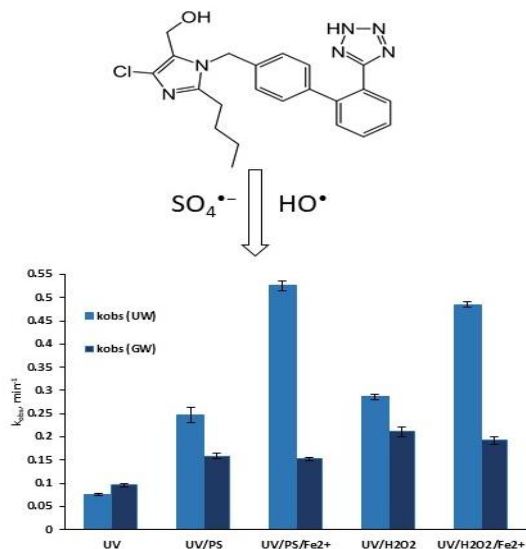
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A Comparative Study of Losartan Photodegradation: Activated Persulfate Versus Hydrogen Peroxide

ORAL
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The increasing demand of pharmaceutical drugs has led to elevated production as well as disposal of the pharmaceutical waste. As a result, the pharmaceutical products such as antibiotics, analgesics, β -blockers, antidepressants, antihypertensives etc. have been frequently detected in wastewaters. According to World Health Organization (WHO) over one billion people are suffering from hypertension (high blood pressure) worldwide and this number would rise to 1.5 billion by 2020 [1]. Sartans, angiotensin receptor blockers (ARBs), are prescribed to treat high blood pressure. Once consumed, they are partially metabolized in human body and as a consequence significant amount of antihypertensives is excreted as parent compound. ARBs, in particular losartan (LOR), which has been detected in seawater, wastewater treatment plants influent and effluents [2], undergo structural modification to generate valsartan-acid during activated sludge treatment. Valsartan-acid is a persistent pollutant and accumulate in various environment compartments [3].

Advanced oxidation technologies (AOTs) have been implemented for degradation of micropollutants by generation of hydroxyl and sulfate radicals from strong oxidants once effectively activated by transition metals, UV light, ultrasound radiation, etc. [4]. AOTs have been effectively applied for the removal of pharmaceuticals, but the rate of oxidation of individual compounds may significantly depend on the constituents of the aqueous matrix.

In the current study, the oxidation of LOR (40 μ M) by UV photolysis and UV/ Fe^{2+} -activated persulfate ($S_2O_8^{2-}$) and hydrogen peroxide (H_2O_2) systems was investigated and compared. The application of direct UV photolysis, UV/ $S_2O_8^{2-}$ and UV/ H_2O_2 systems proved to be efficient for LOR degradation, which followed a pseudo-first-order kinetic model. The effects of operating parameters including pH value, reaction time, and oxidant dosage on the efficacy of treatment were studied. In the studied systems even with a moderate concentration of added oxidant (LOR/[oxidant]₀ molar ratio of 1/1) a 99% LOR conversion was achieved twice as fast (~30 min) compared to the direct UV photolysis (60 min). The effectiveness of LOR mineralization based on total organic carbon (TOC) removal was also considered. Similarly, the addition of the studied oxidants to UV photolysis considerably improved the extent of decomposition of the target compound and transformation products. In addition, the use of UV/ Fe^{2+} -activated systems led to a further increase in the efficiency of LOR removal from aqueous solution. The optimized results of the studied systems obtained in ultrapure water were used in groundwater to assess the effectiveness of LOR decomposition in more complex environmental matrix. Moreover, the acute toxicity of LOR solutions before and after the UV/ Fe^{2+} -activated oxidation to *Vibrio fischeri* was investigated.

According to the findings of this study the application of UV- and UV/ Fe^{2+} -activated $S_2O_8^{2-}$ and H_2O_2 systems with carefully adjusted chemicals dosage could be feasible solution for the degradation of LOR in various water matrices.

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Permanent Coatings Based On Imidazolium Cations In The Separation Of Biological Active Analytes By Capillary Electrophoresis

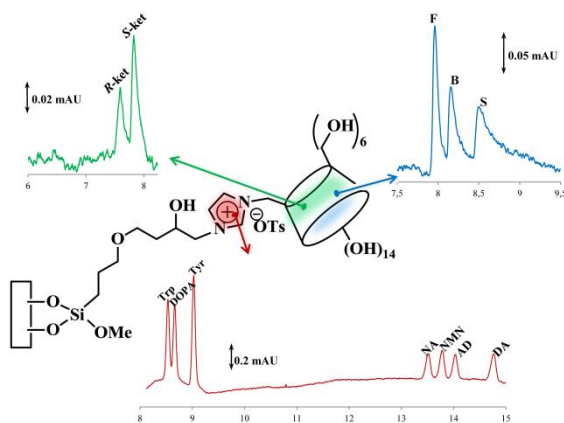
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In most cases the creation of permanent coatings includes three stages: activation of fused capillary walls by alkali, silylation and functionalization. Earlier our research group proposed the synthesis route for the covalent coatings based on *N*-alkylimidazolium ILs, where butyl- and octyl-bromide were used as a functionalizing agent [1]. For the creation of coatings with β -cyclodextrin (β -CD) in a structure, the first stages were carried out as described in the above-mentioned paper and *p*-toluenesulfonyl- β -cyclodextrin (Ts- β -CD) was chosen as functionalization agents.

For optimization of the imidazole substitution reaction with Ts- β -CD on inner capillaries walls, the reaction time (from 10 to 22 h), temperature (from 80 to 100°C), concentration of the modifying agent (from 25 to 750 g/mL) and the inner diameter of capillary (50 and 75 μ m) were varied.

The physicochemical properties of formed permanent coating were studied. The coating thickness was 18-22 nm according to scanning electron microscopy data. Besides, it was established

that the synthesized coatings are stable in the range of pH 2-7 and are destructed in an alkaline medium.

The presence in the structure of the CD allowed to perform the simultaneous separation of hydrophobic (steroid hormones) and hydrophilic (biogenic amines) analytes and ketoprofen enantiomers, which was not observed on previously synthesized coatings.

The results of the biogenic amines separation were compared with that previously obtained on *N*-alkylimidazolium coatings. The results of the steroid hormones separation were compared with one, that was obtained on dynamic coatings with the same structure. It was found that created permanent coatings exceed in the following characteristics: the reproducibility, analysis time and the limits of detection.

In addition, the possibilities of on-line preconcentration techniques were examined. It was found that application of sweeping and with a large volume sample stacking mode on synthesized coating is limited. The limits of detection of steroid hormones and biogenic amines with preconcentration were 120-160 ng/mL and 160-140 ng/mL respectively.

Acknowledgements

This work was supported by Russian Science Foundation (grant number 19-13-00370). The authors are also grateful to the Chemistry Education Centre and Nanotechnologies Centre of Research Park, Saint Petersburg State University, for technical support.

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Chitosan-Clay Materials For Drinking Water Production : Stability Improvement and Reactivity Towards Dissolved Organic Matter

ORAL
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Coagulation-flocculation is one of the main processes used in drinking water treatment for the removal of suspended particles, colloids and Dissolved Organic Matter (DOM) from surface freshwaters. The most widely used coagulants are metallic salts but they produce a large quantity of non-recoverable sludge, raising environmental questions relative to disposal. Bio-based flocculants such as chitosan, a derivative from chitin, are of great interest for water purification due to their biodegradability and low dosage requirement. However, the poor reactivity towards DOM tends to increase organic content of treated waters due to the accumulation of unreactive dissolved polymer. In addition, the residual chitosan might lead to toxic disinfection by-products formation during the final chlorination step. Development of new bio-inspired solutions to improve DOM removal is thus a challenging task.

This work is focused on the design of new eco-friendly flocculants based on the association of clay materials (Montmorillonite-MMT) and biopolymers (Chitosan-CS) to combine advantages of the inorganic and organic parts (good sorbent, biodegradability and effective settling ability). In a first step, the structuration role of the clays was investigated by varying the preparation routes of the hybrid materials (addition sequence, polymer:clay ratio, drying or washing steps). The obtained materials reactivity and stability were then tested on synthetic waters containing a model pollutant, Methyl Orange (MethO), dissolved in an ultra-pure or mineralized water matrix (containing Ca^{2+} or Mg^{2+} ions). Then, in a second step, the optimized hybrids were selected and tested on a river water (Vienne, France) to determine their efficiency and selectivity towards DOM, as well as to check their stability. Structural information was obtained from XRD and FTIR analyses. Treatment efficiency was determined by turbidity, spectrophotometry and Dissolved Organic Carbon (DOC) measurements. 3D fluorescence spectroscopy and size-exclusion chromatography (SEC) coupled to UV-Fluorescence-DOC detection allowed to specifically investigate the DOM components removed by each of the tested reactants.

The structure-reactivity relationship was clearly established and organo-clay combination gave a better sorption capacity than their individual components for MethO. The drying step played a key-role by promoting the interactions between CS chains and MMT sheets. These stronger interactions prevented the hybrids destabilization that occurred with undried hybrids when competitive cations were present in the water matrix. These results were further confirmed by experiments on real surface waters. As a consequence, the quantity of released CS was maintained under an acceptable level (Figure 1).

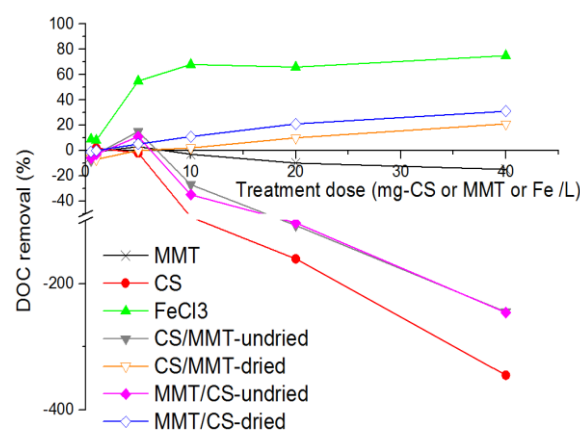


Fig. 1. Dissolved Organic Carbon (DOC) removal for Vienne River jar-tests with FeCl_3 , chitosan (CS), montmorillonite (MMT) and chitosan-based hybrids.

Moreover, DOM characterization after treatment showed that building blocks were preferentially removed by pristine CS and undried hybrids; low molecular weight neutral molecules were more easily removed by all hybrids compared to pristine CS, while humic substances were more efficiently removed by FeCl_3 . As a conclusion, chitosan-clay hybrids are promising flocculant materials for DOM removal in water treatment and preparation routes influenced selectivity and stability.

Acknowledgments

The authors acknowledge financial support from the European Union (ERDF) and “Région Nouvelle Aquitaine”.

Decatungstate, $W_{10}O_{32}^{4-}$, as a photocatalyst for the simultaneous oxidation of organic pollutants and reduction of Fe^{3+} and/or H_2O_2

ORAL
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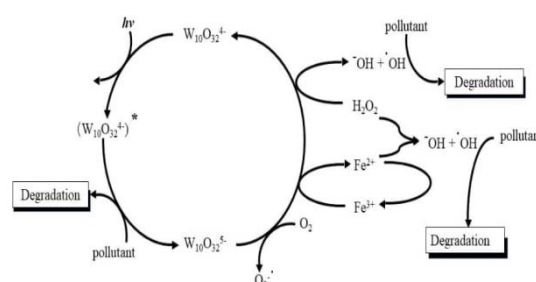
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Nowadays, the water remediation from pharmaceutical and pesticides compounds is of high interest owing to the effect on the Environment. Moreover, the extensive use of these highly hazardous pollutants and therefore the contamination of air, soil, surface and ground waters has an unavoidable effect of human health. Thus, research is undertaken for their elimination from these media and more particularly from water. Advanced Oxidation Processes (AOPs) are the best promising techniques to update of the treatment plants that are enable to remove emerging contaminants. These techniques are based on the generation of highly reactive species such as hydroxyl radicals ($\cdot OH$). These radicals are very strong oxidants (2.8 V) and are able to react with a very wide variety of organic pollutants. The water soluble polyoxometalate sodium decatungstate, $Na_2W_{10}O_{32}$, has been investigated mainly for its catalytic versatility both in organic chemistry and in environmental applications. In the latter case, it has largely been employed as a catalyst in the field of water contamination treatment, especially as homogeneous photocatalyst for the degradation of organic pollutants in order to minimize their environmental persistence and hazardous effect.

Upon excitation at 365 nm, the ion $W_{10}O_{32}^{4-}$ leads to the formation of an oxygen-to-metal charge transfer excited state $W_{10}O_{32}^{4-*}$. Such reactive species is able to oxidize organic compounds through electron transfer or/and hydrogen abstraction. Such mechanism leads to the formation of the one electron reduced form of decatungstate $W_{10}O_{32}^{5-}$. The reduction of molecular oxygen to superoxide anion by such species may regenerate the starting ion, $W_{10}O_{32}^{4-}$ [1-3] which enhances the efficiency of the photocatalytic cycle. In the present work, the reduced species of decatungstate, $W_{10}O_{32}^{5-}$ has been efficiently used for the reduction of iron(III) and hydrogen peroxide in order to

generate high amounts of hydroxyl radicals. The whole system is described in the scheme 1.



Scheme 1. Photocatalytic behaviour of $W_{10}O_{32}^{4-}$ in the presence of H_2O_2 and Fe^{3+} .

Decatungstate-Ferric-Hydrogen Peroxide system is shown to be a catalyst system with great potential for the treatment of water. The optimal concentration of H_2O_2 and pH value is 1.0×10^{-2} M L^{-1} and 4.0 respectively. The study will pursue the pathway of target pollutants and Hydroxyl radical reaction rate with pollutants measured by Liquid chromatography-mass spectrometry (LC-MS/MS) and Laser flash photolysis (LFP) in the presence of iron(III) and hydrogen peroxide.

Acknowledgements

P. Cheng acknowledges the China Scholarship Council (CSC) for his PhD grant (201806690001).

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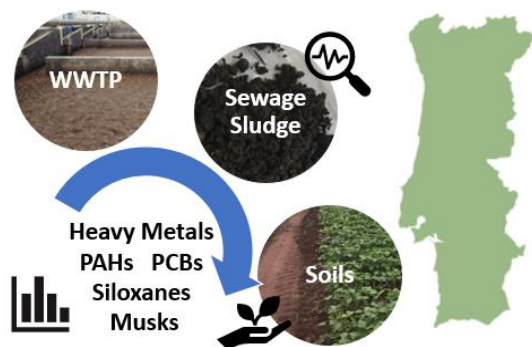
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Nutrient Content, Heavy Metals, Microorganisms and Organic Pollutants in Portuguese Sewage Sludge - A Country Level Analysis

ORAL
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Sewage sludge application to agricultural fields is a promising way to sustainably handle with the disposal issues of a waste whose production has been increasing. Its high organic matter content and micro and macronutrients composition have shown a positive effect in the correction of nutrient deficiencies in farming soils, reducing the need on inorganic fertilizers and contributing to a circular economy model [1,2]. However, the treatment processes employed at wastewater treatment plants (WWTPs) do not target numerous pollutant species that are continuously released down-the-drain by households, social and industrial infrastructures, and other sewer leakages, which inevitably end up in the solid waste of WWTPs processes [3]. Heavy metals, pathogenic microorganisms, organic pollutants such as pharmaceuticals, microplastics, pesticides, flame retardants, household and industrial detergents, personal care products (PCPs), are prone to enter to the soil compartment by sludge application to farmlands, raising concerns regarding the safety and risks of this practice to the environment and to the food produced in sludge-amended soils [4].

In Portugal, following the Council Directive 86/278/EEC, national law establishes limits for the concentration of heavy metals, pathogenic microorganisms *Salmonella spp.* and *Escherichia coli*, as well as some organic compounds, such as polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). In this work, a monitoring plan in Portuguese WWTPs was established and sewage sludge samples were collected and analysed for some of the parameters considered in

national legislation, including PAHs and PCBs concentration, as well as for two classes of emergent pollutants associated with the use of PCPs, namely volatile methylsiloxanes (VMSs) and synthetic musk compounds (SMCs) [5]. A first sampling campaign during the summer season was concluded and results suggest compliance with legal heavy metals concentrations, but high concentrations of some siloxanes and musk compounds suggest increased attention on such emergent pollutants is needed.

Acknowledgements

This work was financially supported by: (i) Project UID/EQU/00511/2019 - Laboratory for Process Engineering, Environment, Biotechnology and Energy - LEPABE funded by national funds through FCT/MCTES (PIDDAC), (ii) Project "LEPABE-2-ECO-INNOVATION" - NORTE-01-0145-FEDER-000005, funded by Norte Portugal Regional Operational Programme (NORTE 2020), under PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF) and (iii) Project PTDC/ASP-PLA/29425/2017 (POCI-01-0145-FEDER-029425) - AGRONAUT - Agronomic Impact of Sludge Amendment Using a Comprehensive Exposure Viewpoint, funded by FEDER funds through COMPETE2020 - Programa Operacional Competitividade e Internacionalização (POCI) and by national funds (PIDDAC) through FCT/MCTES.

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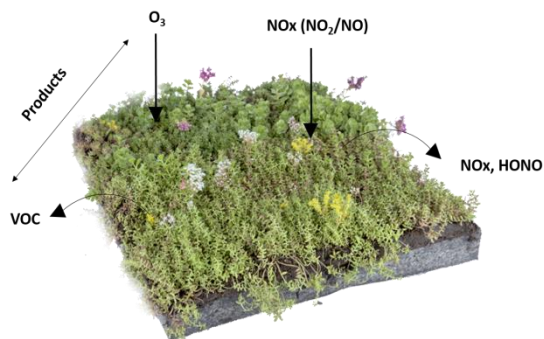
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Development of an Experimental System to Measure Air Depollution Performance of Green Roofs

ORAL
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Exposure to outdoor air pollutants is associated with adverse health effects and increased mortality [1,2]. In recent years, urban vegetation and particularly the use of green roofs has become a widespread strategy to potentially reduce air pollution and mitigate the urban heat island effect [3]. Many scientific researches mainly modelling studies have focused on its economic and environmental benefits but very limited experimental data exist on the efficiency of green roofs for the uptake and removal of outdoor pollutants.

In this presentation, we report on the first development of a laboratory experimental setup to measure the emissions and depolluting capacity of various green roof plants towards two principal air pollutants: ozone and nitrogen oxides (NO_x). The setup consists of glass and stainless steel chambers with various volumes (1 - 15 L), equipped with sources of ozone and NO_x under controlled conditions of concentrations (20 - 200 ppbv), light (dark, natural light, UV 365 nm), soil, and humidity/temperature. The uptake of Ozone and NO_x by freshly cut-leaves and small size plants (pot size: 9-15 cm) was measured online using real-time analyzers with 10 second temporal resolution. Moreover, the production of volatile organic compounds (VOCs) was also measured under various conditions using sorbent tubes coupled with thermal desorption and GC-MS analysis.

Among 12 plants species we tested, two species showed excellent performance: sedum sexangulare and thyme. Under dark and natural light conditions, sedum sexangulare had the highest NO_x uptake (1.4-2.1 mg·m⁻²·h⁻¹) while thyme had a higher ozone uptake (1.2-1.6 mg·m⁻²·h⁻¹) which was attributed to reaction of ozone with secondary metabolite VOCs emitted by thyme. Moreover, the uptake was shown to be higher under UVA 365 nm than under natural light, probably due to higher stoma opening and increased production of VOC metabolites. Experiments with small size plants revealed a lower overall efficiency in the uptake of NO_x due to a compensation via (i) production of NO by the soil and (ii) of nitrous acid (HONO) via disproportionation of NO₂ on the surfaces of leaves/soil, respectively. On the other hand, the uptake of ozone was greatly improved especially when plants were exposed for long hours.

These findings suggest that further investigation of green roof plants should be performed to better understand their behavior and performance under realistic conditions, in order to better assess their environmental benefits in polluted urban areas.

Acknowledgements

This research was supported by a PhD fellowship from the University Clermont Auvergne/French Ministry of Higher Education and Research. A special thanks is to Peng CHENG for his assistance.

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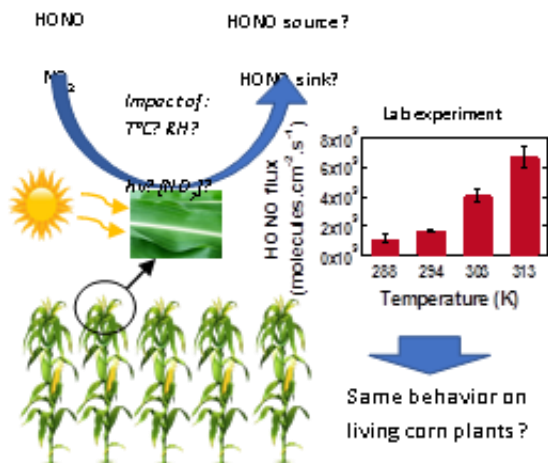
Nitrous acid (HONO) formation on corn leaves by reduction of nitrogen dioxide (NO₂)

ORAL
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Nitrous acid (HONO) is of considerable interest in atmospheric chemistry as it is an important precursor of hydroxyl radicals, a key species for photo-oxidative pollution episodes. HONO photolysis could represent up to 34% of OH formation on the morning [1]. Moreover, HONO can lead to the formation of nitrosamines which are carcinogenic compounds [2]. It is therefore important to model and predict its formation in the atmosphere. Compared to atmospheric measurements, air quality models underestimate atmospheric HONO concentrations, especially in rural areas with low NO₂ concentrations, indicating a possible missing source [3]. This source has been shown to be maximal at midday suggesting a photochemical pathway. As NO₂ is known to undergo heterogeneous reactions on different surfaces and higher concentrations of HONO have been reported above the canopy than aboveground [4], we can hypothesize that one production pathway is the photosensitized reduction of NO₂ on leaves surface.

The aim of this study is to investigate the production of HONO on corn leaves via reduction of NO₂. First, experiments have been carried out in a flow tube reactor in which the corn leaf has been placed on a glass plate. The reactant gas (NO₂) is introduced in the reactor with a mobile injector in order to modify the contact time between NO₂ and leaf surface and determine the rate constant. HONO and NO formation, as well as NO₂ consumption are studied under several conditions of temperature (283 to 313 K), relative humidity (6 to 58%), light intensity (0 to 20 W·m⁻² in the range 340-400 nm) and NO₂ concentration (10 to 80 ppb). HONO formation was noticed for all conditions tested. A slight increase of HONO emission was observed with temperature and NO₂ concentration while no influence was observed with RH and light irradiation.

Acknowledgements

We thank PRIMEQUAL and the Academy of Science for their contribution to the project.

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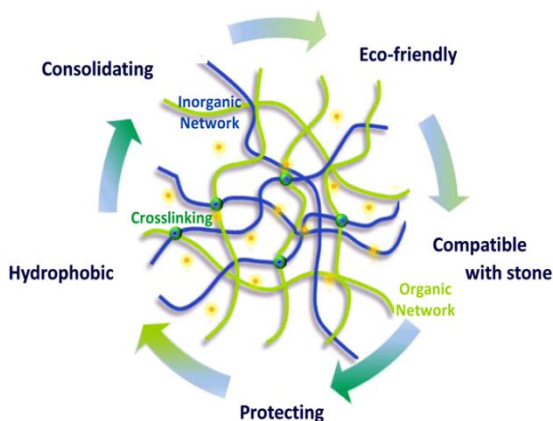
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Design of Epoxy-Silica Hybrids Based on Environment-Friendly Cycloaliphatic Diol Compounds for Potential Application as Stone Conservation Materials

ORAL
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The organic-inorganic hybrids are employed in different industrial fields such as packaging, adhesives, paints and coatings, among others. Their appeal comes from the combination of the organic and inorganic precursors, which confer them tailored physical, thermal and chemical properties. Due to their high versatility, the potential of the epoxy-silica hybrids as stone conservation materials has attracted the attention of the scientific community. In addition they are currently highlighted for the research in nanotechnology and material science [1]. However, a great issue of these materials come from BPA-based products, since BPA is a highly toxic and pollutant precursor that may lead to infertility, endocrine disorders and cancers. That is why using organic precursors based on green cycloaliphatic compounds is a strategy to achieve eco-friendly products. Pursuing this challenge, the 2,2,4,4-tetramethyl-1,3-cyclobutanediglycidyl ether (CBDO-DGE) was synthesized from the 2,2,4,4-tetramethyl-1,3-cyclobutanediol (CBDO), a compound obtained from the arnica root and the vanilla extract, via epichlorohydrine under alkaline conditions, using tetra-n-butylammonium bisulphate (TBAB) as a phase transfer catalyst [2].

The monitoring of the clean-up process and the characterization of the obtained product were carried out by Fourier-transform infrared spectroscopy (FTIR), Attenuated Total Reflection (ATR) infrared spectroscopy, Raman spectroscopy and ¹H and ¹³C Nuclear Magnetic Resonance.

For the assessment of the epoxy ring cleavage, the amines 1,8-Diaminooctane, 5-amino-1,3,3-

trimethylcyclohexanemethylamine and O,O'-bis(2-aminopropyl)polypropylene glycol-block-polyethylene glycol-block-polypropyleneglycol) were tested by ATR and Differential Scanning Calorimetry (DSC) measurements in order to improve the conditions for the development of the hybrid network.

The synthesized product and the most suitable amine were used for the sol-gel synthesis of new epoxy-silica hybrids, in the presence of the silica-forming additive 3-glycidyloxypropyl trimethoxysilane (GLYTS) [3]. Different reaction mixtures were studied thanks to a combination of scanning electron microscopy/energy-dispersive X-ray spectroscopy (SEM-EDS) and imaging Raman analysis. Finally, the thermal and hydrophobic properties of the most promising hybrids were investigated by thermogravimetry/differential thermal analysis (TG-DTA), DSC and contact angle measurements.

Acknowledgements

This work has been financially supported by the project PHETRUM (CTQ2017-82761-P) from the Spanish Ministry of Economy and Competitiveness (MINECO) and by the European Regional Development Fund (FEDER). Pablo Irizar also acknowledges his predoctoral grant from the MINECO (PRE2018-085888)

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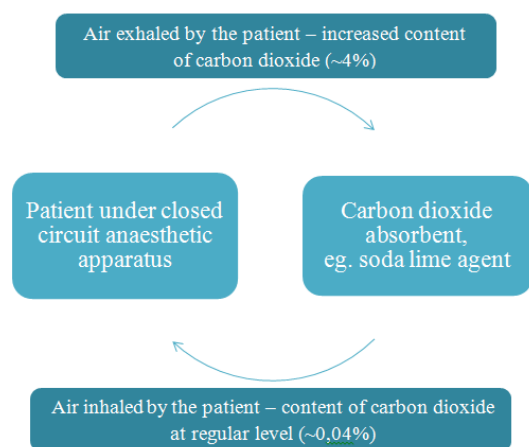
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Impact of medical use on composition of two carbon dioxide absorbents used in anaesthesiology. Research on kinetics of carbon dioxide absorption under specific conditions

ORAL
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Nowadays carbon dioxide is one of the most crucial gases taking into consideration environmental issues. As a green gas it has negative effect on environment, as well as higher concentrations of carbon dioxide in blood can lead to dangerous poisonings. In this paper we present research of one of the carbon dioxide adsorbent - soda lime. Soda lime is a widely used agent for gas adsorption in closed circuit environments.

As a mixture of calcium and sodium hydroxide it absorbs various gases [1], with carbon dioxide being the most important of them [2]. Depending on the producer, additional ingredients like indicator dyes may be added. Soda lime agent is extensively used for various reasons. It acts reliably in a simple way and it is relatively cheap. Therefore it is applied in medicine, diving apparatus and in submarines. In general anaesthesia it ensures

elimination of carbon dioxide from patient's cardiovascular system [3]. This paper describes a series of experiments conducted on three samples of soda lime.

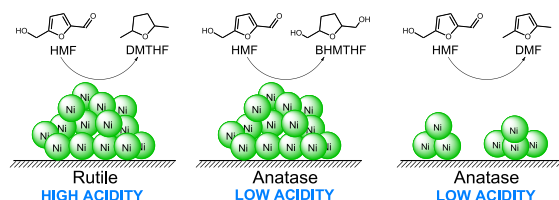
Two of them (P1 and P2) come from different producers and were not used prior to the experiments. The last sample (PIU) comes from the same producer as P1, however this sample was already used in a typical anaesthetic apparatus, therefore is characterized by different composition. The aim of this study is to investigate differences in chemical composition of gas absorbents before and after their medical use. Also the kinetics of absorption of carbon dioxide by one of medically unused samples was investigated in a closed circuit apparatus under specific conditions of gas flow imitating air exhaled by a patient under closed circuit anaesthetic apparatus.

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Does polymorphic form of TiO₂ influence the HMF hydrogenation course?ORAL
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Growing demand for energy, dwindling resources of fossil fuel and pollution of environment are important issues of modern societies. These constitute the main motivation for searching for renewable energy sources, among which 3rd generation of biomass is a valuable food-uncompetitive option (comparing with different types of biomass). Utilization of organic plant waste to meet human energy needs is economically and ecologically beneficial and provides access to liquid fuels, which is particularly important for the transportation industry.

One biomass-derived candidate for substitution of fossil fuels is 2,5-dimethylfuran (DMF) [1]. Currently it is obtained mainly over relatively expensive precious metal catalysts from biomass-derived 5-hydroxymethylfurfural (HMF) [2-4]. Our group has proved that catalysts containing cheaper, non-noble metals are also active in hydrogenation of selected platform molecules available from biomass [5]. This encouraged us to further explore usefulness of such systems. However in the case of 5-HMF to 2,5-DMF transformation there are at least two possible reaction pathways that lead to multiple hydrogenated products. Hence the catalyst should be tailored to provide high selectivity. As an alternative to precious metal, nickel was chosen due to its electronic similarity to palladium and platinum whereas titanium (IV) oxide was a carrier of choice. To investigate the impact of specific surface area, crystallites size and different TiO₂ polymorphs (anatase and rutile) ratio on the reaction course, different titania materials, i.e. hydrothermally-prepared and commercially available TiO₂ were examined. It was observed that the kind of titania strongly influenced the properties of the supported nickel nanoparticles, which

allowed to tune the reaction selectivity towards specific products. Rutile-containing titania forced stronger Ni-Ti interactions, enhanced hydrogen adsorption, and formed larger Ni particles which resulted in high activity. Although DMF is the main reaction product, the reaction is pushed towards the production of DMTHF through the reduction of the furan ring. This high Ni activity can be diminished by lowering the Ni content in the rutile-containing catalysts, which results in a higher DMF yield. Hydrothermally-prepared materials allowed to obtain selectively 2,5-bishydroxymethyltetrahydrofuran (BHMTFH - biopolymer precursor) due to a relatively small surface acidity and large Ni particles. By contrast, large surface area anatase with small nickel particles and small surface acidity allowed to selectively obtain 2,5-dimethylfuran (DMF - biofuel additive).

Acknowledgements

The authors gratefully acknowledge that this work was financially supported by a grant from the National Center of Science (NCN) in Krakow (Poland) (SONATA BIS 2016/22/E/ST4/00550). Competitive catalysts based on non-noble metals for biomass conversion to the industrially-important compounds.

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Environmental Life Cycle Analysis of Corn Ethanol under Different Scenarios for the Valorisation of Whole Stillage

ORAL
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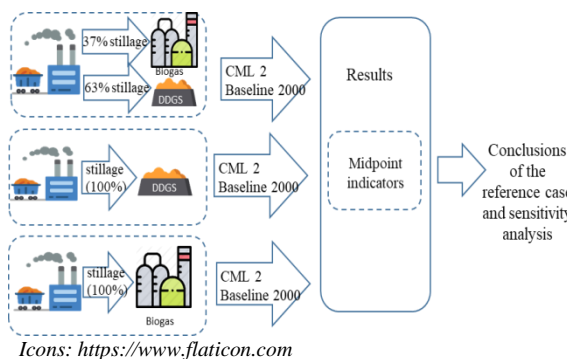
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Ethanol industry based on bio-resources is developing rapidly. The most important reasons for the quick development of bioethanol production are fossil fuel depletion and environmental issues caused by conventional fuels [1,2]. Despite the advantages of bioethanol over fossil fuels, bioethanol production has unavoidable environmental impacts. Each stage of production including feedstock provision, conversion processes, transportation and end use as well as valorizing by-products (if applicable) has an impact on the environment. The production of ethanol from biomass such as; sugar crops, starch crops and cellulosic materials results a main by-product known as whole stillage [3]. There are several options to upgrade the by-product to use in other industries.

In this paper, we considered scaling-up and evaluate environmental potential of ethanol conversion processes along with different ways for using whole stillage by using Life Cycle Assessment (LCA) methodology. A life cycle modelling was made in a consequential way expanding the system to include by/co-products. The system boundary and functional unit chosen were “gate-to-gate” and “production of 1 kg bioethanol”. Gate-to-gate system boundary covers ethanol bioconversion processes, DDGS (Dried Distillers Grains with Solubles) and biogas production. Agricultural activities, final application of products and end of life stage excluded from the system boundary. The background data used in the LCA analysis was taken from literature and Ecoinvent database version 3 [4]. Foreground data on bioethanol production processes were generated by a company in Poland. The life cycle impact assessment follows the CML 2 Baseline 2000 as a midpoint level method developed by the Centre of Environmental Science of

Leiden University in the Netherlands. The calculations were performed using OpenLCA v.1.7.2 (GreenDeLTa, Germany) life cycle assessment software.

In this study, ethanol conversion processes along with production of DDGS and biogas was treated as the reference case. In this case 63% of whole stillage produces DDGS and the remains is used for biogas production. Also, the study assessed the environmental impacts of ethanol production analyzing system expansion approach in 2 different scenarios. Scenario (A); whole stillage from distillation is converted to biogas and the second one named (B) considered entire whole stillage only for producing DDGS.

Results revealed that reference case has the best environmental performance among the defined options. There is a reduction in contribution of each impact category in reference case than the single scenarios. Furthermore, assessment result showed that the highest environmental impacts caused by scenario (A) in the terms of global warming, acidification, eutrophication, human toxicity, ozone layer depletion, terrestrial ecotoxicity and photochemical oxidation. In mentioned scenario main impacts were caused by electricity market available in Poland, steam production with the average fuel mix used in the European chemical industry, and anaerobic digestion processes.

Acknowledgements

The authors acknowledge Chemat Sp. Z o.o. for their assistance with the collection of data.

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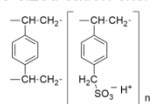
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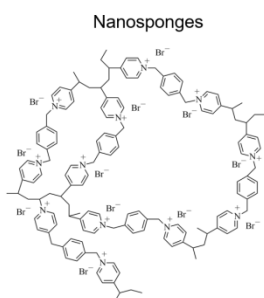
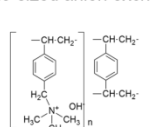
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Nanoparticles as modifiers of electrophoretic systems:

Nano-sized cation exchanger



Nano-sized anion exchanger



Nano-sized organic and inorganic particles are widely used in electrophoretic separation methods due to their unique surface-to-volume ratio as well as wide variety of chemical properties [1].

In current investigation we propose to apply the nano-sized anion exchanger (NSAE), cation exchanger (NSCE) and hydrophilic hypercrosslinked polyvinylpyridinium nanoparticles (nanosponges - NS) as coatings of fused silica capillary as well as pseudo-stationary phases in capillary electrochromatography (CEC).

Stable suspensions of NSAE and NSCE consist of styrene and 8% divinylbenzene copolymer matrix functionalized with quaternary ammonium and sulfo-groups, respectively [2]. These particles possess high ion-exchange capacity and adhesion to the quartz surface which make them appropriate stationary phases for the capillary electrochromatography mode.

The coating based on NSAE demonstrated extremely high stability and wide pH range (from 2 to 10). It should be especially noticed that proposed procedures of coatings formation are very fast (less than 15 min) and reproducible. The prepared capillaries we applied for simultaneous electrophoretic separation and quantitation of 8 carboxylic acids [2] and 8 inorganic anions [3]. Proposed methods demonstrated high separation efficiency (from 112 000 to 1 500 000 t.p./m.) and resolution ($R_s = 0.9-7.8$).

It was shown that the modified by NSCE capillaries prevented the sorption of biogenic amines (dopamine,

epinephrine, norepinephrine and normetanephrine) during their electrophoretic separation.

Despite the inspiring selectivity that was achieved using NSAE-modified capillaries, the adsorption of NSAE and NSCE in UV contribute to increase of detection limits, which hampered the quantitative analysis of real objects. That is why we suggested to apply the various on-line concentration techniques. Field amplified sample stacking (FASS) and field amplified sample injection (FASI) were used. LODs of inorganic anions were 8-30 ng/ml for FASS and 1 pg/ml - 7 ng/ml for FASI. In case of carboxylic acids - 9-34 ng/ml and 1-2 ng/ml for FASS and FASI, respectively. LODs of biogenic amines were 67-72 ng/ml in case of FASS application. It was the unique combination of high separation efficiency of analytes (due to NSAE/NSCE modification of capillary walls) and the preconcentration techniques (FASS, FASI) that allowed to achieve such a low detection limits. The proposed methods were applied for the determination of catecholamines and inorganic anions in urine and carboxylic acids in wine samples.

The different from NSAE particles selectivity to the charged analytes was achieved by using hydrophilic nano-sized anion exchangers – nanosponges as capillary coatings. NSs have a polymeric porous structure with hydrophilic cavities and contain ion exchange groups [4]. Here we demonstrated the applicability of NS-modified coatings for the separation and on-line concentration of amino acids, carboxylic acids, catecholamines and proteins.

Acknowledgements

The authors are thankful for the financial support provided by the Russian Foundation for Basic Research (no. 17-03-01282-a and 18-33-01091).

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Comparative Study of Persulfate and Hydrogen Peroxide Activation by Humic Acid Coated Magnetic Materials for BPA degradation: A Life Cycle Assessment Evaluation

ORAL
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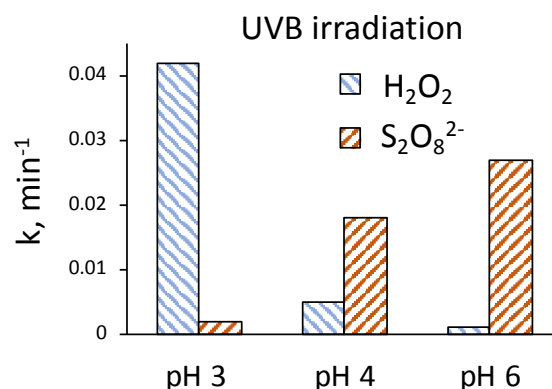
Among the advanced oxidation processes (AOPs), Fenton, photo-Fenton and Fenton-like have been attracting wide attention to degrade recalcitrant organic pollutants in water for environmental remediation due to its ability to generate highly reactive species [1]. In the “classic” Fenton process, the highly reactive species, mainly hydroxyl radical ($\bullet\text{OH}$), are generated by the reaction between Fe(II) ions and hydrogen peroxide. The reaction strongly depends on the pH: the pH has to be adjusted to the optimum of 3. At the end of the process the treated water has to be neutralized, with sludge formation and increase of the overall cost of the process. In the heterogenous Fenton processes the H_2O_2 is activated by iron supported in a solid matrix at acidic or even circumneutral pH. Due to its advantages on the catalyst recovery and reuse, avoiding the sludge formation and significantly simplifying the process, the heterogenous conditions are worth to be explored for activation of H_2O_2 [2] and also for other oxidants, i.e. persulfate.

The activation of persulfate ($\text{S}_2\text{O}_8^{2-}$) to generate the $\text{SO}_4^{\bullet-}$ can be promoted by reaction with iron both in the dark and under irradiation [3]. Sulfate radical ($\text{SO}_4^{\bullet-}$) due to its high oxidation potential has been investigated for oxidation of recalcitrant pollutants. Considering its low cost and high reactivity, the activation of H_2O_2 and $\text{S}_2\text{O}_8^{2-}$ by heterogeneous iron-based catalysts is raising growing interest. Fe_3O_4 magnetic particles (MPs) have been investigated water treatment for contaminant abatement; their main drawbacks are: *i*) their air oxidation and aggregation in aqueous systems, these limitations can be reduced by coating with organic molecules; *ii*) the acidic optimum pH of work [4].

In this work MPs coated with humic acid ($\text{Fe}_3\text{O}_4/\text{HA}$) were tested for the activation of persulfate and hydrogen peroxide for removal of Bisphenol A (BPA) in water, a good example of a non-biodegradable pollutants. Beside evaluating BPA degradation in different experimental conditions, the overall process sustainability was considered and a comparative Life Cycle Assessment (LCA) study was performed between H_2O_2 and persulfate activation. Considering also the effect of pH and of different irradiation systems: artificial UVA, artificial UVB and simulated sunlight. The chemicals, pH

adjustment cost and the electricity consumption on the BPA removal, at laboratory scale were evaluated.

Although results show that both, persulfate and hydrogen peroxide, are able to efficiently degrade BPA, significant efficiency were observed with persulfate also at pH higher than 3 (up to pH 6). The LCA indicates that even if the reagents and pH adjustment has an impact on the overall cost of the process, the energy consumption for the photo-activation represents a significant impact in the process cost.



Acknowledgements

This work is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 765860.

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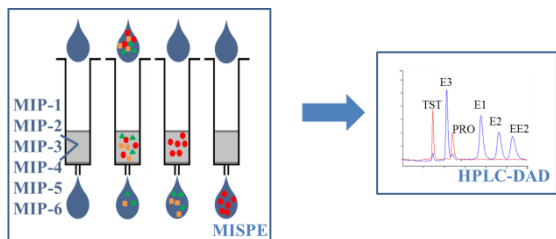
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Molecularly imprinted polymer film grafted from porous silica for efficient enrichment of steroid hormones in water samples

ORAL
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Steroid hormones as endocrine disrupting compounds can interfere with the functioning of hormonal systems of organisms and thus affect the health and reproduction of humans and wildlife. Numerous reports on the negative effects of hormones in surface waters have raised concern in the scientific community. Unfortunately, these types of harmful endocrine disrupting compounds have been found in a variety of environmental samples at very low concentrations [1-3]. Therefore, a simple, fast, and efficient method for enrichment of water samples is needed.

The MISPE process was carried out using the SPE-12G glass vacuum chamber. The MISPE columns were prepared by packing 500 mg of sorbent into empty 3 mL glass SPE-cartridges between two PTFE frits. The obtained MIPs based on the silica gel were determined as follows: MIP-1-MIP3 (silica gel about pore size 60 Å) and MIP4-MIP6 (pore size of silica gel 100 Å). To carry out the MISPE, 100 mL of water samples were spiked with the target compounds at 100 µg·mL⁻¹ and applied to cartridges previously

equilibrated with 5 mL of methanol and 5 mL of deionized water. After loading the 100 mL of sample, cartridges were washed with 5 mL of deionized water and 5 mL of 5% methanol. Next, eluted extracts were evaporated to dryness for 10 min and the residues were dissolved in 2 mL of methanol for further HPLC/DAD analysis.

Satisfactory recoveries as well as good precision obtained during these studies confirm that MIPs have great potential in enrichment of analytes, and the developed MISPE method demonstrated its practical applicability for simultaneous extraction and routine sample preparation of steroid hormones in environmental water samples.

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Biodegradation of phenol and catechol by cloud microorganisms. Comparison with radical chemistry

ORAL
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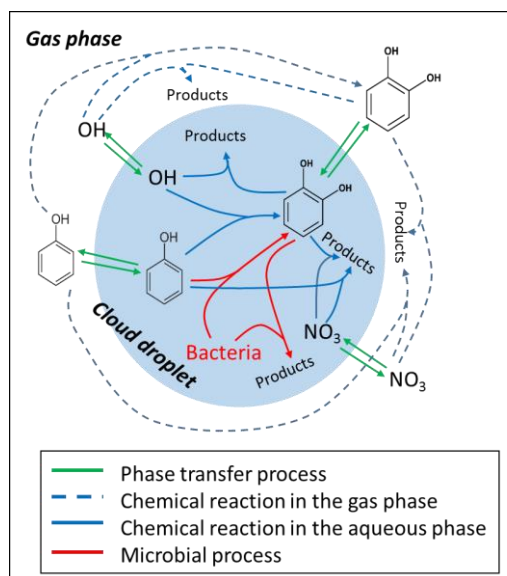
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Although organic species are transported and efficiently transformed in clouds, more than 60% of this organic matter remains unspciated. Using GC×GC-HRMS technique, we were able to detect and identify over 100 semi-volatile compounds in three cloud samples collected at the puy de Dôme station, 1465 m, France)[1]. Among these compounds, priority pollutants from the US EPA list were identified and quantified. We found phenols (Phenol, Benzyl alcohol, p-Cresole, 4-Ethylphenol, 3,4-Dimethylphenol, 4-Nitrophenol) and dialkylphthalates (Dimethylphthalate, Diethylphthalate, Di-n-butylphthalate, Bis-(2-Ethylhexyl)-phthalate, Butylbenzylphthalate, Di-n-octyl phthalate).

As our team showed the presence of active microorganisms in clouds, we decided to investigate the potential biodegradation of phenol and catechol in clouds using two strategies [2]: 1) a metatranscriptomic analysis showed *in-cloud* activity of microorganisms. We detected transcripts of genes coding for phenol monooxygenases (and

phenol hydroxylases) and catechol 1,2-dioxygenases. These enzymes were likely from Gamma-proteobacteria (*Acinetobacter* and *Pseudomonas* genera).

2) 145 bacterial strains isolated from cloud water were screened for their phenol degradation capabilities, 93% of them (mainly *Pseudomonas* and *Rhodococcus* strains) were positive. These findings highlighted the possibility of phenol degradation by microorganisms in clouds.

To go further we measured the biodegradation rates of phenol and catechol by one of the most active strain (*Rhodococcus* *enclensis*) and compared them with the transformation rates resulting from the reactivity of $^{\circ}\text{OH}$ and NO_3° radicals. In the cloud water phase, both phenol transformation rates are within the same range, while biodegradation of catechol is ten times quicker than chemical transformation. When the multiphase compartment of cloud is considered (including the reactivity in both the liquid and gas phases, and mass-transfer efficiency), the activity of bacteria is the major process for catechol transformation at night.

Acknowledgements

This work was supported by the MOBIDIC project (MOPGA ANR French program).

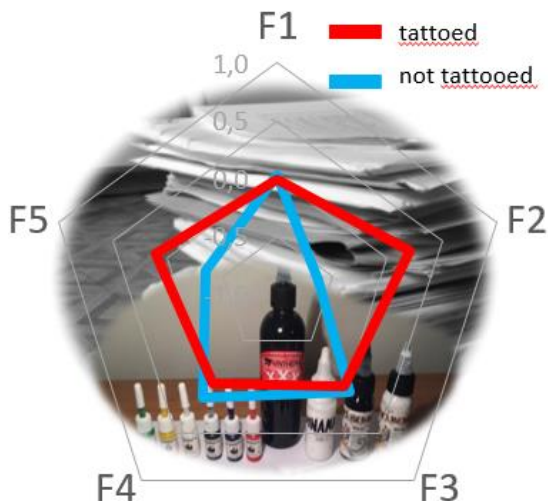
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Tattooing has been a part of human history for thousands of years and is a worldwide socio-cultural phenomenon. In the last 25 years, the popularity of tattoos has been increasing and the perception of the importance of tattoo has changed. Previously, people associated tattoos with sailors, soldiers, but also with deviants, rapists, convicts, and marginalized people. In recent years, tattoos have spread to middle-aged and upper-class people, but prejudices about people with tattoos often persist, and tattoos can bring some limitations in social life. In addition to social risks, tattoos also have health risks. Numerous studies have highlighted the content of dangerous and toxic substances in tattoo paints such as primary aromatic amines, polycyclic aromatic hydrocarbons and heavy metals, which through the tattoo process reaches the body where they can have a long-term negative impact on human health [1,2]. In addition, black tattoo inks contain a certain proportion of nanoparticles, particles smaller than 100 nm, whose action on the human body has not yet been fully elucidated [3]. Even the tattoo process itself carries a certain risk, because during the tattoo the skin structure is disturbed, making it more susceptible to infiltration of pathogens that can induce the development of infectious diseases. Thus, the issue of tattoo safety can raise legitimate concerns for the general public, as is the case with the safety of food and products [4]. People are more and more interested in the quality and composition of products, and often prefer products that are of natural origin and seemingly free of chemicals that could endanger their health. Chemicals are

perceived as harmful and dangerous and their use raises general concerns.

The submission is focused both on the chemical risk assessment (coming from heavy metals) and social perception of risks associated with tattooing. The determination of heavy metal content in tattoo inks, which are the contaminating components of tattoo inks, was carried out by inductively coupled plasma mass spectrometry and inductively coupled plasma optical emission spectrometry. The potential health risk is estimated based on the found heavy metal contents and the average amount of tattoo ink applied and compared with this corresponding to drinking water consumption. To assess the nanoparticle content, the size of particles of tattoo inks is evaluated. The assessment of the perception of the risks associated with tattoos is based on the evaluation of the survey (1946 internet and "paper" respondents) on the perception of risks associated with chemicals, tattoo inks and the process of tattooing. Differences between various demographic and social categories as well as between tattooed and non-tattooed are assessed due to their social background, mental health and risky behaviour using graphical methods and univariate and multivariate statistical methods.

Acknowledgements

Authors acknowledge the support from the University of Pardubice, Faculty of Chemical Technology project 30350/20/SG370002

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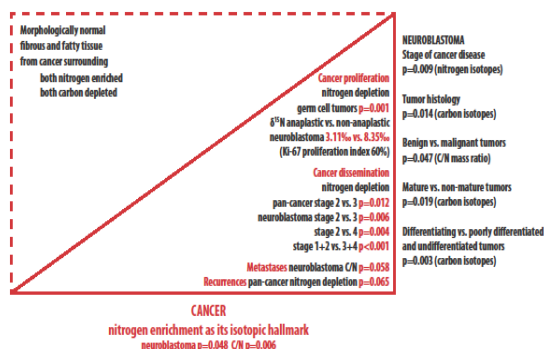
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An Innovative Dilemma Of Interplay Between Cancer 'In Vivo' Cells And Their Environment In Macro And The Atomic Scale

ORAL
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The summary of results of Nitrogen ($^{15}\text{N}/^{14}\text{N}$) and Carbon ($^{13}\text{C}/^{12}\text{C}$) Stable Isotopes Prognostic Database shows the relation of composition of tumor tissue to the fundamental mechanisms of cancer. The left triangle covers description of unusual isotopic composition found to be specific to cancer environment.

Introduction

Isotope Ratio Mass Spectrometry (IRMS) implementation into clinical oncology demanded by medical constraints has proved the method met the highest requirements concerning prognostic impact [1,2]. Current efforts in understanding of cancer biology have focused on the evolving interplay between the tumor cell and their environment.

Material and methods

IRMS advanced approach coupled with interdisciplinary analysis was developed to reveal for the first time environmental impact on cancer 'in vivo'.

Results

Unexpectedly, both fibrous and fatty tissues from tumor environment appeared on average ^{15}N enriched and ^{13}C depleted comparing with cancer cells.

Discussion

The obtained results indicate to an important role of fatty tissue in cancer metabolism. Strikingly, the anaplerotic pathway is known to be upregulated in

many cancer cells [3]. Well known fact of higher cancer incidence rate in polluted areas [4] may be explained by specific to cancer cells nitrogen fractionation and environmental interactions in macro and the atomic scale revealed in presented studies.

Conclusions

Presented interdisciplinary analysis for the first time alights cancer – environmental interactions in macro level and leads to an innovatory concept for cancer support via heavy nitrogen from environmental pollutants stored in fatty tissue.

Acknowledgements

The author acknowledge Prof. P. Paneth and Dr T. Frączek from Institute of Applied Radiation Chemistry Lodz University of Technology for their valuable help and support of the cancer-environment studies.

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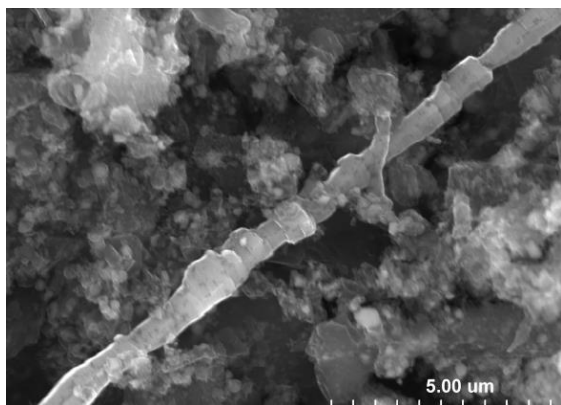
Synthesis and Characterization of SiC-based Composites Prepared from Plant Material**ORAL
40****J. Rogowski*, P. Gorazda, W. Maniukiewicz, P. Malinowski, M.I. Szyrkowska***Institute of General and Ecological Chemistry, Faculty of Chemistry, 90-924 Lodz University of Technology, ul. Żeromskiego 116, Lodz, Poland; *jacek.rogowski@p.lodz.pl*

Fig.1. Scanning electron microscopy (SEM) image of the SiC-based composite modified with iron.

Silicon carbide is a valuable material because of its unique properties such as hardness, high melting point, high thermal conductivity, low electrical resistivity [1] and biocompatibility [2]. The production of monocrystalline silicon carbide for use in electronics requires advanced methods. However, silicon carbide in the form of micro- and nanoparticles can be produced by simpler processes such as the silica reduction with carbon. The silicon carbide type 3C-SiC obtained in this way has several advantages as a catalyst support. Due to its high heat conductivity, it enables rapid heat transfer from the catalyst bed thus preventing the formation of carbon deposit and catalyst sintering [3]. Therefore, it seems reasonable to use cheap waste plant material to produce silicon carbide. It is also interesting to obtain composite materials based on

silicon carbide due to their possible catalytic activity.

In this study the influence of metal admixtures on the chemical composition and morphology of composites based on silicon carbide type 3C-SiC obtained from plant material was investigated.

The SiC-based composites based on SiC were produced in a process involving two stages: (1) horsetail pyrolysis at 900°C; (2) annealing of the resulting pyrolysis product with selected additives in argon atmosphere at 1550°C.

The chemical composition and structural features of the 3C-SiC composites were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDS).

It was found that the addition of metals to the products of horsetail pyrolysis results in the formation of a composite containing 3C-SiC and metal silicides as the main components. In addition, it was shown the chemical composition and morphology of the SiC-based composite can be modified by adding silica and silicon carbide to the horsetail pyrolysis product.

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Removal of Quaternary Ammonium-Based Corrosion Inhibitors from Produced Water and Seawater: Photodegradation and Bioremoval

ORAL
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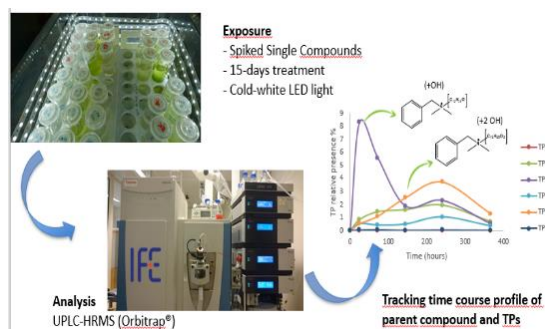
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Produced water (PW) is the main waste generated by oil and gas extraction processes (more than 70 billion barrels per year in 2009). Among the different pollutants that PW may contain, scale and corrosion inhibitors have been found at high concentration (between 7.7 to 2000 mg/L) [1]. Specially, didecyldimethylammonium chloride (DDA) and benzalkonium chloride (BAC) are commonly employed. Their removal becomes of paramount importance to ensure a safe discharge. However, up to date, very few investigations has addressed the removal of scale inhibitors from PW.

PW is treated through different methods including physical, chemical and biological operations. However, most of these technologies have unveiled disadvantages, mainly due to their acquisition and exploitation costs. Alternative low-cost and eco-friendly technologies could contribute to decrease the load of hazardous chemicals entering the environment whilst minimizing the energy consumption of the overall treatment. Among them, microalgae have proven to be effective microorganisms to address the removal of a large variety of organic pollutants from wastewater. However, despite of the large number of studies that target pollutant removal by microalgae water treatment, few attention has been paid to the study of the transformation products (TPs) generated along the process. The presence of these unknown chemicals can pose an environmental risk and thus, should also be considered in a holistic evaluation of water treatment performance.

In this work, we explore the removal of two tensioactive-type compounds (one scale inhibitor, DDA and one corrosion inhibitor, BAC) in seawater (SW) and PW using two approaches: i) photodegradation using cold-white LEDs and ii) bioremoval using microalgae. The removal and generation of TPs was investigated by UPLC-HRMS (Orbitrap-QExactiveTM). Samples were analyzed in Data Dependent Acquisition (DDA) and the data was treated using Compound Discoverer 2.1 (Thermo ScientificTM). The analytical workflow included different identification strategies for the confirmation of their chemical structures in a single run. A transformation pathway was suggested for each target compound after microalgae treatment. This is the first time that the removal of selected compounds has been thoroughly studied in microalgae and photodegradation treatments.

Acknowledgements

This work has been partly supported by the Generalitat de Catalunya (Consolidated Research Group ICRA-ENV 2017 SGR 1124 and 2017-SGR-1404-Water and Soil Quality Unit). S. Rodríguez-Mozaz acknowledges the Ramón y Cajal research fellowships (RYC-2014-16707) from the Spanish Ministry of Economy and Competitiveness. Adrián Jaén acknowledges the predoctoral grant from Generalitat de Catalunya (2019FI_B2_00202) and the extra mobility support provided by NordAqua. This research has also been financed by NordForsk through the Nordic Center of Excellence NordAqua: “Towards Versatility of Aquatic Production Platforms: Unlocking the Value of Nordic Bioresources” (project 82845). Thanks are also given to IFE for hosting Adrián Jaén and co-funding the analysis of his samples.

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POSTER PRESENTATIONS

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For several years carrying on non targeted analyses of environmental samples we keep finding pyridine and its closest homologues and derivatives (C1-C3). Due to the presence of nitrogen in the aromatic cycle they are better dissolved in water than their carbocyclic analogues and may easily penetrate ground or cloud waters. These compounds were reliably identified in the samples of snow in Moscow collected in 2011-2018 and Arctic island Novaya Zemlya collected in 2017, in rain water collected in Moscow in 2017 and in Valparaiso, Chile in 2003-2015, as well as in cloud water in central France. Since GCxGC-HRMS tool was used in these cases there are no doubts in the reliability of the identifications. Moreover, identification of 6 pyridines was confirmed by the subsequent analysis of the standards. The levels of pyridine reached mkg/l values while methylpyridines were detected up to hundreds nanograms per liter levels.

Surprisingly there are not many papers mentioning detection of pyridines in the environmental samples. Maybe it is due to the fact that mainly target analysis is carried out in the majority of the laboratories all over the world. Moreover, pyridines are not included into the lists of priority pollutants, although pyridine and 2-methylpyridine are listed in EPA 8270 Method proposed for the detection of semi volatile pollutants.

Anyway, the sources of pyridines in the environment are not reliably established. Pyridine and its derivatives may be treated as a group of industrial contaminants. They are formed in coal chemistry, present in waste waters of petrochemical and pharmaceutical enterprises, and widely used as solvents, dyes and pesticides. Heterocyclic aromatic compounds with single N atom were recently identified in biomass burning aerosol samples collected from test burns of rice straw and it is worth mentioning that N-heterocyclics including pyridines are often ascribed to volatilization from plant material and pyrolysis of biopolymers. One more possible source of pyridines in the atmosphere might involve automobile exhausts as similar benzene derivatives are observed. Definitely the higher is the level of nitrogen containing compounds in the fuel, the higher should be the levels of pyridines.

In the present study we decided to elucidate the source of pyridines in the atmosphere carrying out

model laboratory experiments on peat burning, peat pyrolysis, automobile exhaust followed by qualitative and quantitative GC/MS analysis. The burning experiments were carried out in a home-built smoking machine, while the burning products were collected on the wool, glass, solvent, and in cryo trap.

All experiments were performed using time-of-flight (TOF) high resolution mass-spectrometer Pegasus GCxGC-HRT (LECO Corporation, Saint Joseph, MI, USA) with an Agilent 7890A Gas Chromatograph (Agilent, Palo Alto, CA, USA). The system was controlled by the ChromaTOF-HRT® software version 1.91 (LECO Corporation), which was also used for spectra collection and data processing.

Despite of the numerosity of the organic compounds there was not a single pyridine in the diesel exhaust sample. This result allowed as delete car engine exhausts as a possible source of pyridines. On the contrary, quite a number of light pyridines were identified and quantified among the peat burning products. It is worth mentioning that the levels of the detected pyridines are in the same ratio as in our previous environmental studies.

The principal component among the targeted group in pyrolysis experiments is pyridine itself, with isomeric methylpyridines being the next in abundance. The levels of other detected pyridines are an order of magnitude lower. This fact perfectly matches the results of the peat burning as well as the results of our previous environmental studies.

Therefore, laboratory burning, pyrolysis, and thermodesorption experiments with peat samples demonstrated that these processed may be responsible for the appearance of lower alkylpyridines in the Earth atmosphere. The distribution of pyridine homologues remains the same in the conducted experiments and in the environmental studies carried out in Arctic, Central Russia, and Central France.

Acknowledgements

This research was supported by Russian Science Foundation (grant No. 17-13-01112).

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Benzo[a]pyrene (B[a]P), an indicator of carcinogenic polycyclic aromatic hydrocarbons, remains one of the main concerns in Balkan countries due to often practice of biomass burning for household heating. A study focused on Belgrade urban area has shown that B[a]P concentrations increase up to 17 times on average during the heating season [1]. Recent study referring to 60% of European population living in the regions that could provide regular B[a]P measurements, showed that only 7% of the examined population was exposed to B[a]P concentrations below WHO estimated reference level of 0.12 ng m⁻³ [2]. Furthermore, the authors suggested that 370 cases of lung cancer per year in the examined area could be attributed to the adverse effects of B[a]P exposure.

In this study, a three-step procedure was implemented to characterize the environmental conditions that shape B[a]P levels in an university building. First, the eXtreme Gradient Boosting (XGBoost) was applied to produce regression model for B[a]P, as target, and predictors including: 15 PAHs (Acy, Acp, Ant, B[a]A, B[b]F, B[ghi]P, B(k)F, Chy, DB[a,h]A, Flu, Fla, I [1,2,3-cd]P, Nap, Phen, Pyr), PM_{2.5} mass concentrations, PM_{2.5} heavy metal and ionic content (As, Cd, Cr, Mn, Ni, Pb, Cl⁻, NO₃⁻, SO₄²⁻, NH₄⁺, and Ca²⁺), gaseous oxides (CO, SO₂, NO_x, NO, and NO₂), meteorological parameters (temperature, pressure, and relative humidity) and radon concentrations. XGBoost is a supervised ensemble learning method which iteratively combines the ensembles of weak predictors into a single strong learner [3]. The dataset was divided into stratified training (80%) and validation (20%) sets. Hyperparameter tuning was done by using an advanced grid search and stratified cross-validation replicated 10 times, while the stability of the obtained model was assessed by using 100 times replicated bootstrap procedure. Subsequently, SHapley Additive exPlanations (SHAP) method was applied on the obtained regression function to produce model explanations. The framework unifies individualized additive attribution algorithms and offers uniquely consistent and locally accurate attribution values. Finally, to produce clusters of environmental factors

which govern B[a]P evolution in university building, fuzzy clustering of SHAP attributions was performed.

Five clusters representing different conditions that shape B[a]P indoor levels were identified. Clusters C1 and C3 represented the ambient with elevated B[a]P concentrations (1 and 2.6 ng·m⁻³, respectively) mostly registered during the colder part of the year. The B[a]P concentrations were positively associated with the levels of B[b]F, Chy and B(k)F in both clusters, as well as with CO levels in cluster C3 only, which can be attributed to fossil fuel burning for heating purposed. In the clusters representing the ambient of lower pollutant levels (C2: 0.4, C4: 0.2 and C5: 0.01 ng·m⁻³), B[a]P concentrations were negatively associated with Flu and B[a]A levels. The negative associations between B[a]P concentrations below 0.2 ng·m⁻³ and CO concentrations in clusters C4 and C5, define the ambient influenced by processes other than combustion. For instance, in the case of cluster C5, positive association with B[ghi]P indicates the ambient dominated by traffic-related B[a]P emissions.

Acknowledgements

This study was performed as a part of projects no. III43007 and no. III41011, funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia, within the framework of integrated and interdisciplinary research for the period 2011-2019.

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Comprehensive assessment of exposure to trihalomethanes existing in water and air of indoor swimming pool facilities**1P3****S. Garbos*, D. Świącicka***National Institute of Public Health - National Institute of Hygiene, Department of Environmental Health Safety, 24 Chocimska, 00-791 Warsaw, Poland; *sgarbos@pzh.gov.pl*

Water disinfection in swimming pools is an essential process leading to the elimination of pathogenic microorganisms. It is usually carried out using active chemicals such as chlorine, chlorine dioxide and ozone. They act like biocides, but at the same time react with organic and inorganic compounds present in water to form the so-called disinfection by-products (DBPs) - including trihalomethanes, chlorate(III), chlorate(V) and bromate(V).

The Ordinance of the Minister of Health of November 9, 2015 on the requirements that should be met by swimming pool water imposes an obligation to monitor chloroform concentration and the sum of trihalomethanes concentrations (the sum of concentrations of chloroform, bromoform, bromodichloromethane and dibromochloromethane) in water from pool troughs whose concentrations may not exceed 0.030 mg/l (0.02 mg/l – in the case of water in pool basins for infants and children up to 3 years old) and 0.1 mg/l, respectively.

In this work, some aspects related to monitoring the concentration of trihalomethanes (THMs) in water and the air of indoor swimming pool facilities is presented.

The water sampling was carried out at 30 cm under the surface of the swimming pool. Samples were collected into 100 ml bottles (Schott Duran, Germany) made of amber glass with a ground glass stoppers (samples poured into the cork without an air bubble) and preserved on-site with sodium thiosulfate (Merck, KGaA, Germany) in order to quench any residual chlorine reaction. Transport and storage of samples were carried out in a dark place at 4°C ±2.5°C. Trihalomethanes in pool water were determined by gas chromatography with electron capture detection (GC-ECD), after initial concentration by liquid-liquid extraction in n-pentane (factor of preconcentration = 5).

The air sampling was carried out at 30 cm above the surface of the swimming pool. Trihalomethanes present in the air were concentrated for specific period of time (30-120 minutes) in glass tubes filled with the Anasorb CSC sorbent (SKC Inc., USA) using a constant flow of aspirated air obtained by means of

224-52MTX pumps. Transport and storage of samples were carried out in a dark place at 4°C±2.5°C. The sorbent with concentrated analytes was poured into screw cap tubes with a Teflon washer caps and THMs were extracted into an organic solvent using a shaker. Trihalomethanes in the extracts were determined by a method based on the GC-ECD technique.

This study shows that in chlorinated drinking water pools the speciation of DBPs in the water and air is predominantly chlorinated. Chloroform is the most abundant species (among THM) found in air and water of such swimming pools. This study also emphasizes the need to not only improve water treatment systems or to decrease hydraulic retention time of water in pools (rate of renewal of water, rate of filtration rate), but also to improve air treatment systems. Moreover, the levels of inhaled chloroform are also affected by physical activities of bathers in pools. On the other hand, bathers' hygienic behaviour strongly influences the creation potential of THMs, too.

Acknowledgements

Research work financed under the Intelligent Development Operational Program 2014-2020: POIR.01.01.01-00-0460/16: Intelligent HVAC OPTIMIZER as a function of THM creation potential in indoor pools (OHT) - a new method of managing electricity and heat on an ongoing basis control of ventilation, heating, cooling (HVAC) to concentrations of carcinogenic halogenated methane compounds such as trihalomethanes (THM) and their removal from indoor pools.

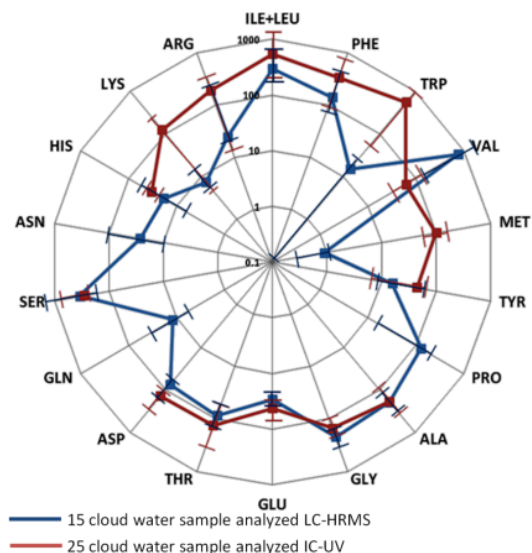
Separation and quantification by LC/HRMS of amino acids present in the cloud water of Puy de Dôme 1P4

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Cloud is a multiphase environment where chemical and biological reactions are complex and still poorly known. To better understand these reactions, it is necessary to characterize chemical composition of cloud water and the biodegradation reactions by microorganisms populating clouds. A recent study shows for the first time the presence of amino acids (AAs) in cloud [1].

The main difficulties of study of this matrix are related to the low concentrations of the compounds, to the origins of the masses of air impacting the chemical composition of the cloud and to the difficulty of collecting the clouds. Among the clouds collected at the Puy de Dome (ACTRIS, EMEP and GAW sites), the compounds characterized up to now are carboxylic acids and aldehydes (~ 10%) and also amino acids (~ 10%) [1,2]. To get more information about the presence of AAs cloud water, the first part of our work focuses on the quantification by LC-HRMS.

Also we want to know if this amount of AAs in cloud water remains constant or if it changes depending on other parameters yet unknown. The second part of our work focuses on the biodegradation of AAs in “artificial cloud medium”. It is a medium of reference for *in vivo* biodegradation experiments performed on chemical compounds present in clouds. We investigate the importance of the matrix effect

(natural cloud water versus artificial cloud water) on the detection and quantification of AAs by LC-HRMS.

Acknowledgements

This work was supported by the MOBIDIC project (MOPGA ANR French program).

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Determination of pesticides in water by HPLC-MS/MS using new variant of dispersion liquid-liquid microextraction with ionic liquids **1P5****V.A. Deev, E.A. Bessonova, L.A. Kartsova***Saint-Petersburg State University, Institute of Chemistry, 26 Universitetskii prospect, St. Petersburg, 198504, Russian Federation; hitcherv@mail.ru*

One of the important tasks of environmental monitoring of natural objects is control of trace quantities of pesticides in water samples. Such attention is due to their increased resistance to external influences, combined with high toxicity to living organisms of both the pesticides themselves and their decomposition products. The main stages of environmental monitoring is the sample preparation and the enrichment of analytes to increase the sensitivity of their determination by physicochemical methods. To date, the solid phase extraction (SPE) technique is one of the most frequently used sample preparation techniques in the environment field. However, a long extraction time, complex multi-stage procedures, and expensive cartridges in some cases limit the application of this method.

Two current trends in sample preparation seem to offer new perspectives: the first trend is the use of microextractions and the second trend is the use of alternative extraction solvents (environmentally friendly and safe) other than the conventional volatile organic solvents. In recent years, dispersive liquid-liquid microextraction (DLLME) has been developing very actively. An interesting group of alternative extraction solvents in DLLME are ionic liquids (ILs). ILs have successfully established themselves as extractants for the extraction and concentration of various organic and inorganic compounds in aqueous samples.

In this paper, we have developed a new variant of dispersive liquid-liquid microextraction using ILs based on imidazole as an extractant (IL-DLLME) in combination with HPLC-MS/MS for determination of combined pesticides (imidacloprid, bifentrin, cypermethrin, karbofos, fozalon and diazinon) in water environmental objects.

The effect of the nature of the ILs ([C₆MIm][BF₄], [C₆MIm][NTf₂], [C₄MIm][PF₆]) and dispersing solvents (acetonitrile, methanol, acetone), their amounts, extraction time, pH of sample solution and salt concentration (NaCl) on the extraction efficiency of analytes were studied. High recovery rates were obtained (from 86% to 99%) for the pesticides with the use of IL C₆MImPF₆ as an extracting solvent and acetonitrile as a dispersing solvent. The absence of the influence of pH on the distribution of analytes

between the aqueous and organic phases confirms the partition mechanism of the DLLME of pesticides. The matrix effect (ME) on the ionization of pesticides was evaluated. To reduce ME conditions for pesticide re-extraction into hexane was proposed, followed by its evaporation and redissolution of the dry residue in a smaller amount of methanol. This ensures the concentration of analytes up to 100 times.

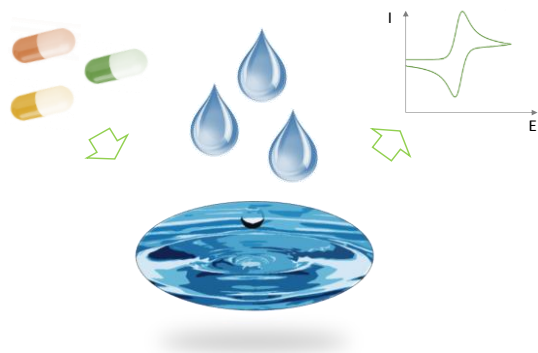
Acknowledgements

The current study was supported by Russian Science Foundation grant (№ 17-03-01282-a and 18-53-80010 BRICS_t). We express our gratitude to the Resource Educational Center in the direction of chemistry of St. Petersburg State University for the equipment provided.

Determination of antibiotics and painkiller residues in environmental water by electrochemical sensing 1P6

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Antibiotics and painkillers are leading pharmaceuticals used for leveling of bacterial infections and pain, respectively. It is worth to highlight that antibiotics play an important role in ecosystems taking part in processes regulating their functioning. However, their common production and application may lead to undesirable presence of pharmaceuticals in environment [1,2,3]. Their residues in sewage, water and soil is an important issue not only in view of environment protection. Antibiotics residues in the environment may have deleterious influence on living organisms causing allergic reactions, as well as antibiotics resistance being reduced sensitivity towards therapeutic drug dose [3,4], while presence of painkillers residues can affect cells multiplication [2].

In this work we present a new analytical method for electrochemical determination of amoxicillin, and for simultaneous determination of ciprofloxacin and paracetamol.

Amoxicillin (2*S*,5*R*,6*R*)-6-[[*(2R)*-2-amino-2-(4-hydroxyphenyl)acetyl]amino]-3,3-dimethyl-7-oxo-4-thia-1-azabicyclo[3.2.0]heptane-2-carboxylic acid) belongs to the most popular antibiotics from β -lactam group. It is applied for ear and bladder bacterial infections treatment, as well as pneumonia [5].

Another antibiotic, ciprofloxacin (1-cyclopropyl-6-fluoro-1,4-dihydro-4-oxo-7-(piperazinyl)quino- lone-3-carboxylic acid) is a representative of another group - fluoroquinolones. It is widely used for digestive, respiratory and urinary system infections treatment [6,7].

Paracetamol, N-(4-hydroxyphenyl) acetamide is one of the most popular pharmaceutical in the world used as analgesic and antipyretic agent [8, 9].

The proposed method of pharmaceuticals determination is based on application of an electrochemical sensor. For its construction a graphite electrode was modified with TiO₂ sol, used as binding agent of other components: CMK-3 type mesoporous carbon, gold nanoparticles and conductive polymer – Nafion®. Such modification of electrode surface enhanced the sensor sensitivity and also improved the stability of its indications.

Developed sensor exhibited low limit of detection for amoxicillin (0.30 μ M) and for ciprofloxacin and paracetamol during their simultaneous determination (0.11 μ M and 0.21 μ M, respectively). For verification purposes the sensor was employed in determination of drug residues in matrix of surface water samples with satisfactory results.

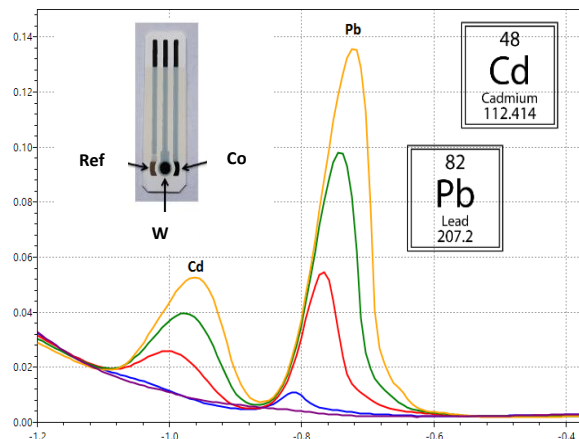
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Electrochemical sensing of Pb²⁺ and Cd²⁺ ions in environmental water samples with the use of electrode modified with halloysite 1P7

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The detection of heavy metal ions, such as cadmium and lead, is of great importance due to their highly toxic properties and negative effects on human health. These metals exhibit to accumulate in the environment because of their nondegradable characteristics and long-term chemical stability [1]. Analysis of Cd and Pb in environmental samples remains challenging as these metal ions are normally present at very low concentration levels, often in complex forms. Therefore, new approaches for improving the parameters such as: sensitivity, stability and reproducibility of electrochemical sensors are highly desired.

Within recent years various nanomaterials were extensively used to adsorb, detect or remove heavy metal ions from aqueous solutions or soils, especially in electrochemical methods. Among them, clay minerals have gained special interest due to unique features such as high specific surface area, natural availability at low price and low toxicity. Halloysite nanotubes are particular clay minerals with a predominantly hollow tubular structure which possess a peculiar chemical composition of the surfaces which allow for selective functionalization at the inner and outer side [2].

Electrochemical stripping analysis was used as an effective method for measuring traces of heavy metals due to its remarkable sensitivity, low cost, speed and satisfactory selectivity. For improving sensitivity of the measurements three different composites for electrode surface modification were tested: 1) halloysite + Nafion, 2) halloysite + carbon nanotubes + Nafion, 3) halloysite + CMK-3 + Nafion.

Based on the results of preliminary experiments, a screen-printed graphite electrode modified with halloysite (doped with carbon used as the catalyst during the methane combustion reaction), carbon nanotubes and Nafion, was applied to determine both of the elements simultaneously. The experimental parameters related to the fabrication of the electrode, i.e. composition of the modifying matrix, and the voltammetric measurements were optimized. Compared with unmodified electrode, our sensor exhibited noticeable higher electrochemical surface area and significantly better sensitivity for both elements (13.44 $\mu\text{A}\cdot\text{L}/\mu\text{mol}$ for Cd and 23.00 $\mu\text{A}\cdot\text{L}/\mu\text{mol}$ for Pb). Under optimal conditions, the peak currents increased linearly with the metal concentrations in a range of 1-10 $\mu\text{mol/L}$ with detection limit of 0.631 $\mu\text{mol/L}$ for Cd and 0.398 $\mu\text{mol/L}$ for Pb. The developed sensor designed for simultaneous determination of cadmium and lead was verified in analyses of environmental water samples.

In the next step of research, the green flow system combined with electrochemical direct injection detection, as a tool for improvement of analytical parameters, will be employed.

Acknowledgements

The study was supported by Polish National Science Centre, Project 016/23/B/ST4/00789.

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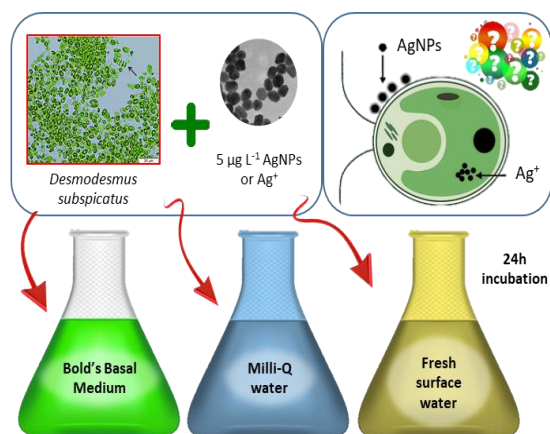
Application of *Single Particle ICP MS* for speciation analysis of AgNPs and Ag⁺ ions in surface waters and green algae

1P8

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In recent decades significant increase in production and utilization of metallic nanoparticles (MNPs) in modern technologies have been observed. Silver nanoparticles (AgNPs) are widely used in many industrial, scientific and medical applications. Therefore, it is certain that AgNPs will enter the environment. AgNPs due to their small sizes can pass through the biological barriers and damage the biological structures. *In vitro* studies showed, among other, cytotoxic and genotoxic effects of AgNPs and Ag⁺ on biological organisms [1], including humans [2]. The bioavailability and toxicity of AgNPs directly depends on the concentration and physicochemical properties of nanoparticles, including particle size and shape.

Recently, single particle inductively coupled plasma mass spectrometry (sp ICP MS) has been increasingly used for the characterization and quantification of MNPs. Sp ICP MS technique allows to distinguish between nanoparticulate forms of metals and their dissolved counterparts. In addition, this technique provides different types of analytical information: size, number and mass concentration of NPs, as well as the concentration of dissolved forms of metal.

In this study, the influence of environmental matrix on the determination of AgNPs and Ag⁺ by sp ICP MS technique has been examined. The most substantial problem of quantitative analysis was adsorption of analyte on the surfaces of micropipette tips, vials and sample introduction system. The effect of following substances, which can eliminate

occurrence of adsorption, was examined: Triton X-100, SDS, trisodium citrate, PVP and methanol. The best stability of AgNPs was obtained in the presence of 0.1% Triton X-100. The stability and conversion of AgNPs and Ag⁺ in surface water was studied. The biosorption and transformation of Ag⁺ and AgNPs by green algae (*Desmodesmus subspicatus*) were also investigated. The algae were exposed to 5 µg L⁻¹ of Ag⁺ or 40 nm PVP-AgNPs for 24h. The experiment was done in three types of medium: Bold's Basal Medium [3], Milli-Q water and fresh surface water. The developed sp ICP MS method was successfully used for the studies of biosorption and transformation of silver species in environmental matrices.

Acknowledgements

This work was supported by the Polish National Science Centre (DEC-2014/15/B/ST4/04641).

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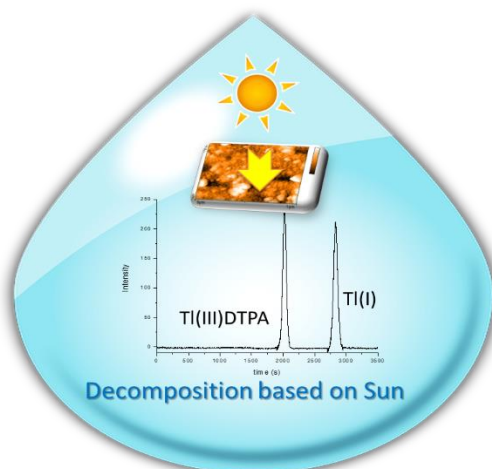
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Simplification of organic matter before thallium speciation analysis in water using nanostructured Fe&W oxides and solar light

1P9

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Water is responsible for the spread of mobile and bioavailable forms of thallium in the environment. In natural aqueous systems thallium occurs in two redox states: Tl(I) and Tl(III), which have markedly different toxicities, mobilities, and biological activities [1]. Speciation analysis of thallium can be performed using HPLC ICP MS, but the chromatographic separation can be disturbed with too high concentration of surfactants [2]. Surfactants are present in high concentrations in many water samples, especially in sewage, and have to be previously decomposed or at least their concentration significantly reduced. The aim of this study was to check the possibility of utilization of hierarchically organized layers of nanostructured Fe and W oxides in sample pretreatment of water before speciation analysis of traces of thallium [3]. The proposed photolayer system ($\text{Fe}_2\text{O}_3/\text{WO}_3/\text{Fe}_2\text{O}_3$) was already successfully applied in speciation analysis of arsenic [4]. The proposed procedure is based only on using UV Vis light range photolysis without any addition of chemical reagents. The key point of this study was to prove that the equilibrium between both thallium species is not affected by the procedure of photolysis, which was used as a method of simplification of sample matrix containing surfactants, and that this method of sample pretreatment leads to correct results of Tl speciation analysis. After stabilization of Tl speciation by addition of DTPA, photolysis assisted with nanostructured hierarchically organized film ($\text{Fe}_2\text{O}_3/\text{WO}_3/\text{Fe}_2\text{O}_3$ at pH 6) was performed by applying “solar lamp” (380-800 nm). During the studies it was proved that: Tl(I) is not oxidized in the

presence of water matrix (containing SDS) and DTPA, 100-fold excess of Fe(III) ions over Tl(I) ions does not accelerate their oxidation, and 2 h heterogeneous photolysis allows to eliminate the interferences caused by SDS and obtain reliable results. The correctness of the results was proved using an inter-method comparison (ASV and SEC ICP MS). Another findings are that the reduction rate of Tl(III) during its complexation with DTPA was 2.5%, while after 2 h of irradiation it increased to 5%. The presence of natural matrix (river water) causes a slightly increased (8.5%) reduction of Tl(III)DTPA [5]. However, these changes of speciation are irrelevant in the context of instability of Tl(III) compounds. The proposed method of “soft decomposition” can be applied in thallium speciation analysis in water matrix.

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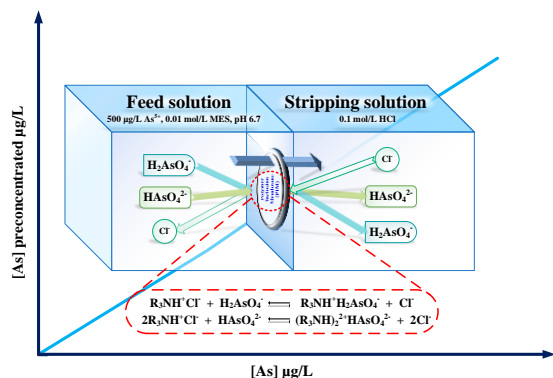
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Determination of arsenic(V) bioavailability in aquatic systems using a passive sampler based on polymer inclusion membranes (PIMs) and filamentous fungi 1P10

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The presence of arsenic(V) in aquatic environments and exposition can derive in adverse effects to aquatic and non-aquatic organisms. Therefore, it is necessary to develop analytical methods to determine, monitor, and control the levels of this contaminant. Most aquatic monitoring programs are based on spot sampling, which only provides information on contaminant levels at the time of sampling and depends on the pre-treatment applied. This sampling technique does not provide information on the truly dissolved and bioavailable fraction of contaminants [1].

Passive sampling is an analytical technique used to the in situ determination of kinetically labile metal species in aquatic systems [2]. In most cases, the sampling process is based on diffusion of the species of interest a hydrophilic or hydrophobic barrier, usually a porous membrane, into a receiving phase [3].

In this work a semi-permeable barrier, which separates the external aquatic environment, from the receiving phase where the As(V) is collected, is a polymer inclusion membrane (PIM). Polymer inclusion membranes (PIMs) consist of a base polymer (cellulose triacetate (CTA)), a plasticizer (tris (2-ethylhexyl) phosphate (TEHP)) and an extractant (Aliquat 336). The polymer provides mechanical strength while plasticizer offers elasticity and increases the solubility of the species extracted in the liquid phase. The extractant, also called carrier, is component responsible of the complex formation and the transportation of target species through the membrane [4]. Recently, PIMs have received more attention for As(V) transport. The aim of this work was to evaluate a PIM-based passive sampler for As(V) and compare the data with the filamentous fungi.

A four-factor Doehlert design was used for optimization of membrane content. The optimal membrane for passive sampling was the one containing 37% CTA, 28% Aliquat 336, and 35% TEHP. A home-made passive sampler was developed. It was partially immersed in 500 mL of 500 µg/L As(V), using 0.1 mol/L HCl as receiving solution. Additionally, transport profiles were obtained, and data were compared with the sorption of As(V) by the filamentous fungi biomass. All experiments were performed at least in duplicate at room temperature. The proportionality between the mass of As(V) accumulated in the receiving phase of the sampler and the exposure time (*t*) was analysed, and the concentration of As(V) predicted by the PIM sampler compared to the concentration of As(V) of the synthetic solution. Moreover, a comparison of transport profiles and sorption of As(V) on the fungi was performed to evaluate the potentiality of the PIM-based system to be used for monitoring of As(V) in aquatic environments.

Acknowledgements

The authors acknowledge grants from the Postdoctoral Fellowships Program (postdoc-UNAM) and financial support from PAPIIT IN229219 project of the Dirección General de Asuntos del Personal Académico (DGAPA). They also thank Q. Nadia Marcela Munguía Acevedo, Q.F.B. María Guadalupe Espejel Maya and Angel Núñez for technical advice.

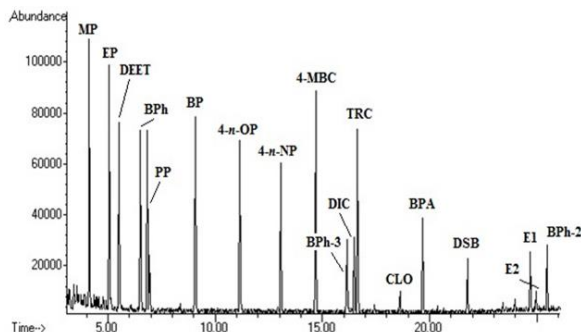
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Occurrence and environmental risk assessment of organic micropollutants 1P11 in leachates, groundwater and wastewaters

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The one of main sources of environment pollution by organic compounds are municipal and industrial wastewaters. Wastewater treatment plants (WWTPs) are not efficient in eliminating of many micropollutants thus many of this compounds may pass through wastewater treatment processes [1,2]. Other potential source of these compounds, relatively little researched yet, are municipal solid waste (MSW) landfill leachates [3,4].

The purpose of this study was to better understand the occurrence of the emerging organic micropollutants from the groups of pharmaceuticals and personal care products in environmental matrices: influent and effluent wastewaters, municipal solid waste (MSW) landfill leachates and leachate-affected groundwater from northeast Poland. Analytical methodology based on ultrasound-assisted emulsification microextraction followed by gas chromatography with mass spectrometry was used for the determination of nineteen emerging organic contaminants. Its applicability was verified through the analysis of 19 micropollutants in environment matrices such as landfill leachates, groundwater from landfill sites as well as influent and effluent wastewater. Target compounds were antimicrobial preservatives: methylparaben (MP), ethylparaben (EP), propylparaben (PP), buthylparaben (BP), sunscreen agents: benzophenone (BPh), benzophenone-2 (BPh₂), benzophenone-3 (BPh₃), 3-(4-methylbenzylidene) camphor (4MBC), insect repellent: N,N-diethyltoluamide (DEET), antiseptic: triclosan (TRC), industrial chemical: bisphenol A (BPA), surfactants: 4-n-octylphenol (4OP), 4-n-nonylphenol (4NP), hormones: estrone (E1), 17 β -estradiol (E2), diethylstilbestrol (DSB), non-steroidal anti-inflammatory drug: diclofenac (DIC), anticonvulsant: carbamazepine (CAR) and antifungal agent: clotrimazole (CLO).

BPA and BPh were detected in all samples analyzed. The highest concentrations (to several hundred micrograms per liter) of targeted compounds were registered for BPA and DIC in leachate. BPh₂ and DSB were not detected in any analyzed samples. The maximum of concentration of target EOCs in landfill leachate was one order of magnitude higher than that in groundwater samples. Target compounds in influent and effluent wastewater were present at levels exceeding a dozen micrograms per liter. Obtained results show that landfill leachates introduce EOCs into the environment as well as that they have an adverse impact on groundwater quality. Conducted research indicated that considered municipal wastewater treatment plants (WWTPs) cannot efficiently remove target EOCs. Removal efficiency varied depending on individual WWTPs and the type of compound. Among the compounds considered in this study TRC showed a high environmental risk for acute toxicity and should, therefore, be considered by WWTPs as deserving special attention.

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Sedimentary record of oil pollutant saturated biomarkers in alluvial sediments of the Sava River 1P12

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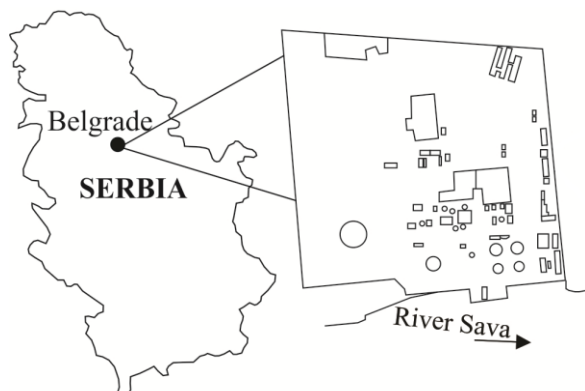


Fig. 1. Location of the heating plant in Belgrade.

One of the largest heating plants in the Balkan is located in Belgrade (the capital of Serbia), close to the Sava River (Figure 1). Due to the potential risk of contamination, this site has been a subject of detailed environmental monitoring for several years. Our previous research was focused on the pedologic analysis of the sedimentary profile, and on the analyses of *n*-alkanes and isoprenoids in the alluvial sediments in this area [1].

According to the pedologic analysis, the lithologic profile at this location is represented by alternating layers of sand and clay, and by low content of organic matter. Because of that, a reduced adsorption capacity and a reduced retention of oil pollutants can be expected at this locality.

These results of the analyses of *n*-alkanes and isoprenoids in this sedimentary profile revealed presence of oil pollutant in almost all of the samples analyzed. However, in some samples, based on the distribution of *n*-alkanes and isoprenoids, only presence of native organic material was confirmed.

The aim of our present research was to investigate the presence, composition and distribution of oil pollutant saturated biomarkers (sterane and terpane polycyclic alkanes) in alluvial sediments of the Sava River in the vicinity of the heating plant in New Belgrade, Serbia.

Surface soil and sediment samples were collected at three microlocations from this locality. The sediment samples were collected at regular depth intervals, down to the depth of 15 m. From these samples extractable organic matter was isolated with dichloromethane using a Soxhlet apparatus. Saturated

hydrocarbons were isolated from the extracts using a column chromatography and analyzed by GC-MS. The analytical procedure employed was described in our previous papers [2].

Terpane- and sterane-type polycyclic alkanes with distributions that are characteristic for crude oils were identified in all samples investigated. These results confirmed presence of oil pollutant in all samples analyzed, even in those where previous analyses of *n*-alkanes suggested presence of native organic substance only. However, the results also indicated presence of different oil pollutants at different depths.

According to these results but also considering reduced adsorption capacity and a reduced retention of oil pollutants at this locality, it can be concluded that multiple discharges of different oil pollutants to the surrounding soil occurred over the years.

Acknowledgements

The study was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Projects: 176006 and III43004).

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Origin of polycyclic aromatic hydrocarbons in the coastal soil and sediments of the Vrbas River (Bosnia and Herzegovina) 1P13

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Figure 1. Location of Banja Luka (Source: www.worldatlas.com).

The objective of this research was a source apportionment of polycyclic aromatic hydrocarbons (PAHs) in the coastal soil and sediments of the Vrbas River in Bosnia and Herzegovina.

In our previous research of the soil and river sediments from this area, saturated hydrocarbons were analyzed [1]. Based on the presence and distribution of *n*-alkanes, steranes and terpanes, presence of an oil pollutant in these samples was confirmed. These results also suggested that the oil pollution occurred in the water flow, and that a small quantity of oil was probably dispersed from the river to the coastal sediments.

The focus of our present research was a source apportionment of PAHs identified in the samples from this locality.

Seven river samples and seventeen coastal soil samples were collected in the area of the city of Banja Luka (Bosnia and Herzegovina). The samples were extracted in a Soxhlet apparatus and fractionated using column chromatography. In the fraction of aromatic hydrocarbons, PAHs were analysed by gas chromatography - mass spectrometry (GC-MS) in a selected ion monitoring (SIM) mode. The ions monitored were: $m/z = 128$ (naphthalene), $m/z = 152$ (acenaphthylene), $m/z = 154$ (acenaphthene), $m/z = 166$ (fluorene), $m/z = 178$ (phenanthrene and

anthracene), $m/z = 202$ (fluoranthene and pyrene), $m/z = 228$ (benzo[a]anthracene and chrysene), $m/z = 252$ (benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[j]fluoranthene, benzo[e]pyrene and benzo[a]pyrene), $m/z = 276$ (indeno[1,2,3-c,d]pyrene and benzo[g,h,i]perylene), and $m/z = 278$ (dibenzo[a,h]anthracene). Thereafter numerous PAH diagnostic ratios were calculated and analyzed.

The PAH profiles of the investigated samples were dominated by 4-, and 5-ring PAHs. Additionally, in some samples peaks originating from 3-ring and/or 6-ring PAHs were also prominent. No regularity was observed in the distribution of PAHs in the samples, indicating existence of multiple sources of these compounds in the investigated area.

The analysis of numerous PAH diagnostic ratios demonstrated that the PAHs in these samples originated from petroleum and also from different combustion sources, leading to the conclusion that this area was exposed to both, point and diffuse sources of these contaminants.

Acknowledgements

The study was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project 176006), and by the Ministry for Scientific and Technological Development, Higher Education and Information Society of the Republic of Srpska.

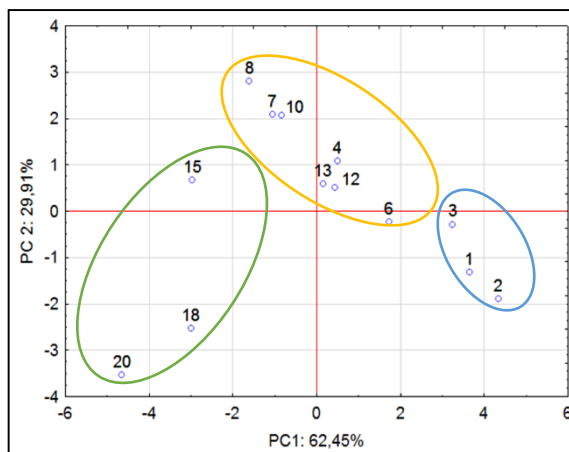
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The impact of anthropopressure on the migration of heavy metals in the catchment of Bzura River 1P14

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Nowadays, fast urbanization and steadily growing human activities result in production of many substances damaging our natural environment [1]. Water is the natural environmental component particularly exposed to the influence of contaminants. Condition of this element is inextricably linked to the quality of our life. Therefore, every effort should be made to assess the state of the environment, identify the types and sources of contamination and finally to determine relationships between factors responsible for adverse effects. It will allow to determine the dynamics of changes and the pollution migration pathways and take effective action to protect the environment.

One of the elements to which special attention should be paid in the process of environmental protection are rivers. In literature, much attention is devoted to the question of water contamination by heavy metals. The main sources of metals are human activities such as transport, agricultural practices, industrial plants or landfills [2]. In addition to external factors, adverse effects may also occur at the water-soil interface, as water quality in rivers may deteriorate due to the leaching and surface runoff [3]. Harmful substances are often accumulated in bottom sediments, which are usually characterized by the high sorption capacity. During floods or hydrotechnical works, bottom sediments may be re-suspended and accumulate on flood plains, so the soils in these areas are particularly exposed on heavy metal pollution.

Bzura is one of the most important rivers in the Łódź region. The river basin is diverse in terms of the land management. Due to not very long length and relatively small flows Bzura waters are extremely susceptible to hazards associated with the discharge of untreated sewage and other types of pollution. In the 1990s, the share of natural waters in the river below Zgierz was 6.2%, while the remaining part was industrial and municipal sewage. As a result of the water and sewage management operations and the startup of the sewage treatment plants the quality of the Bzura water improved, however, according to the Provincial Environmental Inspectorate in Łódź, the chemical state in recent years is below good. Currently, on the river within the Lodzkie Voivodship there are only 4 measurement-control points, which are separated from each other by distances of 15 km, 58 km and 24 km, respectively. The location of control pointson the river practically makes it impossible to assess the impacts and pathways of pollutant migration in the water and soil environment of the Bzura basin. Therefore, it is necessary to carry out comprehensive analyzes of water and soil condition at measurement sites representative for the Bzura catchment.

Acknowledgements

Investigations received support from the Łódź Voivodship Environmental Protection and Water Management Fund (project 804/BN/D/2016)

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Organic geological characterization of the organic matter from the Great War Island (Belgrade, Serbia)**1P15****G. Gajica^{1,*}, A. Šajnović¹, M. Kašanin-Grubin¹, B. Jovančičević²**¹*University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Center of Chemistry, Studentski trg 12-16, 11000 Belgrade, Serbia*²*University of Belgrade, Faculty of Chemistry, Studentski trg 12-16, 11000 Belgrade, Serbia*

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The Great War Island (Belgrade, Serbia) consists of two river islands (Great and Small War Island), representing a unique geological formation located between 1172 and 1169 km of the Danube flow. It covers a total area of 211 ha and is of unique ecological, cultural, historical and recreational importance, located 500 m of the air line from the city center. The Great War Island has a special status based on its position, because it relies directly on international waterways of the Danube and Sava Rivers. Within this study for the first time sediments from the Great War Island were investigated with the aim of organic geological characterization. Fifteen samples were taken from 8 sampling points.

The grain size analysis was done by sieving and pipet method. The soluble organic matter was extracted using automatic Soxhlet extraction, fractionation by liquid chromatography on silica gel to saturated fraction for gas chromatography-mass spectrometry (GC-MS) analysis.

The obtained results of grain size analysis divided the investigated samples in two groups. The first group contained of samples taken in a coastal area consisting mainly of sandy siltstone, while the second group involved samples taken from the central parts of the Great and Small War Island consisting of clay siltstone.

The group and specific organic geochemical parameters indicated that the majority of the investigated samples mainly contain native organic matter with certain input of anthropogenic organic matter [1, 2]. Biomarkers that are characteristic for petroleum and its derivatives have not only been identified, or they are present in low abundance, in the samples taken from central part of the Great War Island (channel Mali Galijaš). Native organic matter originated from higher land plants, various grass species, emergent and submerged macrophytes, as well as from bacteria, algae and phytoplankton [1, 2].

Anthropogenic organic matter originated from petroleum and their heavier derivatives, and is associated with river traffic and other activities of ships and boats [3, 4].

The locality of the Danube side of Great War Island is particularly interesting, where the occurrence of the biodegradation of the petroleum pollutant is

particularly pronounced even before it reached the investigated site, which was observed by the presence of higher odd n-alkanes and hopanes, while other members of the homologous series of n-alkanes are absent in Total Ion Chromatogram (TIC) of saturated fraction [4].

The Small War Island reflects specific sedimentation conditions because the flow of water is not high and the environment is extremely wetland, which is confirmed by the distribution dominated by diterpian pimarans and phylloclades in TIC of saturated fraction.

The shores of the Great War Island and the channel Veliki Galijaš are under constant sedimentation, while sedimentation in the channel Mali Galijaš occurs during heavy floods and is gradually deposited by fine-grained sediments. Examination of samples from the channel Veliki Galijaš and especially from the channel Mali Galijaš can give the most realistic picture of the condition over a long period of time, while the coastal samples are constantly in contact with the real flow of high energy, so that sediments are transported faster and slightly downstream and their investigation gives an insight into the current state.

Acknowledgements

Research was supported by Project of the Ministry of Education, Science and Technological Development of the Republic of Serbia (No. 176006).

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Distribution, possible sources and degree of total mercury pollution in sediments from Tisa River (Serbia) 1P16

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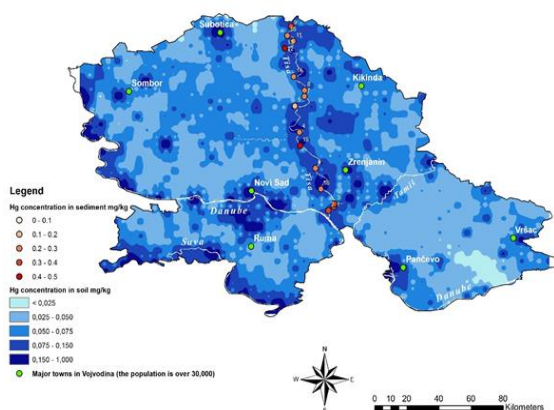


Fig. 1. Spatial distribution of THg in soils of Vojvodina [3].

Mercury (Hg) has been listed as a global high priority pollutant by many international organizations due to its mobility and persistence in the environments and high toxicity to organisms [1]. The control and management of Hg pollution require both global and local efforts. The Minamata Convention requires that countries around the world control both new and existing sources and monitor the effectiveness of those controls. The particular importance of research dealing with the biogeochemical cycling of Hg through the environment, and also is reflected in view of the presence of rapid global changes [2]. Ninkov et al. (2017) studied total Hg content (THg) in agricultural soils from the aspect of soil suitability for the production of healthy and safe food, and its spatial distribution in different parts of Vojvodina (Serbia). The same authors aimed to establish the initial point for the national monitoring of THg content in the agricultural soils and they found the highest THg concentration in alluvial plains of the Danube, Sava, and Tisa Rivers (Fig. 1). The highest THg concentrations in the alluvial plains in these Rivers can be related with natural and anthropogenic sources located in their huge catchments [3]. This research was conducted with the aims to determine: (i) THg distribution in sediments of Tisa River along the river course, (ii) possible sources of Hg and (iii) degree of Hg pollution in sediments from the Tisa River through different criteria. Total Hg content in the

surface sediments ranged from 0.071 to 0.486 mg·kg⁻¹, with mean ± S.D. value of 0.261 ± 0.103 mg·kg⁻¹. Total Hg concentrations in Tisa River sediments do not show a significant heterogeneity, as evidenced by their lower CV values (39.42 %). The highest mean values of THg concentrations (0.30 mg·kg⁻¹) was found in the downstream, while the lowest concentration (0.13 mg·kg⁻¹) was found in the tributary. In the Tisa River sediments THg is likely to be transported primarily by the small particles. The anthropogenic activities in the area of the samples with minimum and maximum values of THg concentrations do not present other likely sources of Hg pollution of the Tisa River, so the observed increase could be explicated by change in the grain size of surface sediments in this area. Strong positive loading of examined metals in all parts in the Tisa River are mainly controlled by anthropogenic sources. Results of PCA suggested mainly anthropogenic origin of Hg in the Tisa River. Compared with NOAA guidelines 80.49% of sediment samples showed that THg concentration in the Tisa River sediments represented minimal and possible risk towards to organisms. Integrating the results of pollution assessment it could be concluded that THg concentration in Tisa River sediments in Serbia showed considerable contamination according to Enrichment factor (EF), Geoaccumulation index (I_{geo}), and Contamination factor (CF), and high pollution risk according to Potential ecological risk (PERI).

Acknowledgements

This work was supported by the Ministry of Education and Science of the Republic of Serbia [grant number 176006].

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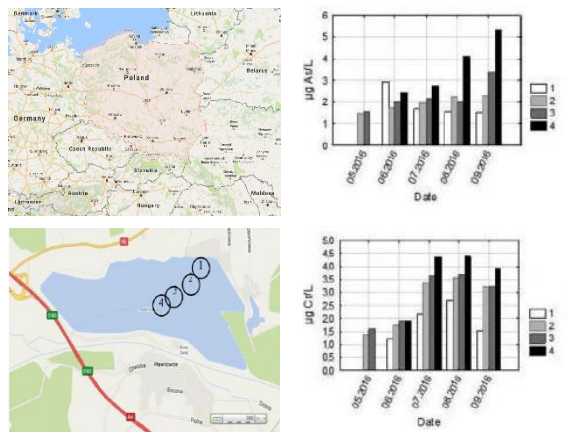
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Time and spatial variability of selected metals in water and bottom sediments of three water reservoirs located in South Poland 1P17

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The migration of metals and metalloids between bottom sediments and water and the other way round is a complex process. Understanding those mechanisms is essential for recognizing transformations taking place in water reservoir ecosystems. Physical and chemical properties of water ecosystems can be characterized with a number of parameters, such as temperature, oxygen content, pH, contents of soluble components, and concentrations of metals/metalloids (including their ionic forms) [1]. Bottom sediments are an integral part of water ecosystems as they play a key role in the biochemical cycles of elements [2]. The objective behind the following study was to define time and spatial correlations in the changes in total concentrations of selected elements (Cr, Zn, Co, Mn, Cu, Ni, Pb, As, Ba, Sb, Sr, V) in waters and bottom sediments from three water reservoirs located in Upper Silesia (Poland), i.e. Pławniowice, Dzierżno Małe and Dzierżno Małe [3,4]. The research was carried out to demonstrate whether the bottom sediments deposited in the discussed reservoirs could pose an environmental threat due to the possible release of toxic metals and metalloids into the pelagic zone. The obtained results constitute material helping to describe the bioavailability of particular elements. They also expose the existing environmental threats for such water reservoirs and their users.

Acknowledgements

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Assessing the impact of urbanization on the sediment and bivalves archives of the Great War Island (Serbia) 1P18

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Fig. 1. Sampling locations at the Great War Island, Belgrade, Serbia.

The Great War Island (GWI) covers a total area of 210.8 ha and is of unique ecological, cultural, historical and recreational importance located in the centre of Belgrade, Serbia. At only 500 m of the air line from the city centre Island represents one of the largest protected areas in Belgrade, as well as important part of urban green infrastructure of the city. The GWI has a special status based on its position, because it relies directly on international waterways of the Danube and Sava Rivers. It is one of the repertoire points on the most important European waterway, which connects the North with the Black Sea.

The main objective of this paper is to assess the impact of urbanization on the GWI by determining anthropogenic inorganic pollution status in sediments and bivalves shells.

Urbanization can affect water reservoirs by input and accumulation of metals [1]. Metals are bound to sediments through multiple mechanisms, including particle surface adsorption, ion exchange, co-precipitation and complexation with organic matter [2]. The study of metals in river sediments is very important because sediments serve as habitat for many benthic organisms [3]. Bivalves, can be very useful bioindicators of metals pollution. They can accumulate metals both in the soft tissue and their hard calcium carbonate shells. The bivalve shell is a complex organic/inorganic system which consists of calcium carbonate crystals and a small amount of organic matrix. Metals taken up from the environment

can substitute for the Ca^{2+} ion and incorporated in the calcium carbonate crystals making them suitable as components of a biomonitoring study. Because of the above shells could theoretically serve as long-term records of trace element exposure.

Total of seventeen sediment samples were collected at 8 sites (Fig. 1). Sediment samples were placed in glass bottles and transported to the laboratory where they were air dried for 48 hours. Dried samples were sieved through < 0.0063 mm sieve for inorganic chemical analyses. Thirteen samples of *Anodonta anatina* (Linnaeus, 1758) shells were collected from one site on GWI. Bivalves were collected manually, placed in a plastic bucket flushed with water from given sites and transported to the laboratory within 2 h.

The concentrations of As, Cd, Cu, Mo, Pb, Sb, Sn, V and Zn in sediments from the GWI show elevated concentrations in comparison with reference values. The elevated concentration of these elements in sediments could be attributed to vehicular emissions and commercial and industrial discharges and the application of agrochemicals. Highest concentrations of microelements in sediments are the result of direct influences of Sava and Danube Rivers. *Anodonta anatina* showed the highest value of Ca, Si and Al (355838 $\mu\text{g/g}$; 26273 $\mu\text{g/g}$ and 10420 $\mu\text{g/g}$, respectively) within their shells. The highest biomineralization factor (BMF) ratios were observed for Ca (7.06).

Acknowledgements

This work was supported by the Ministry of Education and Science of the Republic of Serbia [grant number 176006].

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Determination of heavy metal content by ICP-OES in soil from special nature preserve (Suva Mountain) 1P19

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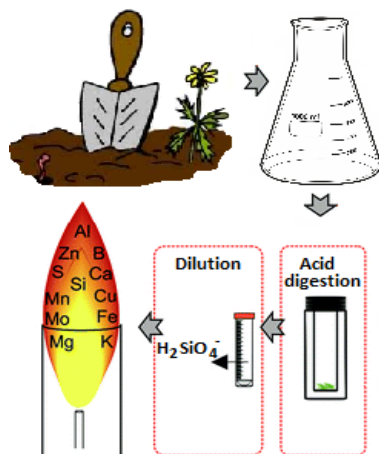
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Purpose of this study was to determine the type and degree of heavy metal pollution of soil sampled from eastern slopes of Suva mountain that is declared a special nature preserve. Heavy metal contamination of soil is a growing concern of modern age since it can impact soil fertility, microbial activity, biodiversity, crop yields and pose risks to human health due to dietary exposure [1].

One sediment and eight soil samples were taken from different sampling sites. The samples were air dried for 7 days, than pulverized and sieved to grain size of 500 μm after which moisture and ash content was determined. The total content of selected elements in the samples was extracted by microwave-assisted acid digestion method [2]. Following digestion, macro- and microelements (19 in total) were determined by using inductively coupled plasma with optical emission spectrometry (ICP-OES).

Results showed expected values for dominant macroelements, Si 47%, Al 19%, Ca and Fe 13% each, K 5%, Mg 2% and Na 1%, on average in correspondence to all 19 elements measured. This is indicative for presence of aluminosilicate minerals (kaolin and clay minerals) with Fe, K and Na as main cations while Ca and Mg are mainly represented in form of CO_3^{2-} . Exception was noticed in the case of one sample (SPT2) which was high in Ca (~44 %) but that is due to the fact that this particular sample was taken from inside of limestone cave, while 1 investigated sediment sample was expectedly found to be 99% pure CaCO_3 . As for microelements,

concentrations of toxic elements such as: Cd, Cr, Ni, Pb and As (in mg/kg) were compared to legal regulation of Republic of Serbia [3] which is in accordance with Guidance on the establishment and maintenance of monitoring programs [4]. It was found that there was no contamination of soil with Cd, Cr and Pb, while As concentrations were elevated in 2 samples (~68 and 77 mg/kg) in comparison to 55 mg/kg which is limit value. As for Ni, ICP-OES analysis has shown that there was an excess of this metal in almost all samples ranging from ~26 to 56 mg/kg, averaging at 45 mg/kg (limit value is 35 mg/kg). Presence of nickel in high amount in samples is most likely because of its geogenic origin (siderophilic element) and other natural sources that include forest fires and wind-blown dust [5].

This preliminary study was done in order to obtain information concerning potential soil contaminants in the form of heavy metals and will be used as a starting point for further complete geochemical characterization of Mt. Suva soil.

Acknowledgements

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Badlands are worldwide erosional landforms. The formation of different badland morphologies is due to the type of sedimentary bedrock, especially texture and cementation degree, as well as climate.

In this study badland mudstones which have high silt and clay contents from different locations in Italy, Spain and Canada (Figure 1) were investigated from organic-geochemical point of view. It is known that vegetation is commonly identified as a significant controlling mechanism of land degradation in sensitive, semi-arid environments [1].



Fig. 1. Sestino badlandes, Italy.

Total of 18 samples were analysed from 9 different locations. From each location unweathered mudstone and crust were taken. Qualitative and semi-quantitative composition of the mineral part of samples was determined using X-ray diffractometer. Additionally, chemical properties such as pH, EC, Eh, SAR are determined. The content of organic carbon (Corg), was determined by elemental analysis after removal of carbonates with diluted hydrochloric acid (1:3, v/v). Soluble organic matter, bitumen, was extracted from sediments using the Soxhlet extraction with an azeotrope mixture of dichloromethan and methanol (88:12, volume %). Isolation of the saturated and aromatic fraction was done using column chromatography. Organic compound were analyzed by gas chromatography-mass spectrometry (GC-MS) technique in the fractions of saturated hydrocarbons.

Many study has shown that clay mineralogy is extremely important for the behaviour of different materials undergone weathering/erosional processes

as well as smectite-containing sediments have been shown to be more erodable [2]. Additionally, the presence of enough amount of organic matter, iron and aluminum oxides causes to make marls durable while, sodium ions cause more erosion associated with dispersed clay particles [3].

In this study, it was observed that major changes in the distribution of saturated hydrocarbons occurred in samples containing smectite compared to those samples where mentioned mineral was not identified. This confirms that the presence of smectite is crucial factor for changes inorganic and organic matter during erosional processes.

Mentioned changes in distribution of saturated hydrocarbons are most pronounced for *n*-alkanes, whereby higher odd-numbered *n*-alkanes are most sensitive during erosive processes. For that reason parameters which reflect the ratio of higher and lower *n*-alkanes (for example, TAR, TAR/MAR, CPI) decrease in eroded samples compared to unweathered mudstones.

Significant changes in distribution of polycyclic alkanes of sterane and terpane types were not observed.

Acknowledgements

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Development of an analytical method to determine PAHs, PCBs, synthetic musks and volatile methylsiloxanes in sewage sludge 1P21**F. Rocha, I. Bragança, V. Homem****LEPABE - Laboratory for Process Engineering, Environment, Biotechnology and Energy, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal; *vhomem@fe.up.pt*

Sewage sludge is a by-product generated during the wastewater treatment process. Due to the increased production worldwide, some questions emerged about the proper management of this organic waste. An important disposal strategy is the reuse, particularly for agriculture purposes. In fact, sewage sludge contains a high organic matter content, minerals and other nutrients such as N and P, which are essential in intensive farming, where large supplementation to maintain fertility and enhance crop yields is needed [1].

However, concerns continue to arise on the potential risks of this practice to soil and public health (migration to crops) because sewage sludge may contain a broad range of toxic contaminants [2]. In fact, in some countries these reuse strategies have several restrictions [1]. To better understand this situation, it is crucial to start programs to systematically monitor sewage sludge, especially regarding emerging pollutants.

Therefore, in this work, four representative classes of organic pollutants were selected - polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), synthetic musk compounds (SMCs) and volatile methylsiloxanes (VMSs) - and an analytical method based on solid-liquid extraction followed by a dispersive solid-phase clean-up step was developed. The method was then validated, evaluating the linearity ranges, coefficients of determination, limits of detection (LODs) and quantification (LOQs), accuracy and precision (intra and inter-day). Finally, the proposed methodology was applied to different sewage sludge samples in order to assess the fitness of the method. Galaxolide, tonalide and D5 were the predominant compounds.

Acknowledgements

This work was financially supported by: (i) Project UID/EQU/00511/2019 - Laboratory for Process Engineering, Environment, Biotechnology and Energy - LEPABE funded by national funds through FCT/MCTES (PIDDAC), (ii) Project “LEPABE-2-ECO-INNOVATION” - NORTE-01-0145-FEDER-000005, funded by Norte Portugal Regional Operational Programme (NORTE 2020), under PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF) and (iii) Project PTDC/ASP-PLA/29425/2017 (POCI-01-0145-FEDER-029425) - AGRONAUT - Agronomic Impact of Sludge Amendment Using a Comprehensive Exposure Viewpoint, funded by FEDER funds through COMPETE2020 - Programa Operacional Competitividade e Internacionalização (POCI) and by national funds (PIDDAC) through FCT/MCTES.

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Identification of soil characteristics that should be come criteria of “smartness” for the European mountain forests

1P22

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Mountain forests yield multiple benefits, they support biodiversity, mitigate natural disasters, sequester carbon, but they also provide an environment for sustainable commercial activity. Forests and the use of forest products can contribute to climate change mitigation by increasing sequestration and through substitution effects [1].

Climate-Smart Forestry in mountain regions is an approach that can help to realize potential of the forest sector to contribute to climate change mitigation and to identify new principles and measures to reap this potential.

The aim of this study is to help in the definition of climate-smart forestry and identification of “Smartness” criteria for the European mountain forests. This particularly include identification of key soil characteristics and establishment of characteristics of beech forest lands in Europe. Total of 80 soil samples from 15 soil profiles (0-10 cm, 10-20 cm, 20-40 cm and 40-80 cm) were collected from beech forests of Spain, Czech Republic, Slovakia, Germany, Poland, Romania, Serbia, Italy, Bosnia and Herzegovina and Slovenia (Figure 1).

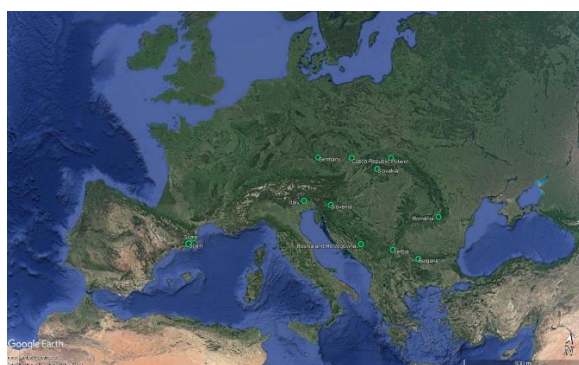


Fig. 1. Soil sampling sites across Europe.

Methodology used for soil analyses: electrical conductivity (EC) and pH (measured by portable meters), content of organic carbon (C_{org} - elemental analyser), grain size distribution (pipet analysis), content of carbonates, concentrations of major and minor elements, exchangeable cations Al, Fe, Mn, Ca,

Na, K, Mg (XRF, ICP-OEC), concentrations of anions (IC).

The content of soil stable aggregates >2mm varies greatly with bedrock type. In limestone soils it is above 60%, in sandstone soils around 50% and in granitic soils around 40%.

The average content of organic carbon in tested soils is 2.4%. The highest concentrations are found in soils on limestones, than on granitic rocks and lowest concentrations on soils developed on sandstones. C_{org} concentrations decreased along the soil horizon, but with lower gradient on limestone soils than on soils from other bedrock types. pH of soils also showed variations with the bedrock. The highest pH (6-7.7) was found in liemstones soils, while soils on all other tested soils have lower pH (3.9-6). EC is higher for soils from Slovenia and Bosnia and Herszegovina (150-240 μ S) then in other tested soils. The values of EC decrease along the soil horizon. Concentrations of carbonate and suphate anions are also highest in limestone soils, while phosphate and nitrate ions do not show variation with bedrock type.

From the obtained results it can be concluded that the bedrock has strong influence on soil properties. The obtained differences are reflected in the depth of soil profiles, structure of aggregates and physico-chemical coposition.

Acknowledgements

This study is part of the COST action „Climate Smart Forestry in Mountain Regions“ CA15226. We acknowledge all participants in the soil sample collection. Laboratory analyses were financed by the Ministry of Science and Technological Development of the Republic of Serbia (Project number 176006).

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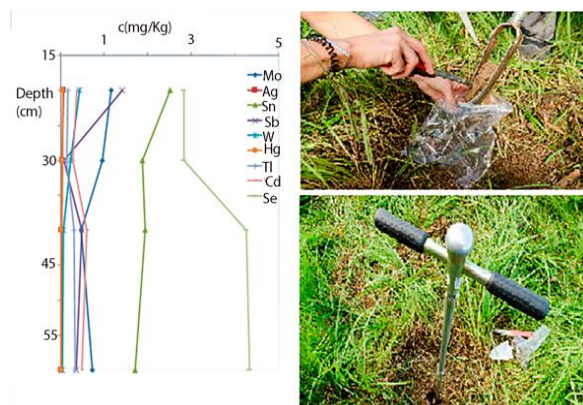
Accumulation of heavy metals in soils covering an historical construction exposed to different pollution sources

1P23

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Metal exposure is one of the most important pathways to human health due to the non-degradable and deadly nature of these contaminants. Soil metals can come from natural sources, such as high background soil concentrations, or from anthropogenic sources, as for example, via atmospheric depositions coming from human activities (industry, traffic, docklands etc.) [1]. These anthropogenic sources are generally higher in the case of urban areas. Soils that are part of architectural urban complexes suffer not only these pressures, they are also affected by the conditions of the building where they are situated.

In this work soils located in the upper part of the historical construction *Punta Begoña Galleries* (Getxo, North of Spain) have been analysed. The Galleries Punta Begoña are one of the most significant buildings of the early twentieth century in Bizkaia. They have been abandoned for more than forty years. Soils covering the construction, therefore, have suffered the deterioration of the galleries and all the pressures coming from the strategic location of this historical construction, between the city of Bilbao and the Cantabrian sea [2]. The marine aerosol and pollution from the industrial port of Bilbao, road and maritime traffic and various industries, have been present during all the existence of the galleries.

In order to know the environmental status of the soils covering the historical construction, superficial and soils from different depths were collected and analysed (more than 150 samples). The analytical determination of metals and metalloids (Li, Al, Sr,

Mo, Ag, Sn, Sb, Ba, W, Hg, Tl, Pb, Na, Mg, K, Co, Ti, Cu, Zn, As, Se, Cd, V, Cr, Mn, Fe and Ni) was carried out following the US Environmental Pollution Agency EPA 3051A method and ICP-MS (Inductively Coupled Plasma Mass Spectrometry). Lead isotope ratios ($^{208}\text{Pb}/^{207}\text{Pb}$ and $^{206}\text{Pb}/^{207}\text{Pb}$) were also measured. The results obtained were statistically analysed (Principal Component Analysis, Correlation Analysis, etc.) and the spatial distribution of metals and metalloids was interpolated to all the studied area by means of *Kriging* geostatistical method.

The results obtained revealed a clear heterogeneity between the soil samples. A large part of sampling sites showed a usual vertical distribution of metals and metalloids in soils, with maximum concentration for elements with possible anthropogenic origin in the superficial layers, and low or values closed to the reference values in the innermost soils. However, some points confirm the existence of disturbed areas in the garden, where the presence of metals and metalloids did not present a decreasing vertical profile. Some of these areas correspond to areas where artificial fillings were made for the construction of the building.

Despite, the calculation of geoaccumulation indexes (I_{geo}) classified the soils as no or low contaminated, the concentration values (for Pb, Zn, Cu and As, between others) found in some of the areas more exposed to the influence of port activities, exceed the values defined by the legislation currently in force for soil quality assessment.

Acknowledgements

This work has been financially supported by the cooperation agreement between the University of The Basque Country (UPV/EHU) and the City Council of Getxo (OTRI2014-0639).

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Elemental composition of road dust collected from the vicinity of the coal combustion power plant**1P24****J. Orlić^{1,*}, N. Zarić², K. Ilijević¹, M. Aničić Urošević³, M. Frontasyeva⁴, K. Vergel⁴, I. Gržetić¹**¹University of Belgrade - Faculty of Chemistry, Studentski trg 12-16, Belgrade, Serbia²Innovation Centre of Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia³Institute of Physics University of Belgrade, Pregrevica 118, Belgrade, Serbia⁴Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia

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Road dust is a special type of environmental medium with complicated chemical composition [1,2]. Elevated concentration of metals and other pollutants on roads can come from wide range of human activities, such as traffic emission, disintegration of vehicle brakes and tires, wear of road surface, atmospheric deposition, coal combustion, industrial solid waste dissipation and individual heating [3].

The area investigated during this research may cover all of the aforementioned sources of pollution. Road dust samples were collected at 17 locations in the coal combustion power plant Kostolac area (mine, powerplant, ash disposal site) and near to steel factory “Železara Smederevo“. In addition to urban sites (Kostolac city), samples were also collected in rural areas (villages in a 15 km radius). Moreover, dust samples were collected from the main roads, but also from the side roads at each site.

Samples were separated into 3 fractions based on particle size < 63 µm, 63-250 µm and 250-1000 µm. Approximately 0.1 g of the smallest fraction (< 63 µm) was pelletized and taken for measurements of short-lived isotopes. In order to determine the short-lived isotopes (Mg, Al, Si, Cl, Ca, Ti, V, Mn) the samples were packed in polyethylene bags and irradiated for 3 minutes. To determine the long-lived isotopes (Na, K, Sc, Cr, Fe, Co, Ni, Sb, Zn, As, Rb, Sr, Rh, Pd, Pt, Cs, Ba, La, Sm, W, Th, U) the samples were packed in aluminium cups and irradiated for 3 days. Gamma-ray spectra were measured using an HP Ge detector. Instrumental neutron activation analysis (INAA) was performed at the pulsed fast reactor IBR-2, Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia.

After grinding, 3 g of larger fractions (63-250 µm and 250-1000 µm) were mixed with 0.6 g of wax and pressed into 32 mm diameter pellets. The concentrations of Al, Ba, Ca, Cl, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, P, Rb, S, Si, Sr, Ti, V, Y and Zn were measured using ARLTM PERFORM^X Sequential wavelength dispersive X-ray fluorescence spectrometer (Thermo Scientific, Switzerland).

The obtained results are very important because they can point to the origin, distribution, and levels of metals in the environment. Comparing content of

metals in different particulate sizes is important because smallest fraction has the greatest impact on human health.

One of the initial assumptions was that traffic would produce the increased concentration of heavy metals in dust from the main roads. Since none of the investigated elements showed drastically higher concentrations at the main road, it is concluded that traffic was not a crucial factor that contributes to the level of toxic metals pollution.

It was concluded that the largest pollution source is the ash disposal site. Ash is abundant with small mass particles with increased mobility and higher concentration of toxic metals. The spread of pollution was under high influence of local microclimate factors.

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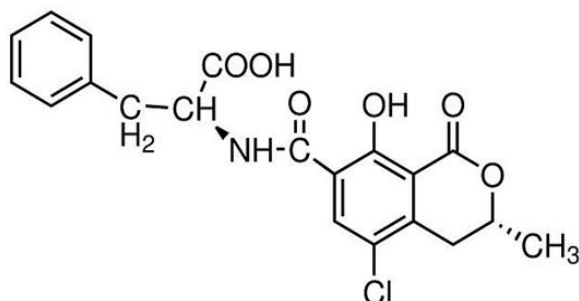
This paper was realized as part of project No OI 176006, which is financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia and in the frame of the bilateral project of Republic of Serbia with the Joint Institute for Nuclear Research, Dubna, Russia.

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Determination of Ochratoxin A and heavy metals in selected wine sample of small commercial producers from Montenegro**1P25****Ž. Jaćimović¹, M. Rakočević¹, D. Đurović², M. Kosović¹**¹*Faculty of Metallurgy and Technology, Cetinjski put, 81000 Podgorica, Montenegro*²*Institute for Public Health, Džona Džeksona bb 81000, Podgorica, Montenegro*

Ochratoxin A



The determination of mycotoxins and heavy metals is extremely important for the wine industry, the quality of grapes and wines, and therefore for the health of consumers [1, 2]. All food and beverage companies have an obligation to during the process of manufacturing to the placing on the market and offers the consumer implement preventive actions to avoid potential possibility that food contains substances or pathogens that may have adverse effects on human health [3].

The aim of this study was quality control of wine samples (7 samples) selected from Montenegro vineyards with great and long tradition in the production of premium wines. The content of Ochratoxin A (OTA) and heavy metals was examined.

Ochratoxin A, as the most widespread in the ochratoxin group, is considered to be a potentially nephrotoxic, teratogenic and immunotoxic mycotoxin [4-6]. Analyses for the determination of OTA were performed by ELISA (Enzyme - linked immunosorbent assay) method. All of the obtained values of OTA in the analyzed samples of wine are lower than the M.A.C. (2 µg/l) in wine.

By consuming wine, one enters sufficient amounts of some essential elements into the body (K, Ca, Mg ...), but at the same time brings into the body toxic metals and metalloids (As, Pb, Cd). International Organization of Vine and Wine has found the maximum allowable amounts of certain elements in wine [7]. The metal content was determined using the ICP-OES technique. The content of Fe, Mn, Cu, Cd, Zn, Pb, Hg and As was determined in the selected samples. The concentrations of metals in wines were below their M.A.C. in each analyzed sample.

The test samples are from the point of presence of ochratoxin A and heavy metals, completely safe for consumption.

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Fungicidal activity of Cu(II) complex with 4-bromo-2-(1H-pyrazol-3-yl)phenol as ligand on phytopathogenic fungus *Phomopsis Viticola* 1P26

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Phomopsis cane and leaf spot disease of grapevine (*Phomopsis viticola* Sacc. (Sacc.)) is known as a disease of European grapevine and it is in particular important for Mediterranean.

Pyrazole-based compounds and their transition metal complexes have attracted considerable research interest because of their potentially beneficial biological properties. The wide biological activity of this class of compounds (anticancer, antimicrobial, antiviral, anti-inflammatory, antifungal and others) is described in several reviews [1-4].

A large number of pyrazole derivatives and their transition metal complexes have shown significant inhibition of the pathogenic fungal mycelium *Phomopsis viticola* (pathogenic fungi that causes Phomopsis cane and leaf spot disease) [5,6]. Some of them have shown 100% efficacy (patent application pending).

In the study inhibitory effects of newly synthesised Cu(II) complex obtained in reaction Cu(NO₃)₂ with 4-bromo-2-(1H-pyrazol-3-yl)phenol (HL) were examined to the mycelial growth of *Phomopsis viticola* in vitro. The compound was applied in five different concentrations. Obtained results were compared with the commercial fungicide Cabrio Top with active ingredient pyraclostobin that belongs to pyrazole derivatives. All examined compounds expressed weak effect on mycelial growth.

Acknowledgements

This research was conducted within the innovation project: „Study on biological efficacy of newly synthesized compounds and plant extract to the most important diseases of grapevine in Montenegro-BIOEXTRA” supported by Ministry of Science of Montenegro.

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Hydrogels are defined as two- or multi-component materials consisting of a three-dimensional network of polymer chains. They are insoluble in water, and because of their specific structure they are able to absorb huge amounts of water when compared to their own weight. Hydrogels can be characterized by their "soft and wet" form, just like biological material, and can be formed and modified in various ways, which guarantees a huge range of their possible applications. The hydrogel swelling potential depends on the hydrogel matrix defined by the amount and type of hydrophilic functional groups which are present in the hydrogel structure, e.g. amine, hydroxyl, amide or sulfone groups [1]. Thus, their chemical and physical properties give hydrogels a chance to be successfully employed in different areas such as environmental sciences as chelating agents for waste water treatment and as a hydrating medium for plants by ensuring them constant access to water [2]. Nowadays, natural polymer hydrogels, like the one based on the chitosan, are in the center of attention. They gained a lot of interest due to well documented biocompatibility, low toxicity, and the ability to be degraded by human enzymes. Chitosan is a natural, polycationic polysaccharide, which contains dispersed units of β - (1-4) -linked of D-glucosamine and N-acetyl-D-glucosamine. It is obtained from chitin by the deacetylation process, which results in the removal of some part or even all acetyl groups from the acetilamino group of chitins. During this transformation, the number of amino groups increases. As a consequence, the degree of the desired biodegradability and hydrophilicity compound is much higher. Additionally, in order to improve the properties of hydrogels, they are also modified by the introduction of additional substances into their matrix like synthetic polymers or metal ions [1-2].

The aim of the study was to evaluate the properties of chitosan hydrogels modified with gold. Another aspect of this work included detailed characterization of the hydrogels swelling process, the quantitative determination of the gold concentration in hydrogel samples after their earlier mineralization as well as the assessment of the influence of various parameters on gold concentration in hydrogels. Chitosan-gold hybrid hydrogel was formed as a result of the reaction of aqueous solutions of chitosan previously dissolved in

1% acetic acid with solutions of tetrachloroauric acid (III) at various concentrations. Six measurement series with different options for various gold and chitosan concentrations were prepared. In total about 90 samples were tested. Created Au nanoparticles worked as physical cross-linking points. To determine the gold content of chitosan-gold hydrogels, flame atomic absorption spectrometer, Solaar M6 by UNICAM was used. Before the quantitative analysis, samples were mineralized in a microwave system, UltraWave by Milestone with reverse aqua regia. Moreover, selected samples, after the separation of hydrogels via filtration, were analyzed using a UV-VIS spectrophotometer V-530 by Jasco in order to confirm the presence of nanogold particles. The dynamic laser light scattering instrument by Nicomp was used to characterize the size distribution of chitosan-Au nano /microgels which remained in the tubes after removal of formed hydrogels. The highest measured concentration of gold in the studied samples reached approximately 0,004 g of gold/g hydrogels for samples with the lowest swelling time.

The results of the non-parametric test showed the existence of statistically significant differences in the concentration of gold in hydrogel samples in relation to the concentration of the applied tetrachloroauric acid (III). It was also proven that the amount of gold trapped in hydrogels structure increased with the concentration of the tetrachloroauric acid (III) used, while the contact time and the chitosan concentration turned out to have no impact on the concentration of gold. An opposite general trend was observed for the effect of the swelling time, where the increase in time contributed to the decrease in the concentration of gold retained in hydrogels. It was also indicated that the more gold particles in the hydrogel matrix, the higher the crosslinking density and the lower the sorption capacities of the product

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The assessment of the safety of face cosmetic products based on the analysis of the content of selected metals**1P28****A. Pawlaczyk*, K. Załęczna, M. Balcerek, J. Albińska, E. Leśniewska, M.I. Szynkowska***Institute of General and Ecological Chemistry, Lodz University of Technology, Żeromskiego 116, 90-924, Łódź, Poland; *aleksandra.pawlaczyk@p.lodz.pl*

The cosmetics market is one of the fastest growing sectors of the economy. The cosmetics business lines include, among others, cosmetics for skin care, hair, personal hygiene and make-up cosmetics. The so-called industry of colored cosmetics is not only a key player of the growth of the "beauty market", but also the second largest category in the whole chemical and cosmetic basket. According to some general predictions made by the Euromonitor International research company, the sales of the make-up cosmetics may even increase by 5% compared to last year. It is believed that both large marketing campaigns as well as the increase in the importance of our physical attractiveness and how we are perceived by others can be responsible for the phenomenon. Color cosmetics fuel the growth of the beauty market in Poland because nowadays appearance plays a significant role equally in women's and men's lives. It is often one of the main indications of our social status.

A very important aspect related to cosmetics is the safety of their use. Each cosmetic that is released in the market should not under any circumstances threaten people's health. The risk connected with their use depends on many factors like the amount of product, place and frequency of application of the cosmetic. All may contribute to the incensement of allergic reactions risk or development of other sides effects appearing with their prolonged application. It has been reported that many toxic metals such as Cd, Co, Cr, Ni and Pb are retained as impurities e.g. in the pigments or they are released by the metallic devices used during the manufacturing of cosmetics. According to some authors, China is the source of 60 percent of recent cosmetics and other product recalls because of the toxic components they contain. The use of any kind of heavy metal in a cosmetic product is strictly banned inside the European Union under EU Regulation 1223/2009. The substances listed include elements such as Pb, Cd, As, Sb and its compounds as well as Hg and its compounds, except some special cases. The unintended presence of these heavy metals in cosmetics products is only allowed if it is technically unavoidable under good manufacturing practice (GMP) and if the products are still safe for the human health. Recently, legal regulations related to the use of colored cosmetics which entered into force in Poland on the 1st January,

2019 were updated. The regulations were designed to harmonize standards throughout Poland and to ensure greater levels of consumer safety.

The aim of this study was to assess the impact of selected factors on the levels of toxic metals such as Cd, Pb, Cr, Cu, Hg, Mn or Ni in the cosmetic samples (e.g. eye shadows) available commercially on the Polish market. The assessment was made by comparing the obtained results with the currently available legal regulations and literature data. All cosmetic products were purchased from the Polish market. The evaluated parameters for all samples included e.g. the price range, product type, color, origin or the brand. The total mercury content was determined by Cold Vapors Atomic Absorption Spectrometry (CVAAS) technique using the Automatic Mercury Analyzer MA-3000, Nippon Instruments Corporation. In the next stage, samples were treated with concentrated nitric acid and perhydrol in the microwave oven system UltraWAVE, Milestone. The concentration of selected metals in the obtained extracts was evaluated by the Flame Atomic Absorption Spectrometry (FAAS) technique using the Solaar M6 spectrometer by Unicam and by the Inductively Coupled Plasma Mass Spectrometry technique using the Optimass 8000 spectrometer by GBC (ICP-MS). Statistical analysis of the obtained values was performed using the Statistica software delivered by Statsoft. Since none of the considered in this study variables met the condition characteristic of the normal distribution, for further analysis the non-parametric Kruskal-Wallis test was used to assess the potential influence of selected grouping factors.

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Semi-quantitative assessment of selected metals of whisky samples in relation to their type and origin

1P29

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The first mention of mass production of whisky dates back to 1494. However, the date of whisky birth goes back a long way. According to legends, in the fifth century Saint Patrick brought the skill of distillation from France to Ireland. These alcohols were produced by monks (in monasteries) and their purpose was to improve of health. Currently, whisky consists of many trace elements coming from the ingredients used in all production processes (fermentation, distillation and maturation). These materials are responsible for organoleptic characteristics of the beverage. Their analysis is important to better control the stages of production processes, taste repeatability and brand protection as well as to ensure the product quality [1,2].

The aim of this work was to assess the potential correlation between the elemental composition of 20 whisky samples and the country of their origin (Scotland, Ireland, and the United State) based on the semi-quantitative data obtained by ICP-MS (21 isotopes: ⁴⁴Ca, ⁴⁵Sc, ⁴⁷Ti, ⁴⁸Ti, ⁵¹V, ⁵²Cr, ⁵⁴Fe, ⁵⁵Mn, ⁶⁰Ni, ⁶³Cu, ⁶⁶Zn, ⁸⁸Sr, ⁹⁰Zr, ⁹⁵Mo, ¹⁰¹Ru, ¹⁰⁷Ag, ¹¹¹Cd, ¹¹⁸Sn, ¹³⁸Ba, ²⁰⁸Pb, ²⁰⁹Bi. An additional parameter to be evaluated was the pH of 100 alcohol samples (including whiskey samples from different countries and 12 "Fake" whisky samples).

Additionally, the chemometric methods were applied in terms of identification of similarity among objects. Finally, two main parameters were taken into account, namely the region of their origin as well as the type of product. The evaluation of the dependence

of the age of the product turned out to be non-conclusive and was rejected from further analysis.

The collected semi-quantitative data were used for multivariate analysis performed by the Statistica 10.0 software. The results showed that Irish whiskey is characterized by quite a high amount of Ba and Ti compared with other samples, which made it possible to distinguish this sample from the others. No strict correlation was found between the type of whisky and the amount of trace elements, however, the projection of objects on the first two components revealed that single malt samples created one cluster.

The pH of products turned out to be an important parameter from the point of view of brand protection.

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Discrimination of wine samples in relation to their type and origin based on the concentration level analysis of selected metals

1P30

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The history of wine is as old as history of man. The winemaking process, which was already known thousands of years ago, has evolved over the years. From primitive products of fermentation of rice, honey and fruit in ancient China through Egypt, Mesopotamia, Greece to vineyards with the noblest of grape varieties in Italy, France and Spain - wine ambassadors in the world. Currently, wines are produced worldwide. Only in 2018, 292.3 million hectoliters of this spirit was produced. The highest annual wine consumption per capita is recorded in France - 51.2 L, in Italy 43.6 L and in Spain 26.5 L [1,2].

The main objective of the presented research was to assess the consumer's safety connected with wine consumption based on the quantitative results of heavy metals concentrations. Additionally, an attempt to establish the real geographical origin of studied wine samples in relation to the content of chosen elements was made.

141 wine samples (including 64 red wines, 60 white wines and 17 rosé wines) from 22 different countries were analyzed for the determination of the concentration of selected metals based on the measurement of the following isotopes: ^{10}B , ^{52}Cr , ^{55}Mn , ^{60}Ni , ^{59}Co , ^{63}Cu , ^{66}Zn , ^{85}Rb , ^{95}Mo , ^{114}Cd , ^{138}Ba , ^{208}Pb , ^{209}Bi , ^{238}U . This was examined by ICP mass spectrometry and CV atomic absorption spectroscopy (total Hg content [$\mu\text{g/L}$]). In addition, the pH of all wine samples was measured.

The collected quantitative data were used for multivariate analysis performed using the Statistica 10.0 software. Based on the Kruskal-Wallis test, statistically significant differences in the concentration of selected metals were found in relation to some of the analyzed criteria, i.e.

- between the contents of Cr, Mn, Cu, Ba and the color of wine,
- between the contents of Cr, Mn, Mo and the type of wine,
- between the Mn content and the country of origin of wine,
- between the contents of Cr, Mn, Ba and the type of wine.

The wines pH measurement results are consistent with the literature data. Red wines had the highest pH. It is associated with specific methods of producing red wines, which are usually subjected to a second fermentation. During this process, the transformation of malic acid into lactic acid takes place.

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Opportunity of the sugar beet pulp utilization for reclamation of fly ash dump site with plants of *Poaceae* family

2P31

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Until the 2014 as a main source to generate electricity in the world remained combustible fuels [1]. In Poland, it is primarily hard coal and lignite. According to EUROSTAT data until the 2016 80% produced energy came from combustion these fuels [2]. As a result of these processes the Coal Combustion By-products are received, among them fly ash. There are several methods of utility of these wastes, however they are insufficient and the excess is landed on dump sites and must be reclaimed [3].

Many methods of reclamation of fly ash dump sites have been described in the literature. They usually consist of hydro-seeding and adding macronutrients (mineral fertilisation NPK), organic substances, e.g. wastewater, sewage sludge, waste from food industry, compost [4,5]. Most of these methods are complex, time-consuming, cost-intensive and require special preparation. Furthermore, the additional pollutants are introduced into the environment.

The aim of our work was to assess the opportunity of using sugar beet pulp as a source of organic substances for reclamation of fly ash dump site coming from lignite combustion. The suitability of the obtained substrate for growing energy crops was examined. For this purpose 2 varieties of maize (Zawisza and Opoka) were used. Plants were growing through 3 weeks on fly ash with/and without sugar beet pulp and harvested after that time. Then they were washed with deionised water and dried to constant weight at 70°C and crop yields were

determined. In the next step plants were digested in a microwave oven using a mixture of HNO₃ and HCl. Micro- and macroelements were determined in solutions by F-AAS, GF-AAS and ICP-AES. The composition of beet pulp was also analysed.

Statistical analysis of received data was made with STATISTICA program ver. 10. Addition of sugar beet pulp caused translocation Pb into above-ground plant parts in both varieties. At the same time accumulation of Cu and Ni in leaves was limited and there was noticed immobilization of copper and nickel in roots. Sugar beet pulp also slightly facilitates uptake of cadmium to above-ground parts in Opoka variety in opposite to Zawisza variety where slightly higher immobilization in roots was noticed. Zawisza slightly limited migration of Na and K to above-ground parts of plants cultivated on fly ash with sugar beet amendment, however Opoka was found to have significant increase of K uptake and at the same time immobilization of Na.

Acknowledgements

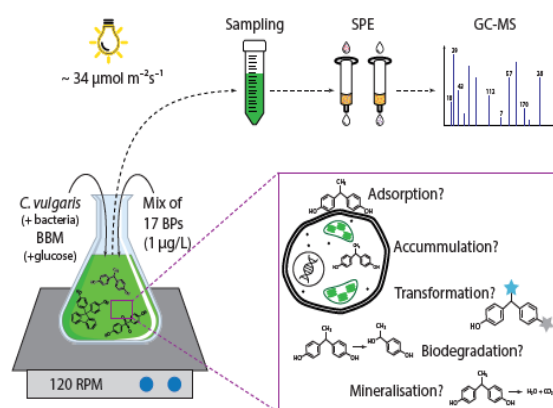
The authors are grateful Lodz University of Technology for granting access to the computing infrastructure built in the projects No. POIG.02.03.00-00-028/08 "PLATON - Science Services Platform" and No. POIG.02.03.00-00-110/13 "Deploying high-availability, critical services in Metropolitan Area Networks (MAN-HA)

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Endocrine-disrupting compounds (EDC) are organic pollutants that interfere with the normal functioning of the endocrine system. Bisphenol A (BPA) is a known EDC, used mainly in the production of polycarbonate plastics and epoxy resins. Bisphenols are BPA analogues of which traces have been found in the environment, food, drink and human bodily fluids [1]. Structural similarities to BPA mean there is concern regarding endocrine disruption and other toxic effects, which have been confirmed for some BPs [2]. Industrial and municipal wastewaters present an influx of BPs into the aquatic environment, therefore wastewater treatment is key to lowering emissions. Algae-based treatment systems rely on high algae growth, low energy inputs and long hydraulic retention times to achieve high removal efficiency of pollutants. Harvested algal biomass may be reused (fertiliser or biofuel production), while the high-quality effluent produced could be used for irrigation [3]. Although several studies are investigating the removal of BPA in algal bioreactors, the removal of other BPs was not yet studied. In this work, the removal of BPs in bioreactors with algae alone (in mixotrophic and autotrophic conditions) and as a co-culture with bacteria was compared in laboratory-scale bioreactors. The distribution of residual BPs in aqueous and biomass phase to further understand the mechanisms involved in their removal, was also assessed.

Chlorella vulgaris was inoculated into a series of batch reactors with a starting volume of 0.5 L of Bold's Basal Medium (BBM). Bacteria used in co-cultures were isolated from activated sludge and were

unknown. The reactors were spiked with a mixture of 17 BPs, with an initial concentration of $1 \mu\text{g}\cdot\text{L}^{-1}$ per BP. Reactors were continually shaken under fluorescent tube grow-lights with a 16:8 (light:dark) photoperiod. Samples for BPs analysis were collected every three days and an analytical method for the determination of 17 BPs in the aqueous phase, and the biomass was developed and optimised. This involved separation of the phases by centrifugation, solid-phase extraction and analysis on GC-MS operated in SIM mode. The separation was achieved on a DB5-MS $30 \text{ m} \times 0.25 \mu\text{m}$ column. Additionally, parameters, such as biomass growth, cell viability, pH, chlorophyll *a* content, and dissolved oxygen were measured daily.

The results show that BPs with high partition coefficient K_{OW} were predominantly found in the biomass phase at day 0 and that BPs found in the biomass phase appeared to be removed to a higher degree than those in the aqueous phase. Their removal from the aqueous phase ranged from $13.1 \pm 3.2\%$ (BPS) to $99.0 \pm 0.8\%$ (BPPH) depending on the compound and their log K_{OW} , indicating that adsorption and/or bioaccumulation play an important role in the removal of BPs with higher log K_{OW} . In most cases, there was no statistically significant difference in removal from the aqueous phase between different modes of *C. vulgaris* cultivation.

Acknowledgements

The authors acknowledge the projects: P1-0143, L1-9191, N1-0047, J1-8147, and J2-8162, which were financially supported by the Slovenian Research Agency, as well as ISO-FOOD project (Era chair for isotope techniques in food quality, safety, and traceability, Grant 621329).

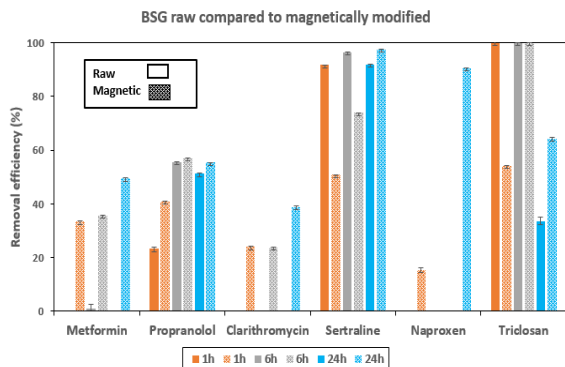
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Sustainable water treatment of pharmaceuticals using functionalised waste materials as adsorbents 2P33

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With prescription rates and the number of pharmaceuticals being used expanding, there is a greater need for efficient low-cost treatment methods for their removal from wastewater. Conventional forms of wastewater treatment such as activated sludge have been found ineffective for a number of pharmaceuticals and personal care products (PPCPs) such as metformin [1]. Other treatments such as commercial activated carbon have proven to be effective in the removal of a wide variety of contaminants [2]. However, these materials are expensive to produce as they use activation methods such as high pressure steam, etc. [3].

Here, we look to produce low-cost materials from Scottish waste/by-products (brewery/distillery and shellfish industries) as adsorbents for the removal of 6 prioritised compounds. These include 5 pharmaceuticals; metformin (an anti-diabetic), propranolol (a beta-blocker), clarithromycin (an antibiotic), sertraline (an antidepressant), naproxen (an anti-inflammatory), and triclosan (an antimicrobial) used in personal care items.

Raw spent grain from distilleries and breweries, and waste crab carapace and mussel shell from the shellfish industry were used as adsorbents for the removal of these 6 PPCPs. Removal efficiency was calculated and results were then compared with functionalised forms (e.g., magnetic modification) of the same material. Experimental conditions used were: adsorbent dose - 4 g/L; initial contaminant concentration - 10 mg/L of each compound (in a mixture); room temperature stirring at 150 rpm at pH 7. Samples were taken at 1 h, 6 h and 24 h during adsorption experiments and were analysed using an Agilent 1100 HPLC coupled to a Micromass Quattro

Ultima Platinum mass spectrometer (equipped with an electrospray ionisation source).

Results indicated that the modification of raw materials improves removal efficiency for several compounds (as can be seen in the Figure). Magnetically modified brewer's spent grain was more efficient for the removal of metformin, propranolol and naproxen. Improved efficiency at specific time points was also noted for other compounds; for example, naproxen which had 0% removal at 24 hours using the raw adsorbent material, had 90% removal at 24 hours using the magnetic BSG.

Future work will involve a comparison of efficiency for all the modified materials for the removal of the target compounds. Optimisation of adsorption experimental conditions will also be performed using *response surface methodology* for parameters such as time, solution pH, adsorbent dosage and rotation speed. Kinetic/isotherm modelling, thermodynamic studies and instrumental characterisation will also be used to determine adsorption mechanisms.

So far, results are promising, indicating that functionalised waste materials could be effective in the removal of pharmaceuticals from water.

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Reductive technology using Raney alloy for quick and effective degradation of halogenated organic compounds in contaminated waters 2P34

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Halogenated organic compounds collectively referred as AOX (Adsorbable Organic Halides) are one of the most widespread group of water contaminants (wastewaters, surface waters, ground waters). Reasons are both historical and industrial. Historical reasons include use of wide range of halogenated chemical compounds for preparation of solvents, degreasers, pesticides, flame retardants, and technical liquids in the past. Industrial reasons are that some of these substances are still used in many sectors of industry (paper, textile, chemical etc.). Due to their environmental persistence and potential toxicity, these substances have become subject of strict controls in surface and waste water. Therefore, there is a need of their elimination from these types of water. This can be achieved via utilization of fast and effective technologies.

This study is focused on development of technology based on strong reducing properties of Al-Ni 50:50 wt. % alloy (Raney alloy) in alkaline water environment for degradation of a wide range of halogenated organic compounds directly in contaminated waters. The mechanism involves the catalytic hydrodehalogenation reaction on the surface of porous nickel by the action of hydrogen gas produced in-situ during aluminium dissolution step (Figure 1).

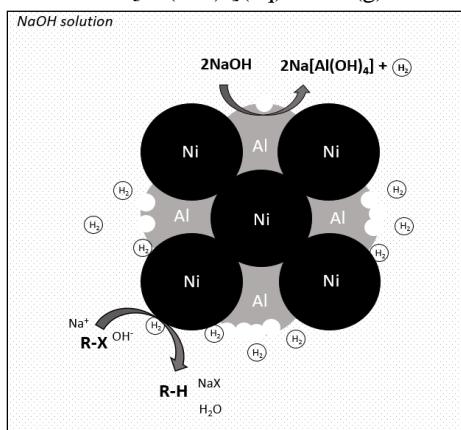
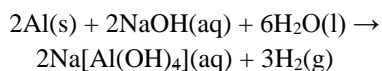


Fig. 1. Principle of catalytic dehydrogenation.

The proposed technology was subsequently applied for degradation of halogenated organic substances directly in contaminated waters under ambient temperature and atmospheric pressure. For purpose of verification, a special technological device (Figure 2) for water treatment in large volumes was constructed and verified on model water samples as well as on a wide range of real waters (industrial wastewater, groundwater, landfill water). In all cases, significant degradation of all monitored halogenated contaminants, including even persistent forms, was observed within a few hours.

The use of Raney Al-Ni alloy for degradation of halogenated organic substances (AOX) directly in contaminated waters under alkaline conditions thus seems to be a very promising method especially for treatment of heavily contaminated waters.



Fig. 2. Technological device for on-site application.

Acknowledgements

This study was supported by the Ministry of Industry and Trade of the Czech Republic, project No. CZ.01.1.02/0.0/0.0/16_084/0009123.

Development and application of combined LDH-Biochar for removal of As and Sb from mine waters 2P35

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At present, a large number of sites is negatively affected by past mining activities in Slovakia and Czech Republic due to extensive extraction of rich mineral deposits. Despite some ongoing remedial measures including passive geochemical barriers in old mining areas, mine water remediation is not the main priority of environmental policy. To prevent the risk of sediment and groundwater contamination caused by metals and metalloids in mine waters, new materials with large specific surface area, stability and adsorption capacity for both, cations and anions are used as an innovative remediation tool.

This study is focused on the production and optimization of the biochar derived from wood and modified by Mg-Fe layered double hydroxides synthesised from Fe sludge (LDH-biochar). In addition, the application of this new material is tested for removal of As and Sb from mine waters in Slovakia. Production of LDH-biochar consists of two steps: acid hydrolysis of dried Fe-rich sludge to extract Fe for LDH synthesis purposes and LDH co-precipitation on the biochar surface as a carrier under alkaline conditions [1].

Textural analysis, morphology and structural characterization of Mg-Fe LDH-biochar have been performed to optimize the synthesis of LDH-biochar. Removal efficiency of LDH-biochar for As and Sb

has been tested in the laboratory using batch kinetic experiments as well as fixed bed column experiments in the continuous flow. Material has been tested for mine waters, which were collected from outflows from old adits (pH 7-8) containing elevated As and Sb concentrations (up to 1500 µg/L for both elements). Moreover, transportable columns technology has been used in the field application of LDH-biochar for post-cleaning of local mine water sources near the abandoned Sb deposits in Slovakia.

Well removal efficiency of LDH-biochar, reaching up to 100% and 40% for As and Sb, respectively, has been confirmed by kinetic experiments (LDH-biochar quantity of 1g/L, 24 hours). Shape of the breakthrough curve in the continuous flow column experiments strictly depends on experimental parameters (e.g. mass of LDH-biochar, flow rate). LDH-biochar was also more effective for As under dynamic conditions which was reflected in the results of the field experiment. In general, technology of coupled columns has worked as a complex system which was able to remove 80% of As and 26% of Sb from 4000 L of the overflowed mine water. Technology was proved suitable for remediation companies or municipalities to remediate point water sources of pollution using various powder materials with efficiency for a wide range of pollutants.

Acknowledgements

This work was supported by the Technology Agency of the Czech Republic (program Zéta, grant number TJ01000015).

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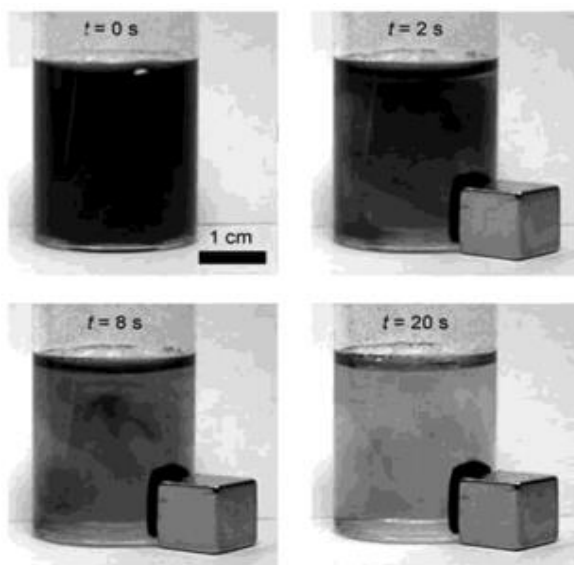
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Comparison of two magnetised carbonous adsorbents for removal of arsenate from groundwater 2P36

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The contamination of drinking water by arsenate, As(V), has been shown to present a serious risk for public health in many regions of the world [1]. Among the various techniques available for the removal of As(V) from water, adsorption is considered to be one of the most promising [2] and several biomass-based magnetic adsorbents have been synthesised and applied to As(V) removal in recent years [3]. Magnetic iron-rich adsorbents have many advantages as As(V) has a high affinity for Fe in solution under certain conditions. In addition, these materials may be used in, and recovered from, slurry reactor systems through the application of a magnetic field.

In this study, two magnetic iron-rich carbonous adsorbents were compared for the removal of As(V) from aqueous media. Activated carbon derived from plum kernels (MPS) and biochar derived from garden waste (MBS) were magnetised through pre-coating carbonisation/pyrolysis with iron chloride. Resultant materials were characterised using Scanning Electron Microscopy, Energy-dispersive X-ray Spectroscopy, Fourier-transform infrared spectroscopy, pH_{pzc} and Brunauer, Emmett and Teller techniques (S_{BET}).

The iron nanoparticle enriched adsorbents were tested for their ability to remove As(V) from solution using batch experiments under variable conditions: pH (2-9), adsorbent dose (10-200 mg), contact time (5-1440 min), initial As(V) concentration (0.1-100

mg/L) and presence of co-existing anions (PO_4^{3-} , SO_4^{2-} , NO_3^- , Cl^- and CO_3^{2-}) to simulate environmental groundwater samples.

Under optimal conditions removal efficiencies of 67% for MPS and 99% for MBS were recorded. Kinetic experimental data best fitted a pseudo-second order model, and multiple diffusion steps appeared to limit mass transfer of As(V). Among the models evaluated, the Langmuir model best described the experimental data with high correlation coefficients ($R^2 \approx 0.99$) for both adsorbents. Monolayer adsorption capacities were found to be 4.34 mg/g and 8.66 mg/g for MPS and MBS, respectively. Instrumental characterisation and pH studies suggested that the adsorption mechanism involved interactions between As(V) and positively charged surfaces due to electrostatic interactions (outer sphere-), and ligand exchange (inner sphere complexation) with functional groups. The degree of influence of co-existing anions on As(V) adsorption decreased in the following order: $PO_4^{3-} > CO_3^{2-} > SO_4^{2-} > Cl^- > NO_3^-$. PO_4^{3-} strongly inhibited As(V) adsorption and reduced removal efficiency by 50%. The higher pH_{pzc} (9.1), removal efficiency ($\approx 99\%$) and lower S_{BET} (8.89 m^2/g) for MBS, compared with MPS (5.0, 67% and 146.6 m^2/g , respectively), suggested that surface chemistry is a more important parameter as compared to porosity and surface area (of the adsorbents).

These results indicate that MBS is a more efficient adsorbent and can, with further studies, be potentially applied to As(V) contaminated groundwater treatment.

Acknowledgements

The authors thank Dr Luke Beesley (James Hutton Institute) for providing the raw biochar.

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Separate extraction of iron and aluminium from Acid Mine Drainage (AMD) wastewaters

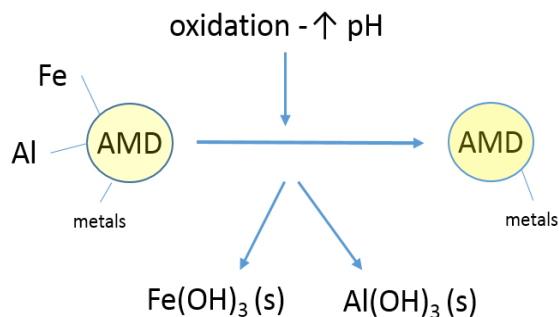
2P37

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Acid mining drainage (AMD) are the outflow of sludge and waters lixiviated from mineral mining processes, residual dumping dams and mining galleries.

AMD waters are usually highly acidic, contain high concentrations of sulphate, and dissolved metals. Traditionally, they have been discharged directly into rivers but nowadays, different methodologies to eliminate the main contaminants has been studied.

Fe and Al ions are usually at very high concentration on AMD and could be a potential source of these metals that deserves be studied [1].

In this work, the separation of Fe and Al from some AMD waters from then Pyrite Belt of the SW Iberian Peninsula is studied to obtain pure separated metals.

The AMD studied are from the Rio Tinto river area. Three AMD waters were tested: Cueva de la Mora waters (CM) with low Fe and Al content (42 and 121 mg·L⁻¹, respectively), Tharsis (Th) waters, with a medium content (734 mg·L⁻¹ of Fe and 237 mg·L⁻¹ of Al), and Peña del hierro (PFe) with a very high content of metals (28490 mg·L⁻¹ of Fe and 3104 mg·L⁻¹ of Al).

The sequential extraction of Fe and Al treatment is based on metal oxidation and pH modification [2-4]. Different combinations of these reactions were studied to obtain separated precipitates of Fe(III) and Al(III). Results determined that the optimal procedure for iron and aluminium separation from AMD is:

- oxidation with H₂O₂ to oxidize Fe(II) to Fe(III).
- addition of NaOH to reach a pH 3.5, followed by a decantation and filtration to separate Fe(III).

c) addition of NaOH to reach pH 5, followed by a decantation and filtration to separate the Al(III).

Results showed that the procedure allows to obtain very pure precipitates of Fe (III) and Al (III) from the AMD waters with medium and low Fe and Al content (CM and Th). On the contrary, a co-precipitation of Fe(III) and Al(III) occurs at pH 3.5 in high metal content AMD samples (PFe), even though a total separation of Fe (III) occurs at this pH. After reaching pH 5, 99.9% of the remaining Al(III) ions in solution are separated from AMD.

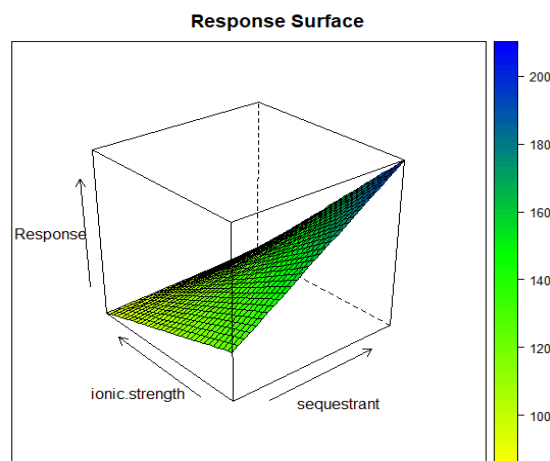
		Fe extracted	Al extracted
CM water	initial	42.5 mg·L ⁻¹	120.8 mg·L ⁻¹
	pH 3.5	96%	< 5%
	pH 5	< 5%	98%
Th water	initial	734 mg·L ⁻¹	237 mg·L ⁻¹
	pH 3.5	99.1%	< 5%
	pH 5	< 5%	98.5%
PFe water	initial	28490 mg·L ⁻¹	3104 mg·L ⁻¹
	pH 3.5	94.5%	51.8%
	pH 5	< 5%	99.9%

Acknowledgements

This research was funded by the Spanish Ministry of Science and Innovation as part of the project CTM2015-68859-C2-1-R (MINECO-FEDER). Hanne Rousere grant was financially supported by a fellowship from ERASMUS 2018-2019

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Optimization of the sequestering ability of modified polymer inclusion membranes (Pims) towards Sn(II) in aqueous solution**2P38****C. Bretti¹, P. Cardiano¹, C. De Stefano¹, C. Foti¹, O. Gomez-Laserna^{2,*}, G. Lando¹**¹*Dipartimento CHIBIOFARAM, University of Messina, Messina, Italy*²*Department of Analytical Chemistry, University of the Basque Country (UPV/EHU), Bilbao, Spain***olivia.gomez@ehu.eus*

The employment of polymeric membranes to afford a wide range of energy- and environmental-related applications has attracted both research and industry. Among them, Polymer Inclusion Membranes (PIMs) have been investigated to produce materials with appealing properties in fields such as separation science, sensors, water treatment, while featuring cost competitiveness and ease of processability. PIMs are usually composed by a polymeric matrix, i.e. PVC or CTA (polyvinylchloride or cellulose triacetate), an extractant (a carrier) and a plasticizer and/or modifier. Such a simple chemistry may be finely tuned to gain membranes able to exert selective pollutants extractions with high efficiency, avoiding the environmental issues of organic solvents use. Bearing this in mind, this work has been focused on the synthesis of PIMs and surface modified PIMs able to exert sequestering properties towards Sn^{2+} . For this purpose, several PIMs were prepared, containing different amounts of PVC and CTA as polymeric matrix, Aliquat 336 or Alicy as plasticizers, and Thiomalic acid (SMAL) or montmorillonite modified with a thiolic group as extractants. In this last case, the use of a compatibilizing agent 3-aminopropyltriethoxysilane (APTES) was necessary to anchor the inorganic montmorillonite with the organic matrix of the polymer. The aim of this double approach is to obtain membranes where the extraction of the metal can be connected either to its diffusion within the bulk of the membrane or to a specific interaction with the functionalized surface. The composition of PIMs and the solution in which test

their sequestering ability were selected with a D-Optimal experimental design, with a total of 9 factors, 6 of which are 3-levels and 3 are 2-levels. The maximum number of experiments was kept to 30, while the optimal number resulted to be 16. The sequestering ability of the PIMs was evaluated in a aqueous solution of Sn(II) 1 ppm (also containing ionic medium and inorganic acid) by differential pulse – anodic stripping voltammetry. The PIMs was immersed directly into the electrochemical cell, thus allowing to collect a scan every two minutes and to profile the absorption kinetic in one hour. The kinetics were fitted to a first-order model, determining Q_e (the amount of tin extracted at the equilibrium) and K_1 (kinetic constant). All the tested membranes were characterized by means of static contact angle measurements, tensile module, thickness and Raman investigations. The surface functionalization of the PIM increased the Q_e of the membrane, indicating that the interaction between the solution of the PIM occurs through a surface configuration rather than the bulk of the material. In this light, the use of more rigid CTA-based membranes is better than the use of more elastic PVC-based membranes.

As regards the ionic liquid, Alicy seems to improve Q_e and this can be attributed to:

1. better interaction with APTES in the functionalization step,
2. interaction with metal cation through the P-OH site.

Alicy makes the membrane less hydrophilic than Aliquat, while remaining within the hydrophilic membranes. The average value of the contact angles of the membranes containing Alicy (74°) is almost exactly twice that of the membranes containing Aliquat (36°), as can be expected from the composition of these ionic liquids.

Acknowledgements

Author thank University of Messina for funding ("Research & Mobility" 2017). O. Gomez-Laserna wishes to acknowledge project PHETRUM (CTQ2017-82761-P) from the Spanish Ministry of Economy and Competitiveness (MINECO) and the European Regional Development Fund (FEDER).

Thermodynamics of interaction between risedronic acid and metal cations: 2P39 investigations in solution and in the solid state

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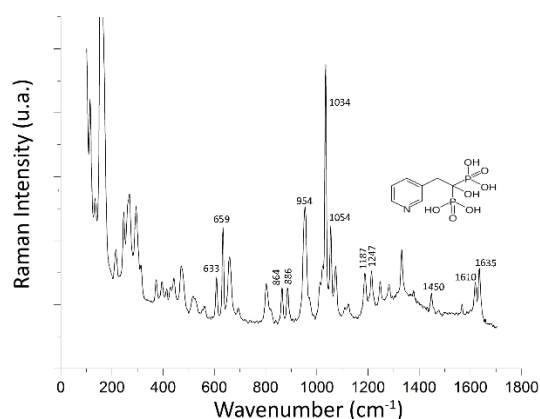


Fig. 1. Raman spectra of risedronic acid.

Risedronic acid (see Figure 1) belongs to the class of biphosphonates (BP), widely used in the medical field to treat bone disorders. Bisphosphonates (BPs, e.g., alendronate, risedronate, and ibandronate) help to maintain bone mass, to inhibit osteoclast-mediated bone resorption, and to reduce the risk of both vertebral and non-vertebral fractures. The clinical efficacy of BPs is mainly based on two key properties: their capacity to strongly bind hydroxyapatite crystals of bone, and their inhibitory effects on osteoclast precursors and mature osteoclasts. Interaction of risedronate with metal cations is poorly investigated. Qualitatively, it is indicated that adsorption of risedronate is inhibited when the drug is taken with mineral water containing high levels of calcium or magnesium, but chemico-physical results are missing. In this work, the interaction of risedronate with Ca^{2+} , Cu^{2+} , Pb^{2+} and Zn^{2+} is investigated by means of potentiometric and calorimetric measurements to determine thermodynamic parameters (ΔG , ΔH and $T\Delta S$). The most important species resulted to be the M_2L and variously protonated MH_iL (with i from 0 to 2) depending on the specific metal cation considered. During all the measurements, the formation of a sparingly soluble species has been noted starting from very acidic pH values (~ 3.5). Thus, four solid samples have been properly prepared and

characterized by means of a combination of spectroscopic techniques (μ -XRF, XRD and Raman) and thermal analysis (TG-DTA). In addition, the solubility of these compounds has also been determined by the shake-flask method followed by differential pulse-anodic stripping voltammetry at different NaCl concentrations, to determine Setschenow and activity coefficients. Preliminary results show that the solubility of lead and copper risedronate increases with chloride concentration, probably due to the formation of chloro complexes with Pb^{2+} and Cu^{2+} .

The combination of several analysis suggests the following conclusions:

- the insoluble species seems to be M_2BP ;
- the role of water is still under question;
- the coordination seems to involve only the phosphonic groups, rather than amino one.

Acknowledgements

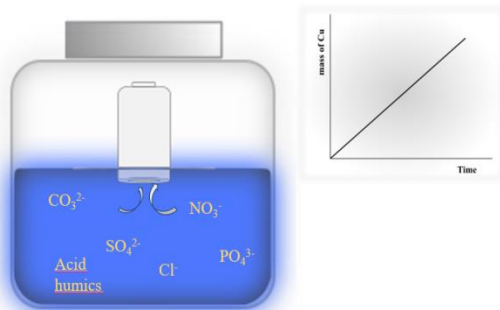
Authors thank University of Messina for funding ("Research & Mobility" 2017). OGL wishes to acknowledge IT1213/19 (GIC18/118) from the Basque Government.

Influence of inorganic anions and humic acids in the passive sampling of Cu (II) with a polymer inclusion membrane (PIM) device

2P40

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Speciation of metal cations in aquatic environments are strongly dependent on the inherent parameters of the medium where they are found, e.g. the pH, redox conditions, temperature and ligands [1]. In this sense, the bioaccumulation and toxic effects to living organisms due to the exposure to metals is related not to the total metal concentration but rather to the specific form, particularly to the free fraction.

Two models have been extensively described for the description of the metal uptake from living organisms: the free ion activity model (FIAM), which uptake from an organism is proportional to the metal free ions in the medium; and the biotic ligand model (BLM) which suggest the competition of cations and protons at the surface of the biological membrane. Nonetheless, exceptions to those models under specific conditions arise [2], suggesting that other species like metal complexes can contribute to the uptake and not only the free form. In this sense, inorganic and organic (as humic acids) can play an important role in speciation and toxicity, mobility and bioavailability in aquatic systems due to changes of biological, and physicochemical properties of the metals [3,4].

Under specific conditions metals might form species (with inorganic or organic ligands) which might be capable of freely diffuse in a passive way through biological membranes making necessary the understanding of those complex species.

Polymer inclusion membranes (PIMs), are synthetic semipermeable barriers originally designed for metal transport and separation; they consist of a carrier, an extractant agent responsible of the metal extraction and transport through the membrane; a base polymer, to confer mechanical strength to the material; and

a plasticizer to make the material less rigid favoring the metal transport. However, they have recently been proposed as materials for passive sampling [5] (a technique based in the free flow of an analyte from a sampled medium to a receptor phase). Passive sampling is a technique focused on the monitoring of contaminants in different compartments (e.g. air, water and soil) and the estimation of their levels without affecting their equilibria. The aim of this work was to evaluate a PIM-passive sampler for the monitoring of Cu and to determine how the presence of inorganic and organic ligands, in different levels of concentration, can affect the process of the passive sampling process and the prediction capacity of the system. The evaluated ligands are: CO_3^{2-} , NO_3^- , Cl^- , SO_4^{2-} , PO_4^{3-} and humic acids.

Acknowledgements

The authors acknowledge Ph.D. grant of R.G.A. and financial support from PAPIIT IN229219 project of the Dirección General de Asuntos del Personal Académico (DGAPA-UNAM). They also thank Q.F.B. María Guadalupe Espejel Maya for technical services.

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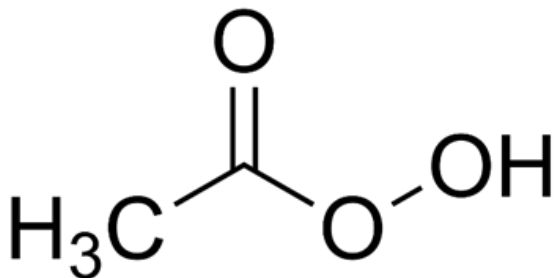
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Studies on kinetics of degradation of some endocrine disrupting compounds by UV activated peracetic acid 2P41

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Peracetic acid (PAA) is a colourless organic liquid with pungent odor. It is well soluble in water, sulfuric acid (VI), acetic acid, ethyl alcohol, diethyl ether, chloroform, benzene and others. It is characterized by high oxidizing potential $E^0=1.960\text{V}$ [1]. Peracetic acid exhibits high biological activity and as such it is frequently used for sterilization purposes [2]. Its commercially available form is an equilibrated mixture of PAA, H_2O_2 , acetic acid, water and stabilizers [1].

The aim of this work was to study the kinetics of degradation of selected endocrine disrupting compounds (EDC) by peracetic acid (PAA) activated by simulated solar radiation. The kinetics of degradation process of benzophenone, 4-n-octylphenol, 4-n-nonylphenol, 3-(4-methylbenzylidene)camphor endosulfan I, endosulfan II, oxybenzene, bisphenol A, diethylstilbestrol and estrone by PAA has been studied. The influence of matrix on the degradation rate has been checked. The experiments have been done using laboratory mixture of studied EDCs and solutions with raw wastewater or purified wastewater as a matrix. The quantification of studied compounds has been done by GC-MS technique after isolation using ultrasound-assisted emulsification-microextraction [3].

At the first step of study, the concentrations of peracetic acid, hydrogen peroxide and sulfuric acid were optimized using experimental design approach [4]. The following conditions were selected: concentration of peracetic acid: 10.5 mg/L, pH 6 and concentration of H_2O_2 : 25 mg/L. Using optimal conditions, the kinetics of degradation of EDCs under study was examined. It was found that the examined processes meet the first order kinetics model. The run of reaction with peracetic acid without light was studied first. After 90 minutes, a reduction in the concentrations of tested compounds in the range of 50-95% was found. Bisphenol A, 4-n-octylphenol,

diethylstilbestrol, and estrone appeared to be the most resistant. The only 50-67% decrease in their concentration was observed after 90 minutes of reaction. In order to increase the rate of reaction peracetic acid - examined EDCs, the simulated solar light was used as activation agent. The significant acceleration of degradation rate was observed. The decrease in concentration of studied organic pollutants in the range 73-99% was noted. No significant changes in removal efficiency was observed for endosulfan I and camphor. After 90 minutes, their concentration was found to fall by 57% and 61% respectively.

The kinetics of degradation EDCs by PAA in the presence of natural matrix was checked. For this purpose samples of raw and purified wastewater were used. It was found that the presence of matrices decreases the rate of degradation of studied EDCs. A reduction of approximately only 50% in concentrations was observed for most of studied compounds with exception of diethylstilbestrol and 4-n-nonylphenol (82 and 78%, respectively). At the same time, an increase in pollution parameters such as COD and BZT5 was observed after reaction with PAA.

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Ni-Pd catalysts for hydrogenation of levulinic acid and hydroxymethylfurfural towards value added chemicals

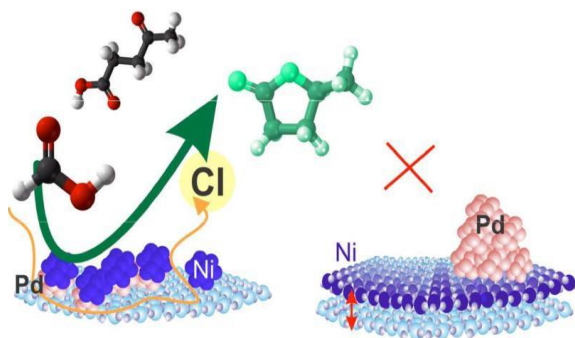
2P42

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Biomass is considered as a very promising feedstock due to its abundance and availability. In particular, lignocellulosic waste material have recently undergone extensive research in the field of renewable and sustainable resources for the production of high-value chemicals and liquid fuels [1]. Two of the most promising intermediates considered as platform molecules that can be derived from the hydrolysis of cellulose in particular from the dehydration of C-6 carbohydrates, are hydroxymethylfurfural (HMF) and levulinic acid (LA). Its further hydrogenation can provide value added molecules. LA hydrogenation gives γ -valerolactone (GVL) which can be used as a fuel additive, solvent, liquid fuel and a precursor for the production of valuable chemicals [2]. 5-hydroxymethylfurfural (HMF) can be converted into 2,5-bis (hydroxymethyl) tetrahydrofuran (BHMTTHF) which can be used as a green solvent or as an intermediate for pharmaceuticals production or possibly even for the production of polyamines such as nylon-6 [3].

In our work we developed series of Ni-Pd materials having different ratio of metals and tested them in the both HMF hydrogenation with external hydrogen source and LA hydrogenation with FA as hydrogen source. In our study we focused on materials supported on alumina. Supports with a high isoelectric point such as γ -Al₂O₃ promote the hydrogenation of the HMF ring allowing the BHMTTHF formation. Additionally, we evaluated the influence of chlorine for the Ni-Pd interaction and propose the key factors having role in the hydrogenation of both investigated bioderived

chemical molecules.

The highest activity in both reactions was observed for the 4%Ni-1%Pd(Cl)/ γ -Al₂O₃ catalyst. The high catalytic activity was related with the synergistic interaction of Ni-Pd. The addition of a small amount of Pd (1%) to 4%Ni reduced the affinity of nickel to alumina, which prevents the spinel formation. Consequently, the number of CO adsorption centers on nickel crystallites increased (which can be seen in the FTIR study), additionally the acidity of the catalyst (NH₃-TPD) increased as well. In addition, another factor that weakens the interaction of nickel with the support is presence of residual chlorine introduced from the palladium precursor, which facilitates reduction of Ni (TPR), improves dispersion of both metals and additionally increases contact between Ni and Pd particles (ToF-SIMS, TEM, EDX) [4].

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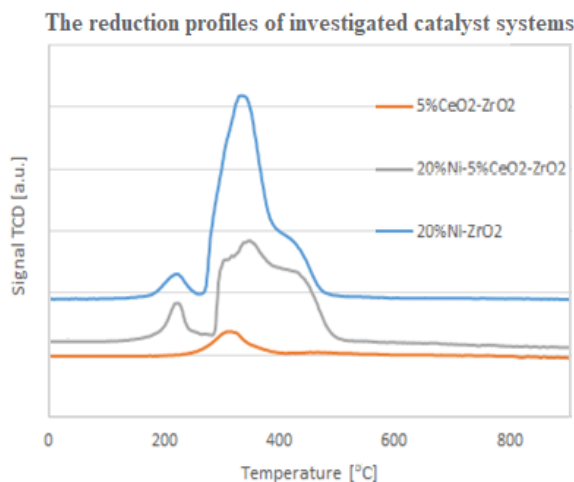
The project was financed by the National Science Center as part of the SONATA BIS project (UMO-2016/22/E/ST4/00550)

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Nowadays, the use of alternative fuels leads to replace of fossil fuel resources. Many research centers are conducting research to develop alternative fuels, that will allow to become completely independent of fossil fuels. One of the possible solution and option is hydrogen, which can be obtained from natural gas reforming process. In addition, this kind of fuel is considered as one of the purest and harmless to the environment. The industrial method of producing hydrogen is steam reforming of natural gas which run in the temperature range 700-900 °C in the presence of methane and water vapor. According to the literature, nickel supported catalysts exhibit high activity and selectivity and are much cheaper compared to the noble metals based catalysts. Although a lot of works concerning nickel catalysts used in the natural gas reforming process, attempts are still being made to improve their catalytic properties in the investigated process.

The purpose of this work was to determine the correlation between the physicochemical properties of nickel catalysts and their reactivity in the CH₄ and LNG oxy-steam reforming reactions. In addition, the effect of structural promoters like La₂O₃ and CeO₂ on the catalytic activity of Ni systems was also investigated. In order to achieve the intended goal of the presented work, nickel catalysts with different nickel loading (5%, 10%, 20%, 30% wt. of Ni) supported on ZrO₂ or on modified ZrO₂ by CeO₂ or La₂O₃ were prepared by impregnation method. Their physicochemical properties were determined using the following research techniques: TPD-NH₃, TPR-H₂, XRD, BET, SEM-EDS and ToF-SIMS. The catalytic

activity tests of the prepared catalysts in CH₄ or LNG reforming process were studied under atmospheric pressure using fixed-bed microreactor. The reactivity measurements showed that the Ni systems starts to works at 400°C and achieve 100% of LNG or methane conversion at 900°C. The analysis of the products formed during the process showed the formation of CO, H₂ and small amount of CO₂ in products leaving the reactor. The catalytic tests performed for the prepared catalysts showed that the most active catalyst was 20%Ni/ZrO₂ system which exhibited the highest activity and selectivity towards hydrogen formation. The catalytic activity tests performed in the studied LNG reforming process at 400°C on 20%Ni/ZrO₂ catalyst showed the conversion of methane, ethane, propane and butane equal 19%, 25%, 37% and 100%, respectively. Increasing of the reaction temperature to 500°C confirmed the 100% conversion of ethane, propane and butane and about 46% of methane. Further increasing of the reaction temperature result in increase of the methane conversion to the value of 46% at 500°C, 77% at 600°C, 98% at 700°C and 100% at 900°C. An important result is also the fact that the ratio between hydrogen and carbon monoxide obtained in the studied reaction at high temperature was about 2. This ratio allows the direct application of the generated syngas to use in other chemical processes, including for example Fischer-Tropsch or higher alcohols synthesis.

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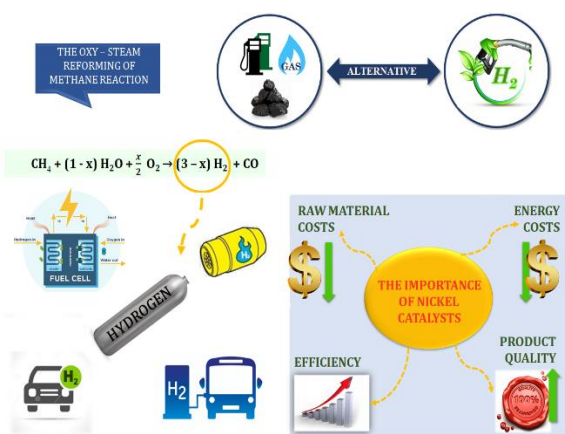
The work was partially funded by the National Science Centre within the “OPUS” Programme, Poland (Grant no. 2018/29/B/ST8/01317).

Hydrogen production via oxy - steam reforming of methane and LNG on nickel catalyst systems

2P44

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The use of fossil fuels for energy supply has a negative impact on the environment, causing the emission of harmful oxides into the atmosphere. The harmful gasses emission is responsible for the smog and the greenhouse effect [1]. In addition, constitute very serious risk to human health. The sources of this energy are non-renewable and their continuous exploitation leads to their total exhaustion in the near future. The challenge is to obtain energy from the safe and renewable sources. Hydrogen is an alternative to fossil fuels. It can be future fuel because it is an environmentally friendly source of energy. The hydrogen combustion generates large amounts of heat and the only products of this process are water vapour. Besides, the sources of hydrogen are practically inexhaustible. Literature proves that the use of hydrogen to power fuel cells is one of the most effective and environmentally friendly technologies of transforming chemical energy into electricity, which does not generate pollution. The potential source of hydrogen may be methane or liquefied natural gas (LNG).

Hydrogen production can effectively occur in the oxy – steam reforming of methane or LNG reactions. Both processes were carried out using nickel catalysts supported on binary oxides ($\text{CeO}_2 \cdot \text{Al}_2\text{O}_3$, $\text{ZrO}_2 \cdot \text{Al}_2\text{O}_3$, $\text{ZnO} \cdot \text{Al}_2\text{O}_3$) prepared during realization of this studies [2, 3]. The main goal of the presented work was to evaluate the physicochemical and catalytic properties of monometallic nickel supported catalysts. In addition, we also correlated the physicochemical properties of the catalytic systems with their activity in oxy - steam reforming of methane and LNG reactions. The physicochemical properties of the catalytic materials were studied using various

techniques such as: XRD, BET, TPR-H₂, TPD-NH₃ and SEM-EDS. Obtained results showed that the acidity, reducibility and composition of the catalysts were the main factors which influence on the reactivity of studied systems in oxy - steam reforming of methane and LNG process. The catalytic activity tests performed in oxy - steam reforming reactions showed that the values of methane and LNG conversion increase with increasing of the reaction temperature.

Acknowledgements

The work was partially funded by the NCN within the “OPUS” Programme (Grant no. 2018/29/B/ST8/01317) and the Lodz University of Technology within FMN programme (No W-3D/FMN/13G/2019). Magdalena Mosinska thanks the Lodz University of Technology for a scholarship (WFS PL programme, Nr RNN/WFS/25/2018).

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Liquefied natural gas is pure gas containing mainly methane, ethane, propane, butane and nitrogen. This very clean, colorless and odorless mixture is obtained without toxic and corrosive properties. Purified LNG has a volume of about 600 times smaller than in the gaseous state, which makes it more economical to transport and storage and can become a source of the future energy. It can be used for syngas generation and further via Fischer-Tropsch^{1,2, 3} synthesis may be potentially applied for valuable hydrocarbons generation. Another advantage of the use of LNG as a source of hydrogen^{4, 5} is the fact that it is possible to receive liquefied natural gas from marginal or waste sources of methane from sources with relatively low methane content (e.g. mines, landfill, with cattle farms), what will benefit for the environment due to the limitation of corrosive gases emissions into the atmosphere. On the other hand the use of liquefied natural gas (LNG) to produce hydrogen, allow powering fuel cells used in vehicles, mobile or stationary devices. The obtained hydrogen can be used to power Solid Oxide Fuel Cell (SOFC) to generate electricity. The production of hydrogen from reforming of LNG process with high yield requires highly active and selective catalysts.

The realization of these two process requires application of various catalytic systems. Hydrogen production via reforming of LNG were realized using Ni catalysts. While, the high pressure hydrogenation of CO process enforces the usage of high active iron supported catalysts. Fisher-Tropsch synthesis was performed on iron catalysts supported on various supports and the activity results confirmed the possibility to obtain high CO conversion with high selectivity towards

liquid hydrocarbons, which are components of driving fuel. The physicochemical properties of the investigated catalysts were also extensively studied using following techniques: TPR-H₂, TPD-NH₃, XRD, ToF-SIMS, BET, SEM-EDS. The activity tests in the studied processes depending on the type of reaction were done under atmospheric or elevated pressure using fixed bed reactor. The correlation between the obtained activity results and the physicochemical properties of the investigated catalytic systems was found. The obtained results confirmed the validity of the conducted research and

the possibility of application of the investigated catalysts for the industrial purposes.

Acknowledgements

This work was partially funded by the National Science Centre within the "OPUS" Programme, Poland (Grant no. 2018/29/B/ST8/01317) and from NCBiR - Grant no. BIOSTRATEG2/297310/13/NCBiR/2016.

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Civilization development contributes directly to environmental pollution caused by the overexploitation of fossil fuels. One possible solution to this problem is production of energy using fuel cells powered by hydrogen produced via reforming process of a natural gas. The use of hydrogen leads directly to reducing greenhouse gas emissions to the atmosphere in highly urbanized cities. Fuel cells due to their high efficiency, durability and reliability can potentially contribute to the rapid development of the various industries. Currently, hydrogen is produced by steam reforming of methane [1, 2]. In the first stage of this process nitrogen and sulphur compounds are removed. The second stage involves proper steam reforming process. Due to the above, it is difficult to obtain hydrogen in the direct process of steam reforming of natural gas. An alternative is the production of hydrogen via reforming process of LNG which is a mixture of methane, light hydrocarbons (ethane, propane, butane) and nitrogen. After the condensation very pure, colourless and odourless fuel is obtained without toxic and corrosive properties. Purified LNG is more economical to transport and storage and may be a source of the future energy.

The main aim of this work was to determine the effect of Ni content and support composition on the physicochemical and catalytic properties of nickel supported catalysts for the oxygen-steam reforming of LNG or methane processes. In order to achieve the main goals of the presented work, nickel catalysts supported on mono- and binary oxides systems were prepared by impregnation method and tested in oxy-steam reforming of methane or LNG process. Their physicochemical properties were extensively studied by BET, TPR-H₂, TPD-NH₃, XRD, SEM-EDS and XPS techniques. Catalytic tests in the oxy-steam reforming of methane or LNG were investigated using fixed bed micro-reactor under atmospheric pressure in the temperature range 400-900°C. The catalytic activity tests carried out in the studied processes showed that Ni catalysts supported on binary oxides showed higher activity compared to the Ni catalysts deposited on mono-oxides carriers. The reduction studies performed for the investigated systems showed that their reducibility depend on the type of support and the Ni loadings in the catalytic systems. The catalytic activity measurements performed in oxy-steam reforming of methane have shown that

almost all systems showed 100% conversion of methane. On the other hand the analogical catalytic measurements performed in LNG reforming process showed similar results. The analysis of the products formed during the reaction gave evidence that methane conversion was also 100% at 900°C. It should be also noted that the reactivity tests carried out in the temperature range 400-900°C showed that the reaction starts to run at 400°C in which we observe incomplete conversion of LNG components. The most active system among of all Ni systems was 5%Ni/CeO₂-La₂O₃ (2:1) system which exhibited high methane conversion equal 97% and 100% at 700 and 900°C, respectively. This catalytic system showed also high selectivity towards hydrogen production. It is also worth to notice that the high molar ratio of H₂/CO equal about 2 in the outlet gas mixture was confirmed. The catalytic tests performed in oxy-steam reforming of methane process showed that the increasing of the amount of lanthanum in the catalytic systems leads to decrease of the activity. The presence of LaNiO₃ in the case of the Ni catalyst was confirmed by the XRD and ToF-SIMS measurements. In addition, the formation of interaction between active phase and support components and also between the carrier components were also detected using ToF-SIMS technique. Obtained results confirmed that new energy production technologies based on liquid natural gas may become an alternative to fossil fuels. All of the remaining above suggestions confirm the validity of hydrogen production via oxy-steam reforming of LNG. Obtained results will contribute to the development of various types of materials based on binary oxide, which can be used in a variety of industrial applications.

Acknowledgements

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The ecological technology of fuel production - the impact of porosity of ZSM-5 zeolites modified by nickel on catalytic activity into hydrocracking of algal oil for Bio-Jet fuel production 2P47

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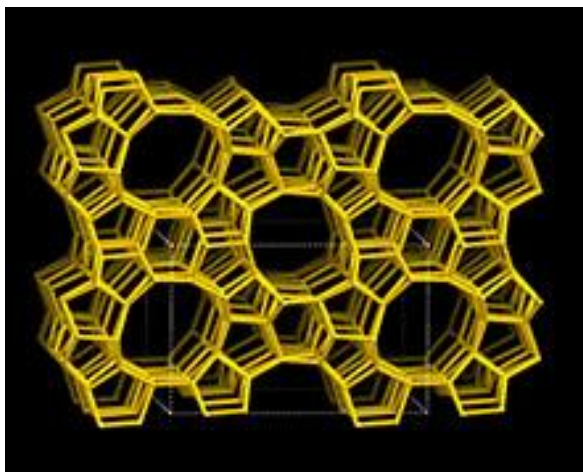


Fig. 1. ZSM-5 zeolite structure [1].

Because the availability of non-renewable sources of fossil fuel is limited and they are slowly running out the scientists search alternative technologies of fuel production and their renewable sources. Moreover the airplanes travelling is more and more popular. Many people do not imagine the trip to farthest places of the world in other way than flying [1]. Today, people are rediscovering the environmental and economic benefits of making fuel from raw and used vegetable oils. The jet fuel can be obtained in catalytic hydrocracking of oil and it is called Bio-Jet fuel. As vegetable oil resources can be used: palm oil, soybean oil, sunflower oil etc. However these oils are also the food oils, what in the face of global hunger can be seen as disadvantage in their application in fuel production. This causes that scientists began to consider the use of algal oil as a source of fuel production. Despite of the knowing of 500 different kinds of algae, only 10 species is used as substrate in fuel production processes [2]. Catalytic hydrocracking process is usually carried out under high hydrogen pressure (5-30 Mpa) and at high temperature (260-400°C) with using acidic catalysts. The most popular metals used as hydrocracking catalysts are cobalt, nickel, molybdenum, platinum and palladium. Because the catalytic hydrocracking process demands using of bifunctional catalytic system, the various zeolites modified by transition

metals are tested. The ZSM-5, Y or molecular sieves can be mentioned as the most popular zeolite support.

In this work, the influence of the metal content (Ni) and the porosity and structure of NiZSM-5 zeolite catalysts on their catalytic activity in hydrocracking of two kinds of algal oil (Fucus Algae and Spirulina Algae) towards aviation fuel were investigated. Nickel-containing ZSM-5 zeolites were prepared by wet impregnation. The ZSM-5 zeolites with different Si/Al ratio (23; 50 and 280) and various specific surface area were used. The nickel containing in catalysts from 1-5 wt.% were presence. The physicochemical properties of NiZSM-5 were determined with using XRD, TPR, TPD and BET techniques. The hydrocracking process was carried out in autoclave at 260°C with hydrogen pressure 50 Barr for 2 hours. The oils composition and products of reactions were analyzed with using of liquid chromatography. Catalysts before the catalytic performance were reduced at 500°C for 1 h in hydrogen flow.

The results show that the best catalytic activity in hydrocracking of algal oil towards Bio-Jet fuel production was achieved for catalysts contained 5 wt. % of nickel based on ZSM-5 zeolite with Si/Al ratio equaled 50. It could be related to size of pore volume (0.14 cm³/g) and average pore radius (3.68 nm), which are similar to size of molecules of n-alkanes, which could be isomerized into zeolite channels.

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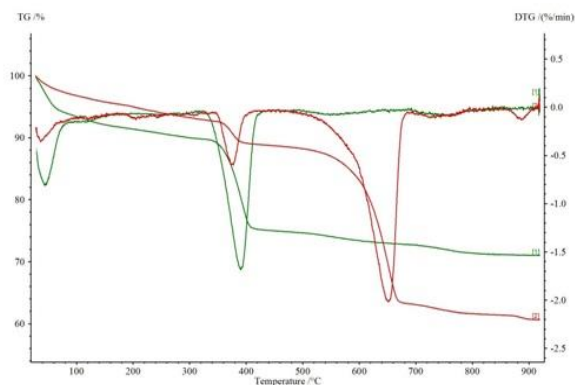
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Respiratory system plays a key role in anesthesiology due to delivery of oxygen and other anaesthetic gases to the patient as well as aiding in the removal of carbon dioxide. There are very important elements that feature in all anaesthetic breathing systems with numerous classification systems used. The layout of individual breathing systems determines their clinical application and use [1]. Carbon dioxide has an impact on the natural environment both in terms of its excessive emission to the environment and its participation in a closed cycle during anesthesia. In order to eliminate carbon dioxide and possible intoxication of the patient, carbon dioxide absorbers are used in a closed system. Under general anesthesia, mechanical lung ventilation with a high concentration of inspiratory carbon dioxide leads to lower consumption of fresh inspiration gases, inhalation anesthesia and soda lime but also to the formation of unwanted anesthetic compounds with absorbers [2]. In this paper we will discuss about thermal decomposition of two carbon dioxide absorbers containing soda lime preparations to remove carbon dioxide (CO_2) from the expired gas. The components of soda lime are calcium hydroxide (80%), water (15%), and two catalysts: sodium hydroxide (5%) and potassium hydroxide (<0.1%). Some types of soda lime lack potassium hydroxide. Silica is added to make the granules harder and more stable, which reduces alkaline powder formation (which could cause bronchospasm). Soda lime absorbs about 19% of its weight in carbon dioxide, hence 100 g of soda lime can absorb approximately 26 L of carbon dioxide. The ability of soda lime to absorb CO_2 is due specifically to NaOH. The neutralization of CO_2 involves a number of chemical reactions, during which heat is released and can

directly affect the properties of the anesthetics used. The thermal properties of these compounds in the solid state were studied using TG-DTG-DTA techniques under dynamic flowing air atmosphere using thermobalance NETZSCH TG 209 F1 Iris with heating rate 5 °C/min and temperature range 25-900 °C. These studies were performed to compare the thermal stability and durability of two absorbers and to determine intermediate and final thermolysis products.

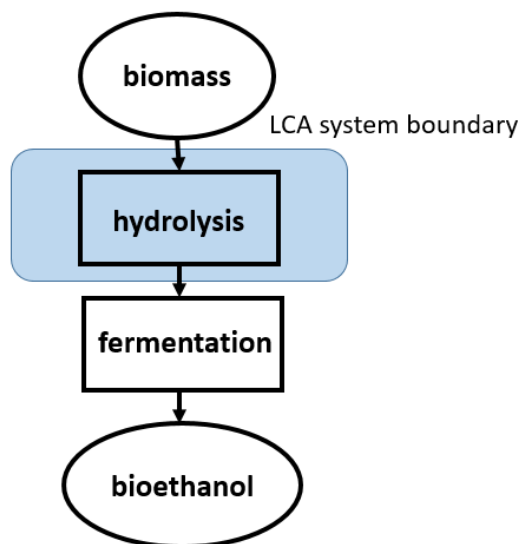
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The biomass is generally all organic matter on the Earth, i.e. all living and dead organisms. The biomass can be the result of agriculture production, but it can be also waste. Waste biomass is often used to produce bioethanol, especially sugar beet, sugarcane or corn and potatoes [1]. Chemically, it consists mostly of glucose, starch or cellulose. Sugar can be fermented directly into alcohol, but starch and cellulose has to be treated before fermentation. The most commonly used method is enzymatic hydrolysis with microorganisms. This process is time consuming, so other less demanding pretreatment ways are desirable. One of these is high temperature hydrolysis with dilute sulfuric acid. Other acids such as phosphoric acid, hydrochloric acid and another can be also used [2, 3]. It has been found that, after this treatment, the material is much better processed to bioethanol [4].

The time aspect cannot be the only one decision criterion in the choice of production process. A steadily deteriorating state of the Environment is the reason to look for environmentally friendly production processes. There are many approaches aimed at limiting or mitigating these negative effects including e.g. the Green chemistry concept [5] with some instruments for an evaluation of possible or real pollution as Life Cycle Assessment (LCA) etc. The LCA defined by international standards ISO 14040 [6] and 14044 [7] describes environmental impacts of technologies and products from a raw material

acquisition through production, use and disposal in categories as resource use, human health, ozone depletion, climate change, etc. [8].

The work is focused on the LCA comparison of environmental impact of cellulose hydrolysis. The “from the gate to the gate” LCA study is used to assess environmental effects of the hydrolysis of cellulose as the pretreatment step in bioethanol production. The effect of two hydrolytic agents nitric and phosphoric acids under two temperature levels with different time demands in laboratory conditions was compared. As a system boundary, the hydrolysis itself, was chosen for the functional unit one kilo of biomass (egg boxes from recycled paper). The evaluation of the environmental burden of individual procedures was based on the impact assessment phase carried out with the software GaBi (Thinkstep, Germany) with ILCD database using the TRACI methodology. Endpoint indicators as Global Warming Air, Acidification Air, Eutrophication, Ozone Depletion Air, etc. Significant issues found were discussed and commented.

Acknowledgements

Authors acknowledge the support from University of Pardubice Technology project SG FCHT 05/17 and SG FCHT 05/18.

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One of commonly used forms of product packaging is a pressure container. The consumable material is dosed under pressure using working gas. Currently, propane or butane, and less often carbon dioxide are the most commonly used propellants. These gases are flammable and pose a threat, especially in situations where a fully charged pressure container becomes a waste.

According to the European Aerosol Foundation (FEA), Europe is the largest producer of aerosol sprays. Following the 2017 FEA report, this is over 5.7 billion packages a year (in 16 billion worldwide). In 2017, Poland produced over 78 million units annually, which gives the 9th position among producers in Europe. The recovery of aerosol container materials is low. In Poland, it reaches 8.4% only in relation to the amount of materials used in the production of these containers, excluding the volume of the imported aerosol packages [1]. A complex structure of containers, involving many different materials is a reason. There is, therefore, a strong need for recycling and utilisation of the resulting waste in the form of empty containers or containers with different levels of the product and working gas filling, which has not been emptied as intended due to various reasons.

A review of patent databases has pointed to three solutions to the problem of pressure container utilisation, however none of them provides a complete and environmentally friendly technology for the utilisation and recycling of aerosol cans [2, 3, 5].

A group of scientists from the Lodz University of Technology and CSD-ECO Ltd. company have

developed a new solution and a method that allow for emptying packaging and recycling materials in an environmentally friendly way [4].

The presentation includes an overview of existing patents, a patented solution developed for the needs of this project [4], as well as results referring to the experimentally determined forces necessary to unseal various containers with puncturing elements of different geometry. A structure of the device for unsealing aerosol containers, which will allow one to conduct tests on the process, an amount of gases released, a composition of the liquid divided into light and heavy fractions, as well as the percentage of materials for recovery in the mass obtained from the process in the given installation will be shown as well.

Acknowledgements

The work has been performed under the project POIR.01.01.01-00-0850/17cofinanced by National Centre for Research and Development.

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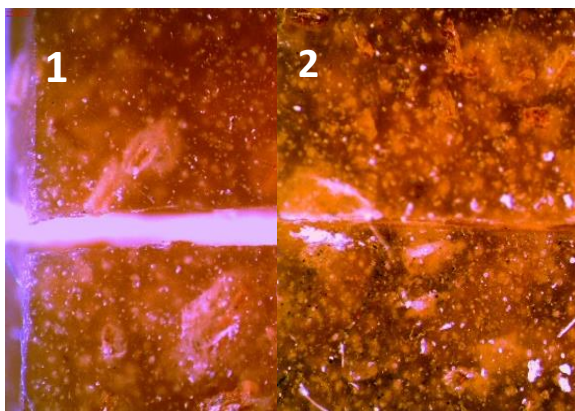


Fig. 1. ENR/cysteine/cellulose composite before (1) and after (2) healing process.

Epoxidized Natural Rubber (ENR) is a diene elastomer enriched with epoxy groups by controlled, chemical modification of Natural Rubber (NR) - one of the most popular natural polymers [1]. This environmentally-friendly material is characterized by enhanced adhesive properties and improved oil resistance in comparison to NR [2]. Good adhesion of ENR is mainly responsible for self-healing effect of the material.

Nowadays there is a huge interest in intelligent materials, especially self-healing polymers. These polymers are capable of reacting on destruction of their structure and rebuild it, thus lifetime of the materials is improved [3]. It is worth emphasising that creating such new materials should be compatible with sustainable development which concerns stable relationship between economic growth, protection of natural environment and care for social well-being [4].

Presented materials based on epoxidized natural rubber (ENR) containing aminoacids as curing agents and cellulose and silica as filler, seem to meet these requirements. Most of components used in presented materials are derived from renewable resources and they do not contribute to irreversible depletion of petrochemical reserves.

ENR is well known as a green material derived from natural resources [4]. Also cysteine, which was applied to the composite as a cross-linking agent, belongs to the biobased substances. The cellulose and silica in a role of fillers reveal pro-ecological character as well. Designed biobased composites exhibit intrinsic self-healing properties. The surfaces of damaged material are able to stick together and

rebuild after connecting them by a human without using any additional elements or substances. Thanks to this phenomenon, the mechanical properties of damaged materials are also partially restored after physical damage.

Presented composites were made by mixing process using micro-mixer and pressed via heating press. Prepared materials were researched in terms of mechanical properties. Obtained samples were also cut into two pieces which were left for 10 days connected to themselves. After this time, damaged sides became stuck together and their mechanical properties were partially restored.

The healing efficiency was calculated in the basis of equation $R(A) = A_{\text{after healing}} / A_{\text{before healing}}$ [6], where A means measured property of investigated material. Photographs of damaged and healed materials taken using an optical microscope confirm healing phenomenon of materials. The surface energy of obtained composites were also determined. Based on research, it can be concluded, that prepared materials based on epoxidized natural rubber containing cysteine, cellulose and silica are pro-ecological elastomers with self-healing ability.

Acknowledgements

This research was supported by Fund of Young Scientists Nr W-3D/FMN/24G/2018

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Lifetime prediction of polymeric materials, including aliphatic polyesters, in the basis of simulated aging processes

4P52

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Fig. 1. Samples of polyhydroxybutyrate (PHB) before and after 100 h, 200 h, 300 h and 400 h of the thermooxidative aging process at the temperature of 100°C.

The bio-based and simultaneously biodegradable thermoplastic are an alternative for conventional petrochemical polymers widely utilized in packaging industry. Applying “green” polymers, such as polylactide (PLA) and polyhydroxybutyrate (PHB) for variety of stuff, including single-used ones is much more environmentally friendly. Nevertheless, these materials are subjected to aging process during a usage, transport and storage [1].

Aging process concerns every type of material, including polymeric ones, which are exposed to many factors, such as oxygen, increased temperature, mechanical stress, UV radiation ect. These factors are responsible for chemical changes of structure as well as materials mechanical and physical properties deterioration. Thus, finally the products degrade and can not be used anymore [2].

Nowadays scientists work on polymers lifetime predicting which helps to determine safe polymer materials application in many fields of industry and human life. Thanks to this researches, composites durability in specific conditions and usage time of products made of these materials can be defined [3]. Lifetime of polymeric materials can be mostly estimated using accelerated aging processes at increased temperature conditions and/or utilizing higher radiation intensity. As a result of this research, the rate of material degradation in controlled conditions can be calculated. The time needed for obtaining degradation degree tantamount to materials

destruction is also possible to determine by using kinetic models [4].

The aim of this study was to estimate selected bio-based and biodegradable polymers lifetime, including polylactide (PLA) and polyhydroxybutyrate (PHB) in comparison to conventional and commonly utilized packaging material – polystyrene (PS). The kinetic models were used for this research. Extruded materials were aged by thermooxidation process in selected temperature and aging time conditions. The accelerated aging process in solar chamber was also conducted in selected periods of time. The impact of aging processes on selected polymer properties, including mechanical ones, contact angle, colour changing was characterised. The infrared spectrophotometric analysis was also conducted.

Acknowledgements

This study was supported by the National Centre for Research and Development (NCBR) project: LIDER/32/0139/L-7/15/NCBR/2016

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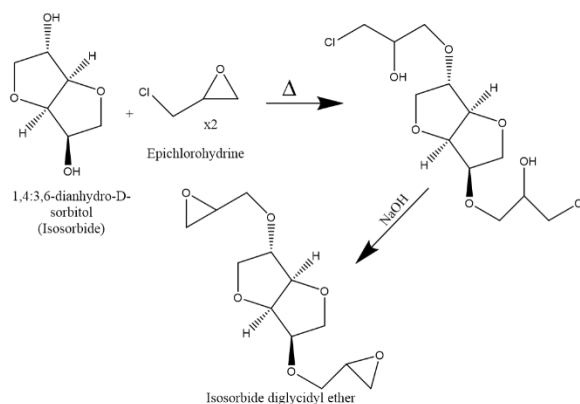
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Analytical assessment for the development of BPA-free epoxy precursors for stone conservation purposes

4P53

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The development of epoxy-silica hybrids has attracted industry attention to achieve eco-friendly long-term stone treatments with consolidating and hydrophobic properties. In this sense, new products derived from Bisphenol A (BPA)-free epoxy resins have become increasingly appealing due to the easy tailoring of their physical, thermal and chemical properties coming from their possible post combination with compatible inorganic precursors [1-2].

In this context, 1,4:3,6-dianhydro-D-sorbitol (ISO), derived from D-sorbitol sugar, was selected to synthesize the BPA-free epoxy precursor isosorbide diglycidyl ether (ISO-DGE) with minor environmental impact than phenolic-based ones.

The synthesis process was carried out via epichlorohydrin (EHC) in an alkaline medium and under an inert atmosphere using a Dean-Stark tube [3]. To characterize the synthesized crude, as well as, to follow and assess the clean-up process, Fourier Transform Infrared (FTIR), Attenuated Total Reflection Infrared (ATR-FTIR) and Raman spectroscopies were employed. Moreover, Nuclear Magnetic Resonance (¹H-NMR, ¹³C-NMR) was also used to determine the structure and purity of the epoxy product.

The epoxy ratio (ER) of the oligomer mixture obtained was calculated by a combination NMR analysis and a back titration with HCl, acetone and NaOH [4]. Finally, the opening of the epoxy ring as well as the crosslinking obtained was studied testing different amines: i.e 1,8- diaminooctane (DAO), triethylenetetramine and O,O'-bis(2-aminopropyl)polypropylene glycol-block-polyethylene glycol-block polypropyleneglycol (Jeffamine® ED-900) to optimize the ratio

epoxy:amine by a combination of ATR and Raman measurements. The thermal behaviour of the most promising mixture for stone conservation purposes was investigated by means of thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC).

Acknowledgements

This work has been financially supported by the project PHETRUM (CTQ2017-82761-P) from the Spanish Ministry of Economy and competitiveness (MINECO) and by the European Regional Development Fund (FEDER). Pablo Irizar also acknowledges his predoctoral grant from the MINECO (PRE2018-085888)

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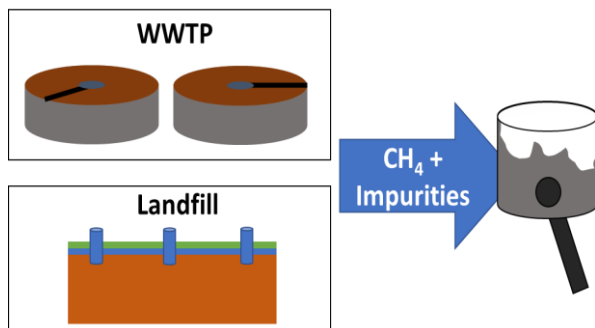


Fig. 1. Impurities in wastewater treatment plants (WWTP) and landfills biogas could lead to SiO₂ precipitates in engines and tubing of power plants.

The use of biogas has increased in the last years worldwide [1]. This fuel is carbon neutral, which makes it a very convenient substitute to fossil fuels. Furthermore, since this gas can be obtained from residues, it can also be used as partial power supplier in landfills and wastewater treatment plants (WWTP). However, biogas obtained in these facilities presents several impurities (e.g. H₂S, NH₃ or VOCs) that should be removed to ensure a proper calorific value and comply with technical specification. Among them, siloxanes are considered the most pernicious according to some studies [2]. These compounds are formed by a Si-O-Si backbone occurring in linear and cyclic form, and have their origin in cosmetics, electronics, and personal care products. Once in the power plant, siloxanes precipitate along the tubing and/or engines in the form of silicon dioxide, affecting the performance of the process. Despite the acknowledged importance of lowering down siloxane concentration in biogas, a standard methodology cannot be found in the literature. Therefore, the main objective of this review is to find the levels of these impurities already reported, as well as the techniques employed to sample and then reduce them.

Our search found about 30 studies dealing with this topic. Sampling technologies differed greatly among the different papers reviewed. Active sampling with aluminium, PTFE, or PVF bags, adsorbent cartridges, impingers, or metal canisters were the most frequent technologies. Regarding analyses, gas chromatography coupled to mass spectrometry (GC/MS) was the most prevalent technique. However, other analytical methodologies, such as online Fourier-transform infrared spectroscopy (FTIR) are also described. Reported concentrations of siloxanes

in biogas are very wide, spanning from 10⁴ to 10⁻¹ µg·m⁻³ depending on compound, location, and season. The most prevalent compounds were octamethylcyclotetrasiloxane (D4) and decamethylcyclopentasiloxane (D5). To lower the presence of siloxanes, the most extensively reported technique is the adsorption in different types of sorbents (mainly carbon and silicate based materials), although other technologies (e.g. photochemical reactions, membranes) were developed with different technical performances.

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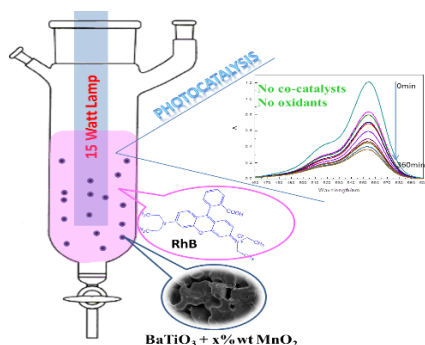
This work was also financially supported by: (i) Project UID/EQU/00511/2019 - Laboratory for Process Engineering, Environment, Biotechnology and Energy - LEPABE funded by national funds through FCT/MCTES (PIDDAC); (ii) Project POCI-01-0145-FEDER-032084 - LANSILOT - LAunching New SILOxane Treatments: assessing effluent, sludge and air quality and improving biogas production in WWTPs, funded by FEDER funds through COMPETE2020 - Programa Operacional Competitividade e Internacionalização (POCI) and by national funds (PIDDAC) through FCT/MCTES; (iii) Project “LEPABE-2-ECO-INNOVATION” - NORTE- 01- 0145- FEDER- 000005, funded by Norte Portugal Regional Operational Programme (NORTE 2020), under PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF); (iv) Investigator FCT contract IF/01101/2014 (Nuno Ratola).

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Evaluation of Rhodamine B photocatalytic degradation over BaTiO₃-MnO₂ ceramic materials**4P55****I. Kuźniarska-Biernacka¹, B. Garbarz-Glos², E. Skiba^{3,*}, M. Antonova⁴, C. Pereira¹, C. Ferire¹**¹REQUIMTE/LAQV, Departamento de Química e Bioquímica, Faculdade de Ciências, Universidade do Porto, Rua do Campo Alegre s/n, 4169-007 Porto, Portugal²Institute of Technology, Pedagogical University, Podchorążych 2, 30-084 Kraków, Poland³Institute of General and Ecological Chemistry, Lodz University of Technology, Żeromskiego 116, 90-924 Łódź, Poland⁴Institute of Solid State Physics, University of Latvia, Kengaraga 8, LV-1063 Riga, Latvia

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Oxide semiconductor photocatalysis has attracted extensive attention due to its wide potential application in environmental protection procedures [1]. Since the spontaneous polarization of ferroelectrics is advantageous to the separation of photogenerated carriers, many efforts have been devoted to promoting the photocatalytic performance of ferroelectric materials [2]. Nevertheless, few studies have been reported on the improvement of the solar absorption of traditional ferroelectrics so far.

Herein, BaTiO₃ + x wt.% MnO₂ (where x = 1, 2 or 3) ferroelectric ceramics were prepared by a solid state synthesis method. The samples were synthesized from analytically pure BaCO₃, TiO₂ and MnO₂. The mixture of the raw materials was homogenized and ground in an agate ball mill in EtOH. The dried material was calcined. The powder was ground in ethanol, cold pressed and sintered for using a conventional ceramic technology [3].

The investigation on the microstructure of the sintered ceramics was performed on fractures and polished sections. The results of the local analysis of chemical composition of the ceramics confirmed the high purity and the expected quantitative composition (no significant impurities were detected in an EDS survey spectrum). However, the FTIR spectra of BaTiO₃ and BaTiO₃ + x wt.% MnO₂ samples showed bands which revealed BaCO₃ traces [4]. The homogeneity of element distribution in the samples was investigated by EPMA (Electron Probe Microbeam Analysis). The obtained "mappings" confirmed the qualitative composition of the examined ceramics. A good homogeneity of the

microstructures and a small degree of porosity were observed.

The adsorptive and photocatalytic properties of the BaTiO₃ (reference sample) and BaTiO₃ + x wt.% MnO₂ materials were evaluated using Rhodamine B (RhB) as model dye in a photocatalytic chamber equipped with UV lamp (15 W) in the absence of oxidant and co-catalyst. The photocatalytic tests were monitored by UV–VIS spectroscopy. No adsorption of the RhB dye was found for all the materials during 360 min (dark experiment). In the absence of the photocatalysts, only a slight dye degradation was observed (10%) after 360 min of light irradiation, illustrating the stability of RhB. The photocatalytic behaviour of all samples followed the first-order kinetic model. The best results were observed for the BaTiO₃ + 3 wt.% MnO₂ material, where RhB was nearly completely removed from aqueous solution after 360 min irradiation. To identify the species produced in the photooxidation of RhB, the temporal proton NMR profiles of the dye and of the final products were monitored in DMSO d₆. For all photocatalysts the characteristic signals of RhB (¹H NMR spectra) assigned to aliphatic and aromatic protons almost disappeared. All of these results indicated that the destruction of the conjugated structure of RhB occurred in the suspension during the course of irradiation.

Acknowledgements

CP thanks FCT for FCT Investigator contract IF/01080/2015.

MSc Jakub Kubicki is kindly acknowledged for his support in AAS analysis.

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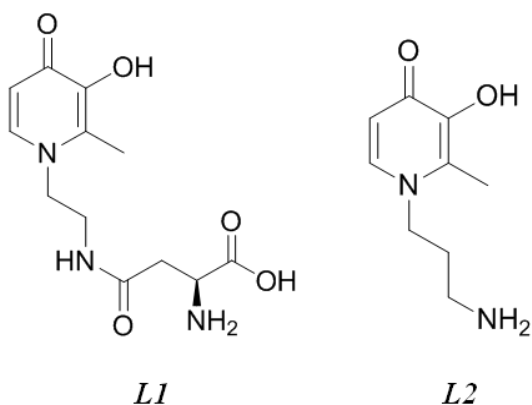
Binding and sequestering ability of two 3-hydroxy-4-pyridinones towards metal cations of biological and environmental interest 5P56

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This contribution is the result of an investigation on the speciation of two 3-hydroxy-4-pyridinone ligands in the presence of metal cations of biological and environmental interest.

The 3-hydroxy-4-pyridinones (3,4-HPs) are a family of compounds, derivatives of deferiprone, which have been extensively developed as possible strong chelators and metal-related pharmaceutical drugs, due to their important role in pharmaceutical/bioenvironmental processes, as for the sequestration of specific metal cations (M^{n+}) from the human body and biological fluids, or also as metal-carriers for therapeutics or imaging purposes [1,2].

The binding ability of two ligands belonging to this class of compounds towards metal cations of biological (Ca^{2+} , Mg^{2+}) and environmental (Al^{3+}) [3] interest was investigated performing potentiometric and UV-Vis spectrophotometric measurements at different conditions of ionic strengths and temperatures.

The elaboration of experimental data led to the determination of complex species with different stoichiometry. ¹H NMR titrations and computational studies were carried out to gain information on the metal-ligand coordination mode. Furthermore, the sequestering ability of the ligands towards the metal cations under study was investigated at different pH values by the determination of an empirical and quantitative parameter, the $pL_{0.5}$, already proposed by the research group [4].

It represents the total concentration of ligand required to sequester the 50% of the metal cation present in trace in solution.

The quantification of the sequestering ability of a ligand towards M^{n+} is very important for remediation processes, chemical treatment of waters and for applications involving the use of a chelating agent. In fact, in all these cases, having information on the amount of ligand to be used, is very important in order to optimize the entire processes.

Acknowledgements

The authors from the University of Messina thank MIUR (Ministero dell'Istruzione, dell'Università e della Ricerca) for financial support (co-funded PRIN project with prot. 2015MP34H3) and the University of Messina for "Research&Mobility 2017" project.

The authors from (IST) University of Lisbon thank the Portuguese *Fundação para a Ciência e Tecnologia* (FCT) for financial support to the projects UID/QUI/00100/2013 and PEst-C/SAU/LA0001/2013, and the postdoctoral fellowship (KC). Acknowledgements are also due to the Portuguese NMR (IST-UL Center) and Mass Spectrometry Networks (Node IST-CTN) for providing access to their facilities.

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Nature as Resource. Characterization of natural and synthetic polymers: acid-base properties and sequestering ability towards bivalent metal cations 5P57

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Fig. 1. Nature as Resources.

The polymer industry has shown exponential and continue growth; this phenomenon, in part, is due to the crisis which results from depletion of fossil fuels resources as raw materials. Environmental sustainability is one of the most important objective of the scientific community, therefore the employ of ecofriendly natural and synthetic polymers in different fields, as in pharmaceuticals, cosmetics, paints, industrial formulations and in medical applications is fundamental. The characterization of the acid-base properties and binding ability, and in general speciation studies, of the polymers is the first step to understand their potential use and application.

The polyelectrolytes presented in this contribute are: polyethylene glycole (PEG), Acusol 445 (homopolymer of acrylic acid), carboxymethylcellulose (CMC) and Carrageenan. The speciation studies of the different polymers were performed by potentiometric technique in NaNO_3 aqueous solutions, at $I = 0.15 \text{ mol}\cdot\text{dm}^{-3}$ and $T = 298.15 \text{ K}$. For the interpretation of the acid-base properties, a simplified approach called Diprotic-like model [1], was used. This model treats a polyelectrolyte like a simple low molecular weight ligand defining a minimum number of protonation sites required to extensively describe the system. The binding ability of the polyelectrolytes was studied towards three metal cations: Ca^{2+} , Zn^{2+} and Sn^{2+} .

To complete the characterization of these polymers, their sequestering ability was evaluated by means the empirical parameter pL_{50} [2].

Acknowledgements

The authors from the University of Messina thank MIUR (Ministero dell'Istruzione, dell'Università e della Ricerca) for financial support (co-funded PRIN project with prot. 2015MP34H3) and the University of Messina for "Research&Mobility 2017" project.

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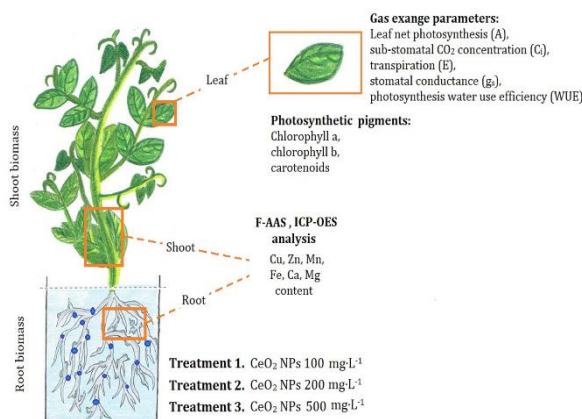
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Metal Homeostasis and Gas Exchange Dynamics in *Pisum sativum* L. Plants as Exposed to Cerium Oxide Nanoparticles

5P58

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Rapid expansion of nanotechnology has prompted many applications of engineered nanoparticles (ENPs) in technology, medicine and agriculture. The widespread use make nanoparticles increasingly abundant in the environment. The thriving production and logistics prompt either controlled or unintended release to soil, water and air. Therefore ENPs became an interesting environmental stress factors of growing importance [1]. Plants play pivotal role in earth ecosystems with metals and ENPs being mostly prone [2]. Metal uptake by plants is frequently mediated by ENPs. This mutual, additive effect is not fully recognized and thoroughly investigated as yet [3, 4]. This important issue should be accounted for when nanotoxicity mechanisms are concerned towards designing of new ENPs with reduced environmental impact [5]. The phytotoxicity of ENPs can be assessed for through its impact on plant topology, biomass production, alterations in nutrients uptake and dynamics of metabolism [6]. Notably, photosynthesis is among the most sensitive physiological processes and a trustful plant stress indicator.

The aim of this study was to investigate additive interactions induced by the CeO₂ ENPs in pea (*Pisum sativum* L.). The former are among the most abundant and widely produced metal oxide nanoparticles [7]. The pea was grown in hydroponic system with Hoagland medium as a nutrient solution. After four days of growth in optimal conditions, seedlings were treated with commercially available CeO₂ ENPs. The concentrations 100, 200 and 500 mg/L of Ce were applied. The yield of photosynthesis upon the CeO₂ ENPs treatments was determined by the leaf gas

exchange parameters as measured with a CIRAS-3 Portable Photosynthesis system. Leaf chlorophyll content was assessed by spectrophotometric method in acetone-water extracts. Diversity of plant biomass and the accumulation of micro and macroelements in roots and shoots were applied to estimate the CeO₂ stressor influence on plant development. Roots and shoots were digested in a closed microwave system and further analyzed for Cu, Mn, Fe, Zn, Ca and Mg contents by F-AAS and ICP-OES.

Supplementation of the nutrient solution with CeO₂ nanoparticles induced changes in the morphological structure of roots and plant biomass production. Gas exchange parameters, i.e. the leaf net photosynthesis, transpiration and stomatal conductance were increased at lower stressor concentrations. All treatments affected photosynthetic pigments concentration. The uptake and further migration to leaves of Cu, Mn, Fe and Zn were hampered. Similar effect was also observed for Mg and Ca content in all plant tissues.

Metal homeostasis and gas exchange dynamics parameters will be presented in detail.

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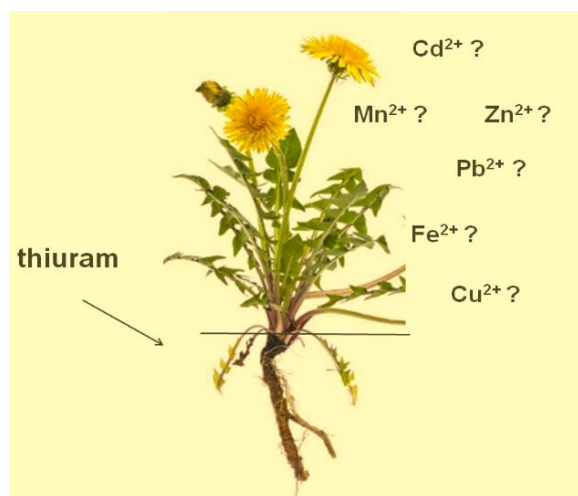
We are grateful to dr. S. Glińska and dr M. Gapińska for kind help in plants cultivation.

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The fungal-induced plagues pose a serious threat to herbs cultivation. They are difficult to fight and usually lead to substantial harvest losses [1,2]. Dithiocarbamates, especially thiuram (tetramethylthiuram disulfide) play an important role in control of fungal plant diseases and are widely used to protect herbs, arable crops, vegetables, and decorative plants [3]. Several works documented that thiuram has ability to chelate metal ions in soil environment and can influence elements uptake by plants [4,5]. The latter is of particular importance for restraining the heavy metals content in either commonly used herbs or food products [6] and should be correlated with pesticide residues concentrations in relevant plants [7].

Taraxacum officinale (dandelion) is a herbaceous perennial plant of the family *Asteraceae*. It is highly appreciated as a natural drug widely applied in the traditional medicine [8]. It demonstrates anti-inflammatory, and anti-oxidative properties. Its anti-diuretic, anti-choleretic and liver stimulating activities are also observed. Until recently, the whole raw material of dandelion was obtained from the natural environment. However, for several years, large *Taraxacum officinale* plantations in Western Europe, mainly France and Germany have been established.

In this work the thiuram impact on manganese, iron, copper, zinc, cadmium and lead uptake by dandelion was investigated. Studies involved soil analyses to determine acidity, organic matter content and either total or bioavailable form of metals. *Taraxacum officinale* was cultivated under laboratory conditions

by the pot method. Thiuram was applied to plants, one month after they had been sown. The HR-CS FAAS Contra300 spectrometer (Analytic Jena) was used to determine concentration of heavy metals in plants and soil. The fungicide content in either dandelion or soil was determined after 2, 4, 7 weeks by the well established HPLC methodology [9].

Thiuram affects the bioavailable forms of metals in various ways depending on the rate of its degradation in soil.

The degradation of thiuram in soil proceeds quite rapidly. This effect influence the heavy metals uptake in a systematic way leading to the hysteresis like pattern of metal concentrations.

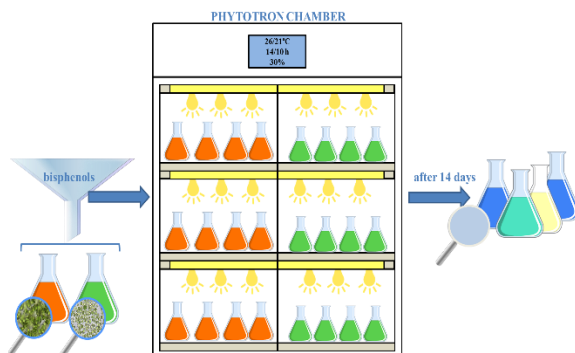
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Toxic effects of single bisphenols and their mixtures on the growth of *Chlorella vulgaris* and *Scenedesmus armatus* 5P60

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Environmental contamination with substances that exert an adverse influence on the endocrine system of living organisms has been posing a growing concern in recent years. Such compounds are referred to as endocrine disrupting compounds (EDCs) [1]. EDCs include phytoestrogens which are produced by plants, substances of anthropogenic origin, such as polycyclic aromatic hydrocarbons, pesticides, detergents, pharmaceuticals, nonyl phenols, polychlorinated biphenyls, phthalates and dioxins, as well as bisphenols [2, 3]. Recently, the number of reports on negative effects of bisphenols in the aquatic environment, as well as their negative impact on human and animal health, has increased [4]. For this reason, it is necessary to study the impact of these compounds on organisms living in aquatic ecosystems.

Chlorella vulgaris (BA-0002) and *Scenedesmus armatus* (BA-0006) were purchased from the Culture Collection of Baltic Algae at the Institute of Oceanography of the University of Gdansk. In order to provide optimal growth conditions, the cultures were carried out in a phytotron chamber in the photoperiod in the light/dark cycle 14/10 h, at temperature 26/21°C (day/night) with constant humidity of 30%. Cultures of green algae were grown under continuous illumination of 60 $\mu\text{mol photons m}^{-2} \text{s}^{-1}$. The *Chlorella vulgaris* and *Scenedesmus armatus* colonies were cultured in the presence of the following single bisphenols: bisphenol A (BPA), bisphenol B (BPB), bisphenol C (BPC), bisphenol E (BPE), bisphenol AF (BPAF) and bisphenol BP (BPBP). The green algae cultures also were exposed to mixed at equal proportion bisphenols (BPA: BPB: BPC: BPE: BPAF: BPBP, 1: 1: 1: 1: 1: 1). Each tested compound was first dissolved in methanol and then the dissolved form was added to

100 mL of green algae culture at the nominal concentrations 5, 10, 15, 25, 50, 75, 100 $\text{mg} \cdot \text{L}^{-1}$. The biomass content were monitored in the cells of *Chlorella vulgaris* and *Scenedesmus armatus* after 1, 2, 3, 7, 8, 10, 11 and 14 days of exposure to the analyzed chemical compounds and in control samples cultured in the same conditions.

The presented studies show that single and mixed bisphenols may inhibit the growth of the green algae *Chlorella vulgaris* and *Scenedesmus armatus*. Therefore, further research on other endocrine and phytoplankton compounds is needed to fully understand how bisphenols affect these aquatic organisms, to provide a more comprehensive view of the ecological risk assessment.

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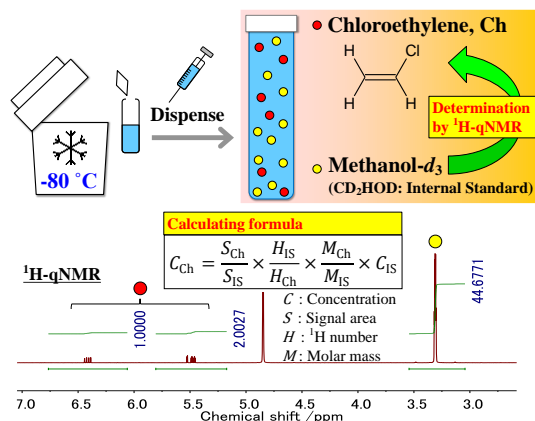
Accurate Determination of Very Highly Volatile Chloroethylene in Standard Solution by Quantitative ¹H NMR Spectroscopy

5P61

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In April 2017, chloroethylene also known as vinyl chloride monomer was specified as a new regulated substance under the Soil Contamination Countermeasures Act in Japan [1]. As the standard values for chloroethylene in soil leachate and groundwater were established, chloroethylene must be determined accurately to ensure the safety of drinking water. Chloroethylene standard solutions with reliable concentration are essential for the accurate determination by gas chromatography. However, such solutions had not been available all over the world. The chloroethylene standard solutions cannot be prepared or evaluated accurately, because chloroethylene is difficult to be handled due to being a gas having -13°C boiling point under the atmospheric pressure.

In this study, we attempted to apply Quantitative ¹H Nuclear Magnetic Resonance (¹H-qNMR) to accurate determination of very highly volatile chloroethylene. ¹H-qNMR spectroscopy is increasingly being used in accurate determinations of various organic compounds [2]. Signal areas on ¹H-qNMR spectra are proportional to numbers of ¹H nuclei regardless of types of the compounds. Concentration of an analyte can be determined by comparing a signal area of the analyte with that of an internal standard added to the sample solution.

Experimental strategies to reduce volatilization of chloroethylene during sample preparation and NMR measurement, are as follows.

Sample preparation

A chloroethylene standard solution in methanol-*d*₃ sealed in glass ampoules was supplied from Kanto Chemical Co., Inc. (Tokyo, Japan).

Use of solvent signal as internal standard

During internal standard addition process, volatilization of chloroethylene from the solution occurs. To omit addition of any internal standard, methanol-*d*₃ (CD₂HOD) originally existed in the solution was used as an internal standard. In advance, the concentration of methanol-*d*₃ in the solvent used to prepare the solution was determined by using an internal standard, 1,4-bis(trimethylsilyl)benzene-*d*₄ for ¹H-qNMR. This strategy made it possible immediate transfer the solution to an NMR tube after opening the ampoule.

Optimization of sampling temperature

Volatilization of chloroethylene to atmosphere could be also reduced by keeping the ampoule at low temperature. The optimum temperature range was founded as below the boiling point of chloroethylene, -20°C to -80°C.

NMR measurement

A 400 MHz ¹H NMR spectrometer (JNM-ECS400, JEOL Ltd., Tokyo, Japan) was used.

Optimization of headspace in NMR tube

Optimum volume rate of headspace in the NMR tube was examined to reduce volatilization of chloroethylene to the headspace. The optimum volume rate range of the headspace was founded as less than 23%. Under the above optimum conditions, the concentration of chloroethylene in the standard solution was able to be accurately determined as 117.6 mg/kg ± 1.2 mg/kg (the number after '±' indicates the expanded uncertainty, *k*=2).

By using the special chloroethylene standard solution determined by ¹H-qNMR as a calibrant, concentrations of commercial chloroethylene standard solutions in methanol are being determined accurately by gas chromatography. The commercial chloroethylene standard solutions will be supplied in future.

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Cigarettes are highly addictive due to the presence of nicotine in tobacco [1]. Globally it is estimated that over 22 % of the population are smokers. In Serbia this number is even higher. Around 33% of adult population is smoking [2]. All tobacco products are harmful to health. There are over 4500 compounds found in tobacco. Many of them are toxic, including as aromatic hydrocarbons, aldehydes, ketones, and heavy metals [3]. Therefore, it is important to monitor these substances in tobacco products, in this case cigarettes.

In this study element concentrations were measured in 14 brand name cigarettes available in Serbian markets. For the analysis three packs of each brand from different production series were purchased on local markets. From each pack five cigarettes were cut open and a homogenized tobacco sample was made. An aliquot of 0.5 g was digested using sub-boiled HNO₃ in an ultraCLAVE III microwave digestion system. The same digestion procedure was applied for the digestion of rolling paper, with the difference that rolling paper of five cigarettes was used. Concentrations of 35 elements Li, B, Na, Mg, Al, P, S, K, Ca, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Mo, Ag, Cd, Sn, Sb, Te, Cs, Ba, Gd, Hg, Tl, Pb, Bi, and U were determined using ICPMS (Agilent ICPMS 7700cx).

Not surprising for most elements concentrations in the tobacco are significantly higher than those in filter papers. Exceptions are Na, Ca, Te, U, while for V and Sn it was depended upon the brand.

Statistically there were no differences in tobacco concentrations of B, Na, Cd, Sn, Te, Gd, Hg, Tl, and Pb between any of the brands. Pall Mall super slims blue stands out with the highest concentrations of Mg, Al, Ca, V, Fe, and As, while Lucky red had the highest concentration of Sb.

When it comes to the rolling paper, the same brand Pall Mall super slims blue again stands out with the highest concentrations of Na, Al, Ca, V, Cr, Fe, Co, As, Sn, Cs, Pb, and U. Although they had the highest concentrations in absolute amounts, these are slim cigarettes and the mass of tobacco and paper used per cigarette is smaller than in other brands leading to similar concentrations per cigarette.

The presented study is the first thorough study of element concentrations in cigarettes from Serbia.

Considering the percentage of smoking population, these analysis should be performed regularly.

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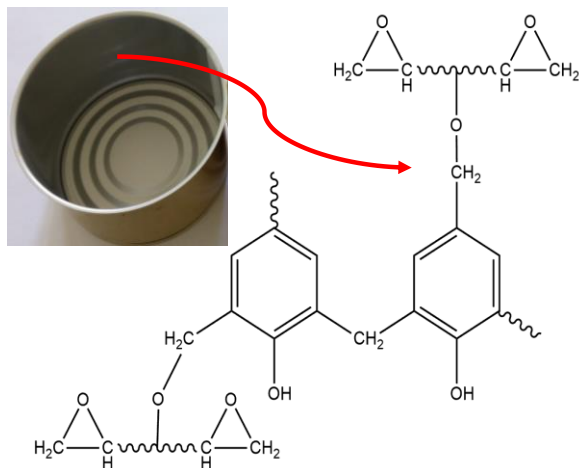
Nenad Zarić did the presented work as part of his postdoc study at the University of Graz. It was made possible through: Scholarship of the Scholarship Foundation of the Republic of Austria, Postdocs, Reference number: ICM-2018-11534 awarded by OeAD-GmbH. We also acknowledge the support of project No OI 176006, which is financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

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The interaction between food and metal packaging might be a potential source of toxic elements release, which if ingested by humans can cause harmful effects. The present study is undertaken to investigate possible leaching of toxic elements from packaging materials into canned meat products, under different storage periods. The meat products were packaged in cans made of electrolytic tinplate, produced by the special requirements of the Serbian Armed Forces. Cans were protected inside and outside with epoxy-phenolic coating [1]. The structure of the coating was previously examined by IR spectroscopy [2], and by ¹H NMR in this work.

The concentrations of the metals (Cr, Mn, Fe, Cu, Zn, As, Se, Cd, Sn, Hg and Pb) in the canned foods were determined by Inductively Coupled Plasma with Mass Spectrometry (ICPMS). The samples of canned meat products were manufactured for the needs of the Serbian Armed Forces, according to the Regulation on the quality of meat products [3], in industrial facilities of various manufacturers. The products were preserved by sterilization and stored in typical military facilities that provide prescribed microclimate requirements. Sterilized meat products are one of the strategic foods in the Serbian Army due to their high nutritional value and long-term sustainability. Content of the metals was determined in beef goulash, pork ragout, spam, liver pate and meatballs in tomato sauce, stored minimally 3 months and maximally 6 years. The storage period of the meat

products was within their shelf life and longer. The concentration of the metals obtained under this study were compared with the EU maximum permitted levels [4]. It has been shown that the degree of migration of some metals in the canned food (Fe, Sn) is dependent on the storage period.

During the storage, changes were observed in both metal packaging and sensory properties of the contents. The most common defects in the packaging were from the nuances of slight damage, then marbling, up to corrosion. Cans with the lowest rating of the outer appearance of the packaging showed mostly low ratings for other sensory properties such as color, aroma and texture of the content. The occurrence of metal taste, as well as changes in the color and texture of the meat product during the storage, in many cases correlates with the higher metal content of the corresponding sample.

Acknowledgements

This work was financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project No. 172062).

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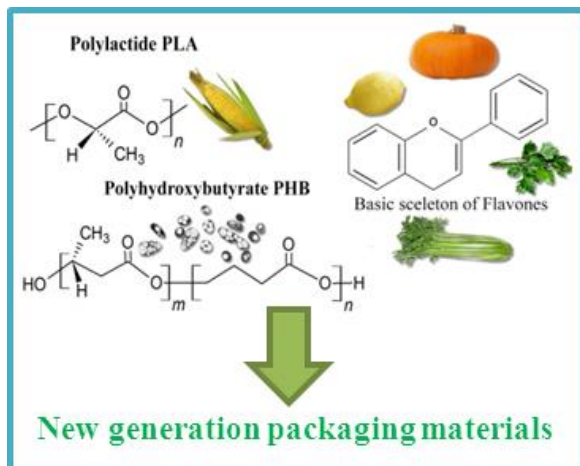
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Environmentally friendly packaging materials based on biodegradable polyesters and plant polyphenols

6P64

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Polymers are commonly used in the production of packaging, intended for contact with food products. Biodegradable polymers are becoming more and more popular as packaging materials. Legislation and pressure on the use of environmentally friendly materials has increased interest in biodegradable materials and natural processing additives. Polylactide (PLA) and polyhydroxyalkanoates (PHA) are typical polyesters that can be used as proecological packaging. These polymers are called double-green materials because they are made from natural raw materials and are also fully biodegradable. Moreover, their properties are compared to the properties of the polymers of petrochemical origin [1-3], which are currently used for the production of packaging materials.

PLA and PHA are an excellent base for designing easily decomposing packaging. However, only the addition of other technological substances allows you to obtain interesting and practical materials. In our research, we propose the use of plant-derived polyphenols as replacements for commercial processing additives, such as stabilizers and dyes. The properties of plant polyphenols, such as antioxidant activity, bactericidal and fungicidal properties, as well as a change of colour under the influence of external factors [4], make these compounds good alternative to functional synthetic substances added to packaging materials.

The proposed polymeric materials combine the basic functionality of the packaging with the advanced features characteristic of smart packaging.

By changing the colour of natural polyphenols under the influence of external conditions, it is possible to monitor the freshness of the packaged food product, as well as the life time of the packaging. It seems that the proposed materials meet stringent environmental requirements, as well as the high requirements of conscious consumers.

Acknowledgements

This study was supported by the National Centre for Research and Development (NCBR) project: LIDER/32/0139/L-7/15/NCBR/2016.

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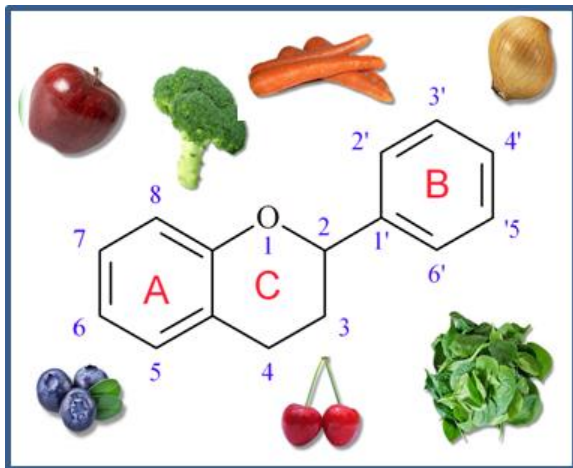
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Analysis of the properties of monomeric and polymeric forms of plant polyphenols from the group of flavonoids

6P65

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Plant polyphenols enjoy an ever-increasing recognition by the scientific community and by the general public because of their properties and presence and abundance in fruits, vegetables, seeds and derived foodstuffs and beverages. Regular consumption of natural polyphenols has been claimed to be beneficial for human health. The capacity of plant polyphenols to scavenge oxidatively generated free radicals is considered their utility in reducing the risk of certain age-related degenerations and diseases [1].

Flavonoids are the most important and the biggest group of polyphenols. They are commonly found in food products, such as fruits, vegetables and some drinks (wine, coffee, tea). These group of natural polyphenols are assigned a positive impact on human and animal health, and the current interest in flavonoids relates to disease therapy and chemoprevention. Flavonoids have high antioxidant and pharmacological activities and these properties are closely related to their structure. Certain structural elements of these compounds condition their properties and improve or degrade the activities [1].

The polymerization of flavonoids may cause changes in their specific properties, e.g., it may intensify beneficial properties such as, bactericidal effects or antioxidant capacity [1]. The literature proposes a few methods of polymerization of flavonoids, such as enzymatic polymerization [2], polymerization with a crosslinking agent [3] and photopolymerization [4].

During presentation will be show properties of natural plant polyphenols from flavonoids group

before and after different methods of polymerization. Antioxidant activity and ability to reduction of transition metals ions of monomeric and polymeric flavonoids will be presented. Impact of type of polymerization on properties and structure of polymeric form of flavonoids will be analysed.

Acknowledgements

This study was supported by the National Science Center (NCN), project no.: 2018/31/N/ST8/02565.

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Cellulose as a universal matrix for inorganic plant composition analysis using WD-XRF: accuracy testing 6P66**J. Orlić*, K. Ilijević, I. Gržetić***University of Belgrade, Faculty of Chemistry, Studentski trg 12-16, Belgrade, Serbia***jovanaorlic@chem.bg.ac.rs*

Instrumental techniques most commonly used today in plant analysis are time-consuming and require the use of aggressive digestion methods. The need for a technique that does not primarily require the use of toxic and corrosive chemicals makes X-ray fluorescence spectrometry one of the leading techniques for the direct analysis of solid samples.

During instrument calibration, it is necessary to fulfill the requirement that the calibration standards must have very similar or the same matrix as the analyzed samples [1]. It is often difficult to find a sufficient number of standards with desired elements and with appropriate concentrations. Plant-like matrix properties make cellulose a potential universal matrix for plant analysis. By adding a liquid standard to cellulose, it is possible to easily create a method with selected elements at desired concentration levels [2, 3].

During this research, synthetic cellulose standards were created by adding the liquid standard which contained: Na, Mg, Al, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Sr, Ag, Cd, In, Tl, Pb, and Bi. The concentration range was from 0 ppm to 500 ppm. Based on different sample preparation procedures, three methods were created: pure cellulose (PC), cellulose with 20% wax (CW) and cellulose on a thin layer (TL). The addition of wax was necessary because it leads to more stable pellets under high vacuum conditions and elevated temperatures inside the instrument chamber. In situations where the amount of sample is not sufficient to make a regular pellet, it is possible to make a pellet with a sample in a thin layer applied on a boric acid carrier.

The accuracy of the created methods has been tested in several ways. Accuracy was primarily verified by certified reference materials analysis (NIST SRM 1573a Tomato leaves and NIST SRM 1575a Pine needles).

Synthetic cellulose standards were subsequently digested and analyzed by induced coupled plasma with optical emission spectrometry (ICP-OES). The correlation coefficients between measured and expected concentration values in the synthetic cellulose standards showed very high values and thus it was confirmed that the elemental concentration values in the synthetic standards were reliable.

A large number of plant samples was divided into aliquots which were later analyzed by ICP-MS as well as with WD-XRF methods. The results of comparison show that the created methods tend to underestimate the concentration values, but this systematic error can be easily corrected since very good correlations between ICP-MS and XRF measurements indicate that observed systemic error is highly predictable.

It can be concluded that cellulose with the addition of a liquid standard can be reliably used for the preparation of synthetic standards for the WDXRF spectrometer calibration in order to determine the inorganic composition of plant samples. The method is followed by simple sample preparation procedure that does not require the use of aggressive and potentially toxic chemicals. Also, the method is sufficiently accurate for the analysis of large number of elements over a wide concentration range.

Acknowledgments

This paper was realized as part of project No OI 176006, which is financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

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Green Synthesis of aluminium nanoparticles by using plant extracts and acid mining drainages

6P67

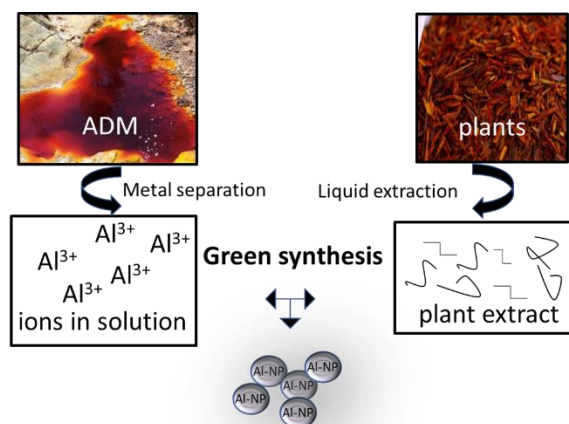
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Plant extracts contain bioactive compounds that have significant redox activity and are good chelation agents. Recently, some plant extracts were used as reagents in an environmentally friendly and low cost approach synthesis [1]. Recently, the production of aluminium nanoparticles (Al-NPs) using a green method based on reduction and stabilization by bioactive compounds has been described [2]. Aluminium nanoparticles have many applications such as catalysts, heat-transfer fluids, transparent conductive coatings or biosensors.

On the other hand, aluminium ions are one of the main metals present in acid mining drainages (AMD) generated by the mining activities in the pyritic belt of the Iberian Peninsula (SW Spain) [3]. These AMD have caused severe pollution on the rivers with transference of large amounts of acidity and dissolved metals. In our laboratory, we are currently studying the separation of valuable metals from these waters to obtain individual metal solutions that can be used as starting solutions for metal nanoparticles synthesis.

In this work, the study of green synthesis of aluminium nanoparticles by using plant extracts and aluminium ions separated from ADM solutions is presented.

First at all, the ability of different plant extracts for the synthesis of aluminium nanoparticles has been studied. Extracts of grape stalks, rooibos and coffee beans have been prepared, characterized and used as bioagent for the Al-NPs synthesis. To do this, Al-NPs were prepared by using aluminium chloride solutions

and the three different extracts. After the reactions, the solutions were centrifuged at 5000 rpm for 10 min and Al-NPs size and stability were measured by using a dynamic light scattering (DLS) equipment.

DLS results indicate that the most stable and smaller particle size Al-NPs was obtained when rooibos was used as bioagent. Afterwards, a deeply study of the optimal conditions for the synthesis of Al-NPs by using this extract were conducted. To do this, a factorial experimental design [4] was used to investigate the effect of two independent variables on Al-NPs size: metal concentration and extract concentration.

After Al-NPs synthesis optimization, aluminium solutions generated from AMD were used as a source of Al ions for Al-NPs synthesis.

As a conclusion, green nanoparticles were successfully synthesized by using rooibos extract and aluminium solutions separated from AMD. Results showed that these Al-NPs are bigger and less stable than Al-NPs synthesized from AlCl₃ solutions.

Acknowledgements

This research was funded by the Spanish Ministry of Science and Innovation as part of the project CTM2015-68859-C2-1-R (MINECO-FEDER). Flor Fonteyne grant was financially supported by a fellowship from ERASMUS 2018-2019.

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From environmental burden to valuable resource - a fungal reduction of phytotoxicity of grape pomace waste

6P68

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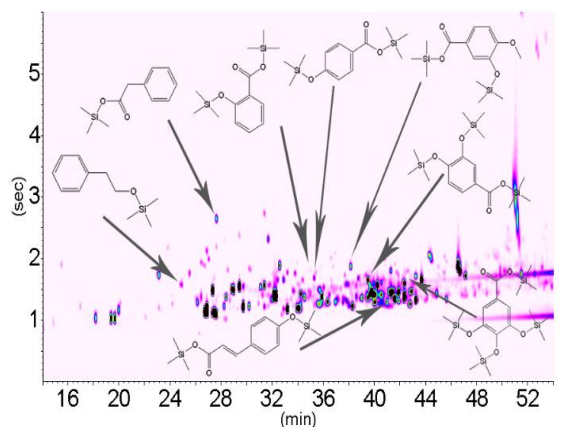
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Fig. 1. GCxGC-MS chromatogram of grape pomace.



Grape pomace is the main byproduct of wine production. It is composed of seeds and skins that remain after the crushing of grapes. The pomace is rich in sugars, nitrogen, amino acids, phenolic compounds, antioxidants, anthocyanins etc [1].

Although grape pomace is considered to be waste, there are a lot of recent studies focused on revalorization of this byproduct. It can be used in composting, as animal feed, for the production of organic acids, bioethanol, grape seed oil, as a substrate for the production of medicinal mushrooms [2,3]. However, the reuse of pomace is limited due to its susceptibility to the development of pests and pathogens. Also, pomace can contain different phenolic and other monoaromatic compounds that can have a phytotoxic effect. Pretreatment steps are necessary in order to decrease the negative environmental impact and assure the further utilization of pomace [2].

The main objective of this paper was to analyze the transformation of grape pomace by a fungal strain isolated from leaf-litter and assess if it can be a successful pretreatment method for the grape pomace waste. Grape pomace was inoculated with *U. botrytis* in solid-state fermentation conditions and incubated for 90 days. After that, pomace was extracted with methanol, derivatised with BSTFA+TMCS, and analysed using comprehensive two-dimensional gas chromatography with mass spectrometer (GCxGC-MS).

The results demonstrate that after 90 days of incubation, fungal treatment decreases grape pomace mass and the content of monoaromatics, which in turn decreases the phytotoxicity of grape pomace. This suggests that this strain could be efficiently used for the management of grape pomace waste before its further application.

Acknowledgements

This work was supported by Ministry of Education, Science and Technological Development of the Republic of Serbia (Project III 43004) and by Agencia Nacional de Promoción Científica y Tecnológica (PICT 2015-1620 to MCNS), CONICET (PUE INFIVE), CICPBA, UNLP, Argentina.

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One of the most important oil crops in the world is oilseed rape (*Brassica napus* L. var. *napus*). World production of rapeseeds was 39.1 million t in 2015-2016 and European Union was the main producer of this crop (13.9 million t). The main product obtained from rapeseeds is edible oil (rapeseed oil), from which margarine and other kitchen fats are also produced, but also rapeseed meal is formed during processing. Waste rapeseed meal is produced in the amount of 50-55 wt% of raw material charge during fully extraction of rapeseeds by solvent and it should not contain more than 2-3% oil. Rapeseed protein is poorer in lysine than soybean (5.5% vs. 6.3% of the crude protein) but is richer in sulphur-containing amino acids (sum of methionine + cysteine: 4.3% vs. 3% of the crude protein). This kind of waste are particularly valuable in organic farming as well as may be used as the addition to animal feed as a source of protein.

Processes of rapeseed meal acidic hydrolysis were carried out in the semi-industrial installation in sugar factory located in Dobrzelin. 12 portions of 12.5 kg of rapeseed meal were subjected to the hydrolysis process. Each portion was mixed with 37.5 kg of water. The mixtures were thoroughly mixed for 1 h using an efficient agitator in a tank with a conical bottom to absorb water and equalize the moisture in the entire volume of the preparations. Then, the content of the tank was pumped into pressure reactors, sulfuric(VI) acid was added in an amount of 1% by weight based on the weight of the mixture, and the whole mixture was heated in sealed tanks to 120-130°C for 2 hours. The reaction of hydrolysis was carried out simultaneously in two pressure tanks, in

six successive batches. After a set time, the pressure reactors were unsealed and volatile fractions containing furfurals, which are fermentation inhibitors, were collected. After cooling to 60°C, the reactor contents were pumped into a bioreactor equipped with a stirrer and a heating jacket. After adjusting the pH to 6.5-7.0 with ammonia for four collected portions of hydrolysates and after cooling them to 30°C, the mixture was inoculated with biomass of yeast *Pienia stipitis*, *Pichia stipitis* and *Candida guilliermondii* added in an amount of 10 L. The inoculum used was made by transferring pure cultures on YPD media (100 ml, culture 48 hours at 30°C, then 250 ml, culture 48 hours at 30°C, 10 l, culture 48 hours at 30°C), followed by rapeseed hydrolysates supplemented with (NH₄)₂HPO₄ and (NH₄)₂SO₄. Fermentation was carried out for 72 hours at 30°C, adding 2 L of molasses for each started day of yeast cultivation. After the fermentation process, the temperature of the preparation was raised to 90°C. After removing from the bioreactor, protein-rich preparations were dried at 80-100°C to reach a moisture content of 10-11%. Depending on the yeast monoculture or mixed yeast cultures used, as well as depending on the type of rapeseed meal used, 43 to 47% content of the protein was obtained in high-protein feed additives. The obtained products were used as high-protein chicken feed additives. The test results indicate the usefulness of such feed additives in chicken farms.

Acknowledgements

This work was supported by the National Centre for Research and Development under Grant BIOSTRATEG2/296369/5/NCBR/2016.

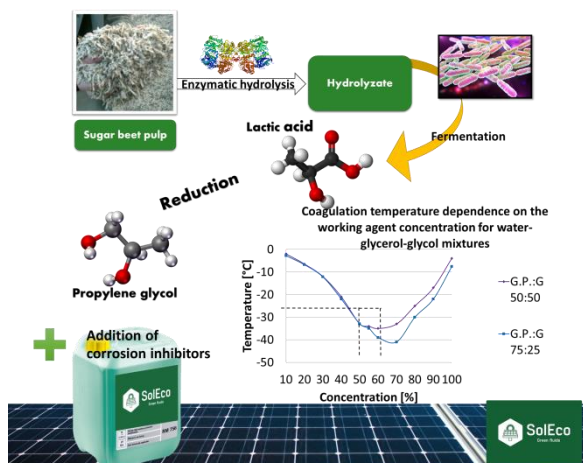
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Requirements And Test" were determined other parameters of fluids such as boiling point, density, pH, alkaline reserve. Also, it was checked the corrosiveness of ecological fluids for year-round solar installations containing of propylene glycol on metal plates made of copper, brass, aluminum, steel and stainless. It was demonstrated that an addition of corrosion inhibitors such as dehydrate sodium molybdate and borax allows to inhibit the corrosion on selected construction materials and thus to assure a correct working of solar and its efficient protection.

Acknowledgements

This work was supported by the National Centre for Research and Development under Grant BIOSTRATEG2/296369/5/NCBR/2016.

Working fluids for solar installations circulating between roof collectors and heat exchanger must have:

- resistance to crystallization at low temperatures (frost resistance),
- resistance to high temperatures,
- corrosion neutrality towards the installation (appropriate pH value, buffering capacity towards acids)
- no foaming due to temperature and pressure changes.

These requirements mean that a random glycol-based fluid cannot be used in the solar installation, only special mixtures containing: anti-foaming agents, corrosion inhibitors, fixatives and dyes.

The aim of presented solution SolEco was to develop recipes of ecological fluids for year-round solar installations that can transfer heat in Polish climatic conditions. Compositions developed during the research were supposed to be a safe alternative to well-known commercial products present on the market. On the basis of investigations it was determined the optimum concentration of working medium such as propylene glycol, glycerin, a mixture of propylene glycol and glycerin with a volume ratio of 50:50 and 75:25 which allow the solar installations to work at temperatures up to -35°C. Propylene glycol was obtained from sugar beet pulp hydrolysates by lactic acid fermentation and catalytic reduction of lactic acid over Ru supported systems.

Additionally based on the standard PN-C-40007:2000 „Engine Antifreezes And Coolants -

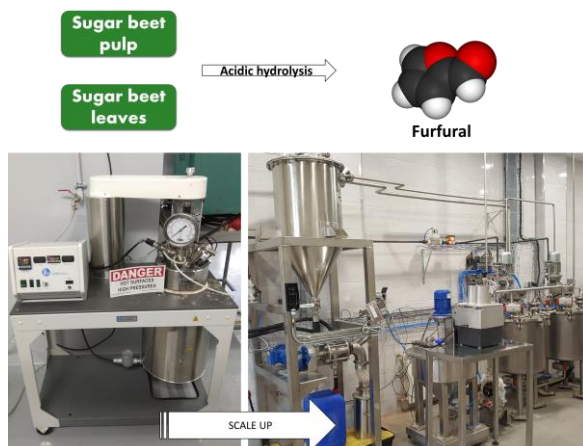
Acidic hydrolysis of sugar beet pulp and leaves on a quarter-technical scale

6P71

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Sugar industry generates large amounts of various types of waste, such as sugar beet pulp, leaves, and molasses, which can be used as valuable substrates in chemistry and biotechnology [1]. Acidic hydrolysis is generally the best known and most commonly applied method of chemical processing of biomass. The effectiveness of this method is based on the depolymerization of hemicellulose and partially cellulose. This method reveals C5 and C6 sugars or more chemically modified products such as furfural and its derivatives, levulinic acid, etc. Furfural is widely used as an important renewable building block with huge market potential, such as solvents (tetrahydrofuran), plastics (polyamides, etc.), resins (furfuryl alcohol) and fuel additives (e.g. methyl-tetrahydrofuran, methylfuran). Furfural is also receiving attention as a possible biobased alternative for use in the production of a wide range of products, from antacids and fertilizers to bioplastics and biofuels [2]. Furfural and its derivatives have been used to make jet and diesel fuel range alkanes and as a gasoline blendstock.

In the project entitled “Processing of waste biomass in associated biological and chemical processes”, we developed a method for producing furfural on a laboratory scale by simply distilling an aqueous biomass slurry in VI sulfuric acid, and then we modified this method by performing the process at elevated temperature (130-140°C) and under an increased pressure in a periodic pressure reactor Parr Instrument Company model: 4552 with a working capacity of 7.5 L. Finally, we have developed a method for the continuous acid hydrolysis of waste

biomass from sugar industry, in two pressure reactors with a working capacity of 75 L.

Acknowledgements

This work was supported by the National Centre for Research and Development under Grant BIOSTRATEG2/296369/5/NCBR/2016

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Waste biomass from sugar industry as raw material to propylene glycol and acrylic acid production

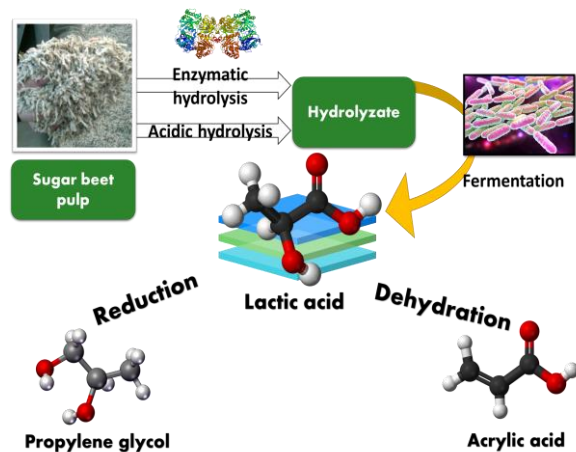
6P72

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Lactic acid (2-hydroxypropionic or 2-hydroxypropanoic) is the most widely produced acid using biotechnological methods [1]. This versatile carboxylic acid is used as an acidulant, flavoring, and preservative metabolite in the food, pharmaceutical, leather, and textile industries [2]. Research on the fermentative production of lactic acid from agricultural by-products has recently concentrated on the direct conversion of biomass. Inexpensive raw materials, such as starch or molasses, have been used to replace pure sugars in lactic acid production processes [3]

Enzymatic saccharification of sugar beet pulp requires the concerted action of cellulases, hemicellulases (including arabinosidases) and pectinases. In the research, a mixture of two commercial multienzyme preparations, Viscozyme and Ultrafo Max, containing these polysaccharidases, was found to efficiently saccharify polysaccharides contained in the sugar beet pulp to monosaccharides, assimilated by lactic acid bacteria. The conditions of saccharification of waste biomass were optimized at the laboratory scale and used in semi-industrial scale in Sugar Factory at Dobrzelin. Sugars present in hydrolysates were easily converted in biological processes into lactic acid using selected strains of lactic acid bacteria. Two different type of fermentation processes were considered: separate hydrolysis and fermentation (SHF) and simultaneous saccharification and fermentation (SSF). Simultaneous saccharification and fermentation proved particularly effective as a way of increasing the concentration of calcium lactate in the post-fermentation broths,

especially supplemented with CaCO₃. In the industrial conventional biological method of lactic acid production, separation and downstream processing of pure LA account for up to 50% of production costs. Therefore, it proposes using a less pure solution of lactate ions as a feedstock. Post-fermentation broth was firstly acidified to pH 2-3 by the addition of sulphuric acid in order to obtain free lactic acid. Next, after CaSO₄ separation, active carbon was used for the purification of the post-fermentation broth to remove potential catalyst poisons, like amino acids.

Finally, hydrogenation of lactic acid into propylene glycol, without excretion of LA from the fermentation broth, was performed over supported metallic catalysts, based mainly on ruthenium, under mild conditions. The second tested reaction is the catalytic oxidation of lactic acid to acrylic acid. This process was carried out in the vapor phase in a flow reactor with a fixed palladium catalyst bed. Both reactions show that lactic acid obtained biologically on biomass hydrolysates can be used to production of valuable chemicals.

Acknowledgements

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Waste Biomass from Food Industry as a Raw Material for the Production of Chemicals in Poland 6P73

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Due to the depletion of fossil fuel resources and care for the quality of the natural environment in the European Union, Community policy focuses on the dynamic development of the use of renewable energy sources. The EU policy in this area is reflected in the Europe 2020 strategy, whose main goal is to cover 20% of energy demand for renewable sources [1-2].

According to Eurostat data, in 2016 the share of renewable energy in gross domestic energy consumption in the EU-28 was 13.2%, of which 8.6% came from biofuels and renewable waste. At the same time, renewable energy in Poland covered 8.8% of gross domestic energy, with the vast majority, as much as 7%, also coming from biofuels and renewable waste [3].

In addition to forest residues and the wood industry, agriculture as well as, to a small extent, municipal waste is the main source of obtaining biomass for energy purposes in Poland. The implementation of obligations regarding the production and energy use of biomass necessitates obtaining it from energy plantations of perennial plants [4].

In accordance with the policy pursued by the Ministry of Agriculture and Rural Development, special emphasis in energy policy has been placed on the use for energy purposes not only of energy crops, but also by-products from agriculture, by-products and waste products from the agri-food industry, as well as liquid and solid animal excrements [5]. Straw, hay, sugar cane, sugar beets, rapeseed, potatoes, and residues from fruit processing, as well as animal droppings, are valuable raw materials from an energy point of view. Moreover, the use of surpluses from the agri-food industry solves the problem of waste utilization.

In addition to popular methods of obtaining energy from biomass, i.e. combustion of biomass, composting, production of bioethanol and biogas, the use of waste biomass as a raw material for obtaining chemical compounds is becoming more and more popular.

Renewable, easily available source of cellulose (30-45%), hemicellulose (20-35%) and lignin (10-20%) attracts the attention of scientists, not only in terms of use for energy purposes. Proper biomass treatment allows obtaining much more valuable products, which include furfural, levulinic acid.

Further conversions of compounds obtained from biomass allow obtaining a wide range of chemical compounds, e.g. furfuryl alcohol or high-quality fuel additives [6-7].

Acknowledgements

This work was supported by the National Centre for Research and Development under Grant BIOSTRATEG2/296369/5/NCBR/2016

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Bio-carbons and Activated Carbons Obtained from Solid Waste Received in Acidic Hydrolysis Processes 6P74

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Among the numerous methods of waste biomass processing, the acquisition of valuable chemical compounds is gaining importance. An example of such a process is acid hydrolysis of biomass leading to the obtaining of a platform molecule which is furfural [1].

The residue from acid hydrolysis of biomass can be used to produce carbonizate or activated carbon. Carrying out such a process makes obtaining furfural from lignocellulosic biomass a completely waste-free technology and allows to obtain an additional product that increases the profitability of the process.

Biochar are characterized by a large surface and charge density, contain nutrients and retain water. The carbonizate can affect soil structural stability, porosity, hydraulic conductivity, soil aeration, and cation exchange capacity, improving soil fertility and performance. The obtained carbonizate can also be activated and used for adsorption purposes, i.e. as activated carbon. Depending on the type and parameters of pyrolysis, it is possible to obtain coals with different structures as well as different physical and chemical properties [2-5].

Currently, many types of biochar can be distinguished on the market. The sale includes both

pure biochar and carbonizate with various types of admixtures. The price of biochar depends mainly on the type of material from which it is produced and is on average \$ 2.06 per kg in bulk and \$ 3.08 per kg in detail.

In Poland, a biocarbon "breakthrough" is foreseen in the coming years, resulting mainly from EU policy and the 2020 strategy. Experts say that the biocarbon market in our country will be shaped not only by the demand for this product, but above all by the products for which it is needed to produce. Such forecasts are justified by the current situation on European markets. There is a risk that with low dynamics in the development of biochar production, there will be a need to import it from abroad [6].

Acknowledgements

This work was supported by the National Centre for Research and Development under Grant BIOSTRATEG2/296369/5/NCBR/2016

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<http://www.spectro-lab.pl/>



Air Products touches the lives of consumers around the globe in positive ways every day. With approximately 16,000 employees and operations in 50 countries, we serve customers across a wide range of industries, including refining, chemical, metals, electronics, manufacturing, and food and beverage. We supply a unique portfolio of atmospheric and process gases, equipment and services.

Specialty gases represent gases which are rare or ultra high purity (99.995% and above). Many industries, including analytical, pharmaceutical, electronics and petrochemical benefit from the unique properties of specialty gases that help to improve yields, optimize performance and lower costs. Our experienced applications teams around the world can use their knowledge of your industry and applications to provide you with a specialty gas supply solution to meet your unique needs.

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Business Development Supporter:

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Katarzyna Góra Jarosz M: 668464152

<http://www.airproducts.com.pl/>

WITKO Group offers complete laboratory supplies, solutions, and services. It was established in 1989 and successfully grew over the years. It is a family company, one of a 500 000 such family companies in the first generation in Poland. Through all the 30 years of experience WITKO has contributed to improvement of Polish R&D institutions significantly and helped them achieve world standards. The innovative solutions in our portfolio include evaporation processes, synthesis, process development, modern lab design, expert consultations and service.



WITKO has been performing its mission, which main aim is to improve the innovativeness of Polish research and development facilities while supplying laboratories with the latest equipment, technologies, design and solutions. The strategic goal of WITKO is to provide products and services that meet the requirements and expectations of even the most demanding customers.

The offer of WITKO includes:

- chemical reagents,
- scientific and laboratory equipment,
- accessories and consumables,
- counselling in terms of selection of the equipment, laboratory furniture and reagents,
- authorized service, IQ / OQ / PQ qualifications,
- equipment calibration,
- safety solutions,
- laboratory design.

Our organization is divided into a number of functional areas such as: Reagents Department, Equipment Department, Department of Designing and Construction of Laboratories, Department of Molecular Biology and Biotechnology, Service Department, Customer service office, Logistics Department, Scientific representatives and Sales Support Department.

WITKO Group employs scientific and sales representatives operating in various cities in Poland, product managers, service engineers, logistics team, many people with a PhD in chemical or biological sciences.

Our services go far beyond delivering goods to laboratories. Due to years of experience in planning, designing of laboratories, and consultancy we not only equip laboratories in accordance with the requirements of user specifications, but we are able to coordinate all design work for investment industries and develop technological guidelines for such fields as architecture, ventilation, sanitary and electrical installations, or technical gases.

Since 2014 WITKO has gained, implemented and maintained Quality Management System in accordance with the PN-EN ISO 9001: 2015 and AQAP2110: 2016 standards, which ensure the construction of long lasting, mutually beneficial relations with our clients.

WITKO has been rewarded with numerous prizes, which, among others, include the following: "Friend of the Faculty of Chemistry at the Lodz University of Technology 2018" (2018) - an award for the cooperation in creating a good image of the Faculty of Chemistry in Poland and worldwide; Diamond of the Polish Economy (2017); Medal of recognition of the Presidium of the Committee of Analytical Chemistry of the Polish Academy of Sciences for the development of analytical chemistry in Poland and worldwide (2013); "Certificate of Reliability" awarded by the National Debt Register (2011).

WITKO has recently modernized its website and an online store, where you can browse products by an alphabetical index, search for products in catalogs, along with functions to facilitate the process of searching, or comparing products. One can also get a specially dedicated option to log in individually.

<https://www.witko.com.pl/>

MS Spektrum



MS SPEKTRUM is a company offering comprehensive solutions in the field of chemical analytics.

We cooperate with a number of companies producing accessories, consumables and auxiliary devices. This allows us to offer you an exceptionally comprehensive and consistent offer with a guarantee of immediate delivery of everything that is necessary to perform chemical analyses and obtain a reliable result.

We have been an authorized distributor of:

- Bruker Optik GmbH: FTIR routine and research spectrometers and microscopes; NIR spectrometers for pharma food and feed industry, Raman spectrometers and microscopes, vacuum FIR/THz spectrometers, imaging spectrographs and monochromators, gas analysers
- BWB:
 - flame photometers
 - standards and consumables (measuring flasks and plastic receptacles, pipettes, gas hoses, etc.)
- Spex:
 - cryomills, mixer mills, extractor/homogenizer
 - very wide range standards and reference materials, including sets of standards/solutions dedicated both to specific methodologies and instrumental applications such as: calibration verification, checking (control) standards, interference testing standards, blind samples, fortification solutions, internal standards, matrix modifiers, ionization buffers, isotopic standards, etc
- Katanax: fusion machines, fusion fluxes
- SolarLight: SPF analyzers for pharma and cosmetic industry
 - Hellma: a wide range of cuvettes and validation filters for UV-Vis spectrophotometers
 - Photron: excellent cathode and deuterium lamps
 - Applied Spectra: laser ablation, LIBS
 - and more others.....

Cooperation with a reputable company Trajan (formerly SGE Analytical Science) a manufacturer specializing in accessories for chromatographic techniques (GC and HPLC) allows us to offer you undoubtedly the best columns and syringes for chromatography in the world.

Another example of our offer are special devices for washing laboratory glass and sub-distillers for obtaining ultra-pure acids. The ambition of our company is to provide you with not only the ordered equipment. Our specialists will help you choose the equipment and adapt the offer to your specific analytical requirements. We also offer group or individual analytical trainings in the Application Laboratory. This will make it easier for you to quickly develop your own analytical methodologies. We are not only equipment supplier but also have well trained service engineers which have big experience. Service Office assists in the implementation of installation requirements, provides professional post-installation training and reliable and efficient warranty and post-warranty service.

<https://www.msspektrum.pl/>



For almost 30 years we have been giving proof, that the key to understanding the world around us is technology. It is the only way to see more, reach further. That is why, **Testchem** specializes in producing professional laboratory equipment, which makes the life of researchers around the world, easier. We owe our success to one person - Tadeusz Glenc PhD - a renowned scientist, determined researcher, inventor and founder of **Testchem**, who has passed on to us his curiosity. It is he who, since the very beginning, pushed us to search for newest, more efficient solutions, which today find use in organizations across the world and in different business sectors. We can boast long lasting relations with esteemed laboratories, factories, leading research institutes, power plants and universities. We are proud to be their valued advisor and supplier.

Since the very beginning, our primary goal was to find the truth hidden in the world around us. We know that getting to the essence, demands from us to break the matter down into the smallest pieces, to give each element a closer look, to get to know it in detail. In order to reach our goal we make use of contemporary technology, our own patented devices and verified solutions. Thanks to our assiduity/tenacity and a natural curiosity we are today an international supplier of efficient, precise and effective devices for laboratories and various industries.

Throughout whole of our history in **Testchem** we have meticulously defined our priorities and found our area of expertise. Our products for gathering and preparing representative lab samples, such as: laboratory grinders, crushers, presses or cooling systems, constantly gain renown in serious companies around the world, and the satisfied customers come back for more. Why? Because we offer exactly what they demand – tailor-made solutions, adapted precisely to their unique needs.

However our offer exceeds that. We are constantly on the path of development, and on it we seek companies like ours – competent partners, who will put their knowledge to work in order to elevate our clients. This approach has brought us to collaborate with Rigaku - a well-known manufacturer of world's highest class X-rays spectrometers and diffractometers, as well as Nippon Instruments Corporation, which supplies industries with instruments which analyze mercury content in various materials. Today we are the sole agent of these two companies in Poland.

Quality, precision and flexibility – these are the values which we follow in our everyday life, both in the production halls, and in business. Many companies around the world have verified that this model works, and works well. To this day our products facilitate the operation of laboratories, factories, science facilities, power plants, and universities in several countries around the world.

We invite you to cooperation and visit our website:

<https://testchem.pl/>



Merazet S.A. has been operating on the market of control and measuring equipment since 1952. We are an authorized partner and distributor of devices from many domestic and foreign manufacturers. We work with scientific and research centers, state institutions, universities and companies all over Poland. The combination of knowledge and experience with modern management makes the company one of the leading suppliers of specialized equipment in the country. **Merazet S.A.** traders have extensive technical knowledge, provide professional support during shopping to tailor the offer to customer requirements.

We also have many years of experience in handling public procurement. We have our own warehouse, thanks to which the delivery time is extremely short. We also have a service and measuring laboratory that provide calibration, inspection and warranty repairs and post-warranty. Long-term cooperation with leading equipment suppliers allows us to offer devices of the highest quality at competitive prices. As experts in the field of control and measuring equipment, we also offer specialist consultancy. In the showroom in Poznan you can see and test selected instruments.

We are also happy to visit our customers presenting the operation of devices in the field and helping in the selection of appropriate solutions. We support our clients also during the operation of devices. A team of service engineers is available for commissioning, maintenance training, inspections and repairs. An internal measuring laboratory ensures periodic calibration of purchased devices.

The high quality of our services is confirmed by the international ISO 9001 certificate awarded and monitored by the certification organization Tüv Nord. **Merazet S.A.** from 2017 became the sole distributor of ICP-OES, ICP-MS, AAS, ContrAA, UVVis, TOC and elemental analyzers from Analytik Jena in Poland. Merazet S.A.'s offer there are over 6000 products and services in the field of laboratory equipment, equipment for construction and geodesy, industrial automation and electric control and measuring apparatus.

The offer of the laboratory department includes: - amino acid analyzers, particle sizes, elemental analyzers, AOX / TOX / EOX, mercury, foam, voltage surface, TOC; - autoclaves, sterilizers, dryers, incubators, CO2 incubators, furnaces, arc furnaces; - colorimeters, photometers, turbidity meters, pumps and vacuum evaporators; - climatic, temperature, salt, laminar chambers, insulators, UV lamps; - conductivity meters, pH meters, oxygen meters, ion meters, osmometers; - viscometers, rheometers, melting point meters polarimeters, refractometers; - baths, thermostats, ultrasonic cleaners, grinders, crushers, sieves and screens; - microscopes and microscope cameras, magnifying glass; - portable devices for precise plant measurements; - spectrophotometers, Raman spectrometers, emission spectrometers ICP-OES, ICP-MS; - scales, moisture analyzers, centrifuges, liquid nitrogen tanks.

www.merazet.pl



Polygen is a Polish company specializing in the sale of chromatography instruments and accessories from highly recognised international companies.

Polygen has been active on the Polish market since 1995. From the very beginning the company was specializing in delivery of a broad range of liquid chromatography instruments, columns and accessories. Polygen represents the leading companies in the fields of **HPLC/UHPLC**, **FLASH** and **GPC/SEC**: Thermo Scientific, Wyatt Technology, Interchim, Tosoh Bioscience, Showa Denko (Shodex), Macherey-Nagel, La-Pha-Pack, VICI Jour Research, Recipe, Biotech, Chrom4, and S.C.A.T.

In addition, **Polygen** offers other kind of devices, like: GONOTEC osmometers, CMA Microdialysis AB microdialysis equipment, F-DGSi gas generators and Riggttek Dissolution Test Systems (DissoPrep, Sampilio, easyDISS).

Company offers also expert service, validation, consultancy and training courses.

Contact: phone: +48 32 238-81-95, e-mail: polygen@polygen.com.pl.

We invite you to cooperation and visit our website:

www.polygen.com.pl



We Simplify Science

CEM is based on the principle that continuous innovation aids in the development of new ideas. As pioneers in microwave chemistry, we enjoy thinking outside of the box. We have been designing laboratory instrumentation and scientific methods since 1978 to meet the needs of chemists in areas such as food testing, sample preparation, and synthetic peptide research, most of whom work for major companies, prestigious research institutes, and universities around the world.

We are pioneers in the field of microwave energy for peptide synthesis, initially creating the first commercially available microwave for peptide synthesis and demonstrating its application. Since that time, **CEM** has steadily raised the bar with advanced methodology, novel instrument development, and reagents that make peptide synthesis easier, cleaner, and faster.

We design and manufacture all of our systems (both microwave and non-microwave) and are the leading provider of microwave instrumentation world-wide. Our patent portfolio is extensive, with over 300 patents. The products we design and manufacture have won 11 R&D 100 Awards and the Presidential Green Chemistry Award. Our support is unparalleled, with sales and service support around the world and applications support directly from product specialists.

Markets served by **CEM** products include: pharmaceutical & biotechnology, chemical, food processing & testing, environmental testing, academic, nutraceuticals, personal care/health & beauty, plastics & polymers, paper & pulp, wastewater treatment, and materials science. **CEM** equipment is used for testing the food we eat, the soil and water we play in, medicines that save our lives, and the consumer products we use every day.

Headquartered just outside Charlotte, NC with distributors around the world and subsidiaries in the United Kingdom, France, Germany, Italy, and Japan, **CEM** is truly a world-wide company dedicated to meeting the needs of our customers.

<http://cem.com/>

EMEC20 Scholarships

On behalf of the organizing committee is our pleasure to officially announce that three early stage researchers had already been awarded a scholarship to attend the annual 20th European Meeting on Environmental Chemistry (EMEC) in Łódź. The scholarships are funded by the Association for Chemistry and the Environment (ACE) and cover the conference fee, travel as well as accommodation costs connected with the participation in EMEC20 meeting.

Mr. Filipe Rocha, Early Stage Researcher, University of Porto

Ms. Balpreet Kaur, Early Stage Researcher, Tallinn University of Technology

Ms. Tahereh Soleymani-Angili, Early Stage Researcher, Lodz University of Technology

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