TURKISH CHEMISTS SOCIETY

EnviroChem

5. INTERNATIONAL ENVIRONMENTAL CHEMISTRY CONGRESS

30 October - 02 November 2023
ANTALYA TÜRKİYE

ENVIROCHEM 2023
Proceedings Book

TÜRKİYE

Dear Participants and Colleagues,

We are pleased to introduce the Proceedings Book of the 5th International Environmental Chemistry Congress (EnviroChem), which took place from 30th October to 2nd November 2023, in the beautiful location of Antalya, Türkiye. Organized by the Turkish Chemists Society in collaboration with Izmir Institute of Technology, Bolu-Abant İzzet Baysal University, and Gazi University, this conference is a testament to our collective dedication to progressing environmental chemistry research and promoting global cooperation.

This publication encapsulates the wealth of knowledge, interesting research, and stimulating discussions that transpired during the congress. With its inception in 2018 as the 1st Eurasian Environmental Chemistry Congress, followed by the 2nd, 3rd, and 4th International Environmental Chemistry Congresses in 2019, 2021, and 2022 respectively, EnviroChem has transformed into a leading platform for the interchange of ideas among scholars, researchers, and practitioners worldwide.

This Proceedings Book contains contributions from ten distinguished invited speakers and over a hundred researchers from 14 different countries, all adding a unique perspective on the overarching theme of Environmental Chemistry.

We sincerely thank all contributors for their dedication and enthusiasm have greatly enhanced the discourse on environmental issues. Additionally, we extend our sincere gratitude to our sponsors, namely—**IZEL KİMYA (main sponsor), Metrohm, BGB, Altium, Solenis, Referans Kimya, Lita Analytical, Teknoparkizmir, as well as** our supporters-**ChromaScience, Terra, Ant-Teknik, Sinerji, Odak Kimya, Rayess, Biem, Ihlamur Konağı, Marina Mekanik** for their unwavering support in making EnviroChem 2023 a resounding success.

As you read through the following pages ahead, you may discover inspiration and valuable insights that contribute to the ongoing dialogue and advances in the dynamic field of Environmental Chemistry. We would like to express our utmost appreciation to Assoc. Dr. Ali ALKAN who supported us throughout this Congress. Furthermore, we thank the Organizing Committee and our graduate students for their endeavors in ensuring a successful event.

Best Regards,

Prof. Dr. Aysun SOFUOĞLU-Chair

Prof. Dr. Gülay BAYRAMOĞLU Co-Chair

Prof. Dr. Serpil YENİSOY-KARAKAŞ Co-Chair

Amara Luxury Hotel and Villas
Göynük-ANTALYA/TURKİYE
2023

ENVIROCHEM-2023 was supported by The Scientific and Technological Research Council of Türkiye (TÜBİTAK) with 2223-B Support Programme for Scientific Activities

COMMITTEES

Congress Chair

Prof. Aysun SOFUOĞLU	İzmir Institute of Technology, TÜRKİYE

Congress Co-Chairs

Prof. Gülay BAYRAMOĞLU	Gazi University, TÜRKİYE
Prof. Serpil YENİSOY KARAKAŞ	Bolu Abant İzzet Baysal University, TÜRKİYE

Congress Secretary

Mesut GENİŞOĞLU	İzmir Institute of Technology, TÜRKİYE

Scientific Committee

Prof. Abdurrahman BAYRAM	Dokuz Eylül University, TÜRKİYE
Prof. Ahmet EROĞLU	İzmir Institute of Technology, TÜRKİYE
Prof. Ali OLAD	University of Tabriz, IRANIAN
Prof. Antony C. CALOKERINOS	National and Kapodistrian University of Athens, GREECE
Prof. Ayşe Müge ANDAÇ	Hacettepe Unıversity, TÜRKİYE
Prof. Aydın AKBULUT	Hacettepe Unıversity, TÜRKİYE
Prof. Duran KARAKAŞ	Bolu Abant Izzet Baysal University, TÜRKİYE
Prof. Elia PSILLAKIS	Technical University of Crete, GREECE
Prof. Eric LICHTFOUSE	Aix-Marseille University, FRANCE
Prof. Ersin GÜLER	Selçuk University, TÜRKİYE
Prof. Esra YEL	Konya Technical University, TÜRKİYE
Prof. Filiz ŞENKAL	İstanbul Technical University, TÜRKİYE
Prof. Güray SALIHOĞLU	Uludağ University, TÜRKİYE
Prof. H. Aytekin ERGÜL	Kocaeli University, TÜRKİYE
Prof. İlkay AÇIKGÖZ ERKAYA	Ahi Evran University, TÜRKİYE
Prof. Irina KARADJOVA	Sofia University, BULGARIA
Prof. M. Angeles SANROMAN BRAGA	University of Vigo, SPAIN
Prof. Mustafa SOYLAK	Erciyes University, TÜRKİYE
Prof. Neval BAYCAN	Dokuz Eylul University, TÜRKİYE
Prof. Nigar ALKAN	Karadeniz Technical University, TÜRKİYE
Prof. Nuray ÇAĞLAR	İstanbul University, TÜRKİYE
Prof. Nurdan BÜYÜKKAMACI	Dokuz Eylul University, TÜRKİYE
Prof. Perihan KURT-KARAKUŞ	Bursa Technical University, TÜRKİYE
Prof. Rashid AHMAD	University of Malakand, PAKISTAN
Prof. Ryszard LOBINSKI	Equipe de Chimie Analytique Bio-Inorganique CNRS, FRANCE
Prof. Sezgin BAKIRDERE	Yıldız Technical University, TÜRKİYE
Prof. S. Sıddık CİNDORUK	Uludağ University, TÜRKİYE
Prof. Sinan KESKIN	Marmara University, TÜRKİYE
Prof. Trajce STAFILOV	SS Cyril Meth University, MACEDONIA
Prof. Yücel KADIOĞLU	Atatürk University, TÜRKİYE
Prof. Zafer YAZICIGİL	Selçuk University, TÜRKİYE
Prof. Zehra Semra CAN	Marmara University, TÜRKİYE
Prof. Zeynep CEYLAN	Atatürk University, TÜRKİYE
Prof. Zeynep EREN	Atatürk University, TÜRKİYE

Assoc. Prof. Elmina GADIROVA	Baku State University, AZERBAIJAN
Assoc. Prof. Gábor MAASZ	Pannonia University, HUNGARY
Assoc. Prof. Nassiba BAIMATOVA	Al-Farabi Kazakh National University, KAZAKHISTAN
Assoc. Prof. Nazlı PAKDIL	Bolu Abant Izzet Baysal University, TÜRKİYE
Assist. Prof. Hale DEMİRTEPE	İzmir Institute of Technology, TÜRKİYE
Assist. Prof. Pınar SEVİM ELİBOL	Düzce University, TÜRKİYE
Assist. Prof. Yetkin DUMANOGLU	Dokuz Eylul University, TÜRKİYE
Assist. Prof. Serhad TİLKİ	Amasya University, TÜRKİYE
Dr. Nuno RATOLA	University of Porto, PORTUGAL
Dr. Vera HOMEM	University of Porto, PORTUGAL
Dr. Elif CERRAHOĞLU KAÇAKGİL	İzel Chemistry Inc., TÜRKİYE
Dr. Hatice KARADENIZ	Bolu Abant İzzet Baysal University, TÜRKİYE

Organizing Committee

Prof. Sait Cemil SOFUOGLU	İzmir Institute of Technology, TÜRKİYE
Dr. Cemil DİZMAN	İzel Chemistry Inc., TÜRKİYE
Çağrı ŞAHİN	İzmir Institute of Technology, TÜRKİYE
Esin BALCI	İzmir Institute of Technology, TÜRKİYE
Hatice KILINÇ	Bolu Abant Izzet Baysal University, TÜRKİYE
Ayşe Gül ÇİMEN	Gazi University, TÜRKİYE
Feyza YALÇIN	Haliç Çevre Laboratury, TÜRKİYE
Ümit Güven ULUSOY	ASKİ, TÜRKİYE
Chemist, Nilüfer KUTUROĞLU	Ministry of Environment and Urbanization, TÜRKİYE

Steering Committee

Assoc. Prof. Ali ALKAN	Karadeniz Technical University, On Behalf of Turkish Chemist Society
Assoc. Prof. Ahmet DEMİRAK	Muğla Sıtkı Koçman University
Prof. Münevver SÖKMEN	Konya Food and Agriculture University (1st EnviroChem Congress Chair)
Prof. Bekir SALİH	Hacettepe University (2nd EnviroChem Congress Chair)

Congress Owner (On Behalf of Turkish Chemist Society)

Chemist İkram CENGİZ	Head of Turkish Chemist Society

INVITED SPEAKERS (IS)

ORAL PRESENTATIONS (OP)

SHORT ORAL PRESENTATIONS (SOP)

POSTER PRESENTATIONS (PP)

IS – 1

How PFAS are threatening our daily life

Jacob de BOER

Vrije University Amsterdam, the Netherlands

jacob.de.boer@vu.ni

Because of their unqie water and dirt repellant properties, per- and polyfluorinated alkyl substances (PFAS) are being used in many different and often useful applications, such as in fire extinghuisers, cosmetics, ski wax, non-stick cookware, glues, protective layers on carpets and furniture, fast food packaging materials, etc. However, PFAS belong to the most persistent synthetic chemicals on earth. The C-F bond in these compounds is so strong that effectively no degradation takes place. Because these compounds are also mobile, they have meanhwile been distributed worldwide. In 2020, the European Food safety Agency (EFSA) has published a new opinion on PFAS. Especially because of the results of a study on immunotoxicity by Grandjean et al. the maximum permissible levels of PFAS in the human body have 1,000-10,000-fold decreased. This has led to concern about PFAS levels in fish and drinking water in Europe. At several places in the world the production of per- and polyfluorinated alkyl substances (PFAS) has led to very high levels of these compounds in the neighbourhoods of PFAS producing plants. Recently, we found high PFAS levels near manufacturing plants in Antwerp, Belgium, and Lyon, France. The analysed matrices included a number of human serum samples, human milk, fish, sediment, air, surface water and tap water. The data were compared to earlier environmental samples taken near a PFAS plant in Dordrecht, the Netherlands.

A set of 17 PFAS was determined in all samples. The analysis included an extraction and cleanup, dependent of the matrix (for blood: extraction with acetonitril and Oasis-Wax SPE with 2M ammoniumformate and methanol/acetonitrile (1:1, v/v), followed by LC-MS/MS analysis on an LC-Sciex Exion LC AD coupled to a Sciex 6500+ triple-quad MS, using an Xbridge BEH C18 XP 150 x 2.1mm, 2.5 μm column and electrospray ionisation).

The safe level of PFAS in human blood is based on the sum of four PFAS congeners: PFOA (perfluorooctanoic acid), PFOS (perfluorooctane sulfonic acid), PFHxS (perfluorohexane sulfonic acid) and PFNA (perfluorononanoic acid). This sum should not be higher than 6.9 μg/L. The maximum value found in our study was 1154 μg/L for the sum of these four PFAS in Antwerp, which is 167-fold the safe value. Most of these persons consumed vegetables or fruit from their own gardens and/or ate eggs from their own chickens. PFOS (and PFOA) have already been banned since around 2012. This is, therefore, most likely a historic pollution. High PFOS levels in soil were discovered when a new section of the ring road around Antwerp was constructed and more than 2 million m^3 of soil was excavated, of which a part was close to the premises of 3M. Based on these results a larger study on PFAS in human blood was initiated by the Flemish authorities in 800 persons living within a circle of 3 km around the 3M site. That study confirmed the here presented results. 93% of the PFAS concentrations found in the larger study exceeded the EFSA guidelines of 6.9 μg/L. In Lyon, where PFAS are being produced for use in batteries of electric cars, different PFAS patterns were found but levels in human milk were all ca. 25-fold higher than the EFSA recommendation. Little difference was found between PFAS levels in surface water and drinking water. In both cases, and in Dordrecht, a circle of at least 5 km around the plants shows seriously elevated levels of PFAS in humans, and environmental matrices. The present results show many similarities with other cases of PFAS pollution such as the Parkersburg case, the 3M plant in Decatur City, AL, USA and the Veneto area, Italy. In case of Teflon® production PFOA is the dominant PFAS in blood and local environmental samples, whereas in case of other PFAS production such as in Antwerp and Lyon, the dominant compounds were PFOS and 6:2 FTS (6:2 fluorotelomer sulfonic acid), dependent of the matrix analysed. The high PFAS levels found more than 20 years after production show the high persistence of these compounds. A proposal to ban all PFAS compounds is currently under discussion by the Europe.

IS – 2

From green to democratic Analytical Chemistry

Miguel de la GUARDIA

University of Valencia

miguel.delaguardia@uv.es

The contributions of our research team in the field of Green Analytical Chemistry are presented highlighting the main aspects of direct analysis of samples through infrared spectroscopy, both, in the middle and near range, and their use to obtain clinical data from serum samples of patients through the employement of portable instrumentation, wifi and chemometrics. So, providing a way to extend clinical analysis to the developing areas.

On the other hand, the tremendous possibilities offered in sample analysis by using smartphones are considered with its application in food analysis, from the determination of global parameters, as fish freshness, to the particular parameters of natural or processed foods. An additional aspect considered was the sample treatment by using domestic microwave ovens and hard cup Nespresso machines.

In the case of microwave-assisted treatments, the use of domestic unmodified ovens permits the on-line sample treatment and also portable ovens can be used to made in-field determination of essential oils in plants. Regarding hard cup espresso machines, stainless steel cups can be filled with samples making a fast extraction of different compounds in few minutes at relatively high temperature and pressure. In both cases, the use of common domestic apparatus permits to improve sample treatments in an easy way.

It will be also commented the possibilities offered by low cost portable sensors for the indoor determination of gases, vapors and particles and their use in biomonitoring of the effects on the human breath of the quality of air.

Many of the aforementioned contributions clearly shown the use of low cost and easily available tools to obtain analytical data and solve actual problems, thus offering tremendous advantages for unexperienced people in order to obtain results suitable to be spread through the social nets and creating the conditions for a new paradigm of Analytical Chemistry, the so called Democratic Analytical Chemistry; which offer a lot of advantages but is not free of problems.

The novel Democratic Analytical Chemistry involves the fact that employed instruments are easily available all around the world and that, based on the use of free licensed software and smartphones, every citizen can do himself the instrumentation required to obtain data and that these results could be distributed outside the control of scientific journals and societies. So, it will be possible to integrate many data but serious drawbacks arise from the lack of a good level of education of many practitioners and the possibility to distribute wrong data. However, we must think that it will be one potential scenario in a near future and make appropriate actions to avoid deleterious effects.

IS – 3

Recovery of Li from geothermal resources by adsorption using MnO_2 polymorphs as sorbent material

Seyra Toprak[a], Berk Akgün[b], Alper Baba[c], Mustafa M. Demir[a,*]

[a]Department of Materials Science and Engineering, [b]Department of Chemical Enginering, [c]Deparment of Civil Engineering, İzmir Institute of Technology, 35430, Gülbahçe, Urla, İzmir, Türkiye

*mdemir@iyte.edu.tr

Lithium is an industrial mineral with a constantly increasing demand in the manufacture of vaious materials mainly batteries and its feasibility of being obtained from natural sources is steadily increasing. Geothermal waters having much more concentration of lithium compared to seawater and underground water sources is already a concept that has begun to be exploited commercially. The uptake of Li from a running geothermal power plant in situ without distubing the energy harvesting is a big challange. *In the first part of the talk*, uptake of Li from both synthetic and geothermal waters by adsorption process will be mentioned. Among many others, adsorption is a method that can be readily applied to geothermal power plants. MnO_2 is a well-recognized selective sorbent material for Li ion. The size of room in crystal lattice is comparable with the size of Li-ion in solution. MnO_2 has six polymorphs, ϒ- and λ- are the two commercially available ones having selectivity to Li^+, where λ- is one of the spinel forms of MnO_2. In this work, a mini-pilot system is established nearby in reinjection well of a representative filed, Tuzla Geothermal Power plant. ϒ-MnO_2, which is originally used in battery technology, is examined for its recovery performance. The oxidic power is treated with brine from 1-24 h. Brine-treated oxidic powder is desorbed in aqueous acidic environment to take Li into a decantate solution. The sorption capacity of ϒ-MnO_2 was found 8.1 mg/g. The concentration of Li in desorption medium is 25 ppm on average. The decantate solution is treated with brine-treated powder 4 times and the concentration is enriched to >200 ppm, which is still below solubility of Li-compounds. To improve the performance of the system to achieve precipitation of Li containing compound for instance Li_2CO_3, the uptake performance of another commercially available polymorph λ-MnO_2 was examined. The sorption capacity was found 21.2 mg/g, which almost triple of that of ϒ- MnO_2. The field experiments are in progress. Pricewise, commercial ϒ- MnO_2 and λ-MnO_2 cost 3 $/kg and 140 $/kg, respectively. There is a factor of almost 50 in price while the uptake performance has 3 times higher for λ-MnO_2. An attempt has been made to apply a phase change of ϒ-MnO_2 to spinel type MnO_2, i.e. chemical reaction starting from ϒ-MnO_2 and treated with LiOH to yield spinel MnO_2. The phase change is proved by XRD. This simple reaction allowed to increase sorption capacity 23.2 mg/g, nearly three times that of ϒ-MnO_2 and almost same as the commercial λ-MnO_2. *In the last part of the talk*, I will be presenting the application of this MnO_2 powder on a polyurethane (PU) substrate such that Li uptake can be performed by a flexible material. A fibrous PU mat was obtained by electrospinning from dimethyformamide solution. MnO_2 dispersion from water is sprayed onto the surface of mat. The resulting composite material is treated with Li-solution with multistage filtration. While single layer filtration has 21% performance, it is increase to 77% using 5 layers of multistage filtration. Uptake performance was tested using natural salt-lake water containing >200 ppm Li. The performance is achieved upto 14% in a spiked brine sample from Lake Tuz (Central Anatolia, Türkiye), where Mg^{2+}/Li^+ ratio is higher than 85. This potential application of this approach to enrich other valueable metal ions such as Sr will also be mentioned in the talk.

This work was supported by the European Research and Innovation program ''CRM- geothermal- Raw materials from geothermal fluids: occurrence, enrichment, extraction'' (project number: 101058163)

IS – 4

Polycyclic aromatic compounds in the environment – distribution and transports

Gerhard LAMMEL

Max Planck Institute for Chemistry, Multiphase Chemistry Dept., Hahn-Meitner-Weg 1, 55128 Mainz, Germany
Masaryk University, Faculty of Science, RECETOX, Kamenice 5, 62500 Brno, Czech Republic

g.lammel@mpic.de

Many polycyclic aromatic hydrocarbons (PAHs) and their nitrated and oxygenated polycyclic aromatic hydrocarbons (NPAHs, OPAHs) are toxic and ecotoxic [1-4]. NPAHs and OPAHs are co-emitted with PAHs from fossil fuel and biomass combustion processes, or are formed in photochemical and microbiological reactions of PAHs in air and soil [3, 5-6]. Despite laboratory and field studies of these pollutants' sources, photochemistry and occurrence in air, little is known about atmospheric lifetimes and environmental fate on large spatial scales. As semivolatiles resisting biodegradation in soils and surface waters, their long-range transport potential is enhanced by multihopping (grasshopper effect) [5, 7].

Features of large-scale distributions and atmospheric cycling of selected PAHs and NPAHs are highlighted based on recent advances in modelling of sources, transports and photochemistry [8-10]. The distributions and exposure of remote environments, including the open oceans to a number of health hazardous NPAH and OPAH species have also been studied based on monitoring [11-12] and field experiments [13]. Some NPAH and OPAH compounds are found to be globally distributed. The multihopping potential was explored in soils of source and receptor sites, and in surface seawater.

References:

1) IARC Monographs on the Evaluation of Carcinogenic Risks to Humans 92. **2019**, 1–852.
2) Rengarajan et al., Asian Pac. J. Trop. Biomed. **2015**, 5, 182–189.
3) Bandowe et al., Sci. Total Environ. **2017**, 581-581, 237-257.
4) Nováková et al., Environ. Int. **2020**, 139, 105634.
5) Keyte et al., Chem. Soc. Rev. **2013**, 42, 9333-9391.
6) Wilcke et al., J. Environ. Qual. **2021**, 50 ,717-729.
7) Mulder et al., Atmos. Chem. Phys. **2014**, 14, 8905-8915.
8) Mu et al., Sci. Adv. **2018**, 4, aap7314.
9) Wilson et al., Environ. Sci. Technol. **2020**, 54, 14224–14234.
10) Mulder et al., Environ. Sci. Technol. **2019**, 53, 8914-8924.
11) Nežiková et al., Chemosphere. **2021**, 269, 128738.
12) Wietzoreck et al., Environ. Geochem. Health. **2022**, 44 ,2743-2765.
13) Wietzoreck et al., Atmos. Chem. Phys. **2022**, 22, 8739-8766.

IS – 5

Biorefinery concept for circular cities: next generation municipal wastewater treatment plants

Zeynep ÇETECİOĞLU-GÜROL

Department of Industrial Biotechnology, KTH Royal Institute of Technology, Stockholm, Sweden

zeynepcg@kth.se

Environmental sustainability is a global goal today and to accomplish it, transition into a circular economy that includes resource recovery, reuse and recycling is essential. Microbial biotechnology is one of the imperative areas to provide sustainable processes for both industrial applications such as food processing-dairy, alcoholic beverage, pharmaceutical, and environmental applications such as municipal wastewater treatment, bioremediation of oil spillage, production of bio-based products from waste streams etc. Despite the promising developments, two main challenges left in this area are obtaining pure products and increasing production efficiency. Even the mono-microbiome (pure culture/single microbial strain) processes produce multiple end products because of the complex microbial pathways.

As a carbon-neutral alternative, fermentation is a well-established bioprocess to obtain specific products such as alcohols, pharmaceuticals, fatty acids etc. from specific substrate and waste streams in which mixed microbial communities (naturally complex mixed culture), that turn waste streams into functional carbon sources, are used. However, the mixed culture systems, which are also called “black-box” systems, are operated by engineering parameters because of the lack of information on microbial ecology. Despite mixed culture applications have many advantageous such as easy operation and higher production efficiency in bioreactors, they result very complex products in fermentation broth.

Therefore, identification of mixed microbiome, and construction of synthetic mixed community are very crucial for next generation biorefinery concept to achieve United Nations Sustainable Development Goals.

IS – 6

Sustainability in the bedding industry: Challenges and opportunities

Emirhan YETERLER

URAL Group, Türkiye

emirhanyeterler@uralmedical.com

Ural Group was founded in 1996 as Turkey's first producer of Visco elastic memory foam and has since become one of Europe's top manufacturers of molded gel and Visco elastic memory foam mattresses, toppers, layers, and pillows. Located in Istanbul at a perfect geographical location, to be visited in a convenient three-hour flight distance from the European continent, Middle East, and North Africa, we can ship by land and sea and deliver in just a few weeks time.

Many people around the World have experienced Ural Group's high-quality memory foam products in over 40 countries. Our product variety has significantly evolved over the years, becoming a wide range for any demand, as our customer-oriented short-line service is formed in line with their needs. In addition to end-user products, Ural Group produces visco elastic memory foam according to the demanded features for the manufacturing of the other sectors.

As Turkey's first "Visco" memory foam mattresses and pillow manufacturer, an overview of the production of memory foam mattresses and pillows will be presented. In this context, with emphasis on environmental chemistry within the production processes, evaluations will be made on the comparison of product production with the new generation technique with textiles produced by traditional methods and their recycling. Additionally, current experiences in the medical equipment industry will be shared, and sustainable practices implemented at Ural Medical will be discussed.

IS – 7

Plastic pollution and their impacts: Macro to microplastics in Rivers

Karla POZO

Masaryk University, Czechia

karla.pozo@recetox.muni.cz

Global plastics production has increased exponentially since the 1950s. As a result, global production reached approx. 370 million tons (Mt) in 2020. Microplastics pollution has become an emerging environmental risk on a global scale. Nowadays, the ubiquitous transboundary movement of plastic waste and microplastics to the ocean is one of the major global problems due to the alteration of natural ecosystems. Moreover, their durability keeps plastic particles in the environment for a long time.

There is now an estimated 30 Mt of plastic waste in seas and oceans, and a further 109 Mt has accumulated in rivers. Rivers constitute unique environments because they safeguard biodiversity and provides water resources. However, freshwater biodiversity is under significant threat, with declines of >90% in vertebrate populations. All plastics are made of chemicals, from basic polymers and solvents to, additives such as plasticizers, and others. Many of these chemicals are released throughout the plastic life cycle – from the production of polymers to the manufacturing, use, and disposal of plastics products – with potentially significant impacts on human health and the environment. Therefore, hazardous chemicals in recycled plastic compromise the transition to a circular economy model. Nevertheless, there is a poor understanding of such emerging impacts on aquatic environments, recycled materials, and human health. International efforts are in progress, with UNEA Resolution 5/14 entitled “End plastic pollution: Towards an international legally binding instrument” (INC). It is expected that by During INC-2, negotiators are expected to base their substantive discussions on a document containing potential options for elements towards a comprehensive approach that addresses the full life cycle of plastics as called for by UNEA resolution 5/14. There is an urgent need to strengthen global coordination, cooperation, and governance to take immediate action towards the long-term elimination of plastic pollution in marine and other environments, and to avoid detriment from plastic pollution to ecosystems.

IS – 8

Potential impacts on air pollutants from future regional climate projections

Selahattin İNCECİK

Istanbul Technical University, Istanbul, Türkiye

inceciks@gmail.com

Air pollution and climate change are closely linked as all major pollutants have an impact on the climate and most share common sources with greenhouse gases. Both air pollution and climate change can have an impact on each other, and both can directly or indirectly affect health. The future climate is expected to be more stagnant. A weakened global circulation and a declining frequency of mid-latitude cyclones are projected. While climate change may affect how primary pollutants are dispersed, particularly particulate matter, it can also exacerbate the production of secondary pollutants such as surface ozone. For example, a warming atmosphere and sunny days can result in higher surface ozone concentrations. Rising ozone levels cause serious health problems, especially in the summer, and may lead to difficulties in complying with ozone air quality standards in the future. $PM_{2.5}$ can also affect the climate. For example, black carbon can absorb heat, thereby increasing local temperatures. Sulfate particles and other secondary particles help aerosols interact with clouds. In addition, ozone, an important secondary pollutant in the troposphere, is a highly reactive gas that interacts with both shortwave and longwave radiation. Tropospheric ozone is also a greenhouse gas that contributes to climate change by trapping heat in the atmosphere.

Future changes in ozone precursor emissions will be the result of complex interactions between photochemistry, transport mechanisms, and climate change. Therefore, a gradual reduction of pollutant emissions will improve air quality while reducing the negative consequences of climate change in the future. Policies on the SLCPs are important in this regard. However, the consequences of climate change on air quality vary around the world, particularly in low- and middle-income countries where air pollution levels are already high. Because of this situation, regional analyses are required.

In this study, the links between climate change and air pollution are discussed in detail. The results are based on future regional climate forecasts employing the IPCC RCP 8.5 emission scenario.

IS – 9

Atmospheric and Environmental Chemistry Laboratory (AECL), Turkiye's first reaction kinetics research facility: Experimental and computational reaction kinetics preliminary research results

Aşan BACAK

Turkish Accelerator and Radiation Laboratory, Ankara University, Türkiye

abacak@tarla.org.tr

Since the early laboratory experiments of Lawrence 1929, and Cockcroft & Walton 1930 accelerators have overgrown laboratory environments and become large scale research infrastructures. These infrastructures around the globe offer services to a fast-growing research community utilizing the radiation provided by particle accelerators and provide answers for humanities fundamental natural science questions.

The Earth's atmosphere is delicately balanced, supporting myriad life to exist on the surface. Yet, existence of human is challenging that balance, through stratospheric ozone depletion (Scientific Assessment of Ozone Depletion:2018 WMO), climate change (An IPCC Special Report on the impacts of global warming of 1.5°C 2018) and air pollution at the surface (World Cancer Report 2014 WHO). Air pollution is noted to be a leading cause of cancer (International Agency for Research on Cancer, 2013 WHO). Although the general principles leading to these problems are known to us, there is still much more to be understood about the complex Earth system.

Fundamental atmospheric science research is essential to direct humanity's transition from the use of polluting fossil fuel to a new generation of clean energy. Accelerator based light sources are advanced instruments which investigate atomic and molecular structures and their reaction kinetics as well as our understanding and our ability to control the matter on the levels of atomic, electronic and spin through particle accelerators with the framework of quantum mechanics.

In this talk I will discuss the use of accelerator facilities by experimental fundamental scientists and introduce Türkiye's first reaction kinetics laboratory the Atmospheric Chemistry and Environmental Laboratory (AECL) at Turkish Accelerator Radiation Laboratory (TARLA) and present my research groups recent research findings.

IS – 10

Global and Local Perspective on Water Management

Ayla ÖNGÖREN

Tüpraş Çevre Müdürlüğü, İstanbul, Türkiye

ayla.ongoren@tupras.com.tr

Abstract

Water is an essential resource for humans, the environment, and the economy. However, water resources are under increasing pressure globally. Factors such as climate change, population growth, agricultural production, and industrialization are leading to water scarcity and water quality degradation. This situation is leading to water becoming a global risk.

The ability of water to be available according to need; at the desired place, in the desired quality, at the desired time and in the desired amount, requires effective water management.

The sustainability of water requires the preparation and implementation of water management plans at the global, national, and local levels. The policies of sectors also play an important role in the sustainability of water.

Stakeholder communication, responsible action, and producing science and nature-based solutions are now a necessity.

Water as a Global Risk

The World Economic Forum's 2023 Global Risk Report ranks "Natural Resource Crisis" as the 9th among the top 10 short-term risks and the 6th among the top 10 long-term risks. Water is one of the most important natural resources that are at risk. In addition, the four long-term risks of climate change, extreme weather events, and biodiversity loss directly affect water and are affected by water[1].

Essential for Sustainability

According to the World Commission on Environment and Development, sustainability is meeting current needs without compromising the ability of future generations to meet their own needs. In 2015, 193 countries, including our country, agreed on the UN 2030 Sustainable Development Goals[2].

Effective water management is directly linked to five of the 17 Sustainable Development Goals: 6. Clean Water and Sanitation, 12. Responsible Consumption and Production, 13. Climate Action, 14. Life Below Water, 15. Life on Land. In addition, it is related to all other goals. For example, in rural areas, the task of carrying water to the house is usually assigned to women and children. This can lead to a number of problems, from the disruption of the right to education to health problems and gender inequality.

A First at COP: Water Day

On November 14 2022 “Water Thematic Day" was declared the first-ever in the 27th Conference of the Parties to the UN Framework Convention on Climate Change (COP 27), which was held in Sharm El-Sheikh, Egypt. Highlighted topics:

- Leadership and collaboration is needed with public, private sector, academia, NGOs, and all relevant stakeholders for water management.
- For effective water management, social solutions, as well as engineering solutions, should be implemented, taking into account local dynamics.
- Water access and water quality are the most important issues. Water should be managed holistically with distribution infrastructure, consumption quantity and quality.

- It is essential to allocate finance and manage it in a transparent way to prevent injustice in terms of water scarcity.
- Sustainable agricultural methods should be applied.
- It should be considered how everything that will be done upstream with water will affect downstream.
- Legislative opportunities should be created for the provision of water security, and short- and long-term scientific goals should be set.
- It is important to look at water from the perspective of the value chain and circularity.

UN Water Conference

The 2023 United Nations Water Conference was held at the UN Headquarters in New York from March 22-24, 2023. The three-day conference, hosted by the Kingdom of the Netherlands and the Republic of Tajikistan, took place forty-six years after the last major UN water conference (1977, Argentina).

The conference began with an emphasis on the fact that water is a common good that requires collective effort. The conference continued with the slogan "Our chance is here and now. We may not have another chance."

Water insecurity is one of the most urgent sustainability challenges of the 21st century, and it poses human, environmental, and economic concerns. More than 2 billion people lack access to safe drinking water, a 40% water deficit is projected by 2030 and ecosystems that protect water are experiencing rapid degradation. Climate change continues to significantly exacerbate these risks, increasing the urgency of action.

During the closing plenary, it was announced that a Special UN Water Envoy will be appointed by the UN Secretary-General in response to frequent calls from Member States to elevate water action on the UN agenda.

The Water Action Agenda included approximately 700 commitments in the form of financial commitments, joint projects, and actions to protect the world's most valuable and irreplaceable resource[3].

Turkey Water Efficiency Strategy

The Presidential Decree on the Water Efficiency Strategy Document and Action Plan, published in the Official Gazette on May 4, 2023, states that Turkey, which is located in the Mediterranean climate zone, is among the countries that will be most affected by global climate change, and that Turkey's water resources are expected to decrease by approximately 25% in the next century[4].

The document titled "Water Efficiency Strategy Document and Action Plan within the Framework of Climate Change Adaptation (2023-2033)", published under the coordination of the Ministry of Agriculture and Forestry, includes the current situation, bottlenecks, targets and action plans for water use efficiency in four areas: 1. Urban, 2. Agricultural, 3. Industrial, 4. Water Use Efficiency Affecting All Sectors.

Key points related to industry in the Action Plans:

It is aimed to achieve water savings of up to 50% by implementing clean production techniques and water efficiency measures in industry.

- Organizing technical training programs and workshops on a sectoral basis, and preparing water efficiency guide documents (2023-2025)
- Studies to determine specific water use ranges and quality requirements for sub-sectors in industry (2023-2030)
- Encouraging the separation of wastewater by source in industry and mandatory / encouraged use of wastewater in the facilities with the high cost-benefit ratio (2023-2028)

- Recording of groundwater wells used in industry and tracking of water use with a measurement system and integration with the National Water Information System (2023-2028)
- Completion of legal regulations regarding the use of high-precision meters in industrial areas, remote reading and monitoring of these meters (2023-2028)
- Implementation of a water pricing mechanism based on full cost (not only financial but also environmental and resource) and prioritizing water efficiency (2023-2028)[5] .

National Water Management

A national management system, the framework of it is determined by the Water Law, is necessary for the prevention of duplication in the comprehensive management of water in terms of quantity and quality, the implementation of basin-based management plans and the monitoring of water resources[6].

It is critical for the environmental and economic sustainability of our resources to work with the sectors in the stage of determining the need and creating an inventory at the sector level while making sectoral water allocations as stated in the Water Law draft.

Sustainable and spatial planning should be carried out by determining the water needs of investments in the development plans.

Legal infrastructure should be prepared to support symbiosis established for the efficient use, recovery, and reuse of water.

Measures should be developed in accordance with the EU acquis with a basin-based management approach; technologies to be established to meet discharge obligations should be technically feasible, financially accessible, and have no negative environmental impact[7].

Incentives and support mechanisms should be strengthened to accelerate the establishment of technological infrastructure for the recovery and reuse of treated wastewater.

Water for the Private Sector

Creditors, rating agencies, customers, shareholders, and internal stakeholders are now pressuring companies to take effective actions on sustainability. Water risk also affects the resilience and reputation of companies in terms of sustainability.

According to the CDP* 2020 Water Report, the cost of inaction on water risks appears to be more than 5 times the cost of taking action. According to the data of reporting companies, the financial impact after the risk has occurred is $300 billion, while the amount required to reduce these risks is $55 billion[8].

It is of great importance to work with water efficiency in mind in facility operations. Innovative technologies should be implemented. Effective and digital monitoring should be done, and any leakage should be intervened early. Treated water and rainwater should be reused repeatedly with recovery systems. The zero liquid discharge perspective should be taken into account by evaluating the life cycle concept.

Instead of freshwater sources, alternative water sources should be used. For example, if there is a municipal wastewater treatment plant near the facility, symbioses should be established to obtain process water by taking the discharge water.

Facilities should assess potential risks to water resources and develop plans to mitigate these risks. Continuous monitoring of the water quality of both the water withdrawn and the water discharged from the facility's treatment unit is important for the rapid detection and resolution of water pollution problems. The facilities must have environmental permits and comply with national/international regulations.

Providing training to facility employees, raising awareness, being transparent to all stakeholders, and developing partnerships will advance water management.

Best Available Techniques (BATs) should be examined to determine how water consumption should be in facilities. For example, according to the last published Oil and Gas Reference Document, the raw water consumption per ton of crude oil processed in the European refineries examined varies between 0.14 and 1.26 (tons/tons)[9]. It should be aimed to reduce this consumption to zero.

Zero raw water consumption is now among the commitments of companies. Companies are conducting internal water pricing by considering their materiality analyses, the water dependencies of their sectors and the water risks of the basins they are located in.

Companies that prioritize sustainability in their long-term strategies are now putting forward visions such as zeroing their ecological footprint, producing nature-based solutions and being water positive.

They are trying to provide integrated water management not only operationally, but also by developing partnerships with both supply chain and local communities.

As stated in the CDP Water Global Report 2022, the current status of 3,909 companies (textiles, pharmaceuticals, food, agriculture, fossil fuels, services, energy, etc.) from all over the world that shared their information on water security with CDP is as follows in Table 1 [10].

Table 1. Key Performance Indicators (KPIs)

Water dependence	
Respondents reporting that sufficient amounts of good quality freshwater available for use is 'vital' or 'important' for their direct operations	63.7%
Respondents reporting that sufficient amounts of good quality freshwater available for use is 'vital' or 'important' for their indirect operations	55.1%
Water accounting	
Respondents that monitor total water withdrawal volumes at more than 75% of facilities	77.2%
Respondents that monitor total water discharge volumes at more than 75% of facilities	63.8%
Respondents that monitor water recycling/reuse at more than 75% of facilities	37.0%
Respondents that meter and monitor the quality of water discharges at more than 75% of facilities	58.3%
Value chain engagement	
Respondents engaging their value chain on water-related issues	84.3%
Respondents requiring 50% or more of their suppliers to report on their water use, risks and/or management information	33.8%
Business impacts	
Respondents that have experienced detrimental water-related business impacts in the reporting year	8.0%
Total financial value of impacts (US$)	$12,7 billion
Respondents subject to penalties, fines and/or enforcement orders	5.9%
Total value of reported penalties, fines and/or enforcement orders (US$)	$19 million
Water risk assessment	
Respondents that undertake a water-related risk assessment	62.7%
Respondents that factor suppliers into water risk assessments	32.9%
Targets & goals	
Respondents with targets and/or goals that are monitored at the corporate level	60.1%
Respondents setting water intensity reduction targets	5.7%
Respondents setting water withdrawal targets	14.6%
Pollution indicators	
Respondents setting pollution-related targets and/or goals	12.3%
Respondents identifying pollution-related risks	19.6%

Respondents subject to pollution-related penalties, fines and/or enforcement orders	1.8%
Nature-based solutions (NbS)	
Respondents with targets and/or goals on NbS	3.8%
Respondents deploying NbS related responses to water risks	0.5%

In conclusion: The need for water of sufficient quality and quantity for all ecosystems makes water management plans imperative to prepare and implement at the global, national, and local levels.

Sectors can remain sustainable by using water in the most efficient way. It is necessary to take into account the reuse of water, the use of new technologies in water management, the digitization of water, and the economic value of water.

*CDP (Carbon Disclosure Project): CDP is a not-for-profit charity that runs the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts[11].

References:

1)The Global Risks Report, **2023** 18th Edition.
2)Ministry of Foreign Affairs of the Republic of Turkey, https://www.mfa.gov.tr/surdurulebilir-kalkinma.tr.mfa.
3)UN, **2023**, http://enb.iisd.org/un-2023-water-conference.
4)T.R. Official Gazette, **2023**, Number: 32180.
5)T.R. Ministry of Agriculture and Forestry, Water Effciency Strategy and Action Plan Document (**2023 – 2033**).
6)T.R. Ministry of Agriculture and Forestry, Draft Water Law, **2019**.
7) https://environment.ec.europa.eu/topics/water/water-framework-directive_en .
8)CDP Global Water Report, **2020**. A Wave Of Change, The role of companies in building a water-secure world.
9)Barthe et al., Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control), **2015.**
10)CDP Global Water Report, **2022**. Riding the Wave, How the private sector is seizing opportunities to accelerate progress on water security.
11)CDP Website: https://www.cdp.net/en.

OP – 1

Integration of Hydrothermal Processes to Biomass Sectors for Circular Economy

Karhan ÖZDENKÇİ[a,*] , Cataldo De BLASIO[a]

[a] *Faculty of Science and Engineering, Åbo Akademi University, Rantakatu 2, 65100 Vaasa, Finland*

**karhan.ozdenkci@abo.fi*

The environmental issues and depletion of fossil sources results in increasing importance of renewable sources and circular economy concept. As an abundant source, biomass can serve as a renewable source for energy and chemical production. Meanwhile, biofuel production from the 1st generation biomass is unsustainable due to emissions in all the steps and competing with the food sector. Therefore, sustainable production requires utilization of waste and non-edible biomass. In other words, waste streams are utilized as feedstock within circular economy concept. This concept would result in integrating conversion processes to the waste-generating sectors, i.e. integrated biorefinery with multiple products. However, waste valorization becomes challenging when processing high-volume, dilute streams, thus requiring advanced and efficient processes.

Hydrothermal processes are suitable for biomass conversion regarding the water content and feedstock flexibility. These processes use water as the reaction media, thus not requiring energy-consuming evaporation pre-treatment. The main hydrothermal processes are supercritical water gasification (SCWG), hydrothermal liquefaction (HTL) and hydrothermal carbonization (HTC). Regarding integrated biorefinery, the hydrothermal processes are promising for valorizing the dilute waste streams.

This study investigates the integration of hydrothermal processes with waste-generating sectors in order to reach circularity. Two case studies are illustrated in this study: SCWG of black liquor in a Kraft pulp mill and HTC of digestate in a biogas plant. SCWG of black liquor improves the energy efficiency compared to the commercial treatment (evaporation followed by combustion). The syngas can be used for energy production or for further synthesis. This study illustrates the feasibility assessment of integrating SCWG with a pulp mill based on the experiments conducted in Åbo Akademi University. Similarly, HTC of digestate provides faster and more efficient valorization compared to the composting method. The digestate waste cannot be used directly due to harmful substances; meanwhile, composting requires large area and very long time (few weeks). Therefore, biogas plants would benefit from the integration of a process valorizing digestate. HTC produces hydrochar, a solid product used either as a fertilizer or as a solid fuel replacing coal. This study investigates integration of HTC process with a biogas plant processing sewage sludge and food waste. The investigation includes the selection of optimum process conditions and process simulation.

In conclusion, this study illustrates the role of hydrothermal processes in reaching circularity with two case examples. Similar process integrations can be developed for other waste-generating sectors as well. These integrations would evolve the existing plants to multi-product biorefineries: minimizing the wastes and generating more revenue through multiple value creation. This would also influence the supply chain structures. The biomass supply chains can become more robust to market changes as well as being more profitable and environmentally friendly.

OP – 2

Removal of Antimony (V) from Aqueous Solutions by Electrodeionization

Ecem KÖSEOĞLU[a], Özgür ARAR[a,*]

[a] *Chemistry Department, Faculty of Science, Ege University, Izmir, Türkiye*

ozgur.arar@ege.edu.tr

In recent decades, antimony (Sb) has been increasingly discharged and distributed into the environment. Contamination of water bodies by Sb had already shown negative effects and led to a global scale. Since 1980, many countries and regions have taken appropriate measures to control and limit Sb levels in the environment. WHO has set a recommended limit of 20 µg/L for antimony consumption. So far, various treatment techniques have been used to re-move Sb from the model or real samples. These techniques can be categorized as ion ex-change/sorption, membrane processes, coagulation/flotation, and phytoremediation[1-3].

In this work, electrodeionization (EDI) was used for the removal of Sb(V). The effects of the applied potential, the flow rate of the Sb(V)-containing solution, and the Na2SO4 concentration in the electrode compartment on the removal of Sb(V) were investigated. The results showed that EDI can be an alternative technique for the removal of Sb(V) from water samples. The EDI microflow cell (Electrocell, Denmark) was used for the experiments. Selemion ion exchange membranes were also used to prepare the EDI cell. The central compartment of the EDI cell was filled with Purolite A500 plus anion exchange resin (OH-form) and Purolite C145 cation exchange resin (H-form). Sb concentration in collected samples was measured by ICP-MS (Agilent 7900). The removal of Sb(V) by EDI was investigated. The results showed that the applied potential has an effect on the Sb(V) concentration in the treated solution. 50 V was determined to be the optimum potential. Increasing the flow rate from 1 L/h to 2 L/h improved the removal rate of Sb(V). Similar results were obtained when the Na2SO4 concentration was increased from 0.005 M to 0.01 M.

Acknowledgements:

This study is supported by the Scientific Research Projects Coordination Office of Ege University (project num-ber: FM-LKP-2022-24201). We thank AGC Engineering Co. (Japan) for providing membranes, Purolite Int. Co. and Mitsubishi Chemical Co. for providing ion exchange resins and polymeric sorbent samples.

References:

1) Dündar et al., Environ. Res. **2022**, 215, 114324.
2) Li et al., Ecotoxicol. Environ. Saf. **2018**, 156, 125-134.
3) Long et al., J. Environ. Sci. **2020**, 90, 189-204.

OP – 3

Ti_2AlN MAX Phase as a Modifier of Cellulose Acetate Membrane for Improving Antifouling and Permeability Properties in Removal of Dye,Protein and Lead Ions

Basak KESKİN, Seyed Ali Naziri MEHRABANİ, Ismail KOYUNCU, Vahid VATANPOUR*

[a] *National Research Center on Membrane Technologies, Istanbul Technical University, Maslak, 34469, Istanbul, Türkiye*
[b] *Environmental Engineering Department, Istanbul Technical University, Maslak, Istanbul 34469, Türkiye*

**vatanpour@itu.edu.tr*

It is predicted that water scarcity will occur all over the world due to the change in climatic conditions and the increase in population growth rate in the coming years. Therefore, it is necessary to reduce water consumption and reuse wastewater [1]. The development of novel materials for the modification of filtration membranes is necessary to enhance their performance [2]. In this study, the application of titanium aluminum nitride (Ti_2AlN) MAX phase in the modification of cellulose acetate (CA) membrane is reported to improve hydrophilicity, permeability, dye rejection and antifouling properties. Firstly, the Ti_2AlN MAX phase was synthesized via the reactive sintering method [2], characterized and exfoliated under ultrasonic to obtain nanosheets with an average width of 35 nm. The Successful synthesis of the MAX phase with high purity in the hexagonal crystalline structure was confirmed with the XRD pattern. The prepared MAX phase was used. Then, the influence of the prepared MAX phase as a hydrophilic inorganic additive to improve the performance of the CA membrane was assessed by blending different concentrations of it (0–1 wt%). An improvement in hydrophilicity of the CA membranes was observed by incorporating the MAX phase into the matrix of membranes. The nanocomposite membrane containing optimum content of MAX phase (0.75 wt%) showed a threefold increase in permeability during filtration of pure water and dye solutions. In addition, the optimum nanocomposite membrane exhibited an improved flux recovery ratio of 92.7 % with a high removal efficiency of 70.7 % for reactive black 5, 93.5 % for reactive red 120, and >98 % for bovine serum albumin. Finally, the rejection of different salts was investigated, and the optimum nanocomposite showed high rejection for lead ions (97 %) with moderate rejection for Na2SO4 (>55 %) and NaCl (>30 %). This study showed that the MAX phase could be considered propitious additives to modify polymeric membrane performance.

References:

1)Keskin et al., Water Proc. Eng. **2021**, 42, 102172.
2)Vatanpour et al., Chemosphere **2022**, 295, 133914.

OP – 4

Utilization of Phosphorylated Hazelnut Shell Waste in a Column for Continuous Lithium Recovery from Water

Yaşar Kemal RECEPOĞLU[a], Aslı YÜKSEL[a,b]*

[a]*Izmir Institute of Technology, Department of Chemical Engineering, 35430, Urla, Izmir, Türkiye*
[b]*Izmir Institute of Technology, Geothermal Energy Research and Application Center, Urla, Izmir, Türkiye*

**asliyuksel@iyte.edu.tr*

Lithium is crucial in various industrial applications, including manufacturing batteries for electric vehicles and renewable energy storage systems [1]. One promising approach is using biosorbents derived from agricultural waste, which offer an eco-friendly and cost-effective solution for lithium sorption from water [2]. Using a biosorbent in the column under dynamic flow has several advantages over traditional batch sorption [3]. Thus, this study is interested in developing a continuous-flow packed-bed column loaded with phosphorylated hazelnut shell waste to investigate the adsorptive behavior of lithium ions. The effects of feed flow rate and bed height on the breakthrough performances were investigated. It was found that breakthrough time, exhaustion time, and uptake capacity of the column bed increased with increasing column bed height, whereas they decreased with increasing influent flow rate. Bed volumes at the breakthrough point were found to be 477, 369, and 347 at flow rates of 0.25, 0.5, and 1.0 mL/min, respectively. Moreover, the bed volumes required for total saturation were 941, 911, and 829, respectively, while the total capacity was calculated as 22.29, 20.07, and 17.69 mg Li/g sorbent. On the other hand, the breakthrough times were 282, 366, and 433 minutes, respectively, while the times required for saturation were 781, 897, and 1033 minutes in the 1.0, 1.5, and 2.0 cm height columns filled with phosphorylated hazelnut shell waste. In studies examining the effect of bed height, the capacity of the material was found to be 20 mg Li/g sorbent on average. The column experimental data fitted well with nonlinear Thomas and Yoon-Nelson models, confirming that both models can predict appropriately the whole breakthrough curves, and are helpful for application in the large-scale field. However, the MDR model had the least relative fit error and the highest correlation coefficients and was more accurate than the conventional models.

References:

1)Harper et al., Nature **2019**, 575 (7781), 75–86.
2)Yelatontsev, Chem. Eng. J. **2023**, 451, 138811.
3)Patel, Appl. Water Sci. **2019**, 9 (3), 45.

OP – 5

Methylene blue Photodegrataion efficiency of iron-titanium oxide from multitemplate system

Maria ULFA [a,*], INDRİYANİ[a], HOLİLAH[b], Hadi NUR[c] , Hasliza BAHRUJİ[d] , Yetria RİLDA[e]

[a]*Chemistry Education Study Program, Faculty of Teacher Training and Education, Sebelas Maret University, Jl. Ir. Sutami 36A, Surakarta 57126, Indonesia*
[b]*Research Center for Biomass and Bioproducts, National Research and Innovation Agency of Indonesia (BRIN), Cibinong, 16911, Indonesia*
[c]*Department of* Chemistry*, Faculty of Mathematics and Natural Sciences,*
State University *of* Malang *(Universitas Negeri Malang)-Indonesia*
[d]*Centre of Advanced Material and Energy Science, University Brunei Darussalam, Jalan Tungku Link, BE 1410, Brunei 10 Darussalam*
[e]*Department of Chemistry, Faculty of Mathematics and Natural Science, Andalas University, Padang, Indonesia*

**mariaulfa@staff.uns.ac.id*
**ulfa.maria2015@gmail.com (+6281392932270)*

Hybrid soft templating P123-Gelatin method was used in the synthesis of mesoporous iron-titaniun (MFe-TiG) nanoparticles. Structures and morphologies of the samples were examined by TEM, SEM, XRD, EDS, FT-IR and UV visible spectroscopy. The pore size of the MFe-TiG nanoparticles was controlled at around 7-9 nm with surface area 44-45 m^2/g which is consist of Fe around 8-9% and Ti 50-55 % w/w/. The composites MFe-TiG were systematically evaluated as photocatalysts for the degradation of methylene blue (MB) as a function of mesoporous iron-titanium content. A marked compositional dependence of the photocatalytic activity was evidenced for MB degradation under visible light. Compared with the corresponding sample MFe-Ti without gelatin, the gelatin- involved in synthesized process display enhanced photocatalytic activities. The enhancement of photocatalytic activity of mesoporous MFe-Ti nanoparticles shivh synthesis with gelatin was attributed to the synergistic effect between large diameter pore and iron-titanium which improved the photodegradation performance. The effects of gelatin content have been analyzed. The results showed that the photocatalytic activity of MFe-TiG nanocomposites increases with the modification of sample by changing the content from 1.0 to 20.0 wt % gelatin to P123, the sample of 1.0 wt. %gelatin on mesoporous MFe-TiG showed the higher photocatalytic activity. As the Fe-Ti in the composites has a very good contact with methylene blue it enhances the photo-electron conversion of MFe-TiG by reducing the recombination of photo-generated electronehole pairs based on the band structures of MFe-TiG.

OP – 6

Synthesis and Characterization of Bead Polyelectrolite Complex Chitosan-Alginate to overcome of Drug Pollutants

Budi HASTUTI[a], Fikriana Arsyada ASNA[a] and Saptono HADI[b]*

[a]Department of Chemistry Education, *Faculty* of Teacher Training and *Education.Universitas Sebelas Maret*
[b]*Department of Pharmacy, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret*

**budihastuti@staff.uns.ac.id*

The process of fabrication bead polyelectrolite complex on chitosan-alginate aims to re-polymerize chitosan alginate. Beads of Alginate Chitosan polymer is more organized so that the structure is more regular and can be applied as an potential adsorbent. This study aims to synthesize modified chitosan by adding of alginate its opposite anion, to form chitosan alginate and form beads. Chi-Alg beads is characterized of active functional group by FTIR, test of the stability of the material by XRD and test the surface morphology use SEM and test the thermal stability using DTA-TGA. Methodology on this research is to make chitosan-alginate beads with a ratio of 4:1 and oven at 50°C for 24 hours. The dried beads were then crushed and characterized used FTIR, SEM, XRD, and DTA-TGA.

The results showed that: The chitosan-alginate beads were successfully synthesized,based on FTIR characterization there were vibrations of O-H, C-H, N-H, C=O, and C-O groups, XRD results showed that pure chitosan was semicrystalline and then alginate was amorphous and chitosan-alginate beads were semicrystalline, SEM results showed that chitosan-alginate modification coud make the pore size larger than chitosan and pure alginate, the DTA-TGA results showed that the chitosan-alginate beads had high thermal stability compared to pure chitosan and alginate. The carboxylate group of the alginate could give a negative charge which could bond ionically with the amine group of the positively charged chitosan.

Keywords : adsorbent, Chitosan, alginate, bead, polyelectrolite

OP – 7

Dioxins with High Resolution Ion Mobility GC-APCI

Ebru MANAV AKYAR[a]*

[a]TERRA Analiz ve Ölçüm cihazları Tic. A.Ş.

*ebru.manav@terraanaliz.com.tr

Colloquially, the term “dioxins” refers to polychlorinated dibenzo-p-dioxins (PCDDs) and related compounds polychlorinated dibenzofurans (PCDFs) also called as “furans”. Those are the most toxic chemicals and classified as Persistent Organic Pollutants (POPs) due to their resistance to degradation. Dioxins are primarily occur anthropogenic compounds produced unintentionally as by-products in some industrial activities and waste combustion processes. In addition to being present in the environment, dioxins are fat-soluble and bio-accumulative compounds in the tissues of animals and humans. Consumption of food is one of the most important exposure pathway for humans, in particular, fish, shellfish, dairy products and meat. According to many reports, dioxins can provoke serious health effects in humans such as loss of body weight, hormone disruption, reproductive disorders, skin toxicity, immune system disorders, and cancer, among other diseases. For dioxin analysis, there are several international standard methods available. Based on these methods different MS instruments are standardized in different countries. Even though TQGCMS and QTOF instruments are well-established in many dioxin applications they still are facing with some different analytical problems. Especially in recent years, it is obvious that we need much more information from the sample matrix to see the compounds beyond existing in our targeted compound lists. By using the GC-APCI coupled with Trapped Ion mobility (TIMS) Q-TOF mass spectrometers it is possible to perform an effective multi class targeted analysis and untargeted analysis with the power and ability of the isomeric and isobaric compound separation. Researchers showed that, it is possible to distinguish compound groups by CCS vs mass plot of mixture of 174 POPs and PAHs compounds and more detailed information. In conclusion researchers showed that GC-APCI-TIMS-TOF has the potential to bring a true added value to the development of multi-residues POPs screening methodologies.

OP – 8

Characterization of Pectin-Chitosan-Poli (Vinyl Alcohol) Cross-Linked with Bisphenol A Dyglycidyl Ether (BADGE) as Dialysis Membrane

Saptono HADI[a], Budi HASTUTI[b]*, Flavia SALSABILA[b]

[a]*Department of Pharmacy, Faculty of Mathematics and Natural Sciences,*
Universitas Sebelas Maret, Surakarta, Indonesia
[b]*Department of Chemsitry Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Surakarta, Indonesia*

**budihastuti@staff.uns.ac.id*

Membranes based on natural biopolymers, such as chitosan and cellulose, have attracted attention in various research fields, especially in biomedical applications. Biopolymers were chosen because of their high biocompatibility and low toxicity. This study aims to synthesize pectin chitosan membranes with the addition of polyvinyl alcohol (Chi–Pec–PVA) as a dialysis membrane for the transfer of creatinine and urea. Membrane synthesis was carried out by solution casting technique with the addition of 1.5% polyvinyl alcohol (PVA). *PVA* is expected to allow improvement of chitosan's mechanical properties. The membrane strength was characterized using tensile test data (Tensile Test). Furthermore, the microstructure and the morphology of these bio-composites were studied by Fourier Transform Infrared (FTIR), X-Ray Diffraction (XRD), and Scanning Electron Microscopy (SEM). The results showed that the Chi–Pec–PVA membrane had a semicrystalline which is classified as microspheres. The FTIR analysis confirmed the presence of O–H, C–H, C=O, N–H, and–CH_3 functional group of the membrane. The addition of PVA significantly increases the mechanical strength of the membrane suitable for dialysis membrane.

Keywords: chitosan, pectin, polyvinyl alcohol, dialysis membrane

OP – 9

Preparation of novel magnetic adsorbents by one-step modification method for recovery of uranium ions from aqueous medium

Serhad TİLKİ[a]*, Gülay BAYRAMOGLU[b]

[a], Department of Chemistry, Faculty of Art and Science, Amasya University, 05100, Amasya, Türkiye
[b], Department of Chemistry, Faculty of Science, Gazi University, 06500, Ankara, Türkiye

*serhadtilki@gmail.com/serhad.tilki@amasya.edu.tr

The need for energy has grown significantly worldwide in recent years due to population growth and industrialization. In order to meet the world's energy needs, it is now crucial to look for low-carbon, environmentally friendly, and clean new energy. Due to its high efficiency and lack of greenhouse gas emissions, nuclear energy is viewed as the most crucial replacement for conventional fossil fuels. One of the most crucial components of nuclear fuel is uranium. Uranium can be easily obtained from seawater via the adsorption method, and various adsorbents have been prepared and employed to recover uranium from seawater. Because the proper adsorbents can be prepared from biodegradable polymeric materials with easy operation, low cost, lack of secondary contamination, and reusable. Materials with magnetic properties can be easily separated from aqueous media by applying an external magnetic field. Due to these properties, the biodegradable adsorbent with magnetic properties can be used in the removal of heavy metal ions from aqueous media with appropriate modifications.

In this study, the magnetic nanoparticles (Fe_3O_4) were prepared via the thermal precipitation method and mixed with chitosan solution. Then, the magnetic chitosan (Fe_3O_4@CHT) beads were prepared via the phase inversion method and grafted with poly(glycidyl methacrylate). The epoxy groups of the p(GMA) were modified into different functional groups. For this, the diamino dimedone ligand was covalently attached to the surface of the Fe_3O_4@CHT@p(GMA) beads by the reaction of the free amino group of DAM and epoxy groups of p(GMA). The nitrile groups of DAM were reacted with hydroxyl amine, hydrazine, and ethylene diamine to generate amidoxime, hydrazide, and imidazole groups, respectively, in a single-step reaction manner. The adsorbents were well characterized using FTIR, SEM, DTA, zeta sizer, and BET methods. These adsorbents with different functional groups were then used for the adsorption of U(VI) ions from the aqueous solution. The adsorption performance of these adsorbents was elucidated under different experimental conditions (i.e., pH, adsorption time, initial (U(VI) concentration, ionic strength, and the presence of interfering ions). The maximum adsorption of U(VI) was obtained on the amidoxime (at pH 3.0), hydrazide, and imidazole groups (both at pH 5.0) adsorbents from 10ppm uranyl solution as to 99.5, 93.2, and 96.0%, respectively. The adsorption equilibrium was reached in about 180 min. Moreover, U(VI) adsorption performance was studied in the presence of competitive ions such as Pb, Cu and Ni in simulated seawater. Amidoxime modified, Ethylene diamine modified and Hydrazine modified adsorbents showed performances as U>Cu>Pb>Ni, U>Pb>Ni>Cu and U>Cu>Pb>Ni, respectively.

Acknowledgment This study was funded by the Scientific and Technological Research Council of Türkiye (TUBITAK) Grant No 121C46

OP – 10

Biochar-Ni from Palm Leaves Waste as Low-Cost Photocatalyst for Methyl Orange Photocatalytic Oxidation

Galih Dwiki RAMANDA[a]*, Is FATIMAH[a], Suresh SAGADEVAN[a,b], Ruey-an DOONG[c]

[a] *Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Islam Indonesia, Kampus Terpadu UII, Jl. Kaliurang Km 14, Sleman, Yogyakarta, Indonesia*
[b] *Nanotechnology & Catalysis Research Centre, University of Malaya, Kuala Lumpur 50603, Malaysia*
[c] *Institute of Analytical and Environmental Sciences, National Tsing Hua University, 101, Sec 2, Kuang Fu Road, Hsinchu 30013, Taiwan.*

**galih.ramanda@students.uii.ac.id*

Photocatalytic oxidation is one of the methods in the advanced oxidation process. The method depends on several factors to be effective in application, one of these is the cost-effectivity and sustainability. The intent of this research work is to synthesize low-cost photocatalyst by using waste: palm leaves ash. The biochar-Ni photocatalyst based on nickel nanoparticles was synthesized by using palm leaves under pyrolysis method on two varied Ni content; 10 and 30 % wt. Various characterization techniques consist of XRD, SEM, and VSM were conducted, meanwhile the photocatalytic activity for methyl orange photodegradation was employed as activity testing. Results showed that single nickel nanoparticles dispersed on biochar structure are appeared by XRD measurement. Optical properties of the samples are demonstrated by the band gap energy of 2.24 and 2.31 eV by Ni content of 10% and 30%, respectively. The porous structure of materials is derived, with the magnetism of 9.64 emu/g and 3.87 emu/g for Ni content of 10 and 30 % wt., respectively. The fabricated biochar-Ni samples showed excellent photoactivity that caused 74.73 and 50.01% degradation of methyl orange. A persuasive mechanism and kinetics are well presented. The kinetics study expressed the fitness of the degradation that follow pseudo-first order kinetics.

OP –11

Characterization of a Continuous Flow Reactor for a Two-Step Derivatization Reaction in Environmental Analysis

Hakan ALYÜRÜK*, Mustafa BİLGİN, Enis DARILMAZ, Esin ULUTURHAN

Dokuz Eylül University, Institute of Marine Sciences and Technology, Izmir, Türkiye

* hakan.alyuruk@deu.edu.tr

In this study, a continuous flow reactor was designed and characterized for its use in a two-step derivatization reaction to achieve photochemically active final products for analysis in liquid chromatography instruments. The reactor was consisted of a manual injection valve, an inline mixer, a ternary mixer, a pressure regulator, a flow resistor, capillary tubings (0.01 inch inner diameter) in different lengths (3, 5, 10, and 25 m), unions, T-connectors, two HPLC pumps with check valves, and an UV-Vis HPLC detector. In the reactor, the two-step reaction take place within two capillary tubings (named as R1 and R2) connected end-to-end with a T-connector. A ternary mixer and an inline mixer were used in the entrance of each tubing, respectively. A union, a pressure regulator, and a flow resistor were used in different setups of R1, R2, and when R1+R2 combined. The reactor was characterized with residence time distribution (t_R) experiments using pulsed dye injection method, and micromixing times (t_m) were determined through segregation index calculations. Average residence time distributions were found between $2 < t_R < 4$ min for R1; $2 < t_R < 7$ min for R2; $5 < t_R < 11$ min for R1+R2. The micromixing times for R1 and R2 were calculated with Villermaux-Dushman reaction experiments, and t_m values were below 1 min as well as below t_R values of each capillary. The effect of back pressure on residence times was greater with the decrease of tubing length. In conclusion, the reactor designed in the study was successful in achieving mixing times far below residence times of reactants. Therefore, the proposed reactor can be integrated in various derivatization or synthesis reactions for environmental analysis as well as for organic synthesis and pharmaceutical production.

Keywords: continuous flow reactor, micromixing, derivatization, residence time, Villermaux-Dushman, liquid chromatography

OP – 12

Seasonal Variation of Microplastic Pollution in Terrestrial Inland Waters

Cumana ALPERGÜN[a], Neval BAYCAN[b*], Nefise ALYÜRÜK[a], Yiğithan KAZANCI[c], Nursena KARA[a], Orhan GÜNDÜZ[c]

[a] Dokuz Eylül University, The Graduate School of Natural and Applied Sciences, Izmir, Türkiye
[b]Dokuz Eylül University, Engineering Faculty, Environmental Engineering Department, Izmir, Türkiye
[c]Izmir Institute of Technology, Engineering Faculty, Environmental Engineering Department, Izmir, Türkiye
**neval.baycan@deu.edu.tr*

In recent years, the increasing production and usage of plastic have led to an increase in microplastics (MPs) in different matrices of the environment. Being an emerging environmental problem, microplastics are defined as particles that are 5 mm or smaller in size and pose a threat to both the environment and the human health. While the majority of the studies in literature have primarily focused on microplastic pollution in seas and oceans, their status in terrestrial waters are yet to be discovered. In this regard, the fate and transport of microplastics in riverine environments is not fully understood. The fate and transport of microplastics within river systems involve complex processes influenced by factors such as flow dynamics, sedimentation, and seasonal variations. Understanding these mechanisms is necessary to assess the accumulation and distribution of microplastics in river ecosystems. In this study, water samples were collected from 21 different points along Nif and Gediz rivers to investigate the presence of microplastics in water column and their quantities in relation to seasonal changes. To determine seasonal changes, samples collected during the winter and spring seasons underwent various pre-processing steps in the laboratory. Microplastics in the prepared samples were analyzed under a three-dimensional stereomicroscope (Leica S Apo) to identify their shape, color, and size. Plastic material types were determined using Fourier transform infrared (ATR-FT-IR) spectroscopy (Perkin Elmer Frontier).

According to the data obtained from the studies, it was observed that the total number of microplastics was higher in the winter season compared to the spring season. The decrease in the number of microplastics in the spring season was attributed to the variability in seasonal discharge and weather conditions in the study area, as well as the influence of numerous facilities affecting the microplastic pollution load in the area. Moreover, the results revealed that the level of contamination from MPs in an effluent-dominant receiving terrestrial aquatic system increased along the flow direction with local extremes within the industrial zone that houses numerous plastic processing facilities.

Keywords: Microplastic, inland waters, seasonal changes.

OP – 13

The Fate of Microplastics in Wastewater Treatment Plants at Organized Industrial Zones: An Assessment Study Based on Seasonal Variations

Nefise ALYÜRÜK[a], Cumana ALPERGÜN[a], Nursena KARA[a], Yiğithan KAZANCI[b], Orhan GÜNDÜZ[b], Neval BAYCAN[a*]

[a] *Environmental Engineering Department, Dokuz Eylul University, İzmir, Türkiye*
[b] *Environmental Engineering Department, Izmir Institute of Technology, İzmir, Türkiye*

**neval.baycan@deu.edu.tr*

The accumulation of plastic waste in various ecosystems around the world has been increasing rapidly because of high rates of plastic production. Plastic waste is projected to increase significantly in the next decades, from 353 Mt in 2019 to 1014 Mt in 2060 (OECD, 2022). Microplastics (MPs), which are typically characterized as plastic particles from 1 nm to < 5 mm in size, are widely considered as a global pollutant (Thompson, 2015). They are entering the aquatic environment through a variety of pathways. Municipal and industrial wastewater have been studied as point sources of MP to aquatic environments (Altuğ and Erdoğan, 2022). This study investigates the occurrence and distribution of MPs in the organized industrial zones (OIZs) wastewater treatment plants (WWTPs). Influent, effluent, and internal samples from primary sedimentation, chemical treatment unit and biological treatment unit from OIZ-WWTPs were analyzed in two different seasonal periods (winter and spring). Microplastics were grouped according to their size, color, and shape. In winter period, MP counts in the wastewater influent from the OIZ-WWTP-1 were 808 particles/L, whereas it decreased to 426 particles/L at effluent water. In OIZ-WWTP-2, MP counts in influent and effluent waters were 1599 and 820 particles/L, respectively. In winter, removal rates of MPs in both plants were approximately in the range of 50%. In spring, MP counts in effluent waters (334 particles/L) were only slightly greater than MPs in influent waters (316 particles/L) for OIZ-WWTP-1. MP counts in influent and effluent waters of OIZ-WWTP-2 were 1056 and 40 particles/L, respectively. While the abundance of MP shapes in winter decreased in the order of fragment > fiber > foam > film, abundances of MP shapes in spring were found to decrease in the order of fiber > fragment > film > foam. The colors and color counts for MPs in both seasons were observed as transparent, yellow, red, black, blue, others and green. In both seasons, OIZ-WWTP-2 was found to have significantly lower MP counts compared to OIZ-WWTP-1 ($p<0.05$). Both WWTPs were efficient at 50% level to remove MPs from influent waters. However, in spring season efficiency of OIZ--WWTP-1 was negligible. In conclusion, substantial amounts of MP counts were observed in discharge points of OIZs and conventional WWTPs were not efficient enough to reach high removal rates.

References:

1)Altuğ, and Erdoğan, Water Air Soil Pollut. **2022**, 233-488.
2)OECD, Global Plastics Outlook: Policy Scenarios to 2060, OECD Publishing, Paris, **2022**.
3)Thompson, Mar. Anthropog. Litter. **2015,** 185–200.

OP – 14

Enhanced Photocatalytic Performance of CdSeTe and CdSeTe/ZnS Quantum Dots for Methylene Blue Degradation

Pinar Sevim ELIBOL*

Environmental Engineering Department, Faculty of Engineering, Düzce University, 81620 Düzce, Türkiye

*pinarsevim@duzce.edu.tr

This study focuses on the synthesis and characterization of CdSeTe Quantum-dots (CdSeTe QDs) and ZnS coated CdSeTe Quantum-dots (CdSeTe/ZnS QDs), achieved through the water-based synthesis method. Additionally, we evaluated their photocatalytic activity using a methylene blue solution. We prepared a series of Quantum-dots, including CdSeTe QDs and CdSeTe/ZnS QDs, by incorporating ZnS coated CdSeTe. These materials underwent thorough characterization using various techniques, including X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), Fourier-transform infrared spectroscopy (FTIR), UV–visible (UV–vis) spectroscopy, and photoluminescence (PL) spectroscopy. Subsequently, we examined the photocatalytic performance of the newly prepared Quantum-dots by exposing them to aqueous solutions containing methylene blue visible and under UV light irradiation. Our findings revealed that when CdSeTe QDs and CdSeTe/ZnS QDs were employed as photocatalysts, they achieved impressive results. Specifically, within a 60-minute timeframe, CdSeTe QDs exhibited a maximum degradation and removal rate of methylene blue at 67.68%, while CdSeTe/ZnS QDs outperformed with a rate of 96.41%. This was observed under the condition where 3 mg of CdSeTe QDs was used in a 30 ppm methylene blue concentration. We observed a notable enhancement in the photo-degradation of methylene blue when utilizing CdSeTe/ZnS QDs. This improvement can be attributed to the interaction between CdSeTe QDs and ZnS, which plays a pivotal role in the observed enhancement.

OP – 15

Assessment of Triclosan Effects on Marine Phytoplankton Growth

Merve KORAL[a], Halim Aytekin ERGÜL[a]

[a]*Kocaeli University, Science and Arts Faculty, Department of Biology, Kocaeli, Türkiye*

merveipsiroglu@gmail.com

Some pharmaceuticals and personal care products (PPCPs) are not totally eliminated in wastewater treatment plants[1]. Triclosan is an antiseptic PPCPs has been used widely in household products like toothpaste, mouthwash, soaps, cosmetics and plastic ware products, also it is one of the top ten common organic compounds in wastewater[2-3]. The aim of the present study was to evaluate varying concentrations of triclosan effect on phytoplankton growth and chlorophyll content. *Isochrysis galbana* and *Tetraselmis sp*. were used to assess the effects of triclosan in laboratory conditions. The phytoplankton cultures were exposed varying concentrations of triclosan in 20°C and 14:10-h day/night period. Each group was monitored during 96 hours for different concentrations of triclosan. Cell numbers of the cultures were determined every 24 hours by using Thoma counting chamber under a light microscope. Chlorophyll-a concentrations were determined spectrophotometrically using acetone extaction method. Results were compared with the control groups for both phytoplankton species. Regarding to the growth inhibition, the highest effect of triclosan was observed with concentrations of 100 mg/L on *I. galbana* and *Tetraselmis sp*. at the end of 96 hours. Obtained data may be used for future consideration regarding to prevent of marine pollution and improvement of advanced wastewater treatment plants which discharges the effluents into the marine systems.

References:

1)Reis-Santos et al., Mar. Pollut. Bull. **2018**,135,1079-1084.
2)Anton et al., Environ. Sci. Technol. **2002**, 36(11), 2322-2329.
3)Brausch et al., Chemosphere. **2011**, 82, 1518-1532.

OP – 16

Phthalates in Diapers: Assessment of Environmental Phthalate Release

Samiye TANRIKULU[a], Hatice Kübra GÜL[a], Nebile DAGLIOGLU[b,c], İsmail Ethem GOREN[b], Perihan Binnur KURT-KARAKUS[a]*

[a]*Department of Environmental Engineering, Faculty of Engineering and Natural Sciences, Bursa Technical University, Bursa, Türkiye*
[b]*Department of Forensic Medicine, Faculty of Medicine, Cukurova University, 01330, Adana, Türkiye*
[c]*Institute of Forensic Sciences, Dept. of Forensic Toxicology, Ankara University, Ankara, Türkiye (present address)*
**perihan.kurt@btu.edu.tr*

Abstract

In recent years, the demand for disposable baby diapers has increased due to several reasons such as easy access and increasing hygiene concerns. A baby uses approximately 6000 diapers before he/she is ready for potty training. The time it takes for a diaper thrown into the environment to disappear is around 400-500 years, and baby diapers rank third on the list of most produced household waste. Baby diapers constitute 30% of the garbage that does not dissolve in nature. Although there are global studies showing the presence of various forms of phthalates in baby diapers, to the best nowledge of authors, there are no studies conducted to Türkiye. In this context, the current study aims to investigate the presence of selected phthalates in diapers used in Türkiye and to investigate the release of phthalates through baby diapers into waste disposal sites. In this study, phthalates were analyzed in three different layers of a total of 39 diaper samples sold in supermarkets, health-cosmetics stores and e-commerce sites throughout Türkiye. Butyl benzyl phthalate (BBP), Diethyl phthalate (DEP), di-n-butyl phthalate (DnBP) were detected in all three layers of diapers. Based on the results obtained, the amount of phthalates that could enter the environmental environment was calculated. Calculations showed that amount of phthalates released from diapers to the waste disposal sites ranges from 8.51 to 341 kg year^{-1} depending on the brand. Based on the estimated number of newborns and infants, the highest phthalate release was estimated to be in Istanbul (59.9 kg year^{-1}), while, the lowest phthalate release was estimated to be in Tunceli (0.285 kg year^{-1}).

Keywords: Phthalates, diaper, environmental phthalate loading

Introduction

Diapers are among the very important products for all societies in terms of health of infants and toddlers. Diaper is a personal hygiene product that is in direct contact with the skin for a long time every day for several years, from the neonatal period immediately after birth until approximately 2-3 years of age, and its safety needs to be investigated due to the chemicals used in the product. Due to the manufacturing processes and raw materials used, baby diapers may contain contaminants such as polypropylene, polyethylene, polyester, polyurethane, perfumes and dyes, dioxins, tributyltin (TBT), volatile organic compounds (VOCs) and phthalates.

Phthalates are widely used plasticizers, which raise concerns due to human contact exposure to polyvinyl chloride-based polymeric materials, and particularly exposure to objects such as baby care products and toys that infants and children come into direct contact with [1-4]. Phthalates easily accumulate in living organisms as they are highly soluble in fatty tissues [5]. Phthalates have attracted the attention of toxicology and public health research due to their presence in many consumer products and their possible adverse human health effects.

In the absence of a suitable disposal mechanism, baby diapers often accumulate in waste dumping sites or open areas around our neighborhoods or in landfills. Because diapers contain high levels of phthalates, there is a highly likelihood that these phthalates will leach into the environment and impact overall ecosystems, including soil and groundwater. Within the scope of this study, phthalate contents in diapers were determined and the amount of phthalates released into the environment in landfills was estimated.

Materials and Methods

Sampling

In the study, phthalates were examined in three different layers of a total of 39 baby diaper samples collected from different brands sold in supermarkets, health-cosmetics stores and e-commerce sites across Türkiye and stored in the freezer until analysis. A method similar to that is given by Park et al. (2019) was used to select what part of the diaper to be analysed [6].

Sample Preparation and Instrumental Analysis

The extraction method reported by Ishii et al. (2015) was used to prepare the samples for analysis [7]. In this context, the samples (weights ranged from 0.063 to 2.84 g) was placed in a 20 mL volume glass tube and 6 mL of 80:20 methanol:Milli-Q water mixture was added. Samples were spiked with deuterated recovery standards (100 ng each) of di-(2-etilhekzil)fitalat-3,4,5,6-d4), dicyclohexyl phthalate-3,4,5,6-d4, diethyl phthalate-3,4,5,6-d4, dimethyl phthalate-3,4,5,6-d4 and bisphenol A-d16, the cap of the tube was closed and left for overnight. The extraction process was completed by shaking the capped tube in a ultrasonic bath for 15 minutes, a subsample of 2 mL of extract was transferred to the GC vial, internal standard (50 ng, di-n-Pentyl phthalate-3,4,5,6-d4) was added before the instrumental analysis [6-7]. The instrumental analysis was performed on a Liquid chromatography-tandem mass spectrometry (Schimadzu 8040 Triple Quadrupole LC-MS-MS System). A column with 150 x 2.0 mm ID (Schimadzu, Shim-Pack FC-ODS) was used for chromatographic separation in the LC-MS-MS analysis of the samples.

Determination of the Amount of Phthalates Reaching Landfills

Using the 2018-2020 national birthrates reported by Turkish Statistical Institute (TUIK) for each province in Türkiye[8], the amount of selected phthalates released into the environment on a provincial basis was calculated using Equation (1).

$$\text{Amount of Waste Phthalates (kg/year)} = \frac{C\ x\ M\ x\ T\ x\ 365\ x\ N\ x\ P}{10^6} \qquad (1)$$

where, C = total phthalate concentration (found in all three layers) determined in the diaper (µg g^{-1}), M = total weight of the phthalate-containing part of the diaper (g), T = total time the diaper was used (2.5 years)[9], N=amount of diapers used daily (N=10)10, P=Number of children currently using diapers on a provincial basis ((P2018 x 0.5) + P2019 +P2020; (P2018, P2019 and P2020 values refer to the number of babies born in 2018, 2019 and 2020, respectively, on a provincial basis from the TÜİK database))[8], 106=conversion factor (µg kg^{-1}). This calculation was made based on statistical data for 2018, 2019 and 2020. There is no data for 2020 or later in the TUIK database, therefore the average values of 2018 and 2019 were used for 2020. Additionally, it is assumed that 50% of babies born in 2018 still use diapers in 2020.

Quality Assurance/Quality Control (QA/QC)

Quality Assurance (QA) and Quality Control (QC) measures taken were preparation of a control/blank samples, use of recovery efficiency test chemicals (di-(2-ethylhexyl)phthalate-3,4,5,6-d4), dicyclohexyl phthalate-3,4,5,6-d4, diethyl phthalate-3,4,5,6-d4, dimethyl phthalate-3,4,5,6-d4 and bisphenol A-d16), triplicate analysis of each sample and taking average value in calculations, and determining instrument detection limit (IDL) and method detection limit (MDL) values.

IDL value for analysed phthalates were 0.180, 0.820 and 38 ng g^{-1} for butyl benzyl phthalate (BBP), diethyl phthalate (DEP), di-n-butyl phthalate (DnBP), respectively. MDL values of target phthalates (ng g^{-1}) were 1.34, 3.33 and 38 for BBP, DEP and DnBP, respectively. Recovery rates were 88.3 ± 13.3 (65.3–110%), 87.4 ± 12.1 (68.2–109%), 88.6 ± 8.9 (70.1–110%), 91.8 ± 8.4 (69.9–107%) and 83.4 ± 9.2 (63.4–107%) for Bis(2-

ethylhexyl)phthalate-3,4,5,6-d4, Dicyclohexyl phthalate-3,4,5,6-d4, Diethyl phthalate-3,4,5,6-d4, Dimethyl phthalate-3,4,5,6-d4 and Bisphenol A-d16, respectively.

Results and Discussion

Butyl benzyl phthalate (BBP), Diethyl phthalate (DEP), di-n-butyl phthalate (DnBP) were detected in all three layers (inner, middle and outer layer) of diapers (Fig.1). The average phthalate concentrations in a diaper by taking into account the wieght of each layer were determined as 2.6±1.4 ng g^{-1}, 429±375 ng g^{-1} and 975±837 ng g^{-1} for BBP, DEP and DnBP, respectively. Among these three phthalates, the highest average concentration was observed in the outer layer, followed by the middle layer and inner layer (Fig.1). DnBP showed the highest mean concentration (583 ng g^{-1}) in outer layer of diapers, whereas the lowest concentration was measured for BBP (0.638 ng g^{-1}) in inner layer of diapers.

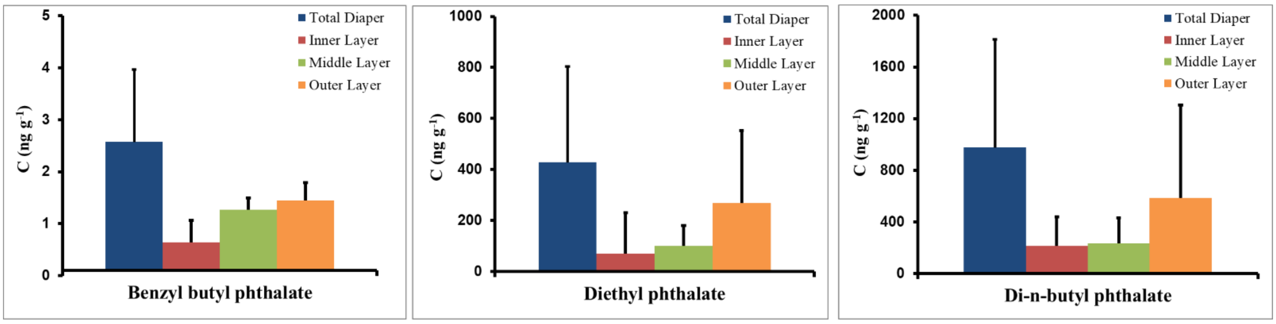


Figure 1. Phthalate concentrations (mean) in diaper samples (ng g-1)

The amounts of phthalates that might enter the environment due to disposal of diapers are shown in Figure 2. Accordingly, it was estimated that the amount of phthalate released from baby diapers into the environment varied between 8.51 and 341 kg $year^{-1}$ depending on pthalate type. When evaluated on a provincial basis, it was determined that phthalate emissions thay might occure due to diaper disposal ranged from 0.285 kg $year^{-1}$ (Tunceli province) to 59.9 kg $year^{-1}$ (Istanbul province) and the amount is varied depending on the number of newborns in provinces.

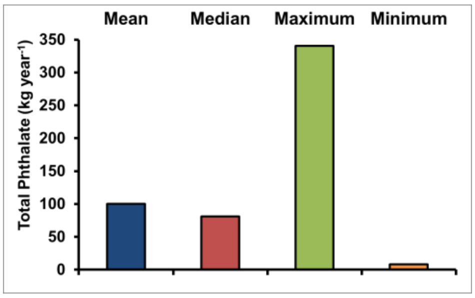


Figure 2. The amount of phthalates released to the environment from diapers annually in Türkiye (kg year-1)

The main source of toxic compounds in diapers is the raw materials and materials used and the layer connections or materials used for the manufacturing processes.11 Research has shown that a baby uses approximately 6000 diapers during a diaper changing period and 95% of the diapers used are disposable[12-13]. Waste diapers are an important contaminating agent for the environment, and yet raise concerns for human health due to potential of diaper-oriented chemicals' transport through environment. There is increasing awareness and concern about the environmental damage caused by diapers. These include issues such as water, air and soil pollution, resource consumption and waste generation, which has led to the consideration of more environmentally friendly materials and waste management to reduce such burdens.14 Although the size of the samples analysed in the current wok is small, results are still important to show the potention of the environmental and health risk that may occure due to chemicals release from disposed diapers in Türkiye.

In the future studies, the fate of the diapers after they go to the landfills and their release from the soil to the groundwater resources and determining the extent of their impact on the ecological system will be more beneficial to assess the impact on the health of environment and human being.

Acknowledgement:

The current study received funding from the Bursa Technical University Scientific Research Project Units under grant number 210Y006.

References:

1)EU-CSTEE, **1998** , 26/27 November.
2)Earls et al., J. Chromatogr. A. **2003** , 983 (1−2), 237−246.
3)Huang et al., Int. J. Chem. **2011**, 3, 169-173.
4)Al-Natsheh et al., J. Chromatogr. B. **2015**, 985C, 103-109.
5)Net et al., Environ. Sci. Technol. **2015**, 49 (7), 4019-4035.
6)Park et al., Reprod. Toxicol. **2019**, 84, 114-121.
7)Ishii et al., Regul. Toxicol. Pharmacol. **2015**, 73(1), 85–92.
8)TUİK, İstatistiklerle Çocuk, **2019**, https://data.tuik.gov.tr/img/SVG/excel.svg.
9)Psikonet, Çocuklarda Tuvalet Eğitimi, **2007**, https://www.psikonet.com/cocuklarda-tuvalet-egitimi_nedir-228.html.
10)Hurriyet Gazetesi, Çocuk bezinde 60 trilyonluk rekabet, **1999**, https://www.hurriyet.com.tr/ekonomi/cocuk-bezinde-60-trilyonluk-rekabet-39071467.
11)Rengarajan et al., Asian Pac. J. Trop. Biomed. **2015**, 5(3), 182-189.
12)Edana, The Absorbent Hygiene Products Manufacturers Committee of EDANA, **2008**, Brussels, Belgium.
13)Reese et al., Waterlines. **2015**, 255-268.
14)Ntekpe et al., Am J Med Public Health. **2020**, 1009.

OP – 17

Occupational Health and Safety Evaluation of Biogenic and Anthropogenic VOC Emissions in Car Paints Workplace and Artists' Paint Workplace

Gökçe DEVECİ[a], Hatice KARADENİZ[b,c]*, Serpil YENİSOY-KARAKAŞ[a]

[a] *Bolu Abant İzzet Baysal University, Faculty of Arts and Science, Department of Chemistry, Bolu, Türkiye*
[b] *Bolu Abant İzzet Baysal University, Scientific, Industrial and Technological Application and Research Center, Bolu, Türkiye*
[c] *Bolu Abant İzzet Baysal University, Faculty of Engineering, Department of Chemical Engineering, Bolu, Türkiye*

* *haticekaradeniz@ibu.edu.tr*

There is a great concern regarding pollutant inventories to understand the major sources of emissions and their impacts on human health effect. The study investigated the indoor air quality of pollutants to which workers were exposed during different painting processes, such as car painting and artists' painting processes. The sampling was carried out using Tenax-TA in one painting class and two print making classes at Faculty of Fine Arts and Faculty of Education in Bolu Abant İzzet Baysal University, and in a car painting repair shop in the city center of Bolu. The sampling time varies between 15 minutes and 4 hours depending on the features of the sampling point. Totally, 69 volatile organic compounds were determined by TD-GC-MS. Among the observed VOCs, anthropogenic VOCs like chloroform, carbon tetrachloride, benzene, 1,2-dichloroethane, heptane, toluene, chlorobenzene, ethylbenzene, xylenes, styrene, isoproprylbenzene, 1,3,5-trimethylbenzene, benzaldehyde, 1,2-dichlorobenzene, phenol, acetophenone, naphthalene and biogenic VOCs like crotonaldehyde and d-limonene, the carcinogenic and noncarcinogenic effects on workers were investigated. Health risk assessments were conducted for seven different working places. The lifetime cancer risk of carbon tetrachloride, benzene and 1,2-dichloroethane, benzaldehyde was ranging from 5.17x 10^{-8} to 1.2x 10^{-5}. Noncancer risks for workers exposed to chloroform, carbon tetrachloride, benzene, toluene, chlorobenzene, ethylbenzene, m+p-xylene, o-xylene, styrene, isopropyl benzene, 1,3,5-trimethylbenzene, 1,2,3-trimethylbenzene, benzaldehyde, 1,2-dichlorobenzene, phenol, acetophenone and naphthalene were also assessed. The results showed that seven sampling area in this study had no lifetime cancer risk. The hazard indices exceeded 1.0 for carbon tetrachloride, benzene, and toluene. The print making class was found to be a risky area for students and teachers compared to other sampling points because of the unsuitable ventilation system. The results were also simulated by Monte Carlo approach.

OP – 18

Investigation of Organophosphate Esters Concentrations in Air Due to E-Waste Processing Facility Emissions in Turkey

Yetkin DUMANOĞLU[a], Barış YAMAN[a], Melik KARA[a], Ersan GÜNEL[a], Perihan Binnur KURT-KARAKUŞ[b], Aşkın BIRGÜL[b], Mustafa ODABAŞI[a]
[a]*Dokuz Eylül University, Faculty of Engineering, Department of Environmental Engineering, İzmir, Türkiye*
[b]*Bursa Technical University, Faculty of Engineering and Natural Science, Department of Environmental Engineering*
**yetkin.dumanoglu@deu.edu.tr*

With the rapid updating of technology and the continuous expansion of the electronic industry market, electrical and electronic waste (e-waste) has become a global problem. Hazardous substances like metals, metalloids, rare elements, flame-retardants, and plastics containing several additives could contaminate the environment, especially if e-waste is not recycled/disposed in a regular and controlled manner. Organophosphate esters (OPE) are widely used as flame retardants and plasticizers in many electrical and electronic products and contained in e-waste at substantial amounts. The scope of this study was to investigate OPE levels around several e-waste processing plants in Turkey. Air samples were collected near twenty e-waste processing plants licensed by the Ministry of Environment, Urbanization and Climate Change. These e-waste treatment facilities are in the provinces of Ankara (7), Istanbul (4), Eskişehir (2), Bursa (2), Kırıkkale (1), Kocaeli (2), Manisa (1), and Niğde (1). Eight background sites, far from potential pollution sources were also selected as sampling points. Air samples were collected using polyurethane foam – passive air samplers (PUF-PAS). Sampling was carried out to represent the seasonal conditions of summer, autumn, winter, and spring (between May 2021 and May 2022). Samples were analyzed for 11 OPE compounds, which are widely studied in the literature. Tris(1-chloro-2-propyl) phosphate and triethyl phosphate were the prominent OPE compounds for all seasons. Atmospheric concentrations near e-waste plants were substantially higher than the background sites for all seasons. Concentrations varied between 0.24-1025 (28±119, average± SD) ng/m^3 near the facilities and 0.10-6.2 (1.2±1.3, average± SD) ng/m^3 in the background. At most sites, OPE levels peaked during the summer and fall periods, probably due to increased emissions at higher temperatures. Results of the present study suggested that e-waste processing plants could be important OPE emitting sources.

OP – 19

Determining the Fate of Volatile Methyl Siloxane Compounds during the Electro-Dewatering of the Waste Activated Sludge

Tuğçe DEMİR, Nazlı BALDAN PAKDİL

Bolu Abant İzzet Baysal University, Faculty of Eng., Dept. of Environmental Engineering, Türkiye

**tugce.demir@ibu.edu.tr*

The sewage sludge is produced as a by-product during the treatment of municipal wastewater. Due to the large quantity of water and low dry solid (DS) content, it leads to high transport and disposal costs. Mechanical Dewatering (MD) processes are generally preferred to reduce the water content of sludge because of their low cost. However, the DS content of dewatered sludge is limited to 30%-35% by MD operations [1]. Since the Electro-Dewatering (ED) process enables the DS content of sludge to around 35%-50% which is applied by using an electric field and pressure has taken the attention for effective sludge dewatering in recent years [2]. Many studies in the literature are focused on finding the optimum operating performance of ED reactors, determining the characterization of dewatered sludge and filtrate, and providing the maximum dewatering efficiency at the end of the ED process. However, electro-chemical reactions and ohmic heating occur as the result of the ED process, and volatile and toxic pollutants in the sludge pass into the solid (dewatered sludge), liquid (filtrate), and gas (vapor) phase during the operation of the ED reactor. To our knowledge, it has been seen that there is no work in the literature on Volatile Methyl Siloxanes (VMSs) which might be found as potential pollutants in the gas released during ED due to ohmic electrochemical impacts. VMSs are indicated as emerging organic contaminants and determined as high production volume (HPV) chemicals by the US Environmental Protection Agency [3]. In this study, determining the fate of linear (*Octamethyltrisiloxane* (L3), *Decamethyltetrasiloxane* (L4), *Dodecamethylpentasiloxane* (L5)) and cyclic (*Octamethylcyclotetrasiloxane* (D4), *Decamethylcyclopentasiloxane* (D5), *Dodecamethylcyclohexasiloxane* (D6)) VMSs are specified during the ED process. The experimental study results were statistically evaluated to determine the optimum values of the operation parameters (pressure, voltage, and operation time) to provide the maximum DS efficiency in the ED of WAS. Therefore, the optimum conditions were determined as 100 kPa, 20V, and 15 minutes obtaining approximately 40% DS sludge content. The laboratory scale ED reactor was designed as close-topped and fitted in a chamber. Raw sludge, filtrate, dewatered sludge, and obtained gas were sampled from the ED reactor. Subsequently, these samples were extracted and analyzed by various enviro-friendly low solvent protocols to find their VMS concentrations. After the ED process was applied to sludge samples, the concentrations of ΣVMSs were found as 2.0–15 µg/mL in waste activated sludge (WAS). Among the target VMSs, the distribution of cyclic siloxanes was higher than linear siloxanes in raw sludge. Besides, D6 was determined as the highest concentration in all sludge samples analyzed. A significant difference was found in the concentrations of VMSs between influent sludge and filtrate after the ED process. The VMS concentrations in the gas release were calculated in the range of 0.08-2.75 µg/mL during ED of sludge. It was concluded that in the ED reactor, linear VMSs were eliminated mostly by degradation to dewatered sludge, while cyclic VMSs may be eliminated by both volatilization and degradation. The experimental results provided insights into the fate of the VMS compounds and their treatment mechanism to improve sludge management.

References:

1) Navab-Daneshmand et al., Env. Sci. Techn. **2015**, 49(9), 5417–5424.
2) Qian et al., Sci.Total Environ. **2019**, 667, 751–760.
3) Li et al., Chemosphere. **2020**, 256.

OP –20

Environmentally Sustainable Leather Tanning: Preparation and Application of Oxidized Carboxymethyl Cellulose (OCMC) as an Eco-Friendly Pre-Tanning Agent to Reduce Chrome Tanning Pollution

Ali OLAD*, Maryam BASTANIAN

Polymer Composite Research Laboratory, Department of Applied Chemistry, Faculty of Chemistry, University of Tabriz, Tabriz, Iran

* a_oladgz@tabrizu.ac.ir

The leather industry faces a pressing challenge in the modern era - environmental sustainability. Traditionally, the tanning process relies heavily on chromium compounds for their ability to fix leather properties. However, this reliance has given rise to grave environmental concerns due to the inefficient uptake of chromium by skin collagen, leading to the pollution of wastewater with toxic chromium compounds. In response to the environmental challenges, leather scientists are actively seeking innovative ways to reduce the industry's environmental footprint while maintaining the quality of leather products [1]. One promising avenue lies in the development of eco-friendly pre-tanning agents which cause to the improvement of chromium uptake. These agents have the potential to coordinate trivalent chromium, thereby minimizing waste water pollution and introducing a cleaner and greener tanning process [2].

This study reports the preparation and optimization of a novel pre-tanning agent, Oxidized Carboxymethyl Cellulose (OCMC), derived from renewable and green sources, notably natural-based carboxymethyl cellulose (CMC). The transformation of CMC into OCMC was achieved through a hydrogen peroxide-mediated green process. The oxidation process was investigated and optimized. Comprehensive characterization studies were conducted, including FT-IR spectroscopy and carboxyl content analysis. The analyses revealed a notable increase in carboxyl functionality in OCMC following oxidation process. The structural characterizations proposed that the produced OCMC can effectively coordinate trivalent chromium ions during the tanning process. OCMC demonstrated its ability to enhance the exhaustion of chromium in the tanning process, achieving an impressive 92.76% exhaustion rate. The leather produced by using OCMC, maintained high standards, exhibiting a shrinkage temperature (Ts) of 118°C and a tensile strength of 305.68 $kg.cm^{-2}$ and a tear strength of 50 $kg.cm^{-1}$. Furthermore, the leather possessed desirable organoleptic properties. By implementing OCMC as a pre-tanning agent, a remarkable (79.69%) reduction of chromium content in wastewater was achieved compared to conventional chrome tanning process. In conclusion, the OCMC has demonstrated its efficacy as a pre-tanning agent in enhancing chromium exhaustion and reducing environmental pollution. By adopting this innovative approach, the leather industry can take a significant step towards a more sustainable and environmentally responsible future while continuing to produce high-quality leather products.

References:

1)Yao et al., Chem. Select. **2019**, 4, 670.
2)Yao et al., J. Indian Chem. Soc. **2021**, 98, 100175.

OP –21

Contribution of Detergent Processing Wastewater to Treatment of Marble Processing Wastewater in Dispersed Air Flotation

Esra YEL[a,*], Vildan ÖNEN[b], Merve KALEM[a]

[a] *Konya Technical University, Environmental Engineering Department, Konya, Türkiye*
[b] *Konya Technical University, Mining Engineering Department, Konya, Türkiye*

**eyel@ktun.edu.tr*

Turbid wastewaters with high solids content are being generated from marble processing plants (MPWW) during marble wet cutting. Solid-liquid separation though physical or physicochemical means is necessary for treatment of MPWW and commonly applied methods are sedimentation after coagulation-flocculation. The flotation process has also been employed for solid-liquid separation in wastewater treatment as an alternative to sedimentation and filtration. Essentially, flotation is a common method applied for different purposes in various engineering solutions as dispersed and dissolved air flotation (with and without pressure). Surface tension is the most important factor effecting flotation efficiency, therefore, to increase flotation performance some collector and frother chemicals, surfactants are utilized to change the surface tension. Detergents are among important surfactants. Functional groups (monomers) in some frothers are identical to the functional groups of some collectors and so they may act as both frother and collector in the pulp. For example, sodium dodecyl sulphate (SDS) is an anionic collector, which is also one of the main components of washing liquids. When it is used in flotation as collector, there is no need to an extra frother. Likewise, detergent production process produces wastewater (DPWW) which needs treatment prior to discharge as it includes surfactants and other chemicals. Therefore, the purpose of this study was to determine the effectiveness of surfactant-containing DPWW in co-treatment of this wastewater together with MPWW via the dispersed air flotation. Instead of synthetic surfactant, a wastewater which itself also needs treatment was evaluated. First, dispersed air flotation was applied to DPWW and MPWW separately, to investigate the performance of this treatment method for each of these wastewaters. Secondly, two wastewaters were mixed at varying ratios and dispersed air flotation co-treatment was applied to the mixtures. Volume ratio of the mixture, time, pH on treatment performance were investigated. Efficient treatment could not be achieved when flotation was applied to each wastewater separately, whereas, turbidity, solids, COD, phosphate removals were achieved when the flotation was applied to the mixture. The highest treatment performance was achieved at 90%MPWW-10%DPWW mixture. The proposed treatment had no considerable effect on alkalinity reduction from the wastewaters mixture.

Keywords: Detergent production wastewater, flotation, marble processing wastewater.

Acknowledgement:

This study was financially supported by Scientific Research Projects Fund, under Grant No: 16401122

OP – 22

Effect of Ocean Acidification on Morphometric Parameters of Marine Calcifying Organism

Serdar AKSAN[a], Halim Aytekin ERGÜL[a]

Kocaeli University, Faculty of Arts and Science, Department of Biology. Kocaeli/Türkiye

**serdar.aksan@kocaeli.edu.tr*

Excessive increase in anthropogenic carbon emissions after the Industrial Revolution brought us today's atmospheric conditions. All-time record concentrations of greenhouse gasses. Carbon dioxide, the most abundant greenhouse gas in our atmosphere is being held responsible as the main actor in climate change. However global warming is not the only environmental problem caused by excessive CO^2 in the atmosphere. Ocean acidification is caused by CO^2 dissolving into marine environments. It affects the carbonate chemistry of marine ecosystems and impacts directly calcifying organisms.

A marine mesocosm setup built to project future predictions for ocean acidification. RCP 8.5 (Representative Concentration Pathway - IPCC), RCP 4.5, and a control group (current conditions) were established to replicate these conditions. *Rapana venosa* (Valenciennes, 1846) (Veined rapa whelk) was chosen as the subject of the experiment for its economic importance and invasive capacity.

Mophometric measurements were taken at the start and the end of the experiment. After 1.5 years' duration of the study, difference in proportions between morphometric parameters were mesaured between control group and experimental setups. Most prominent differences were observed aperture length/aperture width and shell thickness parameters of RCP 8.5 group. While control group proportions of aperture length/aperture width were measured as 2.01 on average, RCP 8.5 group proportions were 2.19 on average. Also control group shell thickness increased 13.9 percent on average, while RCP 8.5 group shell thickness decrease by 0.06 percent on average.

These results indicates that, in future climate conditions *R. venosa* could have narrower aperture opening and thinner shell than contemporary populations. This could lead to some shift in ecological niche of *R. venosa* in the future. Also could effect economical importance as a commodity for countries like Türkiye.

OP – 23

Polychlorinated Biphenyls (PCBs) in Turkish Home-Made Butter Samples and Assessment of Human Exposure

Hatice Kübra GÜL[a], Perihan Binnur KURT-KARAKUŞ[a*], Güray SALİHOĞLU[b], Aşkın BİRGÜL[a]

[a]*Department of Environmental Engineering, Faculty of Engineering and Natural Sciences, Bursa Technical University, Bursa, Türkiye*
[b]*Department of Environmental Engineering, Faculty of Engineering, Bursa Uludag University, Bursa, Türkiye*

* *perihan.kurt@btu.edu.tr*

Abstract

Food and nutrition issues are among the most important issues for societies in terms of economic, social and environmental aspects. Therefore, food quality and safety are becoming increasingly important nowadays. For public health, in addition to biological hazards in food safety, chemical hazards are also very important. Contamination of food with chemicals can occur through air, water and soil due to environmental pollution. Persistent organic pollutants (POPs) are substances that are persistent and mobile in the environment that bioaccumulate in food chains due to their vapor pressures and partitioning behavior. POPs are easily subjected to atmopsheric transport via air currents and deposit to terrestrial environments. Following deposition on soil and plant surfaces in open fields, they pass into the bodies of grazing animals through plants and hence into milk and butter, and transfer through the food chain due to their ability to accumulate in fatty tissues of living organisms. In this study, 121 polychlorinated biphenyls (PCB) congeners were analyzed in 94 homemade butter samples collected in Türkiye between April and May 2014. After butter samples were extracted with hexane, the extracts were cleaned using a glass chromatography column and analyzed by GC-MS. Using the data obtained, the degree of exposure to ΣPCBs through butter consumption was determined. The average concentration of the $\sum_{121}$PCB congener was determined as 10550 ±2947 pg/g lipid (minimum 5118 pg/g lipid (Afyonkarahisar), maximum 20622 pg/g lipid (Kütahya)). As a result of the exposure assessment for both children and adults on the basis of geographical regions, the highest exposure was observed in the Marmara Region for both children and adults. It has been observed that $\sum_{121}$PCB exposure due to butter consumption does not exceed acute (0.03 mg kg^{-1} day^{1}) or chronic (0.02 mg kg^{-1} day^{-1}) exposure limit values in any geographical region.

Keywords: butter, exposure assessment, polychlorinated biphenyls (PCB)

Introduction

Intake of food contaminants into the human body poses a significant risk to human health. Food contaminants include phytoestrogens, goitrogens, mycotoxins, plasticizers (phthalates, etc.), persistent organic pollutants (POPs) (pesticides, polychlorinated biphenyls, etc.) and polyaromatic hydrocarbons (PAHs) [1]. Through consumption of various food matrices (vegetables, eggs, fish, meat, oils and milk), these pollutants have been reported to cause health effects such as neurotoxicity, endocrine disruption, cancer, reproductive disorders, leukemia, asthma and risks on fetal development [2-6].

Polychlorinated biphenyls (PCBs) are a group of approximately 209 individual chemical compounds produced by binding chlorine ions to biphenyls in different configurations (ortho, meta, and para) in various industrial mixtures [7]. PCBs are defined as persistent organic pollutants (POPs) and their use is prohibited under the Stockholm Convention [8]. POPs contamination in dairy products may arise from raw materials and/or machinery and equipment that come into contact with dairy products during production and storage, depending on the contamination to which milking animals are exposed [9]. In order to evaluate the effectiveness of the Stockholm Convention, studies carried out in environmental environments to monitor changes in POP concentrations and collect data on long-distance transport of POPs on a regional and global scale are of great importance [10]. POPs, which have high solubility in oil and low solubility in water, have a high potential to accumulate in butter, which consists of approximately 80% fat [11]. Studies on the presence of

POPs in butter in Turkey are very limited and these studies were generally carried out in a certain region [12-14]. There is only one study on the subject on a regional scale, and various POP contaminants were examined in butter samples in the Eastern-Central and Western Black Sea [15]. In the most comprehensive study on the subject, dioxin/furan, PCB and PBDE contaminants were examined in butter samples collected from 14 different provinces [16]. In this study, unlike the literature, a more representative number of butter samples and more PCB types were analyzed and exposure to polychlorinated biphenyls through butter, a food frequently consumed by people, was evaluated.

Materials And Methods

Sampling

In this study, PCBs were examined in 94 homemade butter samples collected from 44 different provinces in Turkey between April and May 2014. All samples were delivered to the laboratory in glass jars and were stored in the freezer at -18°C until analysis.

Sample Preparation and Instrumental Analysis

A total of 121 PCB congeners were analyzed in butter samples. Previously tested and reported effective methods were used to extract target contaminants from butter samples [6,17-18]. Butter samples (approximately 1.7 g) were mixed with ~5 g of baked (at 450˚C) sodium sulfate (Na_2SO_4) and were boiled with 50 mL of high purity hexane for 10 min. A subsample was taken for fat determination. The remaining extract was spiked with recovery standards and the volume of the extracts was reduced to approx. 2 mL on a rotary evaporator. The column chromatography procedure was used to clean up the extracts. For this purpose, a glass column (i.d. ~2.5 cm) containing 15 g of acidified silica gel (2:1 silica gel: acid by weight) was used and the elution was done with 150 mL of hexane. The extract was then evaporated to ~5 mL using a rotary evaporator and the volume was further reduced to 1 mL under a gentle stream of nitrogen. A silica fractionation column (9 mm id), packed with 3 g of silica (activated at 350 °C) was used for further elution. The sample was eluted with 33 mL of hexane (for PCBs) and 15 mL of hexane:DCM (1:1) (for OC pesticides). Both extracts were combined and volume was reduced to 1 mL in isooctane and spiked with 12 ng of internal standard ($^{13}C_{12}$PCB105). Instrumental analysis was carried out on in electron impact ionization using a GC–MS (Agilent, 7890B GC and 5977 MSD).

Exposure Assessment

Equation (1) was used to assess exposure (EDI) (mg/kg/day) to PCBs through butter consumption [19].

$$EDI=C\times LBW \qquad (1)$$

where; C= daily butter consumption amount (g/day) (35 g)[20-21], L= amount of POPs determined in the butter sample (mg/kg), BW= body weight (kg) (12.7 kg for 0-3 years old girls and boys[22] and 73 kg for adults [23].

Quality Assurance/Quality Control (QA/QC)

The use of all kinds of equipment, such as samples, equipment and chemicals involved in various stages of analytical methods, was inspected with strict quality control precautions during the experiments. In this context; Quality Assurance (QA) and Quality Control (QC) measures were taken, such as preparing control/blank samples, using recovery efficiency test chemicals (PCB-14, -65 and -166), testing the recovery of target pollutants, and determining instrument detection limit (IDL) and method detection limit (MDL) values.

Results And Discussion

The concentrations of target pollutants in the analyzed samples were determined in the range of 6.6 - 2134 pg/g lipid. The lowest concentration was obtained in Kars province for PCB-126 and the highest concentration was obtained in Izmir (Aliaga) province for PCB-128. The highest average concentrations were found in the Marmara Region, where industrial activities are intense, and the lowest average concentration was found in the Southeastern Anatolia and Eastern Anatolia regions, where industrial activities are not as intense as western part of the country (Fig. 1).

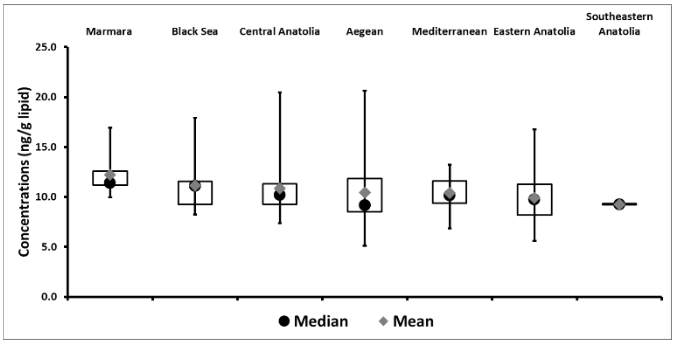


Figure 1. $\sum_{121}$PCB concentration level based on geographical regions (the lower and upper limits of the boxes are the 25th and 75th percentiles respectively, the circles are the median values, the squares are the average concentrations, the vertical lines are the minimum and maximum values of the data)

Exposure assessment revealed that the highest exposure was observed in the Marmara Region for both children and adults (Fig. 2). It has been observed that the $\sum_{121}$PCB exposure value from butter consumption in any geographical region does not exceed the acute (0.03 mg kg^{-1} day^{1}) or chronic (0.02 mg kg^{-1} day^{-1}) exposure limit values reported for PCBs by the Toxic Substances and Disease Registry (Fig. 2) [22].

It can be concluded that butter provides a convenient matrix with which to assess presence of various POPs in different geographical regions. However, it should be kept in mind that ambient air concentrations may not be the only factor influencing the concentrations of compounds in butter and yet several other factors such as animal's lactation cycle; seasonality in air-pasture transfer of POPs; the influence of dietary supplements/soil ingestion/ livestock management regime on the POPs concentrations in dairy products; compound metabolism might play important role. Furthermore, there is always a possibility that samples may become contaminated in the dairy/food processing or mixed at the dairy with milk from other regions. Nevertheless, we suggest that butter can be proposed as a suitable food to monitor POPs to assess human diatery exposure to these chemicals.

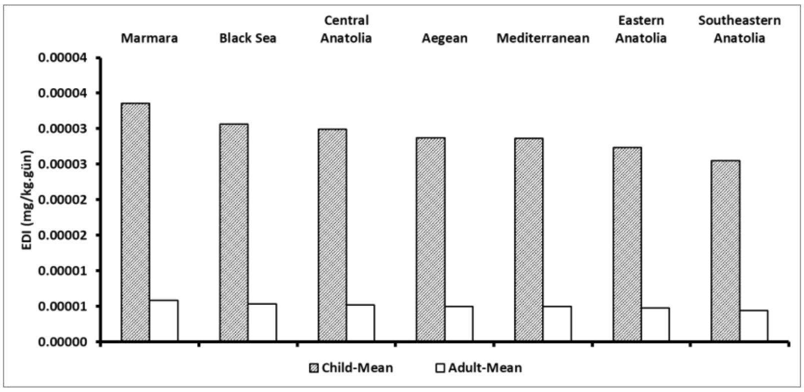


Figure 2. Estimated daily intake (EDI) values (mean, mg kg^{-1} day^{-1})

References:

1)Fernandes et al., Sci. Total Environ. **2019**, 678, 793-800.
2)Gilden et al., J Obstet Gynecol Neonatal Nurs. **2010**, 39, 103–110.
3)Kim et al., Sci. Total Environ. **2017**, 575, 525-535.
4)Lü et al., Crit. Rev. Environ. Sci. Technol. **2014**, 44(1), 1-33.
5)UNEP/WHO,**2012**.https://stgwedocs.unep.org/bitstream/handle/20.500.11822/17015/State_Science_Endocrine_Disrupting_Chemicals.pdf?sequence=1 .
6)Thomas et al., Environ. Sci. Technol. **1998**, 32(22), 3522-3528.
7)Ballschmiter, and Zell, Fresenius' Z. Für Anal. Chem. **1980**, 302(1), 20-31.

8)Lallas, *Am. J. Int. Law.* **2001***, 95(3), 692-708.*
9)Özturan, and Atasever, *Atatürk Üniv. Vet. Bilimleri Derg.* **2018***, 13(2), 229-241.*
10)Wöhrnschimmel et al., *Environ. Pollut.* ***2016****, 217, 149-158.*
11)WHO, **2010**, https://iris.who.int/bitstream/handle/10665/44525/9789241501101_eng.pdf.
12) Nizamlioglu et al., J. Environ. Biol. **2005**, 26(2 Suppl), 375-378.
13)Bulut et al., J. Anim. Vet. Adv. **2010**, 9(22), 2797-2801.
14)Yentür et al., Food/Nahrung, **2001**, 45(1), 40-42.
15)Aksoy et al., Bull. Environ. Contam. Toxicol. Lett. **2013**, 90(1), 110-115.
16)Uçar et al., Food Addit. Contam. Part B. **2011**, 4(2), 141-151.
17)Kalantzi et al., Environ. Sci. Technol. **2001**, 35(6), 1013-1018.
18)Jafari et al., J. Environ. Monit. **2008**, 10(7), 861-866.
19)Nougadère et al., Environ. Int. **2012**, 45, 135-150.
20)Kart, and Demircan, Akademik Gıda, **2014**, 12(1), 78-96.
21)NAM, **2018**. The National Academies of Medicine. Dietary Reference Intakes: Macronutrients
22)ATSDR, **2017**. Agency for Toxic Substances and Disease Registry. Minimal Risk Levels (MRLs) for Hazardous Substances.

OP – 24

Semi-volatile Organic Compounds in Primary School Classrooms

Zülfikar AKMERMER, Sait Cemil SOFUOĞLU, Hale DEMİRTEPE*

İzmir Institute of Technology, Faculty of Engineering, Department of Environmental Engineering, 35430 Urla, İzmir, Türkiye

**haledemirtepe@iyte.edu.tr*

Indoor air is an important source of chemicals that people are exposed to throughout their lifetime. Especially indoor air quality in school classrooms is an essential concern for children who spend almost one-third of their daily time in schools. Poor indoor air quality in classrooms may affect children's health and academic performance [1]. This study aims to investigate semi-volatile organic compounds (SVOCs) in a primary school in Bornova, İzmir. The school is close to a highway junction, and there are industrial facilities nearby; hence, besides indoor emissions, outdoor contamination is considered an important exposure source. Indoor air samples were collected from five classrooms during February-March 2023 using polyurethane foam – passive air samplers (PUF-PAS). Target compounds were 16 polycyclic aromatic hydrocarbons (PAHs), nine organophosphate esters (OPE), and twelve phthalate esters (PEs). As a result, ten PAHs were detected in the classrooms with a total concentration of 52.7 ± 9.6 ng/m^3 (monthly mean ± standard deviation). Phenanthrene followed by naphthalene and fluorene dominated the indoor air profiles in the classrooms. Five OPEs were commonly detected in the classrooms, having a total concentration of 15.3 ± 2.6 ng/m^3. Tris-2-chloroethyl phosphate had the highest concentrations among OPE compounds in the indoor air. Lastly, highest concentrations were observed for total five PEs commonly detected in the classrooms: 109.2 ± 22.5 ng/m^3. Diethyl phthalate and di-iso-butyl phthalate were predominant PEs. For all SVOC groups, lower concentrations were observed for higher molecular weight compounds due to their lower volatility. Interestingly, diethylhexyl phthalate (DEHP), a high molecular weight PE compound, was detected in all samples. The reason for this observation could be wide usage of DEHP in products and building materials in the classrooms resulting in high emissions of this compound to indoor air. In conclusion, presence of these compounds in the classroom air has a potential to pose risk to the school children.

Acknowledgments:

This study is funded by the Scientific and Technological Research Council of Türkiye, Career Development Grant No: 121Y337.

References:

1)Ekren et al., Sci. Technol. Built Environ. **2017**, 23(2), 391-402.

OP –25

Ionic Liquid Recovery from Water Phase via Aqueous Two-Phase Extraction

Nurdan BUYUKKAMACI[a,*] Sema Bahar ERDEM[b], Duygu Totur PAMIK[a], Serap Seyhan BOZKURT[c]

[a]Dokuz Eylul University, Engineering Faculty, Department of Environmental Engineering, Türkiye
[b]Dokuz Eylul University, Graduate School of Natural and Applied Sciences, Türkiye
[c]Dokuz Eylul University, Faculty of Science, Department of Chemistry, Türkiye

**nurdan.buyukkamaci@deu.edu.tr*

Ionic liquids (ILs), known as environmentally friendly solvents, are organic salts that exist as liquids at low temperatures, usually below 100°C. They have superlative physico-chemical properties, very low vapor pressures, generally good thermal stability, and an almost unlimited combination of anions and cations. These advantages of ILs ensure their applicability in many different areas and their use in industrial facilities is increasing. However, these chemicals have disadvantages such as possible toxic effects and high cost in the aqueous environment. With the increasing industrial applications of ILs, there is increasing concern about their future accumulation in aquatic environments due to their high chemical stability and extremely poor biodegradability. Accordingly, it is thought that if the ILs in wastewater are not treated, they will become a new type of permanent pollutant that endanger the ecological environment. Therefore, it is of great importance to investigate how to effectively remove ILs from wastewater[1]. The cost of ionic liquids is too high to limit their use. Therefore, recovering ILs from wastewater will be a beneficial approach, both to reduce their toxic effects in the receiving environment and to provide economic recovery[2]. Methods such as distillation, extraction, adsorption, membrane separation, liquid-liquid extraction and crystallization have been tried to recover them from aqueous media. Within the scope of this study, aqueous two-phase extraction method (ATPE), which is a separation method based on the difference in solubility of the components separated in two immiscible liquid phases, was applied. This method has proven to be an effective method to recover ILs[3]. In this study, ionic liquid with hydrophilic properties, namely $[C_4mim]Br$, recover studies were carried out by adding concentrated salt solution. For this purpose, different salts (KH_2PO_4, K_2HPO_4, K_2CO_3) were added to solutions with different amounts of ionic liquids and mixed in an ultrasonic bath at different temperatures (40 and 50°C). The most suitable recovery condition was determined by controlling the phase formation. The experimental results show that K_2CO_3 and KH_2PO_4 salts are effective salts for the recovery of $[C_4mim]Br$. The optimum conditions determined will be given in detail in the paper.

Acknowledgment:

This study was supported by Research Foundation of Dokuz Eylul University (Scientific Research Project # FBG-2022-2732).

References:

1)Qiu et al., Chemistry Select. **2022**, 7, e202201792, 1-12.
2)Isosaari et al., M. Sci. Total Environ. **2019**, 690, 604-619.
3)Zhou et al., RSC Adv. **2018**, 8, 32832-32864.

OP – 26

Preparation of A National Reference Material Pesticide Mixture for Environmental Analysis

Hatice KILINÇ[a,*], Serpil YENİSOY-KARAKAŞ[a]

[a] *Bolu Abant İzzet Baysal University, Faculty of Art and Sciences, Department of Chemistry, Bolu, Türkiye*

* *haticekilinc992@gmail.com*

In this study, the feasibility of preparing a national CRM of pesticide mixture in acetonitrile was evaluated. Pure pesticide standards (solid or liquid) were used to prepare mixtures (around 1500 ppm). Three mixtures containing 108 pesticides were studied. One of them was prepared volumetrically and two of them were prepared gravimetrically. The short- and long-term stability tests of only organochlorine pesticides was conducted to test the stability of the possible behavior of the material during transport (at 20 °C) and to test the probable behavior of the material under the controlled storage conditions (at 4 °C and -20 °C). HCB, metolachlor, *α*-HCH, *γ*-HCH, aldrin, dieldrin, endrin, 4,4’-DDD, 4,4’-DDT, 4,4’-DDE, 2,4’-DDT, *α*-endosulfan, *β*-endosulfan, heptachlor and heptachlor-*endo*-epoxide were determined in the mixtures. Endrin aldehyde and endrin ketone were observed as impurities or degradation products of endrin[1]. There is no considerable concentration change of pesticides determined weekly in the mixtures for 5 months period. The long-term stability test is still under study. The uncertainty of these pesticides will be calculated regarding the uncertainty from homogeneity, short-long term stability, and uncertainty from characterization (analytical balance, purity of standards, calibration plot of GC-MS, dilution).

References:

1) https://www.atsdr.cdc.gov/ToxProfiles/tp89-c5.pdf (Accessed: 03 August 2023).

OP – 27

Human exposure and health risk assessment of mercury in air from informal e-waste recycling sites in Pakistan

Perihan Binnur KURT-KARAKUS[a,*], Jabir Hussain SYED[b], Askin BIRGUL[a], Merve OZKALELI AKCETIN[a], Mustafa ODABASI[c]

[a]*Environmental Engineering Department, Faculty of Engineering and Natural Sciences, Bursa Technical University, Bursa, Türkiye*
[b]*Department of Meteorology, COMSATS University Islamabad, Tarlai Kalan Park Road 45550, Islamabad Pakistan*
[c]*Environmental Engineering Department, Faculty of Engineering and Natural Sciences, Bursa Technical University, Bursa, Türkiye*

** perihan.kurt@btu.edu.tr,*

The adverse effects of mercury (Hg) on ecosystems and human health are widely recognized. While gaseous elemental mercury (GEM) emissions from e-waste recycling have been recorded in industrialized nations, more is needed to know about the situation in the Global South. Seasonally resolved concentrations of GEM in the air were monitored continuously at 32 informal e-waste recycling sites and background locations in Pakistan for a year between September 2020 and December 2021 using a total of 132 passive air samplers.

The results indicated uncontrolled and large-scale informal e-waste recycling practices were associated with high GEM concentrations in metropolitan areas. These levels exceeded those found at a national background site and are well above hemispheric background levels, suggesting that emissions from e-waste handling and recycling operations contributed to these levels. The levels remained high throughout the year, indicating stable emission sources.

Health risk assessment estimates the nature and probability of adverse health effects in humans due to exposure to environmental contaminants. This study evaluated the non-carcinogenic health risk based on inhalation routes of exposure. Non-carcinogenic health risk from Hg exposure was estimated using the hazard quotient (HQ) in this study.

The results of HQ via inhalation exposure for Hg have not exceeded the safe level for adults and children, indicating non-carcinogenic health risks from inhalation. When the HQ values of the cities where the sampling sites are located were examined, it was determined that the calculated HQ values did not exceed the safe level for adults and children, indicating non-carcinogenic health risks from inhalation exposure.

It is essential for Pakistan, as a signatory of the Minamata Convention, to develop an e-waste management plan that will help reduce emissions and exposure levels. Additional investigations are needed to identify and characterize the e-waste handling activities that result in the release of GEM, to determine the spatial concentration variability within the informal e-waste processing sites, to quantify the human GEM inhalation exposure, and to investigate the potential health effects it may cause.

OP – 28

Graphene Oxide's Potential as an Adsorbent: Analyzing Pentachloronitrobenzene Adsorption Using Cutting-Edge Computational Techniques

Avni BERISHA[a]* Ilir Mazreku[b], Jeton Halili[a]

[a] *Department of Chemistry, FNMS, University of Prishtina “Hasan Prishtina”, 10000 Prishtinë, Kosova*
[b] *Department of Biology, FNMS, University of Prishtina “Hasan Prishtina”, 10000 Prishtinë, Kosova*

avni.berisha@uni-pr.edu

Recent advancements in materials science have played a significant role in stimulating efforts to find practical solutions to urgent challenges related to pollution[1]. Graphene and its derivative[1,2], graphene oxide (GO), are well recognized as highly attractive choices in the field of nanomaterials. This study examines the interaction between adsorbed compounds, namely pentachloronitrobenzene (PCNB) fungicide, and graphene oxide (GO), with a particular emphasis. Fungicides serve a key role in the agricultural sector; nonetheless, concerns over their long-term environmental impacts persist. The main aim of this work is to examine the adsorption capability of graphene oxide (GO) for PCNB and assess its effectiveness in the context of water treatment.

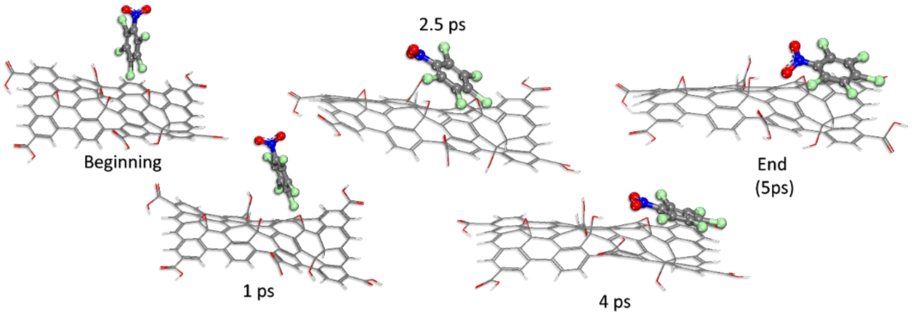


Figure 1. Adsorption dynamics of the PCNB molecule onto the Gox surface.

The Langmuir and Freundlich isotherms were employed to investigate the adsorption capacity and mechanisms of PCNB, therefore expanding our understanding of the topic. The findings of our investigation offer strong support for the notion that the incorporation of graphene oxide (GO) has promise in substantially augmenting the efficiency and effectiveness of water treatment facilities. To explore the interactions of PCNB, advanced computational techniques such as Density Functional Theory (DFT) and Density Functional Tight Binding (DFTB+) were utilized (Figure 1)[3]. The application of molecular docking simulations has yielded valuable insights into the robust interactions and significant binding affinity seen between PCNB and its corresponding target protein. This work represents a substantial and essential addition to the collective effort aimed at both reducing the environmental impact of fungicides and enhancing the conservation and sustainability of agricultural ecosystems.

References:

1)Chen *et* al. Chem. Rev. **2012**, 112, 11, 6027–6053
2)Mehmeti *et* al. Journal of Molecular Liquids Volume 347, **2022**, 118345
3)Hamed *et* al. Front. Environ. Sci., Volume 10, **2022**

OP – 29

Levels of Submicron Particles in a School

Cagri SAHIN[a], Begüm CAN TERZI[a], Aysun SOFUOĞLU[b], Sait Cemil SOFUOĞLU[a]*

[a]*Department of Environmental Engineering, Izmir Institute of Technology, Izmir, Türkiye*
[b]*Department of Chemical Engineering, Izmir Institute of Technology, Izmir, Türkiye.*

**cemilsofuoglu@iyte.edu.tr*

Indoor air quality (IAQ) in schools is a critical issue, as children are more susceptible to poor air quality and spend more time indoors than adults [1,2]. IAQ may have a significant impact on children's health, learning, and attendance [3,4]. This study conducted in fall semester of 2022 in a primary school located in a low-income neighborhood surrounded by heavy traffic and industrial activity. The aim was to investigate differences in indoor air quality (IAQ) in a mechanically and a naturally ventilated classroom in the school. PM_1 was simultaneously measured outdoors along with the inside the two classrooms using Thermo Scientific MIE pDR 1500 devices with selected cyclone, flow rate and filter. The mean PM_1 outdoor concentration was 27.0 ± 24.2 $\mu g/m^3$, while a higher mean concentration was measured in the naturally ventilated (NV) classroom compared to the mechanically ventilated (MV) classroom with a difference of 3.5 $\mu g/m^3$. The measured PM_1 concentrations were consistently lower indoors than outdoors with indoor to outdoor ratio values ranging roughly from 0.28 to 0.39 in various time periods of occupancy. Variation in time indicate effect of traffic and indoor activities such as cleaning on the concentrations. Submicron particles are important in terms of indoor air chemistry as organic pollutants such as semi-volatile organic compounds (SVOCs) are found at higher concentrations compared to the coarser particles, and they have higher potential for adverse health effects [5].

References:

1)Bennett et al., J. Toxicol. Environ. Heal. Part A. **2007**, 71 (3), 227–237.
2)Schwartz et al., Am. J. Respir. Crit. Care Med. **1994**, 150 (5), 1234–1242.
3)Almeida et al., Atmos. Environ. **2011**, 45 (40), 7594–7599.
4)Mendell et al., Indoor Air. **2005**.
5)Genisoglu et al., Chemosphere. **2019**, 231, 216–224.

OP – 30

Linear and Cyclic Volatile Methyl Siloxanes in House Dust and Indoor Air in Izmir, Turkey

Ersan GÜNEL* and Mustafa ODABAŞI

[a]*Dokuz Eylül University, Faculty of Engineering, Department of Environmental Engineering, Tinaztepe Campus, 35390 Buca, Izmir, Türkiye*

**ersan.gunel@deu.edu.tr*

Volatile methyl siloxanes (VMS) are organic compounds containing Si and O, with linear and cyclic structures. They are used as additives in personal care, cleaning and industrial products. Due to their high volatility, VMS can easily evaporate from materials, resulting elevated indoor air levels. They can also reach significant concentration levels in the atmosphere. Recent studies have shown that siloxanes have toxic and endocrine disrupting effects in various organisms. In this study, indoor air and dust samples were collected from five different indoor environments where people spend most of their time (living rooms, bedrooms, offices, classrooms, and cars) and another indoor environment having a high potential for VMS exposure (hairdresser and barber shops). Six indoor air and dust samples were taken from each category of environment. Concurrently, outdoor ambient air samples were also collected (one for each category). Passive air sampling method was used for the determination of indoor air concentrations with a sampling period of 1 week. Indoor dust samples were collected from each site using a handheld vacuum cleaner at the beginning, three days after and at the end of passive sampling period and they were combined. All samples were analyzed for seven siloxane compounds (L3, L4, L5, D3, D4, D5 and D6) using a gas chromatography-mass spectrometry (GC-MS) system. Indoor air Σ_{VMS} concentrations ranged between 1526 and 449836 ng/m^3 (median, 27570 ng/m^3). Atmospheric concentrations were substantially lower (range: 236-9869ng/m^3, median: 1257 ng/m^3). The dominant VMS was D5, followed by D3 and D4 for both indoor and ambient air samples. Average indoor/outdoor concentration ratios were>1.0 and ranged between 16.8 (D4) and 183 (D5) indicating that VMS have significant indoor sources. Indoor dust Σ_{VMS} concentrations ranged between 354 and 40852 ng/g (median, 1067 ng/g). The dominant VMS for indoor dust was D5, followed by D6 and D3. Highest average indoor air and indoor dust Σ_{VMS} levels were measured in hairdresser and barber shops. However, lowest levels were observed for classrooms and homes for indoor air and dust, respectively.

OP – 31

Development of an Efficient Method to Determine Semi-volatile Organic Compounds Using Silicone Wristbands as Novel Passive Sampler Material

Zülfikar AKMERMER*, Hale DEMİRTEPE

İzmir Institute of Technology, Faculty of Engineering, Department of Environmental Engineering, 35430 Urla, İzmir, Türkiye

**zulfikarakmermer@iyte.edu.tr*

Sampling methods and tools used to determine human exposure to chemicals are active or passive air sampling with polyurethane foam (PUF) and filter or biological sampling with blood and urine samples. Recently, silicone wristbands have been used as novel passive samplers to investigate human exposure since they are easy to use and inexpensive compared to others. To date, semi-volatile organic compounds (SVOCs) such as polyaromatic hydrocarbons (PAH), organophosphate esters (OPE), phthalate esters (PEs), polybrominated diphenyl ethers, and polychlorinated biphenyls were evaluated successfully with them [1]. This study aims to develop a practical, economical, and time-efficient method to identify SVOCs in silicone wristbands and to test silicone wristbands as indoor air monitoring samplers. Two extraction methods were tested, i.e., ultrasonic and shaker. Also, two purification methods were tested: classical chromatography column and Pasteur pipette column. The extraction and purification methods were optimized to determine PAHs, OPEs, and PEs in wristbands. To test the applicability as indoor air samplers, silicone wristbands were placed in academic personnel's offices at Izmir Institute of Technology. As a result, ultrasonic extraction followed by a Pasteur pipette column containing silica gel was found to be the most efficient, economical, and practical method. Eight PAH compounds were commonly detected in the offices, including acenaphthene, acenaphthylene, fluorene, fluoranthene, phenanthrene, anthracene, naphthalene, and pyrene. The average concentrations of these compounds were 20.9, 10.5, 31.3, 11.4, 55.8, 10.3, 22.7, and 12.9 ng/wristband, respectively. Four OPEs were identified in the offices. The average concentrations of triethyl phosphate, tri(n-butyl)phosphate, tris(2-chloroethyl) phosphate, and tris(2-chloroisopropyl) phosphate were 45.7, 71.9, 75.8, and 205.3 ng/g wristband, respectively. Seven PEs were frequently detected in the offices. Dimethyl phthalate, diethyl phthalate, diisobutyl phthalate, di-n-butyl phthalate, benzyl butyl phthalate, diethylhexyl phthalate, di-2-ethylhexyl terephthalate had average concentrations of 17.8, 357.6, 447.3, 127.2, 20.6, 50.6, 40.2 ng/g wristband, respectively. Using the wristbands as indoor air samplers was useful for determining indoor contaminants and estimating human exposure.

Acknowledgments:

This study is funded by the Scientific and Technological Research Council of Türkiye, Career Development Grant No: 121Y337 and Izmir Institute of Technology Scientific Research Projects (Project No: 2022IYTE-1-0078).

References:

1)Wang et al., Environ. Int. **2019**, 132, 105104.

OP – 32

Occurrence and dust-gas partitioning phenomenon of indoor legacy and emerging flame retardants, and associated health risks

Mesut GENİŞOĞLU[a], Aysun SOFUOĞLU[b], Cafer TURGUT[c], Sait C. SOFUOĞLU[a,*]

[a]Izmir Institute of Technology, Department of Environmental Engineering, 35430, Izmir, Türkiye
[b]Izmir Institute of Technology, Department of Chemical Engineering, 35430, Izmir, Türkiye
[c]Adnan Menderes University, Department of Plant Protection, 09970, Aydın, Türkiye

** cemilsofuoglu@iyte.edu.tr*

Since the 1970s, brominated, chlorinated and organophosphate flame retardants (FRs) have been used in commercial products to reduce fire incidents and spread of flame. After the regulations on PBDEs due to their long persistence, long range transport and toxicity, the demand for alternative fire retardants increased. The occurrence of legacy (Σ_8PBDE) and alternative fire retardants (Σ_{10}NFR and Σ_{14}OPFR) were determined in settled and air samples taken from houses and schools in Izmir-Türkiye. While the average dust-bound Σ_8PBDE, Σ_{10}NFR, and Σ_{14}OPFR concentrations were determined to be 2039, 886, and 10516 ng/g in homes, those were 2393, 1328, and 22275 ng/g in schools. BDE-209 dominated the residential indoor dust PBDE concentrations with an average of 1998 ng/g, while $\Sigma_{\alpha,\beta}$DBE-DBCH and TBOEP were dominated the AFR and OPFR concentrations with an averages of 678 and 6084 ng/g, respectively. BDE-209 was the most abundant PBDE congener in schools with an average of 2149 ng/g ng/g, while BTBPE and TBOEP were the most abundant AFR and OPFR in schools with and averages of 585 and 8040 ng/g, respectively. The average indoor air Σ_8PBDE, Σ_{10}NFR Σ_{14}OPFR concentration in homes were determined to be 77.6, 333, and 32600 pg/m^3, while those averages in schools were 415, 875, and 32300 pg/m^3, respectively. Residential indoor air PBDE concentrations were dominated by BDE-209 with an average of 52.5 pg/m^3, while the ΣDBE-DBCH and TCEP were the dominant compounds with an average of 26.3 and 14800 ng/m^3, respectively. BDE-209 was the dominant PBDE congener in indoor air of schools with an average of 486 pg/m^3, while EH-TBB and TBOEP were dominant AFR and OPFR compounds with an average of 630 pg/m^3 and 12900 pg/m^3, respectively. Dust-gas partitioning phenomenon of targeted flame retardants shows the targeted compounds were in tendency to be bound to the dust in indoor environments ($\log_{10}K_{D\text{-}PBDE}$=from -4.02 to -1.96, $\log_{10}K_{D\text{-}PBDE}$=from -5.11 to -1.52, and $\log_{10}K_{D\text{-}OPFR}$=from -4.34 to -1.31). Exposure levels through inhalation and hand-to-mouth routes were modeled using Monte Carlo simulation. Although the health risk levels of the targeted compounds were lower than the threshold levels, the synergistic effect may pose considerable health problems. Relatively high concentrations in schools than that in homes indicates that indoor environments in schools need to be taken into consideration in detail.

Acknowledgments:

This study is financially supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK, Grant No: 118Y142)

OP – 33

Heavy Metal Contamination Assessment in Soil and Plants Near Thermal Power Plants in the Kastriot Region, Kosovo

Mentor ISMAILI[a], Dzuliana TOMOVSKA[b], Jeton HALILI[c,*]

[a]*Department of Food Technology, Faculty of Biotechnical Sciences, University," St. Kliment Ohridski- Bitola, Macedonia*

[b]*Department of Food Technology, Faculty of Biotechnical Sciences, University," St. Kliment Ohridski- Bitola, Macedonia*

[c]*University of Pristina ''Hasan Prishtina'' Faculty of Natural and Mathematics Sciences - Chemistry Department, Rr. ''Nëna Terezë'' , 10000 Prishtina, Republic of Kosovo*

*jeton.halili@uni-pr.edu

This study presents the results of an extensive chemical analysis of soil and plant samples collected from the Kastriot region in Kosovo, a site characterized by the presence of thermal power plants. The investigation aimed to ascertain the concentrations of heavy metals in the environment, offering critical insights into potential ecological and human health ramifications.

Numerous heavy metals were found in high amounts in the soil samples, with Fe appearing as the most prevalent pollutant, with concentrations of 45,243 ppm in Kosovo A, 31,866 ppm in H, and 33,725 ppm in Q. There were also notable quantities of Ni, Cu and Zn, with Kosovo A having the greatest concentrations of all three elements. Pb and Al were also abundant, especially in Kosovo A.

Analysis of plant materials found that these heavy metals were translocated from the soil into plant tissues, with Fe, Cu, and Zn exhibiting substantial quantities, indicating bioaccumulation from polluted soil. Notably, the highly hazardous element Cd stayed below detectable levels in both soil and plants.

These findings highlight the possible environmental and human health dangers associated with heavy metal contamination in the Kastriot region from nearby thermal power facilities. Comprehensive research efforts and strong environmental management techniques are required to mitigate these threats and protect the local population's well-being.

OP – 34

A Nanocomposite Hydrogel Based on Grafted-Carboxymethyl Cellulose/Metal-Organic Framework (MOF, MIL-53 (Fe)) for Slow Release of Water and Fertilizers in Sustainable Agricultural Applications

Ali OLAD*, Mina AKBARZADEH

Polymer Composite Research Laboratory, Department of Applied Chemistry, Faculty of Chemistry, University of Tabriz, Tabriz, Iran

*a_oladgz@tabrizu.ac.ir

The use of various agrochemicals is important to increase the yield of agricultural products. Although the conventional use of chemical macro and micro nutrients, increases the agricultural products, it causes to some environmental and health effects. So, it is a big challenge to reduce and control the use of agrochemicals for sustainable agriculture[1]. Polymeric hydrogels have been investigated for large scale agricultural applications to reduce water scarcity and irrigation frequency, control fertilizer release in soil and prevent environmental pollution. For sustainable agricultural applications, natural based biodegradable hydrogels have gained high interest in recent years[2].

In this work, a novel polysaccharide-based nanocomposite hydrogel was synthesized and investigated as slow water and fertilizer release system. The nanocomposite hydrogel was prepared by free-radical graft copolymerization of acrylic acid and acrylamide monomers onto carboxymethyl cellulose (CMC) in the presence of a metal-organic framework containing Fe (MOF, MIL-53 (Fe)) and NPK fertilizer (Hyd/MIL-53/NPK). The scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy, and X-Ray diffraction analysis confirmed the successful synthesis of the nanocomposite hydrogel and loading of NPK fertilizer. The swelling and water retention behavior of nanocomposite hydrogel in various solutions and soil were studied and evaluated. Results showed the improved swelling properties of nanocomposite hydrogel compared to neat hydrogel. The swelling ratio of the nanocomposite hydrogel was increased from 150.6 g/g to 345.8 g/g by the addition of MIL-53 up to 5 wt%. To evaluate the stability of the three-dimensional cross-linked hydrogel network, rheological analyses were performed. Results revealed a strong gel framework with a stable cross-linked network for nanocomposite hydrogel. Also the nanocomposite hydrogel represented better water retention capacity in soil. Based on the results, all of the absorbed water in soil loaded with neat hydrogel, were vaporized after 17 days, but the soil containing nanocomposite hydrogel maintained its own water for a longer period and its water retention capacity reached 21.70% on the 17th day. The release behavior of NPK fertilizer from Hyd/MIL-53/NPK nanocomposite hydrogel to the aqeous solution and humid soil was studied by conductimetry method. Results showed that the NPK release pattern was between 15 wt% on the first day, and 75 wt% on the 30th day. Thus, this formulation can be introduced as a slow-release fertilizer hydrogel. The most important achievement of this research is the biodegradation of the synthesized nanocomposite hydrogel. The SEM images affirmed mostly complete degradation of hydrogel nanocomposite in the soil within 53 days. In conclusion, this project introduces a promising polysaccharide-based nanocomposite hydrogel as a water and fertilizer career benefiting both agricultural production and environmental protection.

References:

1)Olad et al., Polym. Res. **2016**, 23, 241.
2)Olad et al., J. Polym. Res. **2020**, 460.

OP – 35

Hydrothermal Synthesis of Spinel MnO_2 starting from commercial Ƴ-MnO_2

Seyra TOPRAK*, Mustafa M. DEMİR

Department of Materials Science and Engineering, İzmir Institute of Technology, 35430, Gülbahçe, Urla, İzmir, Türkiye

*seyratoprak@iyte.edu.tr

Lithium stands out as an important metal with its valuable properties such as high energy density and diverse industrial applications. The depletion of ores in mining and growing environmental concerns have increased interest in the recovery of valuable elements from natural waters. For the selective extraction of lithium from aqueous systems, spinel-type lithium manganese oxide ion sieves (LMOs) have been recognized as sorbent materials. However, manganese oxides have six polymorphs including α, b, γ, d, e, and λ. Spinel form (λ-MnO_2) is one of them having the highest price in the market. This fact reduces the feasibility of the process from economical point of view. Thus, the cost of sorbent should be minimized to make this process viable.

In this study, we aimed to synthesize a spinel-type lithium-ion sieve starting from commercially available γ-MnO_2 powder, which has relatively cheaper prize (3 $/kg) than spinel form (140 $/kg). The hydrothermal synthesis, known as efficient method for fabrication of metal oxides through solid-state reactions, was employed. A one-step hydrothermal synthesis of $Li_{1.33}Mn_{1.67}O_4$ was conducted at 200 °C for 7 days, utilizing γ-MnO2 powder and an aqueous LiOH solution as reactant. Lithium ion-sieve ($H_{1.33}Mn_{1.67}O_4$) was obtained by leaching the $Li_{1.33}Mn_{1.67}O_4$ product with dilute hydrochloric acid solution. X-ray diffractogram confirmed that the synthesized powder exhibited characteristic reflections, which are consistent with spinel Li1.33Mn1.67O4. Although the spinel structure of the acid-treated adsorbent was preserved, only reduction in reflection intensity was observed. BET analysis revealed a surface area of 45.2 m^2/g for the adsorbent. To assess the lithium uptake performance of the sorbent, parameters for instance solution pH, initial lithium concentration, and sorbent dose were examined in batch adsorption process using synthetic LiCl solution. The uptake capacity reached a maximum of 10.2 mg/g at pH 12. At an initial lithium concentration of 200 ppm, the observed uptake capacity reached a maximum of 23.2 mg/g. At a sorbent dose of 20 g/L, the extraction efficiency reached 90%. Adsorption isotherms and kinetic tests were studied, yielding a maximum Langmuir adsorption capacity of 52 mg/g. This study may highlight the successful synthesis and characterization of a spinel-type lithium manganese oxide ion sieve with promising lithium extraction capabilities and offer a potential solution for the selective recovery of lithium from natural resources.

Acknowledgment:

This work was supported by the European Research and Innovation program ''CRM- geothermal- Raw materials from geothermal fluids: occurrence, enrichment, extraction'' (project number: 101058163).

OP – 36

Quantifying real-world PAH contributions by exhaust and non-exhaust emissions using EFECT method

Duran KARAKAŞ[a,*] Ercan BERBERLER[a1], Tuğçe DEMIR[a], Melike B. BAYRAMOĞLU KARŞI[b], Serpil YENISOY- KARAKAŞ[c]

[a]*Department of Environmental Engineering, Bolu Abant Izzet Baysal University, Bolu 14030, Türkiye*
[b]*Innovative Food Technologies Development Application and Research Center, Bolu Abant Izzet Baysal University, Bolu 13030, Türkiye*
[c]*Department of Chemistry, Bolu Abant Izzet Baysal University, Bolu 14030, Türkiye*
[1]*Department of Environmental Engineering, Bartın University, Bartın 74100, Türkiye*

**dkarakas@ibu.edu.tr*

Road traffic is one of the main sources of particulate matter (PM) in urban areas. Road transport is a source of both exhaust and non-exhaust emissions. Exhaust emissions result from fuel and oil combustions, however, the non-exhaust emissions include particles from brake and tire wear, road surface abrasion, road dust resuspension etc. Worldwide and national emission control regulations have been playing an important role in reducing vehicular exhaust emissions. However, it is not easy to regulate the non-exhaust emissions (brake, transmissions, hydraulic, and gear systems of the vehicles, road cover material abrasion, tire wear, and the secondary particles formed in the tunnel atmosphere, and road dust resuspension emissions). The existence of a large number of sources emitting particulates with similar compositions to the exhaust emissions hampers the search for useful tracers. It has been stated that even with electric vehicles (EVs), the non-exhaust emissions will still be an important source of particulate matter. Emission control regulations for non-exhaust emissions have not been established due to the lack of standardized sampling and measurement methods. The identified sources and the source profiles reported in literature or databases are not comparable and none of the emission data collection techniques and the receptor models used in the literature could produce a standard method to simultaneously identify and quantify the non-exhaust emission sources and their contributions to atmospheric PMs.

In this study, we applied EFECT Method (Road dust Enrichment Factor-Elemental Carbon Tracer Method) developed by our group to USEPA's 16 priority pollutants polycyclic aromatic hydrocarbons (PAHs) collected concurrently at the inlet and outlet of Bolu Highway Road Tunnel. Source apportionments and source contributions to measured particulate PAHs concentrations for the exhaust, road dust resuspension, and non-exhaust emission sources were quantified successfully. Results showed that the exhaust emission was the most significant contributor of Chy (100%), BaP (100%), dBahA (100%), IP (100%), AcN (94%), PhA (92%), BkF (91%), and AN (90%). The second significant contributing source was observed to be the road dust resuspension emissions contributing 55, 26, 23, and 20% to the measured concentrations of BbF, Fl, AcNP, and BghiP, respectively. Non-exhaust emission sources contributed mainly to the concentrations of BbF (20%), Fl (13%), AcNP (13%), and BghiP (11%).

OP – 37

Performance of Collection Substrates for Airborne Microplastics (< 10 µm) in a Cascade Impactor

Parisa Akbari DANA[a], Eftade O. GAGA[a], Gül İpek SELİMOĞLU[b], Kadir GEDİK[a,*]

[a] *Department of Environmental Engineering, Faculty of Engineering, Eskişehir Technical University, Eskişehir, Türkiye*
[b] *Department of Material Engineering, Faculty of Engineering, Eskişehir Technical University, Eskişehir, Türkiye*

*kgedik@eskisehir.edu.tr

Airborne microplastics (< 10 µm) have become a major source of concern over the past few years, as MPs can penetrate the human deep respiratory system and cause adverse health effects. Therefore, the occurrence and levels of microplastics (MPs) should be monitored for better air quality management. However, there is no standard sampling and analysis method for airborne microplastics yet. This study presents an investigation of the collection substrate performance in sampling particulate matter less than 10 µm in aerodynamic diameter (PM10) using a high-volume air sampler. For this purpose, a five-stage cascade impactor (Tisch TE-235) was used in this study at a flow rate of 1.13 m^3/min (40 cfm) for snapshot sampling (24 hours) at the main campus of Eskişehir Technical University on July 3, 2022. The particulate collection was performed using an aluminum filter and polytetrafluoroethylene (PTFE) slotted filter media. Three centimeters from each slotted filter paper in each stage was cut and analyzed to detect MPS by optical microscopy without any sample pretreatment. The results showed that all particles on the aluminum filter surface were black in color, and the polymeric and non-polymeric particles could not be distinguished from other particles. The particles were then transferred from an aluminum filter to fiberglass filters by various methods, including vortexing (5 min), ultrasonic bath (40 kHz and 10 min), vortexing & ultrasonic bath, and washing with distilled water (5 times), for detailed microscopic examination. The vortex method could not transfer the particles from the surface of the aluminum filter, and the ultrasonic bath method also caused corrosion of the aluminum filter. The distilled water washing method was known to be the most efficient method, but this method could not transfer 100% of the particles. On the other hand, the PTFE filter has a transparent surface and does not require the transfer of particles for detection of MPs; therefore, 100% of the collected particles can be analyzed. Raman Spectroscopy is also used for identification and characterization of the polymers.

Acknowledgment:

This study was funded and supported by the Scientific and Research Council of Türkiye (TUBITAK - Project No. 121Y142).

OP – 38

Elimination of Interferences Encountered in Atmospheric Sampling of Particulate Phase Organic Carbon

Duran KARAKAŞ[a], Ercan BERBERLER[a,b] *

[a] *Department of Environmental Engineering, Bolu Abant Izzet Baysal University, Bolu 14030, Türkiye*
[b] *Present address: Department of Environmental Engineering, Bartın University, Bartın 74100, Türkiye.*

**eberberler@bartin.edu.tr*

Due to the harmful effects of carbonaceous fractions of atmospheric particles on human health, visibility, and climate, it has been studied extensively worldwide. However, a standard method has not yet been developed for the sampling of carbon-containing fractions of atmospheric particulate matters (PMs). The determination of organic carbon (OC) and elemental carbon (EC), which represent the organic content of atmospheric particles, is subject to positive (VOCs condensation on filters and PMs collected on the filter) and negative (volatilization of OCs from collected PMs during sampling) interferences from the atmospheric volatile organic compounds (VOCs), depending on the sampling method. This sampling problem arises from the fact that volatile organic compounds (VOCs), which are ubiquitous in almost every environment condense on the particles collected on the filter and form artifact particulates on the sample filter during the sampling of carbon-containing fractions of atmospheric particulate matter.

In this study, two equivalent sampling systems (PM$_{2.5}$ samplers) were designed and developed to eliminate sampling errors in the results of atmospheric particulate organic carbon caused by volatile organic compounds (VOC) present in the sampling air. The sampling system includes the development and experimental application of two equivalent low-volume (8.0 L/min) PM$_{2.5}$ samplers. Two samplers one having a multi-sorbent impregnated glass denuder and the other having bare denuder were run concurrently and samples were collected. Collected samples were analyzed for OC and EC using a desktop OC/EC Analyzer (Sunset Laboratory).

It was found that without the use of impregnated denuders, atmospheric particulate OC concentrations would be reported at elevated levels with a mean error of 53.2 ± 7.23 % (median: 52.0 %). Study results showed that the OC values measured in the backup filters of the samplers increase as the ambient temperature increases but the relative humidity in the ambient atmosphere did not have a significant effect on the OC results. Results showed that the OC determined from the backup filter should be added to the OC results obtained from the primary filter since significant number of ultrafine PMs were observed on the backup filters when the primary and the backup filters were examined with SEM/EDS technique.

OP –39

Characterization of organic and elemental carbon in the $PM_{2.5}$ fraction: the case of Almaty and Astana, Kazakhstan

Nassiba BAIMATOVA[a]*, Madina TURSUMBAYEVA[a], Ravkat MUKHTAROV[a]

[a]*Department of Analytical, Colloid Chemistry, and Technology of Rare Elements, Faculty of Chemistry and Chemical Technology, Al-Farabi Kazakh National University, Almaty, Kazakhstan*

**baimatova@cfhma.kz*

Prolonged periods of lax emission control policies, driven by a focus on short-term economic gains, have exacerbated air pollution to alarming levels in numerous cities across Kazakhstan, with the country ranking among the top 35 polluted countries. High levels of air pollution characterize Kazakhstan's largest cities, leading to a significant increase in the incidence of population and economic losses. In the winter, Astana is frequently among the top ten polluted cities globally, with $PM_{2.5}$ concentration levels ranging from 100 to 200 µg m^{-3}. Limited data on the concentrations of pollutants and the absence of adequate data analysis prevent the appropriate assessment of risks and the development of effective programs to reduce air pollution. The country is becoming a global hotspot of air pollution due to recent developments in air quality monitoring.

Carbonaceous substances, such as organic carbon (OC) and elemental carbon (EC), are important elements of aerosols found in urban and rural areas. While EC is primarily produced when biomass and fossil fuels are burned inefficiently, OC can either be released directly from sources or is produced through chemical processes involving gaseous organic precursors.

The main objective of this study was to evaluate the spatial and temporal trends and sources of OC and EC in fine particles in Almaty and Astana. $PM_{2.5}$ samples were collected on quartz filters simultaneously every three days according to EPA guidelines for 24 h using five-channel MetOne SASS $PM_{2.5}$ samplers during a year (2022-2023). Collected 142 and 125 $PM_{2.5}$ samples in Almaty and Astana, respectively, were analyzed using a thermal–optical transmission instrument (SUNSET Laboratory, OR, USA) following the NIOSH 870 protocol.

The main contributor to the total carbon (TC) in $PM_{2.5}$, was OC, with an average share of 85% and 90% in Almaty and Astana, respectively. The concentrations of OC varied from 3.9 to 48.4 µg m^{-3} in Almaty and from 3.2 to 46.6 µg m^{-3} in Astana. EC concentrations were significantly lower than OC concentrations ranging from 0.6 to 9.4 µg m^{-3} in Almaty and from 0.2 to 4.0 µg m^{-3} in Astana. Changes in OC and EC concentrations during the study period could be influenced by fluctuations in emissions throughout the year, with a gradual increase in coal consumption during the heating season, meteorological conditions, and aerosol transport over long distances.

OC and EC levels demonstrated high seasonality, with winter values being 3 times higher than those during the rest of the year. OC/EC ratio varied from 3 to 17 in Almaty, and from 4 to 28 in Astana. OC/EC ratio was highest during the summer season, suggesting the influence of biomass burning or forest fires on $PM_{2.5}$ pollution in Almaty.

OP - 40

Interactions of organic contaminants with UV-aged PE type microplastics: experimental and LSER model approach

Melek ÖZDEMİR[a], Dilara HATİNOĞLU[b], Elif Yaren ÖZEN[a], İpek İMAMOĞLU[a,*]

[a]*Department of Environmental Engineering, Middle East Technical University, Ankara, Türkiye*
[b]*Department of Civil and Environmental Engineering, University of Maine, Orono, ME 04469, USA*

*ipeki@metu.edu.tr

The fate and transport of plastic debris in the environment and their tendency to break down into smaller particles, known as microplastics (MPs), have raised concerns about potential environmental and human health risks[1]. The hydrophobic and ubiquitous nature of MPs enables many opportunities for interaction with organic contaminants (OCs) in the aquatic environment. Conducting laboratory experiments to investigate the sorptive interaction between MPs and each and every OC to quantify MPs' partitioning constants (i.e., KPE_W) is impractical, considering the time, effort, and cost involved. In this respect, Abraham's linear solvation energy relationship (LSER) approach has gained considerable interest for prediction of adsorption of OCs onto a variety of sorbents. More recently, a few studies were conducted for the prediction of polymer/water partitioning for a variety of OCs. Recently, sorption of non-ionic aromatic compounds with a molecular weight less than 404 g/mol on polyethylene (PE) type MPs was studied using the LSER approach[2]. Accordingly, as an example, it was found that log KD values of triclosan (TCS) and 2,3,6-trichlorophenol (TCP) could be predicted with 0.1 and 7.5% error, respectively.

In this follow-up study, we assess the applicability of the benchmark model for UV-aged LDPE type MPs by using experimental sorption data for TCS and TCP. For this purpose, pristine LDPE obtained in powdered form from a manufacturer having a density of 0.919 g/cm^3 was used. The melting temperature (Tm) and percent crystallinity values are determined with Differential Scanning Calorimetry (DSC) analysis and found to be 102.6 °C and 25.6%, respectively. MPs were sieved to a particle size of 250-500 µm were aged by placing them in a UV cabinet containing UV-A lamps and subjected to a UV dose of approximately 2500 J/cm2. Modifications in the structure of MPs were examined using Fourier Transform Infrared (FTIR) analysis, and carbonyl index (CI) values were calculated. FTIR spectra of UV-aged samples show new bands corresponding to hydroxyl, carbonyl, and vinylene groups, and increasing CI (from 0 to 1.17) values were obtained. Sorption isotherms were conducted for TCS and TCP using UV-aged LDPE MPs, and experimental log KD values were compared with the predicted ones from the benchmark model2, as well as other LSER from the literature. Experimental data yield increased sorption affinity of TCP for UV-aged MPs, while no major change observed for TCS. Effect of UV-aging on potential changes in sorption mechanisms for aged vs. pristine PE and OCs is also evaluated.

Acknowledgment:

This study was funded by the Scientific and Technological Research Council of Turkey Grant No: 220N044.

References:

1)Andrady et al., Sci. Total Environ. **2022**, 851, 158022.
2)Hatinoglu et al., Chem. Eng. Sci. **2023**, 11923.

OP - 41

Health and Economic Impact of Air Pollution in Cities of Kazakhstan

Ravkat MUKHTAROV[a], Ivan RADELYUK[b], Pavel PLOTITSYN[c], Nassiba BAIMATOVA[a,*]

[a]*Center of Physical-Chemical Methods of Research and Analysis, Faculty of Chemistry and Chemical Technology, Al-Farabi Kazakh National University, Almaty, Kazakhstan*

[b]*Department of Chemistry and Chemical Technology, Toraighyrov University, Pavlodar, Kazakhstan*

c Airkaz.org, Almaty, Kazakhstan

* *baimatova@cfhma.kz*

Global ambient air pollution had emerged as one of the leading preventable causes of preventable premature mortality, exceeding 4 million deaths in 2019[1]. In many developing countries, its profound socioeconomic consequences are often underestimated in policymaking. Notably, integrated air quality management strategies based on respective benefit analyses have been lacking.

This study employs data from Kazakhstan's largest cities, Almaty and Astana, to evaluate the economic and healthcare burden of air pollution. The exposure to PM$_{2.5}$ in these cities, was determined using an independent air quality source, “Airkaz.org”. Mortality and economic burden caused by high level of PM$_{2.5}$ pollution were estimated using the Global Exposure Mortality Model (GEMM) and the Value of Statistical Life (VSL) approach.

In 2021, PM$_{2.5}$ concentrations in Almaty and Astana exceeded the World Health Organization’s (WHO) recommended annual limit (5 µg/m^3) by 7.8 and 4 times, registering 38.8 µg/m^3 and 19.8 µg/m^3, respectively. The excess mortality attributed to PM$_{2.5}$ exposure is estimated at 2694-3579 in Almaty and 673-900 lives in Astana. The WHO interim targets represent critical milestones to mitigate health risks associated with PM2.5 pollution2. Improving air quality in Almaty to meet the next WHO target (25 µg/m^3, 36% reduction) by 2021 would potentially averted 649-853 deaths. For Astana, attaining the next WHO target (15 µg/m^3, 24% reduction) would potentially have saved 137-153 lives. In this scenario, Almaty and Astana could have avoided economic damage $320 – $1654 million and $68 – 298 million, respectively, in 2021 solely by preventing premature deaths.

In May 2023, Almaty municipality approved a $0.7 billion project for gasification of Combined Heat and Power Plants, anticipated to reduce PM$_{2.5}$ emission by 56%[3]. The potential benefits, in terms of reduced mortality and subsequent healthcare cost savings, strongly support the implementation of this infrastructural initiative, with projected annual savings amounting to 1.6-7.9% of Almaty’s gross regional product (GRP) ($0.6-2.8 billion). Similarly, a 56% improvement in air quality in Astana would potentially result in annual healthcare costs savings amounting to 0.89-3.89% of Astana’s GRP ($0.18-0.77 billion).

This study emphasizes the critical importance of conducting socioeconomic assessments to comprehensively gauge the impact of air pollution, emphasizing the substantial public health and economic advantages that can be realized by meeting the WHO interim targets.

References:

1)Hans Rosling center for population health, **2023**, https://www.healthdata.org/.
2)WHO, **2021**, WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide.
3)Samruk Energy, **2023**, https://www.samruk-energy.kz/ru/press-center/company-news/11-novosti/1289-podpisan-kontrakt-s-podryadchikom-stroitelstva-almatinskoj-tets-2.

OP - 42

Cities of Central Asia: New Hotspots of Air Pollution in the World

Madina TURSUMBAYEVA[a], Nassiba BAIMATOVA[a]*

[a]*Center of Physical-Chemical Methods of Research and Analysis, Faculty of Chemistry and Chemical Technology, Al-Farabi Kazakh National University, 71 Al-Farabi Avenue, Almaty, Kazakhstan*

baimatova@cfhma.kz

In 2021, Tajikistan, Kyrgyzstan, Uzbekistan, Kazakhstan, and Turkmenistan were ranked as the 4th, 7th, 12th, 23rd, and 44th most polluted countries in the world, respectively [1]. However, despite the seriousness of the problem, there are limited studies and knowledge regarding air quality variation in this region. This study investigates temporal variations of $PM_{2.5}$ and the influence of meteorological parameters on $PM_{2.5}$ concentrations for six major Central Asian cities: Almaty, Ashgabat, Astana, Bishkek, Dushanbe, and Tashkent, using hourly $PM_{2.5}$ data from US Embassy monitoring stations [2].

The results reveal severe air quality degradation in cities with annual $PM_{2.5}$ concentrations up to ten times the WHO annual limit. A clear seasonal pattern, with winter peaks was observed in Almaty, Ashgabat, Bishkek, and Astana with the highest concentrations in January: 112.4 $\mu g/m^3$ in Bishkek, 110.0 $\mu g/m^3$ in Almaty, 40.3 $\mu g/m^3$ in Astana and 27.0 $\mu g/m^3$ in Ashgabat. In Tashkent and Dushanbe, the peak is observed in November (98.9 $\mu g/m^3$ in Dushanbe and 73.6 $\mu g/m^3$ in Tashkent). In summer, Dushanbe and Tashkent exhibited 2-4 times higher $PM_{2.5}$ concentrations compared to other cities. During heating season, over 73% of days in studied cities had daily $PM_{2.5}$ concentrations exceeding the WHO limits (15 $\mu g/m^3$). During the day, the $PM_{2.5}$ concentrations were highest at night, likely due to a lower boundary layer height that promotes air pollutant accumulation. Meteorological parameters, such as temperature, relative humidity, wind speed and direction, precipitation, and boundary layer height had greater impact on $PM_{2.5}$ concentrations in winter and autumn than in summer and spring. The results of back trajectory analysis showed that slow-moving air masses are typical (more than 50%) for the highest hourly $PM_{2.5}$ concentrations in most of the cities. Official reports attribute air pollution mostly to transportation. However, such conclusions are based on outdated methodologies where air pollutant emissions are summed up together with no regard for the toxicity of each pollutant. Analysis of EDGAR emission data suggests that stationary sources that rely on dirty fossil fuels, particularly coal, significantly impact the air quality in most cities. The findings underscore the urgency for policymakers to take swift action to address coal use and adopt effective measures to mitigate $PM_{2.5}$ pollution.

Acknowledgements:

This work was supported by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant No. AP09260359).

References:

1)IQAir, **2022**. https://www.iqair.com/world-most-polluted-countries (accessed 8.18.22).
2)Airnow, **2021**. https://www.airnow.gov/international/us-embassies-and-consulates (accessed 8.18.22).

OP - 43

Determination of Interferences with Particle Phase PAH Levels in Atmospheric Sampling

Duran KARAKAŞ[a], Ercan BERBERLER[a,b]

[a] *Department of Environmental Engineering, Bolu Abant Izzet Baysal University, Bolu 14030, Türkiye*
[b] *Present address: Department of Environmental Engineering, Bartın University, Bartın 74100, Türkiye*

**eberberler@bartin.edu.tr*

Polycyclic Aromatic Hydrocarbons (PAHs) compounds, which are one of the organic contents of particles and are in the class of semi-volatile organic carbons (SVOCs) which can be found in both particle and gas phase fractions. PAHs are carbonaceous compounds released into the atmosphere by various combustion processes. They are also complex organic compounds defined as carcinogenic. Since the toxicity of many of them is well characterized, the determination of their atmospheric concentrations is of great interest to better understand and develop future atmospheric pollution control strategies. In addition, PAHs are highly sensitive to atmospheric oxidant gases, especially ozone, oxides of nitrogen (NOx), and hydroxyl radical (OH), and can be degraded on filters during the sampling process, resulting in inaccurate measurements of PAH concentrations. In this respect, the sampling technique must be designed in such a way that the chemical reactions that may occur on the filter with atmospheric oxidants (ozone) can be prevented before the aerosol comes to the filter to accurately determine the PAH content of the particles.

As part of the study, two equivalent $PM_{2.5}$ samplers designed and developed for the particulate OCs were used for the sampling of $PM_{2.5}$ samples to be analyzed for 16 US EPA Priority PAH compounds.

Study results showed that, In cases where coated denuders were not used in the sampling positive artifacts of 41.0 ± 14.6% (median: 33.8%) on average would be obtained for the total PAHs due to condensation of gas phase PAHs in the sampling air. Ozone-induced negative interference was observed highest for Acenaphthylene (28%), followed by Fluoranthene (20%), Phenanthrene (18%), and 15 % for Naphthalene and Benzo[g,h,i]perylene compounds, relative to their medians. While no ozone effect was seen in Pyrene and Chrysene compounds negative errors of 10% or less were found in all other individual PAH compounds. In terms of total PAH compounds, it was observed that atmospheric ozone caused negative errors at an average of 8% (median: 6.0%) during the study and the temperature in the sampling environment did not affect the magnitude of positive error.

OP - 44

Trace Element Concentration Profiles in Tuz Lake Sediments

Burcu N. CETINER[a], Ozgur CINAR[a], S. Sinan KESKIN[b,*]

[a]*Department of Metallurgical and Materials Engineering, Marmara University, Istanbul, Türkiye*
[b]*Department of Environmental Engineering, Marmara University, Istanbul, Türkiye*

sinankeskin@marmara.edu.tr

Environmental pollution is a common problem of industrialized and developing countries. The most important causes of environmental pollution are industrial activities and the accelerated growth of the world population during the twentieth century. Pollution of soil, water, sediment, and air affects all living organisms. Water bodies such as lakes and lagoons can be exposed to anthropogenic effects, and therefore possible chemical contamination assessment studies are particularly important in these areas[1,2].

Tuz Lake, one of the largest salty lakes in the world, is also the second largest lake in Turkey after the Van Lake. With its great salt potential, it provides a significant part of Turkey's salt production. Tuz Lake is located in Central Anatolia and surrounded by the cities Ankara, Konya, and Aksaray. It connects the Haymana Basin, which is the largest inner basin, and the Tersakan Basin, which is a small channel-shaped basin, in the north[3]. Salinity level, water temperature, and water level of the lake vary significantly seasonally. Until 2010, untreated domestic, agricultural, and industrial wastewater coming from the cities Konya, Şereflikoçhisar, and Aksaray were discharged into the streams and also the General Directorate of State Hydraulic Works (GDSHW) Konya Drainage Canal (built in 1974) which are connected to the Tuz Lake. Therefore, possibility exists to find pollutants related to domestic and industrial wastewater, pesticides and herbicides originating from agricultural activities, and pollutants originating from mining activities in Tuz Lake. In addition, transport from the soil areas around the lake can also be a source of pollution[4].

This study intends to investigate whether there is any measurable anthropogenic pollution in Tuz lake. For this purpose, trace element concentration depth profiles were obtained for three short sediment cores extracted from the dried lake bottom during summer nearby to the discharge point of the GDSHW Drainage Canal. Trends of these depth profiles, related to pre- and post-industrial periods, were examined for any sign of anthropogenic pollution. The approximate dating of one sediment column by gamma ray spectroscopy of Cs-137 isotope was performed in an earlier study[5]. Concentration measurements of 17 elements were performed by X-ray fluorescence spectrometry analyses. Crustal Enrichment Factor (EF) results indicated that, except for the elements Cr, As, Sr, Zr, and U, EFs are below 3 for the rest of the elements in all sediment cores. EFs of these five elements indicate some pollution originating likely from anthropogenic activities.

References:

1)Acornero et al., Env. Cont. Tox. **2008**, 54, 372.
2)Wang, Env. Sci. Poll. Res. **2018**, 25, 13035.
3)Aydemir et al., J. of Pet. Sci. Eng. **2008**, 62, 36.
4)Yildiz et al., Sci. Res. Ess., **2010**, 5, 2656.
5)Keskin, Int. Conf. Env. Rad. **2015**, Thessaloniki, Greece.

OP – 45

A Novel Compatibilizer Obtained from Olive Pomace Oil Maleate (OPOMA) and Evaluation in PLA Composite Production

Gamze GÖKTEPELİ[a], Tessei KAWANO[b], Yoshito ANDOU[b], Esra YEL[a,]*

[a]*Konya Technical University, Environmental Engineering Department, 42075, Konya, Türkiye*
[b]*Kyushu Institute of Technology, Graduate School of Life Science and Systems Engineering, Department of Biological Functions Engineering, Fukuoka, 808-0196, Japan*

**eyel@ktun.edu.tr*

The alternative of using organic and biomass residues as additives or reinforcements in the production of composite materials has attracted great attention since the 2000s. In addition to its contribution to waste management, the use of biomass additive in composite production can reduce the processing temperature, process time and intensity, depending on the type and structure of the organic waste used, and this may change various characteristic properties of composite materials [1]. When ligno-cellulosic biomass is used as natural fiber in composite production, it may have some drawbacks such as low interfacial bonding with the matrix phase. One of the most common methods used to strengthen the bonding between the matrix phase and the additive material is to use maleic anhydride (MA) as a compatibilizer. Some researchers use MA and some chemicals such as dicumyl peroxide (DCP) as reaction initiators to increase the compatibilizing effect of MA and matrix phase-additive material bonding. Kiangkitiwan and Srikulkit[2] synthesized soybean oil maleate by reacting soybean oil with MA using DCP as the initiator and used the resulting maleate in the production of composites. Similarly, in this study, olive pomace oil maleate (OPOMA) was prepared and the performance of produced compatibilizer was investigated in the production of composites with a biodegradable polymer of poly(lactic acid) (PLA) with olive pomace additive produced with ionic liquid pretreatment (OP-IL) in the previous studies of the authors[3]. OPOMA was produced with mixing dry OP powder and MA in the presence of DCM initiator. Then the sample was dried and the PLA composite was prepared by mixing 95%PLA and 5%OP-IL by weight in a twin-screw extruder at 190°C for 10 minutes. Under the same experimental conditions, the effect of OPOMA was evaluated by adding 0.5%, 1% and 2% ratio to PLA + OP-IL mixtures. In OPOMA, a new symmetrical and asymmetric C=O bands were formed differently from olive pomace. PLA is a rigid brittle polymer with low crystallinity and low elasticity. The addition of low doses of OPOMA to PLA+OP-IL composites increased the tensile elongation value. The Young's modulus showed smaller change compared to mechanical strength. To conclude, it can be emphasized that oil maleates of ligno-cellulosic biomass produced in this study can be promising compatibilizer for elastic, biodegradable composite matrices.

Acknowledgement:

The authors gratefully acknowledge the TUBITAK Bilateral Joint Research Project (Türkiye [TUBITAK-CAYDAG-118Y475] and Japan [JSPS], grant No. JPJSBP12019942) for financial support.

References:

1)Jawaid et al., In Lignocellulosic Fibre and Biomass-Based Composite Materials. **2017**, 1-11.
2)Kiangkitiwan et al., The Sci. World J. **2013**, 2013.
3)Kawano et al., Macromol. Mater. Eng. **2023**, 308(5), 2200588.

OP – 46

A Study on ab initio and Kinetic Modelling: Impact of Marine Macroalgae on Atmosphere Oxidation Capacity

Damla ATAKENT[a,b], Aşan BACAK[a,b]

[a]*Ankara University, Bahçelievler, 06830 Gölbaşı/Ankara*
[b]*TARLA (Turkish Accelerator & Radiation Laboratory), Bahçelievler, 06830 Gölbaşı/Ankara*

**datakent@tarla.org.tr*

The contribution of acyclic halogenated monoterpenes isolated from marine red macroalgae (Rhodophyta) to the atmospheric oxidation mechanism was first addressed in the paper by Khan et al.[1]. The products or reactants of these reactions have neither been measured in the open atmosphere nor have kinetic measurements been taken in laboratory conditions, nor have they been modelled with a theoretical model study outside of the SAR (Structure Activity Relationship) method. SAR analysis involves structural modifications to understand the impact of chemical groups, functional groups, side chains, and other structural elements on biological activity[2]. In the scope of the paper, the reaction rate constants for reactions with OH and O3 were determined using the alkene and alkyne groups contained in monoterpenes, and some molecule-specific assumptions were made[1-3]. In this study, computational chemistry methods were used to model the oxidation reactions of three acyclic halogenated monoterpenes mentioned in the paper, taking reference from model studies of other reactions in the oxidation mechanism of our atmosphere. In the first part of the model, theoretical models of the reactions of three monoterpenes ($C_{10}H_{12}Cl_4$, $C_{10}H_{16}Br_2Cl_2$, and $C_{10}H_{14}BrClO$) with OH and O_3 were constructed. The reason for selecting these molecules in the paper is the assumption that these compounds, produced by three algal species, could potentially impact aerosol production on a macro scale when exposed to tides. Geometry and transition state optimisations, as well as IRC (Intrinsic Reaction Coordinate) calculations, were performed using the B3LYP method with the 6-311G(d,p) basis set and the M06-2X method with the DGDZVP basis set, and frequency calculations were carried out using the CCSD(T) method with the 6-311G(d,p) basis set using Gaussian 16 software. Reaction rate constants for the reactions were calculated for different temperatures using the obtained data with the ChemRate software. Models for these reactions were made as a preliminary study and compared with the SAR method results. In this presentation, I will present our research findings for the reactions of acyclic halogenated monoterpenes.

References:

1)Khan et al., Trans. R. Soc. S. Afr. **2022**, 77.
2)Lu et al., Curr. Poll. Rep. **2019**, 5, 238–260.
3)Kwok et al., Atmos. Environ. **1995**, 29: 1685–1695,

OP –47

Feasibility study on enzymatic biodegradation of phthalic acid esters-contaminated soils by esterase from *Geobacillus* sp.

Esin BALCI[a], Buket TOPUZ[b], Aleyna CELIMLI[b], Gulsah SANLI-MOHAMED[c], Aysun SOFUOGLU[b,]*

[a] *Izmir Institute of Technology, Faculty of Engineering, Department of Environmental Engineering, 35430 Urla/İzmir, Türkiye*
[b] *Izmir Institute of Technology, Faculty of Engineering, Department of Chemical Engineering, 35430 Urla/İzmir, Türkiye*
[c] *Izmir Institute of Technology, Science Faculty, Department of Chemistry, 35430, Urla/İzmir, Türkiye*

*aysunsofuoglu@iyte.du.tr

Phthalic acid esters (PAEs) are widely used as plasticizers and are one of the most detected organic pollutants in the environment. They are produced on a global scale of approximately 6 million tons per year and some are among the most dangerous endocrine disrupting chemicals and well-known harmful plasticizers to human health[1]. Its hydrophobic properties cause binding to particles in air and water and adsorb in the soil, resulting in polluting the environment. Therefore, PAEs are regularly found in residential, aquatic, and terrestrial environments [2]. Enzymatic biodegradation, which is considered safer, cleaner, and more environmentally friendly, is a promising method for the removal of pollutants. Specifically, esterase enzyme plays a critical role in the removal of these pollutants from environmental compartments. Prior to this study, thermoalkalophilic esterase from Geobacillus sp. had been isolated from Balçova (Agamemnon) Geothermal Region in İzmir, Turkey [3]. Subsequently, its esterase-producing gene was cloned in pET-28a (+) by Tekedar and Sanli-Mohamed (2011)[4]. In this study, the expression of recombinant enzyme in *E.coli* and purification were performed and lyophilized under vacuum conditions for 24 h at -50ºC (Telstar Cryodos).

Soil samples with different characteristic features from agricultural (soil 1) and forest areas (soil 2) were collected. Prior to degradation experiments, the characteristics of soils were determined and the presence of DBP and DEHP in the soils was not found. With the addition of 100 mg/L of DBP and DEHP to soils, enzymatic bioremediation experiments were conducted using the purified esterase for 7 days. At the end of 7th day, the esterase degraded nearly 50% of DBP and 35% of DEHP in soil 1 while it was able to degrade 80% of DBP and 38% of DEHP in soil 2. These results indicated that soil characteristics and the alkyl side chain of PAEs can have a significant impact on enzyme's degradation performance. The results obtained in this study are expected to well guide the application of enzymes in the remediation of waterbody and soil contaminated by various PAEs. Furthermore, the procedure and results of this study will offer both experimental and theoretical insights for the development of in situ enzymatic remediation of PAEs-contaminated soils.

References:

1)Wang et al., Sci. Total Environ. **2015**, 523, 129–137.
2)Wu et al., Environ. Sci. Pollut. Res. **2019**, 26(11), 11224–11233.
3)Yavuz et al., J. Appl. Microbiol. **2004**, 97(4), 810-817.
4)Tekedar, and Sanli-Mohamed, Extremophiles. **2011**, 15, 203-211.

OP – 48

Central Composite Design-Based Optimization for the Enhanced Removal of Moxifloxacin Antibiotic from Wastewater Using Hollow Carbon Spheres as Adsorbents

Fatma DEMIRKAYA MILOĞLU[a], Hasan CAN[b], Yücel KADIOĞLU[a*], Büşra YÜKSEL[a], Burak BAYRAK[a], Abdul Kayum IDDRISU[a]

[a]*Department of Analytical Chemistry, Faculty of Pharmacy, Atatürk University, 25240 Erzurum, Türkiye*
[b]*East Anatolia High Technology Application and Research Center, Atatürk University, 25240 Erzurum, Türkiye*

**yucel@atauni.edu.tr*

Water pollution, especially the influx of pharmaceutical pollutants into aquatic systems, poses a significant threat to environmental sustainability. Antibiotics, in particular, have attracted attention due to their potential damage to aquatic ecosystems and their contribution to antibiotic resistance [1]. Fluoroquinolones, widely used in human and veterinary medicine, have been shown to be effective against viruses, including SARS-CoV-2, in numerous in vitro experiments. They were among the preferred antibiotics for treatment during the COVID-19 pandemic [2]. Moxifloxacin, a broad-spectrum fluoroquinolone antibacterial, is effective against a variety of bacterial infections including respiratory tract infections, cellulitis, anthrax, intra-abdominal infections, endocarditis, meningitis and tuberculosis[3]. Hollow carbon spheres (HCS) are carbon nanomaterials known for their distinctive hollow spherical structures. They have gained considerable attention, particularly in adsorption applications, due to their ability to encapsulate various substances within their internal cavities[4]. The study aims to effectively remove Moxifloxacin antibiotic from wastewater using Hollow Carbon Spheres and optimize the removal process through the Central Composite Design (CCD) method. Moxifloxacin absorption was assessed via HPLC using a Zorbax C18 column. The quadratic regression equation's statistical significance is evident, with a P-value of <0.01 obtained from the ANOVA for the response surface quadratic model, affirming its validity. CCD was used to assess the effect of the antibiotic initial concentration, pH, ionic strength and contact time on the absorption capacity of moxifloxacin. In the ANOVA statistical analysis for the CCD model, a P value of less than 0.01 indicated the model was significant. The model predicts the most favorable conditions for the removal of moxifloxacin at given factors. Furthermore, when the classical Langmuir isotherm model is applied at given factors, it closely matches the CCD model, indicating a maximum absorption capacity.

References:

1)Kraemer et al., Microorganisms. **2019**, 7(6), 180.
2)Scroggs et al., Viruses. **2021**,13(1), 8,1.
3)Meena et al., J. Entomol. Zool. Stud. **2019**, 7(4), 929.
4)Vieira et al.,J. Environ. Chem. Eng. **2022**, 10(3), 107348.

OP – 49

Methylene Blue Removal Using Nano-TiO_2/MWCNT/Chitosan Hydrogel Composite Beads in Aqueous Medium

Şerife PARLAYICI[a], Erol PEHLİVAN[a*]

[a]*Department of Chemical Engineering, Konya Technical University, Campus, 42079 Konya, Türkiye*

erolpehlivan@gmail.com

Dyestuff, one of the most hazardous compounds in terms of threats to people and the environment, is found in wastewater from industrial usage. The removal of methylene blue (MB) from a water-based medium has been studied by numerous researchers using a variety of adsorbents. To remove MB from aqueous solution, nano-TiO_2/MWCNT/Chitosan hydrogel composite beads (nTiO_2-Cht/MWCNT) were developed in this study using a sol-gel method. This research discusses the characterisation of a new adsorbent substance using FT-IR analysis and scanning electron microscopy (SEM). The batch adsorption method was used to evaluate the removal efficiencies of MB to determine the ideal pH, adsorbent dose, period, and beginning concentration. Adsorption behaviour at the equilibrium state has been investigated using a variety of adsorption isotherms, including Freundlich, Langmuir, and Dubinin-Radushkevich. Adsorption behaviours have become clarified in light of the Langmuir adsorption isotherm. nTiO_2-Cht/MWCNT had an adsorption capacity of 80.65 mg/g for MB. The pseudo-second-order kinetic model offered the best agreement to the experimental data for the adsorption of MB. Kinetic models of pseudo-first-order and pseudo-second-order were employed to explore the adsorption processes of MB on the nTiO_2-Cht/MWCNT. This study demonstrated the efficiency of nTiO_2-Cht/MWCNT for the removal of MB from a water-based solution.

OP -50

The GC-FID Fatty Acid Analysis of the Calf Meat: The dependence of Pasture vs. Food Farming Systems

Mentor ISMAILI[a,*], Dzuliana TOMOVSKA[a], Avni BERISHA[b]

[a] Department of Food Technology, Faculty of Biotechnical Sciences, University," St. Kliment Ohridski- Bitola, Macedonia
[b] University of Pristina ''Hasan Prishtina'' Faculty of Natural and Mathematics Sciences - Chemistry Department , Rr. ''Nëna Terezë'' , 10000 Prishtina, Republic of Kosova

* *mentorismaili92@gmail.com*

This primary objective of this study's was to examine the concentration dependence between fatty acids and the possible patterns that differs two specific agricultural systems based on the presence or absence of graze practices. Specifically, the study evaluated the effect of grazing on the fatty acid concentration and composition of meat samples collected from two farms during the 2022 season.

It is vital to incline that these farms were methodically selected to guarantee that their non-grazing season locations and management practices were matching. The fatty acids were determined using gas chromatography[1-2]. The obtained results confirmed differences in the fatty acid compositions of meat samples from grazing and non-grazing agricultural systems[4,5]. Obtained data signposted that the presence or absence of grazing practices has a tremendous effect on the fatty acid composition of calf meat[3,5]. In terms of the differences in fatty acid concentration among the two agricultural systems, valuable results were obtained, showing the potential influence of grazing practices on the nutritional features of meat. These obtained data have a significant consequence for producers, consumers, and the agricultural industry as a whole. Further analysis and investigation of this subject could give significant insights to the development of environmentally accountable and sustainable agricultural practices that maximize the nutritional value of meat products.

References:

1)Chiu, and Kuo, J. Food Drug Anal. **2020**, 28(1), 60-73.
2)Di Bella et al., Front. Public Health. **2020**, 8, 273.
3)https://foodco3ntaminationjournal.biomedcentral.com/articles/10.
4)Maniaci et al., Animals. **2021**, 11(9), 2675
5)Kandhro et al., Food Chem. **2008** 109(1), 207-211.

.

OP – 51

Investigation of the Transport, Fate, and Treatment of Diclofenac

Elif SIMSEK YESIL[a,b]*, Pınar HASANOGLU OZTURK[c], Emrah OZTURK[d], Mehmet KITIS[b]

[a]Dept. of Geology Engineering, Suleyman Demirel University, Isparta, Türkiye
[b]Dept. of Environmental Engineering, Suleyman Demirel University, Isparta, Türkiye
[c]Dept. of Environmental Protection Technologies, Duzce University, Düzce, Türkiye
[d]Dept.of Environmental Protection Technologies, Isparta University of Applied Sciences, Isparta, Türkiye

**elifsimsekbursa@gmail.com*

Diclofenac (DCF), one of the non-steroidal anti-inflammatory drugs, is globally prevalent in all environmental media due to the abundantly used all over the world[1]. Domestic and hospital wastewater (WW) may contain significant amounts of DCF. The DCF removal efficiency of conventional biological treatment processes vary between 20 and 40%[2-3]. Inadequately treated WW discharge may result DCF accumulation in aquatic environments and chronic exposure that may lead serious health effects [4]. It was reported in many studies that relatively high DCF concentrations were detected in drinking waters (DWs). Nowadays, it has become increasingly important to upgrade existing WW and DW treatment plants with advanced treatment technologies for effective removal of DCF and other micropollutants[5]. In this study, it was aimed to determine the best treatment alternatives for DCF which is one of the priority micropollutants. A total of 18 evaluation criteria were identified and prioritized[6]. Treatment alternatives were identified and their performance was assessed through a comprehensive literature investigation. In decision-making process of determining these alternatives, "complex proportional assessment (COPRAS)" analytical decision-making method were employed, and priority rankings were determined. The final priority ranking was found as membrane filtration > adsorption > hybrid processes > advanced oxidation processes > constructed wetlands > oxidation processes > conventional treatment processes > biological treatment > other treatment processes.

Acknowledgement:

Author Elif Simsek Yesil is a PhD scholar in the thematic field of "Sustainable Water Resources" within the scope of the Turkish Council of Higher Education (CoHE) 100/2000 PhD program and the Scientific and Technological Research Council of Türkiye (TÜBİTAK) 2211/A Domestic General Doctorate Scholarship Program. This study was financially supported by Suleyman Demirel University Scientific Research Projects Coordination Unit (SDU BAP, Project No: FDK-2022-8638) and CoHE 100/2000 PhD Program. The authors thank SDU BAP Unit, CoHE and TÜBİTAK for their support.

References:

1)Gonzalez-Rey, and Bebianno, Aquat. Toxicol. **2014**, 148, 221-230.
2)Alessandretti et al., J.Environ. Chem. Eng. **2021**, 9(6), 106743.
3)Zhang et al., Chemosphere. **2008**, 73(8), 1151-1161.
4)Lonappan et al., Environ. Int. **2016**, 96, 127-138.
5)Krishnan et al., Environ. Technol. Innovation. **2021**, 23, 101757.
6)Ozturk, Environ. Sci. Pollut. Res. **2018**, 25(30), 30517-30546.

OP – 52

Microplastic analysis in soil: basis for establishing an operating procedure

Zhala GACHAYZADE[a], Parisa Akbari DANA[a], Ece Tuğba MIZIK[a], Kadir GEDIK[a,b], Zehra YIĞIT AVDAN[a,b]*

[a] *Department of Environmental Engineering, Faculty of Engineering, Eskişehir Technical University, Eskişehir, Türkiye*
[b]*Eskişehir Technical University, Environmental Research Center (ÇEVMER), Eskişehir, Türkiye*

zyigit@eskisehir.edu.tr

Plastic materials are widely used due to their light weight, ease of molding, durability and low cost. These properties along with the increasing demand for production has resulted in additional waste causing environmental problems. One of the problems caused by plastic pollution in the environment is microplastics. Microplastics (MPs) are intentionally produced or formed when large plastic wastes are broken down into small pieces of which between 5 mm and 1 µm in size. These fragments can be distributed on the soil surface or carried by wind and water currents and spread to various matrices. MPs in soil are taken up by plants and then consumed by humans and other living things, and can move through the ecosystem along the food chain. The analysis of MPs in soil is therefore of critical importance in the plastic age. Although applied research in the field of MPs is advancing, the lack of comprehensive operating procedures for the soil medium motivated this study. To this end, a standard operating procedure for soil MPs was targeted to provide reliable and reproducible data to contribute to the relevant literature. Accordingly, a model (reference) soil sample (without MPs) was first prepared before experimental procedures were conducted to determine the applicability of MP analysis in the soil matrix. In the experiments, at least 1 g of MP-free soil sample was weighed, and PVC and/or LDPE type MPs with sizes in the range of 137 to 150 µm and 376 to 423 µm, respectively, which were previously stained with Nile Red, were added to it. The sample was then kept for 24 hours by adding 30% hydrogen peroxide (H_2O_2). The sample was dried in an oven at 55°C for 24 hours. NaI was added to the dried sample to separate the MPs from matrix, mixed and centrifuged at 3000 rpm for 5 minutes. The supernatant was filtered through a glass fiber filter (1.6 µm) and dried in an oven. As a result of microscopic examination, it was found that organics removal (i.e. H_2O_2 digestion) played an important role in the observed recovery efficiencies, e.g. up to 44 and 75% for LDPE and PVC type MPs, respectively. The results showed that after digestion, the fluorescence intensity of PVC (brightness: from 105-109 to 33-43) and LDPE (brightness: from 67-73 to 31-43) stained with Nile Red was significantly degraded. The extent of the MPs size distribution was also negatively affected, decreasing to 53-71 µm for PVC and 63-113 for LDPE, respectively. Shortcomings related to experimental steps and the lack of a standard operating procedure, including performance variation and misinterpretation of MP data, were further discussed. To sum up, the establishment of a standard operating procedure is critical to improving the validity and reliability of MP research by implementing error prevention measures and facilitating corrective actions.

Acknowledgment: This study was funded and supported by the Scientific and Research Council of Turkey (TUBITAK - Project No. 121Y142).

OP – 53

Sample Pretreatment to Determine Inhalable Microplastics in Atmospheric Size Segregated Particles (< 10 µm)

Parisa Akbari DANA[a], Eftade O. GAGA[a], Kadir GEDIK[a,b*]

[a] Department of Environmental Engineering, Faculty of Engineering, Eskişehir Technical University, Eskişehir, Türkiye
[b]Eskişehir Technical University, Environmental Research Center (ÇEVMER), Eskişehir, Türkiye

* kgedik@eskisehir.edu.tr

The visual and chemical identification methods of microplastics (MPs) require validated techniques for the isolation of microplastics from matrices. To remove interfering substances, such as organic matter and inorganics, density separation, and chemical digestion were suggested as the common physical and chemical pretreatment methods. Although, both approaches are often used to isolate microplastic particles (>10 µm) in the literature, unfortunately, there is no standard methodology for airborne microplastics (<10 µm). The purpose of this study is to investigate the pretreatment methodologies for inhalable MPs (<10 µm) to isolate MP's from other atmospheric particles for analysis with different types of microscopes (optical and spectroscopy). Atmospheric high-volume sampling was conducted at the Eskişehir Technical University campus on July 18, 2022, and samples were collected on slotted Teflon substrates (filters) using a five-stage cascade impactor (Tisch TE-235) at a flow rate of 1.13 m^3/min (40 cfm) for 24 hours. In the experimental step, 2 cm of filter slot was cut from 1., 2., 3., 4., and 5. stages and placed in a clean test tube containing 30% hydrogen peroxide (H_2O_2) (Sigma Aldrich, Mississauga, ON) for 48 h at room temperature for chemical pretreatment. Then, the filter piece (2 cm) was analyzed using a polarization microscope (model Primotech, Carl Zeiss) and results showed little effect on the size and color of the probable microplastics. In the next step, 30% H_2O_2 was diluted to 10% H_2O_2, and the exposure time was also reduced to 24 hours. Although such application may not have a significantly detectable effect on the size of larger MPs (>10 µm) in the literature, dilution also affected the morphology of probable MPs with a small loss of surface material. On the other hand, MPs isolation from atmospheric components were also evaluated by comparing the density of particulate matter (crustal and anthropogenic particles with variable origin) reported in the literature with those of different types of virgin MP polymers. In conclusion, it is suggested that atmospheric samples (<10 µm) should be analyzed in as-received form (without any pre-treatment) to identify and estimate the number of microplastics to minimize biases or errors in environmental monitoring and human health risk assessment.

Acknowledgment:

This study was funded and supported by the Scientific and Research Council of Türkiye (TUBITAK - Project No. 121Y142).

SOP - 1

Effects of cadmium chloride ($CdCl_2$) on the physiological parameters of spermatogenesis in Mus muskulus – Swiss albino

Ylli KRASNIQI[a], Jeton HALILI[b], Kemajl BISLIMI[a], Ilir MAZREKU[a]

[a]*University of Prishtina– Faculty of Mathematics and Natural Sciences, Department of Biology, Prishtinë, Kosovë*
[b]*University of Prishtina– Faculty of Mathematics and Natural Sciences, Department of Chemistry, Prishtinë, Kosovë*

**ilir.mazreku@uni-pr.edu*

Objective: The aim of this study was to determine the effects of Cadmium Chloride on sperm parameters and the testicular weight in mice *Mus musculus – Swiss albino*.

Materials and methods: For this study we used twelve mice divided into three groups: First group served as control group, second group was treated (6 doses) with $CdCl_2$ 50mg/kg of body weight and third group with the same dose but 3 doses. The second and third group were divided in two subgroups: A treated with vitamins (A 11,090 I.U / Kg, D3 770 U.I / Kg, and E 70 mg/kg) and B that was fed with normal diet. Each animal was in individual cage and had access in taping water. The euthanasia method used was with cervical dislocation.

Results: Our results show that $CdCl_2$ intoxication has caused a significant ($p<0.05$) decrease in sperm motility. Sperm vitality results has shown also that $CdCl_2$ has a significant ($p<0.05$) effect on sperm abnormalities in different parts (head, neck, and tail) of the sperm cell. The number of dead sperm has increased significantly ($p<0.05$) in the intoxicated groups. In intoxicated groups there were significant ($p<0.05$) in testicular weight and also color. Our results have shown that vitamins treatment did not have any significant effect on decreasing the $CdCl_2$ effects.

Conclusions: Based on our results we conclude that $CdCl_2$ had toxic effect on spermatogenesis parameters and testes by reducing their weight and changing the color.

SOP - 2

A Preliminary Study on Microplastic Pollution in an Organized Industrial Zone Offshore Sediment from South-East Coast of the Marmara Sea

Halim Aytekin ERGÜL[a], SELİNAY ÇETİN[a], Serdar AKSAN[a]

Kocaeli University, Science and Literature Faculty, Department of Biology, 41001, Kocaeli, Türkiye

halim.ergul@gmail.com

In the present study, MP distribution was assessed in the marine surface sediment taken from an Organized Industrial Region (OIR) offshore, in the South-east coast of the Marmara Sea, that located in the most populated and industrialized region of Türkiye. Surface sediment samples were taken by Ekman type grab sampler from eight locations which were determined based on their distance to the coast and depth in 2023. The sampling depths ranged from 5 m to 30 m. Samples kept in a glass jar and transported to the laboratory for detailed examination. In the first step, sediment samples were passed through a 500 µm stainless-steel sieve, and dried in an oven at 55 °C for 72 hours. Then hydrogen peroxide (%10 v/v) was added to remove organic substances during a day. $ZnCl_2$ (d:1.6) solution was added onto the dried samples to separate microplastics which have different densities. Floating samples were collected, stained Nile Red, and examined under a fluorescence microscope. Also, FTIR analysis was performed for molecular characterization of the particles.

Microplastic particles were found in all surface sediment samples. Total number of MP particles gradually decreased from coastal side to offshore in the west side of the OIR, whereas there was no remarkable differences for MP numbers in the east side of OIR. Similar trends were observed for MP numbers about depth dependent distributions, accordingly MPs decreased from coastal side to offshore by increasing depth. It should be noted that, different from the east side of the OIR, there is a small settlement exist in the west side. Existence of a total of 197 MPs, accordingly 25 MPs/kg average particles per stations were determined in the study. The most abundant MP type was HDPE with total 107 particles (13 MPs/kg). Average abundance of the other MP types determined in the study were as follows: PP (6 MPs/kg), PS (4 MPs/kg), and PET (1 MPs/kg). Regarding their shapes, filament, fragment, and film MP particle rates were 51.2%, 39.5%, and 9.3%, respectively. Nine different color of MPs were determined in the study. The highest number of MPs was determined in the station 1 (30 MPs/kg) which is the closest station to the coast at 7 m depth located in the western side of the OIR, while the lowest in Station 3 (17 MPs/kg) at 30 m depth which is one of the offshore stations. In previous studies it is reported that MP particle numbers in shallow coastal sediments were ranged between 3 to >10000 depending on distance and depth and MP particle numbers were between 100 and 1000 in most of the articles. Therefore, the MP numbers obtained in the present study (i.e., 25 MPs/kg in average) are relatively low compared to MP numbers those reported in other studies for shallow surface sediments.

The data obtained in the present study indicated that MPs were found in front of the organized industrial zone located in the south-east of the Marmara Sea coastal sediment. The abundance of MPs was relatively lower than the amounts found in similar ecosystems. In fact, there are more microplastics in the area of the OIR close to the residential area suggests that human-generated waste affects the ecosystem. Since, the presence of microplastics in aquatic ecosystems poses a great threat to the environment and living organisms, further studies are needed to monitor anthropogenic effect on coastal ecosystems.

SOP - 3

Green Approach on Synthesis of Au/g-C_3N_4 Photocatalyst for Dye Degradation

Salman Al Faridzy AKBAR[a]*, Is FATIMAH[a]

[a] *Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Islam Indonesia,*
Kampus Terpadu UII, Jl. Kaliurang Km 14, Sleman, Yogyakarta, Indonesia

**20612030@students.uii.ac.id*

Chemical pollution, especially water pollution, is one of the biggest pollutants in the world. Water pollution, such as chemical dyes, could be degraded, by using a photocatalyst such as graphitic carbon nitride, g-C_3N_4. g-C_3N_4 is one of the excellent photocatalysts that has an appropriate band gap for low-energy activation. Nonetheless, g-C_3N_4 has low photocatalytic activity due to high charge carrier recombination and low surface area. However, the g-C_3N_4 can be doped with metal such as aurum to increase the photocatalytic activity and degrade the chemical dyes. Aurum nanoparticles was synthesized using banana peel waste (AuNPs). This research aims to evaluate the photocatalytic activity synthesized aurum-doped g-C_3N_4 for the degradation of methulen blue under visible light irradiation. The kinetic behavior of the photodegradation process of methilen blue by aurum-doped graphitic carbon nitride is also being studied. The degradation of the methilen blue has been utilized by using the UV-Vis Spectrophotometer. Aurum-doped graphitic carbon nitride with different amounts of copper was successfully synthesized. Based on the photocatalysts that were being synthesized, Au/g-C_3N_4 presented degradation of methilen blue under visible light irradiation better than g-C_3N_4.

Keywords: chemical dyes, photocatalytic, degradation, banana peel, Au/g-C_3N_4

SOP - 4

Evaluation of Silica-Coated Nickel Ferrite as Dye Adsorbent

Hiroko Kawaii WIJAYANTI[a], Is FATIMAH[a], Suresh SAGADEVAN[b]

[a]Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Islam Indonesia, Kampus Terpadu UII, Jl. Kaliurang Km 14, Sleman, Yogyakarta, Indonesia
[b]Nanotechnology & Catalysis Research Centre, University of Malaya, Kuala Lumpur 50603, Malaysia

** 22923015@students.uii.ac.id*

Adsorption is an effective way to adsorp hazardous contents contained in liquid waste and is often carried out in industrial waste processing. Aim of this work is to synthesis $NiFe_2O_4$/TUD-1 which can act as an adsorbent in the adsorption process of dye waste. $NiFe_2O_4$/TUD-1 nanoparticles were synthesized using 2 methods, namely post synthesis and in situ which were coded as NF-P and NF-I, respectively. Synthesis of $NiFe_2O_4$/TUD-1 was carried out using $NiCl_2.6H_2O$, $FeCl_3.6H_2O$ as a precursor and dodecylamine as a surfactant. TUD-1 can be synthesized using tetraethyl orthosilicate (TEOS), triethanolamine (TEA) and trimethyl ammonium hydroxide (TMAOH). Characterization was carried out using Fourier-Transform Infrared Spectroscopy (FTIR), X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Gas Sorption Analyzer (GSA) and zeta potential instruments. Adsorption activity evaluation was performed on methylene blue (MB), Rhodamine B (RhB), Methyl Orange (MO) and Bromophenol Blue (BPB). It is known that the % adsorption of TUD-1, NF-P and NF-I on MB is 69.96; 94.90 and 99.68%, while for RhB it was 29.93; 34.90 and 46.87%. MO and BPB dyes are not adsorbed because they are anionic where the adsorbent used in this study is ionic as well.

SOP - 5

Effect of pH on synthesis of WO_3 nanoparticles for photocatalytic degradation of dye

Fadhila ANGGRAINI, Is FATIMAH, Suresh SAGADEVAN

[a]*Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Islam Indonesia, Kampus Terpadu UII, Jl. Kaliurang Km 14, Sleman, Yogyakarta, Indonesia*
[b] *Nanotechnology & Catalysis Research Centre, University of Malaya, Kuala Lumpur 50603, Malaysia*

*20612056@students.uii.ac.id

One of the major problems in several industries is related to wastewater contaminated with chemicals, including dyes. One of the technologies that can be used for dye treatment is photocatalysis. One of the active photocatalysts is WO_3. Various methods have been developed for the synthesis of WO_3, and one of them is the green synthesis method using plant extracts. Green synthesis with beetroot fruit extract is one method developed to address waste issues due to its environmental friendliness. This study aims to evaluate the influence of synthesis parameters, particularly pH during the bio-reduction, on the physicochemical characteristics of the materials and their impact on the photocatalytic degradation of methylene blue under exposure to visible light. The physicochemical characterization of the material was conducted by analysis of x-ray diffraction (XRD), particle size distribution (PSD), Zetapotential, and ultraviolet-visible diffuse reflectance spectroscopy (UV-DRS) analysis. Research results indicated that the synthesis pH affects the material's characteristics, with pH 4 providing the best nanoparticle crystallinity as well as higher photocatalytic activity.

References:

1)Xu et al., Ecotoxicol. Environ. Saf. **2019**, 182, 109360.
2)Lin et al., Environ. Sci. Eng. **2021**, 15(2): 22
3)Çomaklı, and Bingöl, Water Air Soil Pollut. **2021**, 232: 515
4)Nahar, and Hossen, Commun. Soil Sci. Plant Anal. **2020**.
5)Öztürk, Sivas Turk. J. Agric. - Food Sci. Technol. **2020**, 8(7): 1508-1516.

SOP - 6

Development of UV-Curable Water-Based Coatings

Ufuk ÇIMEN[a,b], Gokhan TEMEL[c], Şebnem CAMADANLI[b]

[a] *Polymer Material Engineering, Graduate School Of Natural and Applied Sciences, Yalova University, Yalova 77200, Türkiye*
[b] *R&D Department, Kempro Kimyasal Maddeler, Istanbul 34953, Türkiye*
[c] *Polymer Material Engineering, Faculty Of Engineering, Yalova University, Yalova 77200, Türkiye*

**ufukcimen@kempro.com.tr*

Water-based coatings are a type of coating where water is the primary solvent used. Among the advantages of these coatings are low volatile organic compound (VOC) emissions, environmental sustainability, low odor, and a reduced presence of harmful chemicals. Polyurethane coatings are versatile types of coatings used for the protection and aesthetic enhancement of surfaces such as wood, metal, plastic, and concrete. These coatings are known for their durability, chemical resistance, and scratch resistance. Additionally, they can create glossy or matte surfaces and are commonly used in various industrial and household applications.

In this study, UV-curable water-based polyurethane coating resins were synthesized and characterized by different polyols such as polycarbonate and polyesters. The prepared formulations were applied to various surfaces, and coating properties were examined and compared to commercial coating resins. The resin properties such as pencil hardness, solid content, particle size and gloss met were successfully investigated.

SOP - 7

Environmentally Friendly Polyurethane Derivatives: Synthesis and Application of Waterborne Polyurethane Dispersions

Sevilay DURAL[a,b], Şebnem CAMADANLI[a]

[a]*Kempropol Chemicals, Tuzla 34959, Türkiye*
[b] *Marmara University, Institute of Pure and Applied Sciences, Polymer Science and Technology, Göztepe Kadiköy 34720 Türkiye*

sevilaydural@kempro.com.tr

Waterborne polyurethane dispersions (WPUDs) are polyurethane polymer resins dispersed in water. This system is considered as a class of green material because it is virtually solvent-free, non-toxic, and non-flammable[1], in addition to offering the high performance modern applications need, they contain no residual free isocyanate and a low odor, making them safer and easier to use than the alternative. There are three major reasons for applying the waterborne polyurethanes. First, the administrative organization has emphasized on the reduction of solvent emission into the atmosphere. Second, the price of these solvents is high. But, perhaps most importantly, the quality of these waterborne polyurethanes has made them highly suitable for a wide range of applications.[2]

In this research, types of waterborne polyurethanes, synthesis methods, and applications have been studied. The kind of anionic and anionic&non-ionic waterborne polyurethanes were synthesized. The various types of polyols (polyether, polyester, and polycarbonate) were utilized in the process of producing WPUDs. Samples with various mechanical properties were obtained by synthesizing reactions with different NCO:OH ratios. Fourier Transform Infrared Spectroscopy (FTIR), viscosity, solid content, pH, Differential Scanning Calorimetry (DSC), mechanical testing, particle size analysis, and swelling tests were used to characterize and determine the performance of the WPUDs. The obtained WPUDs offer excellent mechanical properties, chemical, good adhesion, water, and weather resistance. WPUDs can be formulated into coatings, adhesives and glass fiber sizing that form films at either ambient temperatures or under controlled heat conditions. These materials are suitable for coatings, adhesives&sealants, leather finishing, paper&textile, and fiberglass sizing. WPUDs with flexible film properties have shown excellent performance on fiberglass sizing, industrial glove coatings, construction, textile and biomedical applications, while WPUDs with medium flexibility have indicated superior features for packaging applications. Besides coating performances, they have provided excellent adhesion between PVC and wood/MDF surfaces. They have shown strong adhesion properties on wood, glass, metal, foam, and fabric surfaces as well.

References:

1)Zhao et al., Constr. Build. Mater. **2023**, 371, 130775.
2)Honarkar, and Honarkar, Dispersion Sci. Technol. **2018**, 39, 507.

SOP - 8

Development of a Green Micro Extraction Procedure for the Determination of Polyaromatic Hydrocarbons in Electronic Equipments

Ege AKKUM[a], Füsun PELİT[a,]*

[a]*Ege University, Faculty of Science, Department of Chemistry, Bornova-İzmir/Türkiye*

* *fusunpelit@gmail.com*

The continuous increase in the production and use of electronic equipment containing plastic materials in recent years causes people to be exposed to some organic pollutants as a result of contact with these equipment, especially in the home environment. The most important of these organic pollutants are polycyclic aromatic hydrocarbon (PAH) compounds. PAHs are toxic, carcinogenic and mutagenic chemicals among the pollutants of concern, many of which are persistent, bio accumulative chemicals. For this reason, products to be supplied to the public and on the market containing PAHs are subject to a certain PAH limit value according to the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) regulation[1]. The defined threshold limits are 0.5 mg kg^{-1} for children's products and 1.0 mg kg^{-1} for all other consumer products. Therefore, it is necessary to develop sensitive methods to detect PAH contamination in equipment.

The aim of this study is to develop a new microextraction technique for the sensitive and selective analysis of polyaromatic hydrocarbon (PAH) residues. For this purpose, the dispersive liquid liquid microextraction (DLLME) technique, which is widely used today as a green extraction technique, was used in this study. Gas chromatography with a mass detector (GC-MS) was used in the experiments.

Considering the number of parameters that can affect the signal in the DLLME method, Plackett Burmann's design was applied to optimize the method. When the magnitudes of the standard effect values obtained as a result of this design were evaluated, Solvent type, pH, and Sample amount were selected as the important parameters to be studied and all other parameters were studied under constant conditions considering the standard effect values obtained. Then Box-Behnken Experimental design was used for optimization. As a result of this chemometric design, pH:12, dodecanol as solvent type, and a sample amount of 0.24 g was chosen as the optimum experimental parameters to increase the signal.

The calibration curves were linear with correlation coefficients above 0.98. Relative standard deviation (RSD) values ranged from 5-17%. The limit of detection values was between 0.004 and 0.1 ng ml^{-1}. The method was tested with electronic plastic samples.

The extraction method applied in this thesis is a newly developed technique that has not been used in the analysis of organic pollutants that may be present in electronic equipment.

Acknowledgment:

The authors thank to the Ege University (Project no: 23453) for financial support.

References:

1) ECHA, **2016**, ANNEX XVII TO REACH

SOP - 9

Development of an Extraction Method for the Determination of Bisphenol A in Aqueous Samples by Deep Eutectic Solvents

İlknur ERBAŞ[a], Füsun PELİT[a], Başak BUDAKCI[b], Neval BAYCAN[b]

[a]Ege University, Faculty of Science, Department of Chemistry, Bornova-İzmir/Türkiye
[b]Dokuz Eylül University, Faculty of Engineering, Department of Environmental Engineering, Buca-İzmir/Türkiye

* *ilknurbgtr@gmail.com*

With the development of green chemistry, many research teams have focused more on the discovery and application of green solvents. Deep Eutectic Solvents (DES), are new type of environmentally friendly solvents, have been used in analytical chemistry for the extraction and separation of target compounds from various samples. These DES compounds are a new generation solvent system that obtained by mixing two or three components together. As a result of hydrogen bond interaction between these components, a eutectic solvent system is obtained and the melting point of this eutectic solvent system is lower than that of its constituent components[1].

The most important feature of DES's is that they have very low freezing points and are liquid below 150 °C. DES's, which replace commonly used organic solvents in many applications, eliminate the disadvantages of organic solvents such as being expensive, flammable and toxic[2].

Within the scope of this study, it was aimed to develop a green micro-pollutant analysis technique that can be used as an alternative to the standard methods applied, which has high pre-concentration efficiency, fast, easy, cheap, can be applied in the field and consumes less solvent. For this purpose, a new generation of solvents called DES with different physicochemical properties was synthesized in the laboratory and used as an extraction solvent in a liquid-liquid microextraction (LLME) method for BPA analysis.

The parameters related to the extraction procedure namely; DES amount, pH, salt effect, sample volume, ultrasonication time and centrifuge time were optimized by applying Taguchi Design. A linearity of 0.9955 and detection limit of 0.39 ng mL^{-1} were found. The reproducibility was found to vary from 2.8% to %6.9. The accuracy of the method was tested with spiked river samples and the recoveries were found in the range of 94-97%.

Acknowledgment:

The authors gratefully acknowledge the Turkish Ministry of Science TUBITAK (121Y460) and Ege and Dokuz Eylül University for financial support.

References:

1)Farajzadeh, and Mogaddam, Feriduni B.,RSC Adv., **2016**, 6, 47990–47996
2)Florindo et al., Journal of Mol. Liq. **2020**, 297-111841.

SOP - 10

Optimization, Validation and Application of Dispersive Liquid Liquid Microextraction Method for Extraction of Polyaromatic Hydrocarbons in Aqueous Samples

Ebru Çalkan YILDIRIM[a], Furkan BAŞ[a], Füsun PELİT[a], Neval BAYCAN[b]

[a]Ege University, Faculty of Science, Department of Chemistry, Bornova-İzmir/Türkiye
[b]Dokuz Eylül University, Faculty of Engineering, Department of Environmental Engineering, Buca-İzmir/Türkiye

*ebrucalkanyildirim09@gmail.com

In recent years, many different microextraction techniques are applied for the analysis of micropollutants in aqueous media rather than solid phase extraction methods. Liquid-liquid extraction (LLE) method has been developed for the analysis of organic micropollutants in aqueous matrices in order to perform more sensitive analyses by miniaturizing the volume of the solvent and to increase the precipitation. The most important advantages of the method are the use of organic solvents at the micro litre level in the LLME process and the absence of the need for long evaporation processes.

The aim of this study was to develop a new microextraction technique that will enable sensitive and selective analysis of polyaromatic hydrocarbon (PAH) residues. For this purpose, the project aimed to use the dispersive liquid liquid microextraction (DLLME) technique, which is frequently used as a green extraction technique today, by integrating it with the GC-MS system.

In this study, DLLME, a modern and green technique, was combined with a new technique, solidified organic phase extraction (SFO). Box Behnken design was used to optimise the experiment and more accurate results were obtained by evaluating the effect of each parameter together. In DLLME method, a sample of surface water or wastewater was placed in a 15 ml centrifuge tube and sodium chloride was added. A mixed solution of undecanol and acetone was pipetted into the sample, pressed firmly to form a cloudy solution. The solution was centrifuged at 5000 rpm for 10 minutes after being kept in an ultrasonic bath at a certain temperature for a certain time. After cooling at -80ºC for a while, the aqueous phase was decanted with a glass pasteur pipette and the remaining frozen organic solvent was allowed to melt at room temperature. Approximately 25 uL of organic phase was taken into a 150 uL insert and a small amount of water trap was added to remove the water content. The insert was centrifuged at 4000 rpm for 5 min and the organic phase was transferred by micro syringe into another 150 µL conical flask. 1.0 uL of this solution was injected into the GC-MS injection port. The PAH species studied were Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Flouorantene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Perylene, Benzo(a)pyrene, Benzo(e)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthrecene, Benzo(g,h,i)perylene.

The accuracy of the method was tested with spiked river samples and the recoveries were found in the range of 88-92%. A linearity of 0.99 and detection limit of 0.020-0,010 ng mL^{-1} were found. The reproducibility was found to vary from 2.8% to %6.9.

Acknowledgment:

The authors gratefully acknowledge the Turkish Ministry of Science TUBITAK (121Y460), Ege University and Dokuz Eylül University for financial support.

SOP - 11

The Combination of a Sericin and Swimming Exercise Reduces Achilles Tendonopathy in Rats Through the TGF-BETA/SMAD Pathway

Köksal GUNDOGDU[a], Özgen KILIÇ ERKEK[b], Gulsah GUNDOGDU[b], Dilek SAYIN[b], Fatma DEMİRKAYA MİLOĞLU[c]

[a]Denizli State Hospital, Department of Orthopedics and Traumatology, Denizli, Türkiye
[b]Pamukkale University Faculty of Medicine, Department of Physiology, Denizli, Türkiye
[c]Atatürk University Faculty of Pharmacy, Department of Analytical Chemistry, Erzurum, Türkiye

**fdkaya@atauni.edu.tr*

Achilles tendonopathy (AT) is a condition primarily observed in athletes due to overuse. Silk sericin is a natural, cost-effective, and easily accessible biomaterial known to enhance collagen synthesis and promote wound healing. Swimming is a water-based exercise that is simple to perform and engages multiple muscle groups. The objective of this study is to assess the effectiveness of combining AT sericin and swimming exercise on the TGF-β/Smad pathway in rats with an experimental AT model. This study was approved by the Local Ethics Committee for Animal Experiments at Pamukkale University Faculty of Medicine. The experimental AT model was established by applying type I collagenase enzyme to the left peritendinous area, and the rats were randomly divided into five groups (Group 1: Control; Group 2: AT Control; Group 3: AT + Exercise; Group 4: AT + Sericin; Group 5: AT + Sericin + Exercise). Rats received intratendinous sericin administration (100 µL, 0.8 g/kg/mL) on days 3 and 6 and performed swimming exercises in a Morris water tank for 30 minutes per day (5 days per week, over 4 weeks). After weighing the rats at the end of the fourth week, they were euthanized under general anesthesia (ketamine + xylazine), and blood samples were collected from the abdominal aorta. The levels of TGF-β1, Smad2, and CTGF in the obtained serum samples were determined using ELISA with commercial kits. Serum levels of TGF-β1, Smad2, and CTGF were significantly higher in Group 2 compared to Group 1 ($P = 0.001$, $P = 0.004$, $P = 0.005$, respectively). Upon examining the treatment groups, it was noted that serum levels decreased in all groups in comparison to Group 2, but reached statistically significant levels in Groups 4 and 5 ($P < 0.01$, $P < 0.001$, respectively). The results of this study suggest that combining sericin with swimming exercise may present an alternative for the treatment of AT, offering a natural, effective, and patient-friendly option.

Keywords: Achilles Tendinopathy, Sericin, Swimming Exercise

INTRODUCTION

The Achilles tendon is the most frequently traumatized and ruptured tendon in the human body[1], due to its higher loading than other tendons. Achilles tendinopathy (AT) is a pathology primarily associated with overuse and is commonly seen in athletes. Although the exact cause remains unknown, factors such as excessive muscle tension, inadequate blood supply to the tendon, inflammation, genetic predisposition, gender, age, height and weight are known to play a role in its development[2].

TGF-β, a potent fibrogenic factor, plays an important role in various cellular processes, including cell proliferation, differentiation, apoptosis, migration and stimulation of extracellular matrix synthesis[3]. TGF-β binds to TGF-β type 1 and type 2 receptors on the cell surface and initiates intracellular signalling by inducing phosphorylation of SMAD 2/3. Active TGF-β1 receptor complexes require SMAD proteins to signal to the nucleus. SMADs are the only known substrates of TGF-β1 receptors. Therefore, SMAD/CTGF signaling is essential for TGF-β-induced fibrogenesis[4]. CTGF is considered to be an important amplifier of the pro-fibrogenic effect of TGF-β1 and serves as a critical down-regulator of TGFβ-1/SMAD signaling in mesenchymal cells and fibroblasts[4,5]. CTGF has been shown to play a key role in several fibrotic diseases[6].

Studies into the pathophysiology of tendinopathy have also demonstrated the effectiveness of exercise in the treatment of tendinopathy. Among these, Alfredson's classic heel-drop exercise protocol is the most popular. This protocol involves eccentric exercises that require heavy loads, which are thought to increase type I collagen production, tendon volume and tensile strength[8]. Research has shown that eccentric exercises can alter neovascularization and are associated with nerve growth[9]. Flexibility exercises (static or dynamic) used as part of the AT treatment program typically aim to improve flexibility around the lower leg complex and increase ankle range of motion. Swimming exercises, a series of meaningful movements performed underwater, are a natural animal behavioural model[10]. However, these exercises are easy to perform and involve multiple muscle groups. This physical activity, which involves all muscle groups in the body, has a positive effect on muscle strength. Swimming is performed horizontally in water, minimizing or eliminating friction. Due to the minimal mechanical stress involved in this type of exercise, it is preferred for its benefits[11]. Swimming exercise has been shown to have a beneficial effect on the structural properties of muscles through aerobic training and is one of the therapeutic strategies used in rehabilitation. However, it is important to consider the type, intensity and duration of exercise when treating tendinopathy. Swimming is often recommended for the treatment of tendinopathies because it is better tolerated by patients than eccentric exercises[12]. Therefore, swimming exercise is considered effective in the treatment of tendinopathy.

The silk cocoon (Bombyx mori) is made up of two main proteins: silk sericin and fibroin. The fibroin found in the cocoon is a protein that forms thin, double-threaded layers of silk sericin wrapped in disulfide bonds, creating silk in a double-stranded adhesive form[13]. Amino acids derived from the hydrolysis of silk proteins have been shown to possess various biological activities such as hypolipidemic, anti-diabetic, anti-tumor, antioxidant, immunoregulatory, antibacterial, anti-viral properties and more[14]. Silk sericin amino acids are natural, inexpensive, easily accessible, biodegradable and biocompatible, which has attracted increasing interest from researchers. Silk sericin has been shown to positively affect tissue repair/regeneration, promote keratinocyte and fibroblast development, regulate cytokine production for wound healing, and produce critical extracellular matrix proteins, facilitating re-epithelialization and healing[15].

Sericin is known for its antioxidant and anti-inflammatory effects attributed to its role in tissue repair/regeneration. In our previous studies, the efficacy of sericin in AT treatment was demonstrated through the TGF-β/SMAD pathway. However, there are no studies in the literature that have investigated the efficacy of the combination of sericin and swimming exercise on the TGF-β/SMAD pathway.

MATERIAL AND METHOD

This study was approved by Pamukkale University Faculty of Medicine Local Ethics Committee for Animal Experiments on 08.08.2022 with number E-60758568-020-244307. Forty male albino Wistar rats (12-14 weeks old, 200-250 g) were reared under standard conditions in rooms with controlled ventilation, constant temperature and 50% humidity. They were kept in specially prepared cages under laboratory conditions with a 12-hour light/dark cycle, under the supervision of a veterinarian. For the experiment, the rats were fasted overnight but had free access to water. They were then subjected to general anesthesia by intraperitoneal injection (ketamine + 2% xylazine), and 30 µL of type 1 collagenase was injected into the left peritendinous area of each rat using a 30 G syringe. One hour after the formation of the experimental AT model, the rats were randomly divided into 5 equal groups;

Group 1 (control): Rats received no treatment.
Group 2 (AT control): Rats with AT model formation in the left leg underwent 100 µL of PBS intratendinously on the 3rd and 6th days.
Group 3 (AT + exercise): Rats with AT model formation in the left leg underwent swimming exercises for 30 minutes per day, 5 days per week for 4 weeks.
Group 4 (AT + sericin): Rats with AT model formation in the left leg underwent 100 µL of Sericin (0.8 g/kg/ml) intratendinously on the 3rd and 6th days.

Group 5 (AT + Sericin + exercise): Rats with AT model formation in the left leg underwent 100 µL of Sericin (0.8 g/kg/ml) intratendinously on the 3rd and 6th days and swimming exercises for 30 minutes per day, 5 days per week for 4 weeks.

Four weeks after establishment of the AT model, rats were euthanized under general anesthesia (90 mg/kg ketamine hydrochloride and 10 mg/kg 2% xylazine hydrochloride). Blood was collected from the abdominal aorta, centrifuged to obtain serum samples, and stored at -80°C until analysis.

To assess the impact of Sericin on the TGF-β1/Smad pathway in AT, serum samples were analyzed using a commercial ELISA kit to measure the levels of TGF-β1, Smad2, and CTGF (BTLAB), and the results were expressed in ng/L, ng/L, and pg/mL, respectively.

SPSS 21.0 (IBM SPSS Statistics 25 software, Armonk, NY: IBM Corp.) was used for data analysis. Results are presented as mean ± standard deviation. The Shapiro-Wilk test was used to determine whether the variables examined in the results were normally distributed. When the distributions of the variables were examined, it was found that they were not normally distributed. For this reason, Kruskal-Wallis analysis of variance (Mann-Whitney U test with Bonferroni correction for post hoc comparisons between groups) was used for all results to compare independent group differences. A p-value <0.05 was considered statistically significant.

RESULTS

Serum TGF-β1 Levels: Analysis showed that serum TGF-β1 levels were significantly different between groups. Specifically, serum TGF-β1 levels were found to be significantly higher in group 2 compared to group 1 (P = 0.001), indicating an increase in TGF-β1 following injury. When the treatment groups were examined in more detail, it became clear that the administration of the treatments led to a reduction in serum TGF-β1 levels in all groups compared to group 2. This reduction was observed consistently. However, it's important to note that statistical significance was achieved in groups 4 and 5, where the reduction in serum TGF-β1 levels was particularly marked and statistically significant (P = 0.004 and P = 0.0001, respectively). **Figure 1** shows a graphical representation of the data obtained.

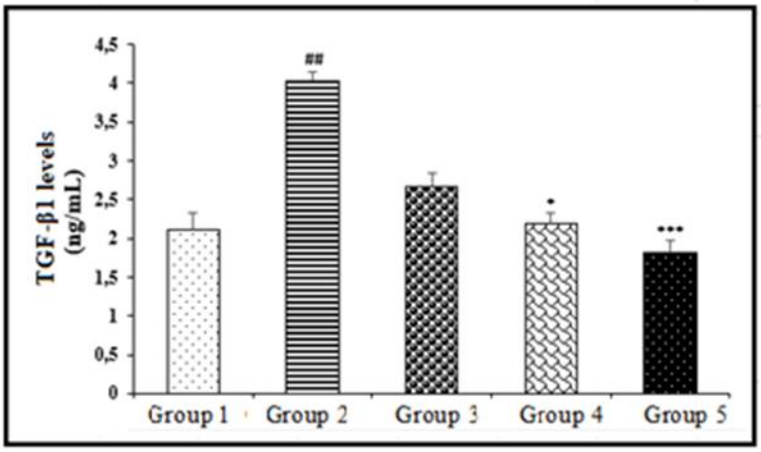


Figure 1: Serum TGF-β1 Levels in Experimental Groups (Results are expressed as Mean ± Standard Deviation; n=8, ##: Significant difference from Group 1 at P < 0.001; *: Significant difference from Group 2 at P < 0.01, ***: Significant difference from Group 2 at P < 0.0001; Group 1: Control group; Group 2: Achilles Tendinopathy group; Group 3: Achilles Tendinopathy + Exercise group; Group 4: Achilles Tendinopathy + Sericin group; Group 5: Achilles Tendinopathy + Sericin + Exercise group).

Serum Smad2 Levels: Serum Smad2 levels were found to be significantly higher in group 2 compared to group 1 (P = 0.004), indicating an increase in Smad2 levels following Achilles tendon injury. When examining the treatment groups, it was observed that serum Smad2 levels decreased in all groups compared to group 2, indicating a consistent trend across treatments. However, statistical significance was reached in Group 4 and Group 5, where the reduction in serum Smad2 levels was particularly significant (P = 0.001 and P = 0.0001 respectively). **Figure 2** shows a graphical representation of the data obtained.

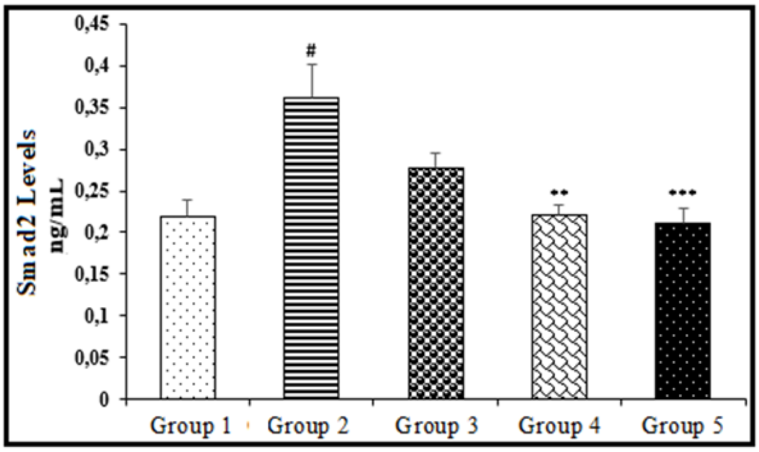


Figure 2: Serum Smad2 Levels in Experimental Groups (Results are expressed as Mean ± Standard Deviation; n=8, #: Significantly different from Group 1 at P < 0.01; **: Significantly different from Group 2 at P < 0.001; ***: Significantly different from Group 2 at P < 0.0001; Group 1: Control group; Group 2: Achilles Tendinopathy group; Group 3: Achilles Tendinopathy + Exercise group; Group 4: Achilles Tendinopathy + Sericin group; Group 5: Achilles Tendinopathy + Sericin + Exercise group).

Serum CTGF Levels: Serum CTGF levels were found to be significantly higher in group 2 compared to group 1 (P = 0.005), indicating an increase in CTGF levels following Achilles tendon injury. When examining the treatment groups, it was observed that serum CTGF levels decreased in all groups compared to group 2, indicating a consistent trend across treatments. However, statistical significance was reached in groups 4 and 5, where the reduction in serum CTGF levels was particularly significant (P = 0.001 and P = 0.0001 respectively). **Figure 3** shows a graphical representation of the data obtained.

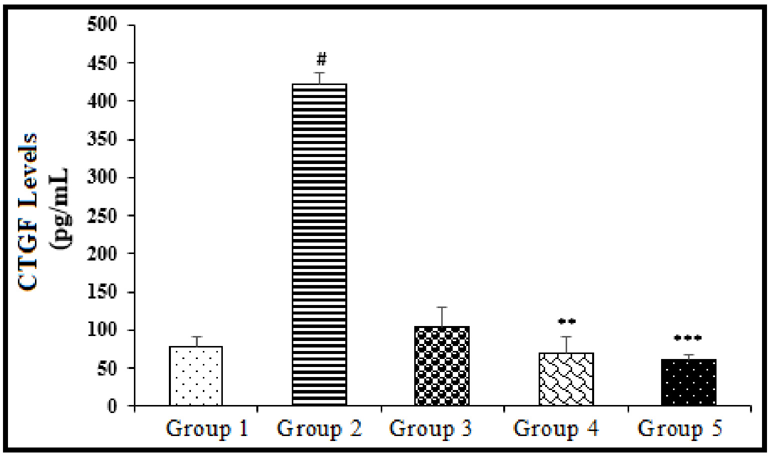


Figure 3: Serum CTGF Levels in Experimental Groups (Results are expressed as Mean ± Standard Deviation; n=8, #: Significantly different from Group 1 at P < 0.01; **: Significantly different from Group 2 at P < 0.001; ***: Significantly different from Group 2 at P < 0.0001; Group 1: Control group; Group 2: Achilles Tendinopathy group; Group 3: Achilles Tendinopathy + Exercise group; Group 4: Achilles Tendinopathy + Sericin group; Group 5: Achilles Tendinopathy + Sericin + Exercise group).

DISCUSSION

AT is a clinical syndrome characterized by pain, swelling and functional impairment. It is associated with a non-inflammatory, degenerative process that affects the collagen structure of the tendon[16]. Factors contributing to AT include degenerative changes that weaken the tensile strength of the tendon and repetitive mechanical stress[17]. The underlying mechanism of AT is complex and not fully understood[18]. Current treatments for AT, both surgical and conservative, such as physiotherapy, steroid injections and anti-inflammatory drugs, have limited effectiveness[19]. Therefore, research into alternative treatments with the potential to improve existing therapies is essential.

Sericin, an 18-amino acid protein with polar side groups[20] (e.g. hydroxyl, carboxyl and amino), has been shown in previous studies to have various beneficial properties, including antioxidant, anti-inflammatory, tyrosinase inhibitory, anticoagulant and anticancer activities[21,22]. While recent research has demonstrated the anti-inflammatory properties of Sericin and its ability to increase collagen synthesis, its efficacy in the treatment of AT remains underexplored.

Swimming exercise, a form of physical activity in water, offers a natural and comprehensive workout for animals[10]. It positively impacts muscle strength due to the engagement of all body muscles. Swimming exercises are preferred as they minimize mechanical stress by reducing friction and allowing for horizontal movements in the water[11]. These exercises have demonstrated benefits such as muscle regeneration and the prevention of muscle atrophy. The type, intensity, and duration of exercise are crucial in tendinopathy treatment. Swimming exercises are often favored by patients due to their ease of tolerance compared to eccentric exercises[12], making them a potentially effective option for tendinopathy treatment.

CONCLUSION

In this study we measured serum levels of TGF-β1, Smad2 and CTGF using commercial ELISA kits. The Achilles tendinopathy (AT) group had significantly higher serum levels of TGF-β1, Smad2 and CTGF compared to the control group ($P < 0.05$). Treatment with Sericin resulted in a significant reduction in serum levels of TGF-β1, Smad2 and CTGF, with a more pronounced reduction when combined with exercise ($P < 0.01$). These results provide further evidence for the efficacy of Sericin in the treatment of AT and emphasis the enhanced effect of Sericin when used in conjunction with exercise.

References:

1)Lantto et al., J. Scand. J. Med. Sci. Sports. **2015**, 25(1), e133-e138.
2)Ham, P.; Maughan, K. L. UpToDate, Fields, K (Ed), UpToDate, Waltham, MA. **2012**.
3)Boon et al., Cytokine Growth Factor Rev. **2011**, 22(4), 221-229.
4)Lee, Histology and Histopathology. **2012**, 27(9), 1131-1141.
5)Lilja-Maula et al., J. Comp. Pathol. **2014**, 150(4), 399-407.
6)Rachfal, and Brigstock, Hepatol. Res. **2003**, 26(1), 1-9.
7)Alfredson, and Cook, Br. J. Sports Med. **2007**, 41(4), 211-216.
8)Langberg et al., J. Scand. J. Med. Sci. Sports. **2007,** *17*(1), 61-66.
9)Alfredson et al., *Am J Sports Med*,**1998,** *26*(3), 360-366.
10)Arshadi et al., *Osong Public Health Res Perspect*, **2015,** *6*(2), 87-93.
11)Grassi et al., *Chest*, **1992**,*101*(5), 312S-314S.
12)Tanaka, H. *Sports medicine*, **2009**, 39, 377-387.
13)Aramwit et al., *BMC nephrology*, **2012**, 13(1), 1-11.
14)Zhang et al., *Nanoscale Res. Lett.*, **2011**, 6, 1-8.
15)Gholipourmalekabadi et al., A*CS Biomater. Sci. Eng.***2019,** 5(3), 1487
16)Van Dijk et al., *Knee Surg. Sports Traumatol. Arthrosc.* **2011**, 19, 835-841.
17)Tallon et al., *Med Sci Sports Exerc*, **2001**, 33(12), 1983-1990.
18)Xu and Murrell, *Clin. Orthop. Relat. Res.*, **2008**, 466, 1528-1538.
19)Kedia et al., *Int. J. Sports Phys. Ther.* **2014**, 9(4), 488.
20)Zhang, *Biotechnology advances*,**2002**, 20(2), 91-100.
21)Aramwitet al., J. Biomater. Sci. Polym. Ed.,**2009**, 20(9), 1295-1306.
22)Zhaorigetu et al., *Biosci. Biotechnol. Biochem.*, **2001**, 65(10), 2181-2186.

SOP - 12

Application of Central Composite Design (CCD) for Optimization of Ciprofloxacin Antibiotic Removal Using Hollow Carbon Spheres

Fatma DEMIRKAYA MILOĞLU[a], Hasan CAN[b], Yücel KADIOĞLU[a], Büşra YUKSEL[a], Burak BAYRAK[a], Abdul Kayum IDDRISU[a]

[a]Department of Analytical Chemistry, Faculty of Pharmacy, Atatürk University, 25240 Erzurum, Türkiye
[b]East Anatolia High Technology Application and Research Center, Atatürk University, 25240 Erzurum, Türkiye

**fdkaya@atauni.edu.tr*

Environmental sustainability is under significant threat, mainly due to the contamination of aquatic systems by pharmaceutical contaminants, which contribute to water pollution[1]. Antibiotics have been a focus of concern among various pharmaceutical compounds due to their ability to promote antimicrobial resistance genes in pathogenic bacteria[2]. Fluoroquinolones, widely used and highly potent antibiotics, have been identified as one of the most prevalent antibiotic groups in the environment, particularly in surface waters[3]. Ciprofloxacin hydrochloride is a member of the fluoroquinolone class of antibacterial agents. It exhibits activity against a broad spectrum of bacteria[3].Hollow carbon spheres (HCS) are a type of carbon nanomaterial known for their unique spherical hollow structures. They have attracted considerable interest, particularly in the field of adsorption applications, due to their exceptional ability to encapsulate a wide range of substances within their internal cavities[4]. The removal of Ciprofloxacin hydrochloride from aqueous solutions was optimized using a central composite design (CCD) combined with response surface methodology. This approach involved the manipulation of four crucial independent factors: pH, the amount of HCS, ionic strength and contact time. A polynomial model was established to relate the independent variable (absorption capacity) to the above dependent factors. The quantification of the absorbed ciprofloxacin hydrochloride was carried out using the HPLC method with chromatographic separation on a Zorbax C18 reversed-phase column. Statistical analysis of the quadratic regression equation shows its significance, with a P value of less than 0.01, as determined by ANOVA for the quadratic response surface model. In this case, the identified factors are observed as significant model terms and have a notable effect on the absorption capacity of ciprofloxacin hydrochloride. Furthermore, application of the classical Langmuir isotherm model to the specified conditions showed remarkable agreement with the CCD model. This close agreement strongly suggests that, under these specific conditions, the Langmuir isotherm model effectively characterizes the adsorption process and predicts the maximum achievable ciprofloxacin hydrochloride absorption capacity.

References:

1)Hejna et al., Int. J. Environ. Res. Public Health. **2022**, 19(13), 7717.
2)Shokoohi et al., Process Saf. Environ. Prot. **2020,** 134, 169.
3)Khattab et al., Planar Chromatogr. - Mod. TLC. **2013**, 27, 287-293.
4)Scroggs et al., Viruses. **2021**, 13(1), 8,1.

SOP - 13

Microalgae Cultivation in Rose Oil Processing Wastewater and Water Footprint, Carbon Removal

F Özge UYSAL, Önder UYSAL*

Isparta University of Applied Sciences, Türkiye

**onderuysal@isparta.edu.tr*

The use of microalgae in wastewater treatment is known to be an environmentally friendly and sustainable method. Microalgae are used in wastewater treatment for nitrogen and phosphorus removal, oxygen production, biomass production and wastewater odor control. The use of microalgae in wastewater treatment offers several advantages compared to conventional chemical treatment methods. These are; lower energy consumption, lower chemical use, reduction of carbon footprint. Turkey's exports of rose products are concentrated mainly to countries such as France, Germany, the United Kingdom, Italy, Italy and the United States. These countries are known as consumers of rose oil, rose water, rose oil essences and other rose-based products. France, in particular, is characterized by its demand for Turkish rose oil for the production of high quality perfumes. In this study, Chlorella sp. strain microalgae cultivation was carried out in the rose oil processing wastewater obtained from the largest factory in Turkey, which has a very important share in the world export market, and the COD removal potential was determined. The study was carried out in two different environments, laboratory and outdoor conditions. As a result of a total of 10 applications, the dosage with the highest COD removal was scaled in 3 channel type ponds with an operating volume of 1 ton under field conditions and a prototype study was carried out. At the end of the experiment, COD removal was satisfactory in 3 ponds separately and the water footprint and carbon removal of the study were calculated for each pond.

SOP - 14

Development of 'Stick Sieve', an Innovative Water Treatment Method Using Environmentally Friendly Novel Adsorbents

Yağmur Deniz ÇİFTÇİ[a], Ela GÜNGÖR[a], Zeliha Ada İPLİKÇİ[a], Serap YILDIRIM METİN[a], Tülin DENİZ ÇİFTÇİ[b*]

[a] Bahçeşehir College, İzmir 50th Year Anatolian High School, Bornova, İzmir, Türkiye
[b] Ege University, Faculty of Science, Department of Chemistry, Bornova İzmir, Türkiye

**tulin.deniz.ciftci@ege.edu.tr*

In this era of water scarcity, water purification has become an important issue [1-3]. Our aim is to contribute to both the ecosystem and the economy by preparing adsorbents that can solve this problem. For this purpose, we used human hair, banana peels, and pine leaves, which are classified as waste, and coated these materials with nano-sized magnetite. Since we get the highest removal efficiencies by using the hair support material, we continued the experiments with this material. SEM and EDX analyses confirmed that the nano-magnetite successfully formed in and on the hair strands. We determined the surface pH of the adsorbent as 10.1 and the optimum pH values for the removal of fourteen heavy metals. The optimum adsorbent dose was determined as 2 g/L. We used isotherm models to determine the nature of adsorption and adsorption capacity for 14 elements. The results of the isotherm study indicate that the adsorptions are favorable and physical. We also used kinetic models to determine the rate constant of the adsorption process for 14 elements.

We have also developed an innovative treatment method by targeting the purification of unhealthy minerals that can be found in drinking water. For the prototype, we put magnetite-hair adsorbent in the sieve, and rolled it into a tubular shape. For visual proof, we immersed the prepared stick sieve adsorbent in the nickel solution and mixed it. We took samples from the solution at different times and observed that the pink color formed by nickel with dimethylglyoxime was completely removed in only 5 minutes. The removal efficiency was higher than 95%. We carried out validation studies to check the accuracy of the method and analyses. We tested our adsorption method with certified drinking water, element spiked commercial drinking water, wastewater, and element spiked wastewater. We achieved high removal and recovery efficiencies.

As a solution to the problems encountered in water purification systems, we developed a novel system 'Stick Sieve' that does not need to stay in the treated water for a long time, does not cause negative effects such as algae formation, will remove toxic substances, has a high capacity, does not take up space, makes fast adsorption, and can adapt to all kinds of water containers. As a result, it has been determined that the stick type sieve method surpasses its counterparts with its superior features, such as the ability to change the adsorptive material to be placed in the sieve, being produced from environmentally friendly low-cost materials, and providing fast and about 100% purification.

References:

1)Somma et al., Chemosphere. **2023**, 337, 139295.
2)T.C. Ministry of Environment and Urbanization and Climate Change, Türkiye Environmental Problems and Priorities Assessment Report, Ankara, **2018**.
3)WHO, 2011. https://apps.who.int/iris/bitstream/handle/10665/44584/9789241548151_eng.pdf.

PP – 1

Development of Floating Metformin hydrochloride Pellets by Solvent-Free Method

DJEBBAR Mohamed, BOUCHAMA Bouchra, and CHAFFAI Nacéra

Badji Mokhtar Annaba University, Faculty of Medicine, Algeria

**mohamed_djebbar@yahoo.fr*

Objective: The aim of this study was to formulate and evaluate the biopharmaceutical behavior of metformin hydrochloride (MTH) floating gastro-retentive granules, prepared by a solvent-free method, thermo-granulation.

Methods: First, we assessed the effect of the nature and concentration of three fusible bases (Compritol, stearic acid and Gelucire) on the flotation properties and *in vitro* release kinetics in artificial gastric medium (pH 1.2) of MTH granules prepared by binder fusion. Secondly, we studied the impact of incorporating two polymers (Ethylcellulose and PVP), release control agents, on the biopharmaceutical behavior of MTH granules. The formulation considered promising was subjected to physicochemical analysis; Fourier Transform Infrared Spectroscopy (FTIR) and Differential Scanning Calorimetry (DSC).

Results: Granules (MTH - meltable binder) at 1:3 and 1:4 ratios showed good flotation properties (immediate delay, total time >12 h, integrity maintained). The study demonstrated the effect of the nature of the meltgranulation agent on *in vitro* dissolution rates of MTH. While stearic acid and Compritol did not achieve prolonged release of MTH, Gelucire produced formulations with prolonged kinetics. The G4 formulation, MTH-Gelucire (1:4), achieves 80% release in 8 hours. It has also be shown that in the presence of Gelucire, ethylcellulose added at 5% and 10%, does not affect flotation and dissolution. Finally, the promising G8 formulation revealed no MTH-Excipients interaction (FTIR & DSC) and showed a more prolonged *in vitro* release of MTH (70.97% dissolved in 8 hours), probably due to the PVP present at 10%. Release followed Higuchi kinetics.

Conclusion: Gelucire could considered an effective carrier for the formulation, by thermo-granulation (solvent-free method), of floating gastro-retentive forms of highly water-soluble drugs such as MTH.

Keywords: Metformin HCl, floating granules, melt granulation, *in vitro* dissolution.

PP – 2

Risk Assessment of Essential and Toxic Elements in Freshwater Fish Species from Lakes near Black Sea, Bulgaria

Katya PEYCHEVA*, Veselina PANAYOTOVA, Albena MERDZHANOVA , Diana DOBREVA, Tatyana HRISTOVA

Department of Chemistry, Medical University of Varna, 9002 Varna, Bulgaria

* peycheva@mu-varna.bg

The aims of this study were to measure the concentrations of selected toxic and essential elements in the muscle tissue of five common freshwater fish species ((roach (*Rutilus rutilus*), freshwater bream (*Abramis brama*), prussian carp (*Carassius gibelio*), crucian carp (*Carassius carassius*) and common carp (*Cyprinus carpio*)) from Lake Burgas and Lake Mandra (Bulgaria). In all samples the levels of Cd, Cr, Cu, Mn, Ni, Pb, Fe and Zn were under the maximum allowed concentrations for safe human consumption in Bulgaria and ranged as follows: Cd 0.02–0.05; Cr 0.03 0.06; Cu 0.11– 0.20; Mn 0.05–0.71; Ni 0.06–0.11; Pb 0.15–0.27, Fe 1.68–5.86 and Zn 1.94–9.06 mg/kg wet weight. The concentration of As was under detection limit.

An assessment of the human risk by calculation of the target hazard quotients (THQ), hazard index (HI) and target risk (TR) was performed. The target hazard quotient (THQ) for individual elements and HI for combined metals were lower than 1, indicating no health risk for consumers due to the intake of either individual or combined metals. The target risk for iAs, Pb and Ni was below 10^{-6}, indicating no carcinogenic risk. According to these results, the consumption of these freshwater fish species is safe for human health.

PP – 3

Strontium Recovery from Geothermal Sources by Adsorption Using Zeolites with Various Particle Sizes

Bernis İLBEY[a], Seyra TOPRAK[b], Alper BABA[c], Mustafa M. DEMİR[b]

[a]Department of Chemical Engineering, [b]Department of Materials Science and Engineering, [c]Department of Civil Engineering, İzmir Institute of Technology, 35430, Gülbahçe, Urla, İzmir, Türkiye

bernisilbey@std.iyte.edu.tr

Environmental concerns and depleting mining resources have intensified efforts to recover valuable elements from aqueous sources. Strontium holds significant importance particularly in Türkiye, where substantial reserves are found. Strontium finds diverse industrial applications including its use in TV tubes, automotive industry ferrites, iron ore separators, fireworks, glass production, paints, pharmaceuticals, and as a bone health supplement. Zeolite-based adsorption from geothermal sources offers a promising method for Strontium recovery. Achieving optimal results necessitates the consideration of various adsorption parameters such as temperature, pH, adsorbent properties, solvent characteristics, and particle size. The structural and morphological characteristics of zeolites were investigated by powder X-ray diffraction (XRD) and scanning electron microscopy (SEM). Zeolites with various particle sizes (10, 40, 100 and 700 µm) were subjected to batch adsorption experiments with Sr-containing solution prepared with $SrCl_2$ to investigate the effect of sorbent dose on adsorption. After the adsorption experiments, the Sr concentration in the decantate was analyzed using a flame photometer. Preliminary results showed that the sorption capacity of zeolites is on nearly 4 mg/g. As the particle size decreases, sorption capacity increases. Not surprising, decreasing particle size increases available surface area and inevitably sorption capacity.

Acknowledgment:

This work was supported by the European Research and Innovation program ''CRM- geothermal- Raw materials from geothermal fluids: occurrence, enrichment, extraction'' (project number: 101058163).

PP – 4

Purification and immobilization of thermoalkaliphilic recombinant esterase enzyme

Buse BASKIN[a], Esin BALCI[b], Gulsah SANLI-MOHAMED[c], Aysun SOFUOGLU[a,]*

[a] *Izmir Institute of Technology, Department of Chemical Engineering, 35430 Urla/İzmir, Türkiye*
[b] *Izmir Institute of Technology, Department of Environmental Engineering, 35430 Urla/İzmir, Türkiye*
[c] *Izmir Institute of Technology, Department of Chemistry, 35430, Urla/İzmir, Türkiye*

*aysunsofuoglu@iyte.edu.tr

Today, enzymes derived from thermophilic bacteria which are resistant to high temperatures, are among the most attractive enzyme groups. However, they are relatively unstable, and have a short catalytic life and cost of separation [1]. Additionally, they are difficult to recover and reuse from the reaction mixture after use. These facts can be listed as obstacles to the utilization efficiency of enzymes. Various immobilization methods have been proposed to overcome or eliminate these problems. Among these methods, adsorption is simple, cost-effective, and doesn't require chemicals [2]. The resulting composite can also be reused multiple times, making it an environmentally friendly approach.

Prior to this study, *Geobacillus sp.* was isolated from Izmir Balcova Geothermal Region in Izmir (TURKIYE) by Yavuz et al. (2004) [3]. The esterase-producing gene of *Geobacillus* sp. had been recombined to *E.coli* (4). The obtained *E. coli* stock with the esterase-producing gene was stored at -86 °C. Within the scope of this study, the expression and purification studies of the enzyme were conducted. Then, the purified enzyme was immobilized to Halloysite nanotubes (HNTs), a natural material with high selectivity due to the charges it carries, by physical adsorption method. Thus, immobilization of thermoalkaliphilic esterase enzyme to HNTs was carried out for the first time in the literature, and biocompatibility between HNTs and the enzyme was investigated. The optimization of the main parameters (pH, adsorption contact time, enzyme concentration, support amount, and temperature) in the immobilization process was performed using Central Composite Design (CCD), a subunit of Surface Response Methodology (RSM). Before and after immobilization, Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy analysis (TEM), Surface area analysis (BET), X-ray diffraction analysis (XRD), Fourier Transform Infrared Spectrophotometer (FT-IR) analysis, Thermogravimetric (TG) analysis were carried out to reveal the success of immobilization. After enzyme immobilization, immobilization efficiency was evaluated by examining the characteristic properties of the HNTs, enzyme loading capacity, enzyme activity, stability, and reusability.

Acknowledgements:

This study has been provided with the financial support by the Scientific and Technological Research Council of Türkiye (TUBITAK) under 2209-A University Students Research Projects.

References:

1)Sassolas et al., Biotechnol. Adv. **2012**, 30(3), 489-511.
2)Zhai et al., Catal. Commun. **2010**, 12, 259-263.
3)Yavuz et al., J. Appl. Microbiol. **2004**, 97(4), 810-817.
4)Tekedar, and Sanli-Mohamed, Extremophiles. **2011**, 15, 203-211.

PP – 5

UV-Curable Membrane for Metal Removal

Beyzanur TAŞ[a], Ayşegül Şennur SAMASTI[a], Hatice BİRTANE[a], Oya AYDIN URUCU[a], M. Vezir KAHRAMAN[a]

[a]Marmara University, Department of Chemistry, 34722 Kadikoy, Istanbul, Türkiye.

tasbeyza65@gmail.com, *aysegul61samasti@gmail.com*

Thiol-ene click reactions have recently been utilized in various synthetic processes, enabling basic chemical synthesis, modification of polymeric materials, and the fabrication of a wide range of polymeric materials with diverse applications. These applications include optical displays, nanoimprinting, holographic diffractive materials, microfluidic devices, high-impact energy-absorbing devices, complex surface patterns, optical switching arrays, and functionalized linear polymers.

In this particular study, a polymeric membrane was prepared using a photo polymerization technique. The membranes in different formulations were prepared by adding N-isopropyl acrylamide at different rates. The resulting crosslinked membrane was employed for the removal of Pb(II) ions from aqueous samples.

The structure and morphology of the cross-linked membrane were characterized using various analytical techniques. Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM) were employed to assess the membrane's chemical structure, and surface morphology, respectively.

To determine the concentration of the metal ions, flame atomic absorption spectroscopy (FAAS) was utilized, which is a technique commonly used for metal ion analysis.

The study also investigated the effects of parameters such as pH, contact time, and the interaction of foreign metal ions on the adsorption process. The behaviour of adsorption was evaluated using Langmuir and Freundlich isotherms, which provide insights into the adsorption characteristics.

Overall, this study demonstrates the preparation and characterization of a polymeric membrane through a photo polymerization technique for the purpose of removing Pb(II) from aqueous samples. The investigation also explores the influence of pH, contact time, and the interaction of other metal ions on the adsorption process, using Langmuir and Freundlich isotherms to analyze the adsorption behaviour.

PP– 6

The Preparation of Polymeric Membrane with TSA for Metal Uptake

Elif KOYUNCU[a], İrem DİNÇ[a], Hatice BİRTANE[a] Oya AYDIN URUCU[a], M. Vezir KAHRAMAN[a]

[a]Marmara University, Department of Chemistry, 34722 Kadikoy, Istanbul, Türkiye.

elif.kync28@gmail.com, iremdnc2222@gmail.com

Thiol-ene click reactions have recently found expanded applications in various synthetic processes, enabling essential chemical synthesis, modification of polymeric materials, and the fabrication of a diverse range of polymeric materials with numerous novel applications. These applications encompass optical displays, nano-imprinting, holographic diffractive materials, microfluidic devices, high-impact energy-absorbing devices, complex surface patterns, optical switching arrays, and functionalized linear polymers.

In this specific study, we focused on the preparation of a polymeric membrane based on thiol-ene chemistry, utilizing a photo polymerization technique. The membranes in different formulations were prepared by adding tri thiocyanuric acid (TSA) at different rates. The resulting photo-crosslinked membrane was employed for the removal of heavy metal ions from aqueous samples.

To characterize the structure and morphology of the crosslinked membrane, several analytical techniques were employed. Fourier transform infrared spectroscopy (FTIR) provided insights into the chemical structure of the membrane. Additionally, scanning electron microscopy (SEM) was utilized to visualize the surface morphology of the membrane.

Equilibrium experiments were conducted using a batch method to investigate the adsorption of Pb(II) ions onto the polymeric membrane adsorbent. The concentration of the metal ions in the solution was determined using atomic absorption spectroscopy (AAS), a reliable technique for quantifying metal content.

The study also explored the influence of pH, saturation time, and initial metal concentration on the adsorption process under optimal conditions to determine their impact.

Overall, this study demonstrates the synthesis and characterization of a thiol-ene-based polymeric membrane and its application as an adsorbent for the removal of heavy metal ions, specifically Pb(II), from aqueous samples. By examining the adsorption process and evaluating the factors affecting it, valuable insights were gained regarding the structure, performance, and suitability of the polymeric membrane for effective removal of heavy metal ions in aqueous environments.

PP – 7

Superhydrophobic Composite Sorbent Prepared from Sponge, Inorganic Mineral and Alkoxysilane with Long Chain Length for Highly Selective Diesel Recovery from Diesel-Water Mixtures

Sibel TUNÇ[a,*], Osman DUMAN[a], Uğur CENGİZ[b], Ceren ÖZCAN DİKER[a], Süleyman Mert GÜREŞİR[a], Candan CENGİZ[b]

[a] *Akdeniz University, Faculty of Science, Department of Chemistry, Antalya / Türkiye*

[b] *Çanakkale Onsekiz Mart University, Faculty of Engineering, Department of Chemical Engineering, Çanakkale / Türkiye*

**stunc@akdeniz.edu.tr*

In oceans and seas, failures in drilling lines cause oil spills occasionally, and this situation poses a major problem for the environment. After the 2010 Deepwater Horizon oil spill in the Gulf of Mexico, only 10% of the oil on the water surface could be recovered [1]. Such disasters demonstrate that there is a need to develop new superhydrophobic materials that can selectively and effectively remove the petroleum product from water[2]. Nowadays, studies on the design of new sorbent materials with superhydrophobic and superoleophilic property are increasing day by day.

Here, a new sorbent material was fabricated using melamine sponge, halloysite nanotube and hexadecyltrimethoxysilane through sol-gel reaction under supercritical carbon dioxide atmosphere. Diesel sorption capacity of sorbent was determined. The reusability of sorbent material was investigated for 15 sorption-desorption cycles. The effect of various parameters such as initial diesel concentration, sorbent amount, and temperature on the removal process of diesel from water was evaluated. Separation of diesel from diesel-water mixtures using different separation techniques was performed and separation efficiency was calculated.

Diesel sorption capacity of the new sorbent was calculated to be 52.4 g/g. Higher than 25% of the initial diesel sorption capacity of sorbent material was obtained at the end of 15th sorption-squeezing cycle. Fabricated sorbent material could separate the diesel-water mixtures with remarkable separation efficiency up to 99.92% using continuous separation technique. The diesel sorption capacity of sorbent material displayed an increase with increasing initial diesel concentration. On the other hand, an increase in the sorbent mass led to a decrease in the diesel sorption capacity of sorbent material. This study showed that the fabricated sorbent material is effective in the sorption of diesel and in the selective separation of diesel-water mixtures.

Acknowledgements:

This study was supported by the Scientific and Technological Research Council of Türkiye (TUBITAK Project Number: 221M385).

References:

1)McNutt et al., PNAS. **2021**, 109, 20222.
2)Kostka et al., Appl. Environ. Microbiol. **2011**, 77, 7962.

PP – 8

Superhydrophobic Sponge-Based Sorbent Material for the Selective Removal of Oils from Oil-Water Mixtures

Ceren ÖZCAN DİKER[a,*], Osman DUMAN[a], Süleyman Mert GÜREŞİR[a], Uğur CENGİZ[b], Sibel TUNÇ[a], Candan CENGİZ[b]

[a] *Akdeniz University, Faculty of Science, Department of Chemistry, Antalya / Türkiye*
[b] *Çanakkale Onsekiz Mart University, Faculty of Engineering, Department of Chemical Engineering, Çanakkale / Türkiye*

**cerenozcan@akdeniz.edu.tr*

With the development of petroleum and organic solvent industries, some accidents occurring during oil and organic solvent transport in the seas and oceans cause oil and organic solvent spills in water. As a result of these accidents, petroleum products, oils and organic solvents mixed with water do not only pose an environmental threat, but also seriously affect the health of people and many aquatic creatures and the economies of countries[1]. In literature, for the removal of oily substances and organic solvent from water, the most used technique is sorption technique. On the other hand, in sorption technique, the development of new superhydrophobic and superoleophilic sorbent materials with high sorption capacity and separation efficiency is needed [2].

In this study, a new superhydrophobic and superoleophilic melamine sponge material coated with methyltriethoxysilane and halloysite nanotube (MS/METES/HNT) was prepared by green synthesis method under supercritical carbon dioxide atmosphere and characterized by SEM and XPS techniques.

MS/METES/HNT sorbent material displayed superhydrophobic surface property with water contact angle of 153.0° and superoleophilicity with oil contact angle of 0°. The robustness of superhydrophobic sorbent was examined by a sandpaper abrasion test. Selective removal of chloroform and machine oil droplets from water and corrosive solutions was achieved within a short time of 5 s. For the separation of chloroform-water mixture using MS/METES/HNT, separation efficiency and flux values were calculated as 99.8% and 2780 L/(m^2.h), respectively. This study confirmed the applicability of superhydrophobic MS/METES/HNT sorbent material for the selective removal of oil and organic solvent droplets, high separation efficiency of oil-water and organic solvent-water mixtures, and effective sorption of oily substances and organic solvents.

Acknowledgements:

This study was supported by the Scientific and Technological Research Council of Türkiye (TUBITAK Project Number: 221M385).

References:

1) Xue et al., Sep. Purif. Technol. **2021**, 259, 118106.
2) Zhan et al., J. Hazard. Mater. **2020**, 388, 121752.

PP – 9

Selective Sorption of Oil and Organic Solvent Spills from Water by Inorganic - Organic Hybrid Material: Sorption Kinetics, and Stability, Durability and Reusability Studies

Osman DUMAN[a,*], Süleyman Mert GÜREŞİR[a], Ceren ÖZCAN DİKER[a], Uğur CENGİZ[b], Sibel TUNÇ[a], Candan CENGİZ[b]

[a] *Akdeniz University, Faculty of Science, Department of Chemistry, Antalya / Türkiye*
[b] *Çanakkale Onsekiz Mart University, Faculty of Engineering, Department of Chemical Engineering, Çanakkale / Türkiye*

**osmanduman@akdeniz.edu.tr*

Oil spill, organic solvent leakage, and industrial oily wastewater discharge into water sources are detrimental for the aquatic ecosystem and human health [1,2]. Various materials in different forms such as sponge, mesh, aerogel, and membrane form have been used as sorbent for oil and organic solvent sorption and oil/organic solvent-water separation. In sorption or separation studies, the most important property is the superhydrophobicity of sorbent material. Superhydrophobic sorbents can be prepared by the controlling of surface energy and surface roughness of the material [3]. Porous materials are considered as starting material for the preparation of candidate sorbents [4].

Here, superhydrophobic porous sorbent material was developed by the coating of halloysite nanotube modified with methyltriethoxysilane onto melamine sponge. Kinetic studies were conducted for oil/organic solvent sorption process. For model pollutants (diesel, machine oil and chloroform), the kinetic data of superhydrophobic porous sorbent were well fitted with the pseudo second order kinetic model. Sorbent material displayed the highest sorption capacity (122.4 g/g) for chloroform among the studied different petroleum products, oils, and organic solvents. Reusability of sorbent material was investigated through 15 sorption-squeezing cycles. After the use of sorbent material for 15 chloroform sorption-squeezing cycles, sorbent material maintained the superhydrophobic surface property. The results of stability and durability studies showed that sorbent material was of good chemical stability in HCl (0.01 M), NaOH (0.01 M) and NaCl (5%) solutions, high thermal stability, and remarkable mechanical durability. Furthermore, prepared superhydrophobic sorbent material exhibited selective oil and organic solvent removal ability.

Acknowledgements:

This study was supported by the Scientific and Technological Research Council of Türkiye (TUBITAK Project Number: 221M385).

References:

1)Zhang et al., Carbohydr. Polym. **2021**, 259, 117750.
2)Ahuja et al., J. Environ. Chem. Eng. **2021**, 9, 105063.
3)Reshmi et al., RSC Adv. **2017**, 7, 2092.
4)Kang et al., Hazard. Mater. **2023**, 445, 130559.

PP – 10

Superhydrophobic Sorbent Materials Fabricated Under $scCO_2$ Atmosphere for the Selective Separation of Oil-Water Mixtures: Effect of Sorbent Density and Porosity on the Sorption Capacity, Separation Efficiency and Flux Values

Osman DUMAN[a,*], Uğur CENGİZ[b], Ceren ÖZCAN DİKER[a], Süleyman Mert GÜREŞİR[a], Sibel TUNÇ[a], Candan CENGİZ[b]

[a] *Akdeniz University, Faculty of Science, Department of Chemistry, Antalya / Türkiye*
[b] *Çanakkale Onsekiz Mart University, Faculty of Engineering, Department of Chemical Engineering, Çanakkale / Türkiye*

**osmanduman@akdeniz.edu.tr*

Pollution of water and water sources with oily substances and organic solvents is mainly caused by petrochemical leaks, oil wastes and untreated industrial oily wastewater systems [1]. Water polluted with these pollutants leads to serious problems in many ecosystems [2]. Therefore, the treatment of wastewater including oily substances and organic solvents is very important. Among the different oil-water separation technologies, physical sorption process is one of the effective, eco-friendly and inexpensive methods. In sorption process, the density and porosity of sorbent materials may affect the performance properties of sorbent to be used in the treatment of wastewater containing oily substances and organic solvents.

In this study, three superhydrophobic sorbent materials were prepared by coating of melamine sponge with methyltriethoxysilane (METES)-halloysite nanotube (HNT), octyltriethoxysilane (OTES)-HNT and hexadecyltrimethoxysilane (HDTMS)-HNT under $scCO_2$ atmosphere and the effects of density and porosity values of sorbent materials on the sorbent sorption capacity value for various oily substances and organic solvent and on the separation efficiency and flux values of oil-water or organic solvent-water mixtures were determined.

A decrease in the coating density value and an increase in the sorbent porosity value of sorbent material improved the sorption capacity value of superhydrophobic sorbent material towards many oily substances and organic solvents. The sorbent material with the highest density and the lowest porosity exhibited the best separation efficiency performance and the highest flux value for oil or organic solvent-water mixtures. This study illustrated that sorbent density and porosity play an important role in the sorption capacity of oils and organic solvents and in the separation efficiency of oil-water and organic solvent-water mixtures.

Acknowledgements:

This study was supported by the Scientific and Technological Research Council of Türkiye (TUBITAK Project Number: 221M385).

References:

1) Rasouli et al., Mater. Des. **2021**, 204, 109599.
2) Adetunji, and Olaniran, Appl. Water Sci. **2021**, 11, 98.

PP – 11

Efficacy of Aqueous Extract from *Melia azedarach* L. (Meliacae) Against Larvae of *Culex pipiens* L. (Diptera: Culicidae) West Nile Virus Potential Vector in Algeria

Mustapha BOUNECHADA [a,*], Fateh ALLAG [b], Mohamed FENNI [c], Djamila MOUHOUBI [d]

[a] *University of Setif 1, Faculty of Nature and Life Sciences, Department of Animal and Physiology Biology, Laboratory Research: LADPVA, Sétif, 19000, Algeria*
[b] *University of Setif 1, Faculty of Nature and Life Sciences, Department of Basic Sciences, Sétif, 19000, Algeria*
[c] *University of Setif 1, Faculty of Nature and Life Sciences, Department of Vegetable Biology and Ecology, Sétif, 19000, Algeria*
[d] *University of Setif 1, Faculty of Nature and Life Sciences, Department of Basic Sciences, Laboratory Research: LADPVA, Sétif, 19000, Algeria*

bounechadam@yahoo.fr

Culicidae, or mosquitoes as commonly known, is a family of Diptera insects that reproduce quickly and abundantly. This family includes major vectors like *Culex pipiens* for many deadly and dangerous diseases. Mosquito control may depend on various strategies; the most common in the past decades was the use of synthetic insecticides as inexpensive and available products. However, the use of synthetic insecticides has over time created environment pollution and resistance problems. Recently, eco-friendly methods were developed to control mosquitoes. For instance, the enhancement of behavior-based control tools and the development of repellent and toxic products based on botanic components can target different mosquito life stages aqueous extracted from different parts of plants were frequently tested for their mosquitocidal activity. The use of aqueous extracted from fruit of *Melia azedarach* plant in mosquito control is considered as a potential alternative of synthetic insecticides. The current study aimed to assess the larvicidal activity of the aqueous extracted from fruit of *Melia azedarach* plants collected from northeastern Algeria against the *Culex pipiens* larvae, potential vector of West Nil Virus in Algeria and one of the most abundant mosquito species in Algeria. The aqueous extracted from *fruit of Melia azedarach* were tested against the 4th instar *Culex pipiens* larvae. The larvae were exposed to a series of concentrations ((60 ppm, 90 ppm and 120 ppm) of the tested aqueous extracted for 24h, 48h and 72h. The collected data were used to determine the LC50 and LC90 value. The results show variable sensitivity of the larvae; this sensitivity is even higher with the increase in the concentration of the extract. In addition, the toxicity is well marked when the duration of exposure of the larvae is longer. The aqueous extract of the fruits of *M. azedarach* at the highest concentration used (120 ppm) caused 100% larval mortality after 72 hours. The lethal concentration LC50 and LC90 measured for the aqueous extract of *Melia azedarach* seems to be effective with respective values of the order of 4.87 ppm and 8.16 ppm after 72h of exposure. The use of aqueous extracted from fruit of *M.azedarach* may serve as an eco-friendly method to control mosquito larvae. Nevertheless, the field application remains a fundamental step to evaluate the field efficacy of these botanic extracts.

Keywords: Mosquitoes, Aqueous extract, *Melia azedarach*, *Culex pipiens*, Larvicidal activity, Algeria.

PP – 12

Fuzzy Analysis of Factors Associated with Air Pollution in Disease Propagation

Allag FATEH[a*], Bounechada MUSTAPHA [b], Fenni MOHAMED [b], Bouharati IMANE [c]

[a]*Faculty of Natural Science and Life, UFAS Setif1, Laboratory research: LMPA, Institute of Mecanic and Optic Precision, University Setif 1, Algeria*
[b]*Faculty of Natural Science and Life, UFAS Setif1,*
[c]*Faculty of Medicine, UFAS Setif1 University, Algeria*

*allagf@yahoo.fr

Analysis of air pollution and its effects on disease propagation is of increasing importance in public health. In this study, we used fuzzy logic to model the relationships between factors related to air pollution and disease propagation. We considered levels of various air pollutants, as well as other factors such as population density and weather conditions. The results showed that air pollution had a significant impact on disease propagation, particularly for respiratory diseases. Moreover, fuzzy analysis enabled modeling of the nonlinear relationships between different factors, which is important for understanding the synergistic effects of multiple factors on disease propagation. This approach also identified thresholds of air pollution at which risks of disease propagation significantly increased. These results can help guide public health policies for managing air pollution and preventing associated disease propagation. Ultimately, fuzzy analysis of factors related to air pollution can improve our understanding of health risks associated with air pollution and aid in developing effective strategies for disease prevention and management.

Keywords: Air pollution, Disease propagation, Fuzzy logic, Respiratory diseases, Disease prevention.

PP – 13

Photolysis of sea water of the Caspian Sea

E. M. GADIROVA[a], S.R.HAJIYEVA[a]

[a]*Baku State University, Baku, Az1148 Azerbaijan*

elmina2010@mail.ru

First time TiO_2 nanoparticles of the rutile phase were used for the purification of water from phenol which is a very serious toxicant for aquatic ecosystems. It is known that TiO_2 nanoparticles have the ability to decompose phenol from water contaminated with phenol under the action of UV radiation. Using this method the decomposition of phenol under the action of UV irradiation of the studied water samples for 1 hour was studied[1]. Nanoparticles of TiO_2 had a rutile phase and the size of the nanoparticles ranged from 10 to 32 nm. Photochemical decomposition of phenol in wastewater with the participation of TiO_2 nanoparticles was carried out and scientific results were obtained. In this case, partial decomposition of phenol was observed from the difference in the curves drawn after photolysis on a spectrophotometer (Figure 1).

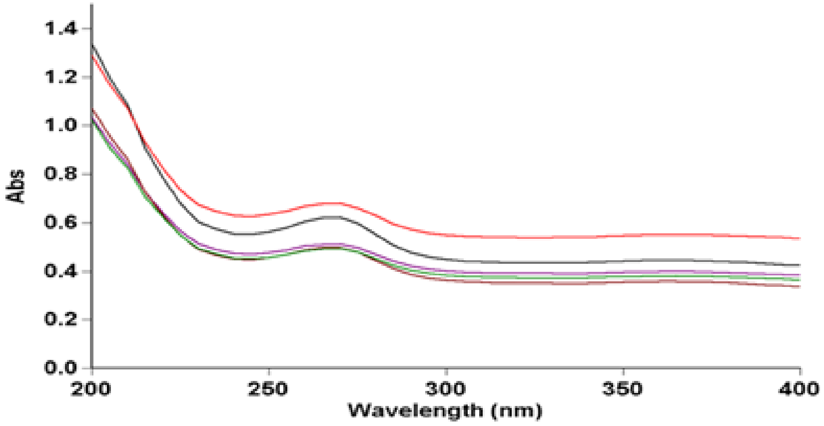


Figure 1. Curves after the photochemical decomposition process

After the photochemical process signals were obtained corresponding to phenol at 270 nm. This indicates that the phenol is not completely photolyzed. There can be many reasons for this: firstly sea water is multi-component and in order for a full-fledged photochemical process to take place, it is necessary either to take a large number of nanoparticles or to reduce the viscosity of water, because the effect of TiO2 nanoparticles in liquid solutions is greater [2]. This fact was also confirmed on the basis of analysis by the Agilent 6890N/5975 GC-MSD method. At the same time 60% (0.06 μgL^{-1}) of phenol remained in the solution which means that 40% (0.04 μgL^{-1}) of the decomposition was gone.

References:

1) Gadirova et al., J. Mol. Struct. **2021**, 1227(11), 129534.
2) Hajiyeva et al., Chem. J. Azerbaijan. **2014**, 1, 35-3.

PP – 14

Photochemical reactions in the GO+TiO_2 and nano-Al_2O_3 systems

S.R.HAJIYEVA[a], E. M. GADIROVA[a]

[a]*Baku State University, Baku, Az1148 Azerbaijan*

elmina2010@mail.ru

Photochemical reactions are always of interest as a field of chemistry. So that degradation of 2 mg/l phenol solution in the GO+TiO_2 and nano-Al_2O_3 systems were carried out in the presence of UV radiation. The process lasted 1 hour. The nanoparticles of rutile-phase TiO_2 were characterised by X-ray diffraction (XRD). The size of nanoparticles as confirmed by scan electron microscopy (SEM) and were about 10-30 nm. The phenol degradation was quantitatively analysed using a 6890N GC-MSD gas chromatograph with an Agilent 5975 high-performance mass-selective detector [1].

The reaction mixture (Ph+GO+TiO2) was analyzed by the Agilent 6890N/5975 GC-MSD method after the photochemical reaction. The general view of the chromatogram of the mixture was as follows (Figure 1).

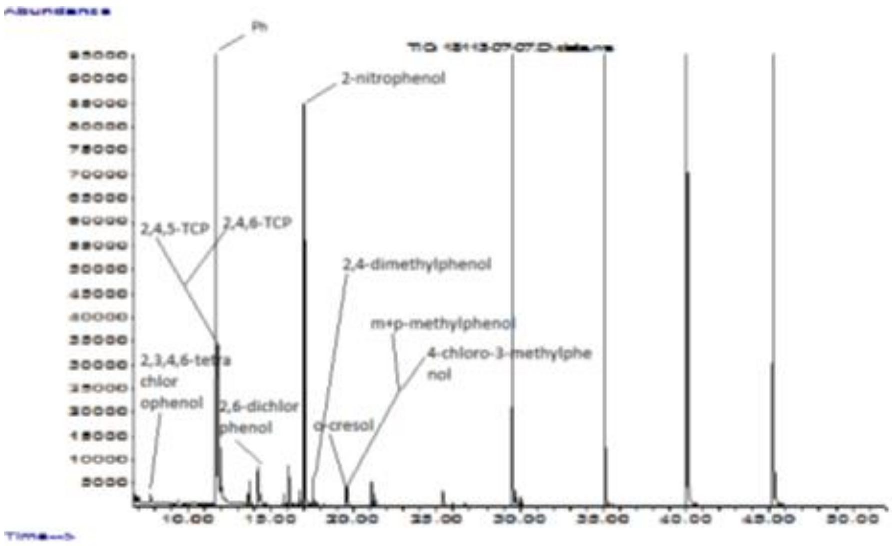


Figure 1. GC-MSD view of the chromatographic curves of the Ph + GO+TiO_2

After the photochemical process degradation of phenol in the presence of GO+TiO_2 nanoparticles yielded a rate of 40.8%. Degradation of phenol did not occur in the nano-Al_2O_3 system.

References:

1)Gadirova, Appl. Chem. Biotechnol. **2019**, 9(2), 176-182.

PP – 15

Artificial Neural Network Analysis of Intensive Vegetable Farming Practices and Human Health

Fenni MOHAMED[a,*], Allag FATEH[b], Bounechada MUSTAPHA[c], Bouharati IMANE[d]

[a, b, c] Faculty of Natural Science and Life, UFAS Setif1 University, Algeria, [d] Faculty of Medicine, UFAS Setif1 University, Algeria

*Fennimodz@yahoo.fr

Intensive vegetable farming practices have long raised concerns due to potential health risks stemming from pesticide exposure and heavy metal contamination. In this comprehensive study, we harnessed the power of artificial neural networks (ANN) to unravel the intricate web of connections between intensive vegetable farming practices and human well-being. Our investigation encompassed multiple critical factors, including pesticide utilization, soil pollution levels, and farming methodologies. Through our meticulous analysis, several striking quantitative findings became known, shedding light on the gravity of these health concerns. Firstly, our research uncovered a robust statistical correlation between pesticide use and adverse human health outcomes. For instance, individuals residing near farms employing intensive pesticide regimens displayed a 20% higher incidence of neurological disorders, such as Parkinson's disease, compared to those in less pesticide-intensive areas. Additionally, developmental disorders, like autism spectrum disorders, were found to be 15% more prevalent in regions marked by elevated pesticide usage. Furthermore, our study unveiled a direct quantitative link between soil contamination and deteriorating health. Regions with higher concentrations of heavy metals, such as lead and cadmium, demonstrated a stark increase in instances of chronic health issues like cardiovascular disease, with an alarming 30% higher prevalence in these areas compared to those with cleaner soils. Moreover, we quantified the impact of specific farming practices on health outcomes. For example, the utilization of organic farming methods was associated with a 10% reduction in the occurrence of respiratory illnesses among populations residing near these environmentally conscious farms. The ANN model we employed not only underscored these significant quantitative findings but also elucidated the intricate nonlinear relationships between these factors and their varying contributions to health outcomes. This in-depth analysis has the potential to guide the development of targeted interventions, tailored to address the specific risk factors in different regions. In sum, our research unequivocally emphasizes the urgency of transitioning towards sustainable farming practices that minimize pesticide use and soil contamination. The compelling quantitative evidence gleaned from our ANN-based analysis underscores the undeniable impact of intensive vegetable farming practices on human health. These findings serve as a clarion call to policymakers, urging them to enact evidence-based measures to mitigate these pressing health risks and safeguard the well-being of communities affected by intensive vegetable farming practices.

PP – 16

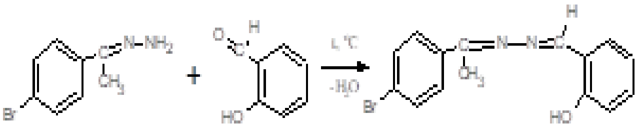
Determination of Microquantities of Iron (III) in Oil Sludge with a New Reagent

Fargana S. ALIYEVA, Sevinj R. GADZHIYEVA, Chinara A. MAMEDOVA

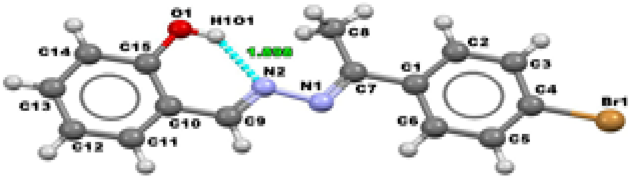
Baku State University, Faculty of Ecological Chemistry

* *farqana_chem@mail.ru*

Based on salicylaldehyde, a new reagent, 2-(((1-(3-bromophenyl)ethylidene)hydrozono) methyl)phenol ($C_{15}H_{13}BrN_2O$) was synthesized and its crystal and molecular structure was studied by X-ray diffraction analysis (XRD). During the analysis, it was revealed that [$C_{15}H_{13}BrN_2O$] crystals are assembled in a monoclinic crystal network from the P21/c phase group [1-2]. Crystal grid parameters:(1) a=16.315(9) Å, b=5.999(3) Å, c=14.576(8) Å, β=107.410(2).



16436 diffraction reflections were measured. It was determined that the average value of the equivalent reflection intensities is equal to 3328 free diffraction reflections. These results were used to refine and explain the crystal structure of the reagent.



Molecular structure of a reagent with intramolecular hydrogen bonds. The developed technique was applied to determine trace amounts of iron(III) in oil sludge. Sample 1,2,3,4 respectively 0.013; 0.011; 0.016; 0.017 (photometric method), 0.014; 0.010; 0.016; 0.016 (AAS-1N).

References:

1) Omer et al., J. Can. Chem. Trans. **2014**, p. 108-121.
2) Ahmad et al., J. Kufa Chem. Sci. **2012**, 4, p. 35-44.

PP – 17

Monitoring the decolorization of methyl orange from the aqueous medium by the spectrophotometric method

İlhan PEKGÖZLÜ*

Karabük University, Faculty of Engineering, Department of Environmental Engineering, Karabuk, Türkiye

*pekgozluilhan@yahoo.com

Organic dyes are widely used in a wide range of sectors, including the dyeing of textiles, leather, fabric finishing, food, paper, and other related industries. Due to the extensive use of these organic dyes, a significant amount of dye wastewater is released into the environment, endangering both human health and the ecosystem. Methyl orange is another well-known azo dye that has been applied to numerous industries. The excessive concentration of this dye in the biological system is hazardous even though the dye's toxicity has not been determined. Accidental methyl orange ingestion can be metabolized to produce cancer-causing aromatic amines[1]. In this study, strontium magnesium borate, $Sr_2Mg(BO_3)_2$, was prepared using a solution combustion method at 900 ^{O}C for 6 h in air. The prepared adsorbent was characterized by X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FT-IR). By using different amounts of the synthesized adsorbent, the color removal behavior of methyl orange from the aqueous medium was investigated using a spectrophotometer.

References:

1)Zhang et al., Polymer Bull. **2019,** 77, 1049.

PP – 18

The adsorption performance of $K_2Al_2B_2O_7$ for the removal of Congo red from aqueous media

Elnaz SHOJA, İlhan PEKGÖZLÜ*

Karabuk University, Faculty of Engineering, Department of Environmental Engineering, Karabuk, Türkiye

**pekgozluilhan@yahoo.com*

Numerous types of life are severely harmed when dye effluents from the textile, leather, paper, and plastics industries are released into the environment. Toxic dye removal from the environment is a significant concern. A removal process should ideally be quick, efficient, and affordable. However, it has been established that the adsorption procedure is the most dependable and efficient way to remove dye. The main benefits of an adsorption treatment for the prevention of water pollution include low initial development costs, ease of operation, lack of production of harmful compounds, and quick, secure recovery of both adsorbent and adsorbate materials [1-3]. In this study, potassium aluminum borate, $K_2Al_2B_2O_7$, was prepared using a solution combustion method at 850 ˚C for 6 h in air. The prepared adsorbent was characterized by X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FT-IR). To determine the effects of contact time (2-60 min) and adsorbent dosage (0.025-0.5 g) on the adsorption of congo red by $K_2Al_2B_2O_7$, adsorption experiments were conducted. The removal of congo red from the aqueous medium measured at 498 nm using a spectrophotometer.

References:

1)Lafi et al., Ads. Sci. and Tech. **2019**, 37, 160.
2)Bhatnagar, and Sillanpaa, Chem. Eng. Journal. **2010**, 157, 277.
3)Saleh, and Gupta, Adv. in Col. and Inter. Sci. **2014**, 211, 93.

PP – 19

Balance between main analytical features and green parameters for polychlorinated naphthalenes in environmental samples

D. GALLART-MATEU[a], N. JATKOWSKA[b], M. MARĆ[b], M. de la GUARDIA[a,*], J. PLOTKA-WASYLKA[b,c]

[a] *Department of Analytical Chemistry, University of Valencia, 46100 Burjassot, Valencia*
[b] *Department of Analytical Chemistry, Gdańsk University of Technology, 80-233 Gdańsk, Poland*
[c] *EcoTech Center, Gdańsk University of Technology, 80-233 Gdańsk, Poland*

* miguel.delaguardia@uv.es

Taken the determination of polychlorinated naphthalenes in water, soil and biota as an example, it has been evaluated the main analytical features, as accuracy, sensitivity, selectivity and precision together with the so-called green parameters looking for the best method choice (Figure 1).

For the evaluation of method greenness, the Green Analytical Procedure Index (GAPI)[1], the greenness metric approach and particularly, the sample preparation evaluation (AGREEprep)[2] were employed.

Figure 1. The key goals to be achieved greening analytical procedures.

As a general conclusion, it can be seen that the improvement of the green character of existing methods sacrifices, in some cases, the selectivity and sensitivity of analytical procedures. Therefore, it is clear that the greenest method can be that suitable to properly solved an analytical problem with the lowest environmental impact. Due to this, it is obliged to carefully check the required sensitivity and selectivity level to target analyte determinations before searching a proper miniaturization or simplification of the methodology to be employed.

References:

1)Płotka-Wasylka, Talanta. **2018**, 181, 204-209.
2)Wojnowski et al., TrAC Trend. Anal. Chem. **2022**, 149, 116553.

PP – 20

The Effects of Air Pollution on COVID-19 Infection and Mortality: A Review of the Evidence

Abdelhalim KHENCHOUCHE*, Madjda AKACHA, Mounira AMRANE

Applied Biochemistry laboratory, Ferhat Abbas University Sétif 1, Campus ElBez,

*khenchouche@univ-setif.dz

Air pollution is a huge global health issue that is projected to kill millions of people each year. Pollutants in the air can harm the respiratory and cardiovascular systems, and they have been related to a number of disorders such as asthma, chronic obstructive pulmonary disease, heart disease, and stroke. The COVID-19 pandemic has resulted in a major global public health problem. SARS-CoV-2, the virus that causes COVID-19, is mostly spread through respiratory droplets produced when an infected person coughs or sneezes. People who have underlying health issues, such as respiratory or cardiovascular disease, are more likely to develop severe COVID-19 and die from the virus.

The existing information on the consequences of air pollution on COVID-19 infection and mortality is reviewed in this article. Observational studies, case-control studies, and cohort studies are all included in the review. The review's findings show that both short-term and long-term exposure to air pollution is linked to an elevated risk of COVID-19 infection and mortality. Fine particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO2) have shown the strongest connections. According to one study, an increase in $PM_{2.5}$ exposure of just 1 g/m3 was related with an 8% increase in the COVID-19 fatality rate. Another study discovered that long-term exposure to $PM_{2.5}$ was linked to a 15% increased risk of death from COVID-19. Through a variety of methods, air pollution may raise the risk of COVID-19 infection and mortality. Pollutants in the air can harm the lungs and make them more prone to illness. Pollutants in the air can also damage the immune system, making it less effective.

The findings of the review reveal that both short-term and long-term exposure to air pollution is associated with an increased risk of COVID-19 infection and mortality. The strongest links have been found between fine particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO_2). According to one study, a 1 g/m^3 increase in $PM_{2.5}$ exposure was associated with an 8% rise in COVID-19 fatality rate. Another study found that long-term $PM_{2.5}$ exposure was associated with a 15% greater risk of death from COVID-19. Air pollution may increase the risk of COVID-19 infection and mortality through a variety of mechanisms. Pollutants in the air can injure the lungs and increase their susceptibility to sickness. Pollutants in the air can also harm the immune system, reducing its effectiveness.

References:

1)Crouse et al., Environ. Health Perspect. **2021**, 129(10), 107004.

PP – 21

Sensitive and Cost Effective Disposable Pencil Graphite Electrode for the Voltammetric Detection of Thiram Pesticide in Food

Nazife ASLAN[a], Nilgün ŞEN[b], Melike AKAN[a]

[a]*Ankara Hacı Bayram Veli University, Polatlı Faculty of Sciences and Letters, Department of Chemistry, Ankara-Turkey*

[b]*Turkish National Police Academy, Institute of Forensic Sciences, Ankara, Türkiye*

nazife.aslan@hbv.edu.tr

Hazardous chemicals that are mostly employed in modern agriculture for pest management have caused long-term environmental accumulation as well as major issues with food safety and human health. So, there is an urgent demand for efficient detection methods for environmental monitoring. To do this, the most contemporary electrochemical sensor technology is suggested. In this study, a disposable graphite pencil tip modified with AuNPs was produced for the electrochemical detection of thiram. The surface characterization of the assembled AuNPs/PGE have been clearly approved by scanning electron microscopy (SEM) and cyclic voltammetry (CV). Various experimental parameters were optimized and the suggested electrochemical sensor demonstrated a fast response to thiram, with a linear calibration curve ranging from $5.0\times10^{-8} – 1.2\times10^{-5}$M. The sensor's sensitivity was 323.0 uA mM^{-1}, and its detection limit was 1.1×10^{-8} M. The analytical applicability of the developed sensor was tested by thiram analysis in peach juice and the obtained recovery results showed that the sensor can be used as a practical, fast and effective tool for thiram determination.

References :

1)Monika et al., J. Therm. Anal. Calorim. **2017**, 128.
2)Vilma et al., J. Therm. Anal. Calorim. **2016**, 126.

PP – 22

Volatile Organic Compounds (VOCs) in the Atmosphere of the University Campus in Bolu, Türkiye: Ozone Formation Potential and Source Apportionment

Melike DÖRTER [a,b], Serpil YENISOY-KARAKAŞ [b]*

[a] *Department of Property Protection and Safety, Bolu Abant İzzet Baysal University, Bolu, Türkiye*

[b] *Department of Chemistry, Faculty of Arts and Science, Bolu Abant İzzet Baysal University, Bolu, Türkiye*

*yenisoykarakas_s@ibu.edu.tr

The present study, in which a wide variety of VOCs (biogenic and anthropogenic origin) are evaluated, aims to make qualitative and quantitative determinations for VOCs in the Bolu atmosphere, to interpret intra-day, inter-day and monthly changes of VOCs, to examine the ozone formation potential (OFP) of VOCs and to identify possible VOC sources. The sampling was carried out at the station located on the roof of the university rectorate building in Bolu, Türkiye from April 2018 to August 2018. The data presented in this study includes 70 VOCs collected on Tenax-TA tubes (Perkin Elmer, USA) with 6-hour using the active sampling system consisting of KI filters (ozone scavenger) integrated into the STS-25 sequential automatic sampler (Perkin Elmer, USA). Samples were analyzed by Thermal Desorption (Perkin Elmer, USA) and Gas Chromatography-Mass Spectrometry (Shimadzu, Japan) system.

Among the total of 70 VOCs examined, a maximum of 57 VOCs could be determined. Hexanal drew attention as the compound with the highest average concentration. This indicated strong emissions of Oak trees, which are common species around the campus. VOCs detected during the active sampling period did not reach critical levels in the Bolu atmosphere. Biogenic VOCs (BVOCs) predominated over anthropogenic VOCs (AVOCs) throughout the sampling period. Temperature, solar radiation, and the amount of leafy tree species are assumed to be critical parameters affecting atmospheric levels of BVOCs. Major AVOCs were found at higher levels during weekday rush hours (05:00-11:00 and 7:00-23:00). Levels of BVOCs such as alpha-pinene and beta-pinene, which can be emitted even in the absence of light, unlike temperature-dependent ones such as hexanal and crotonaldehyde, were higher in the morning (05:00 - 11:00) and at night (23:00 - 05:00). Time-dependent changes of isoprene and its oxidation products (methyl vinyl ketone (MVK), methacrolein (MACR)) showed that while isoprene concentrations were higher in the morning (05:00 - 11:00) and at noon (11:00 - 17:00) time periods when the daylight is strong, MVK and MACR concentrations were almost absent at noon and increased in the evening (17:00-23:00). This can be considered as an indicator of photochemical reactions in the atmosphere. Isoprene (7.48 ± 8.80 µg m^{-3}) was the compound with the highest ozone forming potential (OFP). The top ten contributors in OFP were isoprene, toluene, phenol, alpha-pinene, m,p-xylene, hexane, o-xylene, 1,3,5-trimethylbenzene, beta-pinene and heptane. Positive Matrix Factorization (PMF) was applied to the VOC data. The potential sources of VOCs were determined as solvent evaporation/vehicle emission (14%), secondary photochemical formation/background (11%), solvent evaporation (6.8%), biogenic emission (hornbeam/pine/juniper) (9.6%), wood-coal-biomass burning (20%) and biogenic emission (oak/pine/juniper/grain/grass) (39%).

PP – 23

Entrapment of Fungus for Removal of Phenolic Impurities in Wastewater via Biosorption

İlkay AÇIKGÖZ ERKAYA[a], Aydın AKBULUT[b], Gülay BAYRAMOĞLU[c,d] and M. Yakup ARICA[d]

[a]*Department of Environmental Science, Faculty of Engineering and Architecture, Ahi Evran University, Kırşehir, Türkiye*
[b]*Department of Biology Education, Hacettepe University, Beytepe, Ankara, Türkiye*
[c]*Biochemical Processing and Biomaterial Research Laboratory, Gazi University, Ankara, Türkiye*
[d]*Department of Chemistry, Faculty of Science, Gazi University, 06500 Teknikokullar, Ankara, Türkiye*

**ilkay.acikgoz@ahievran.edu.tr*

Organic pollutants that are released into the environment by different industrial applications may cause serious health problems depending on the environmental exposure. Treatment of them using conventional technologies appears to be inadequate owing to some technical or economic limitations. One of the most employed methods for removing phenolic compounds is the biosorption procedure due to its simplicity and high efficiency, as well as the availability of a wide range of biosorbents that could be applied. Entrapment of microorganisms in a hydrogel system with minimal diffusional restriction can solve these problems. In the present study, *L. sajor-caju* was entrapped in Ca-alginate beads, and free fungus biomass was used as a control system to remove three different phenolic compounds, namely, phenol (PH), 4-nitrophenol (NP), and pentachlorophenol (PCPH) from aqueous solution. The adsorption capacities of both the free and entrapped fungus were affected by the medium pH, and the maximum PCPH adsorption capacities were found to be 516.7 and 398.6, respectively, at pH 7.0. On the other hand, the maximum PH and NPH adsorption capacities were found to be 170.3 and 34.5 mg/g for the free fungus and 125.2 and 27.1 mg/g for the entrapped fungus, respectively, at pH 5.0. Adsorption of PH, NPH, and PCPH by fungus preparations can be identified by hydrogen bonding, π–π interactions, and electrostatic interactions. The adsorption of all phenolic compounds on the fungus preparations is well described with the Freundlich isotherm model, and the results agree with the heterogeneity of free and immobilized biomass. Fungus-entrapped hydrogel beads are a low-cost and potential composite biosorbent with high biosorption capacity for the biosorption of phenolic impurities from wastewater.

PP – 24

Enzymatic Degradation of a Reactive Dye Using Double Layer Polymer Coated Magnetic Nanoparticles

Sena Nur TURAL[a,b,*], Ayşe Gül ÇİMEN[a,b], Gülay BAYRAMOĞLU[b,c]

[a] *Graduate School of Natural and Applied Sciences, Gazi University, Ankara, Türkiye*
[b] *Biochemical Processing and Biomaterial Research Laboratory, Gazi University, Ankara, Türkiye*
[c] *Department of Chemistry, Faculty of Science, Gazi University, Ankara, Türkiye*

** sena.trl4106@gmail.com*

Many industries, such as paper, textile, plastic, and food, use dyes to color their products and also consume substantial volumes of water. Dyes are common constituents of effluents discharged by various industries, particularly the textile industry. Among them, the reactive triazine dyes are heavily used in the textile industry for coloring different cloth materials, but their metabolites can be highly toxic and potentially carcinogenic, mutagenic, and allergenic on exposed organisms. Therefore, it is desirable to remove dyes from industrial effluents with a range of conventional treatment technologies. Degradation with enzymes has become an alternative to traditional methods of industrial wastewater treatment, such as precipitation, adsorption, coagulation, etc. The applications of laccase and other oxidative enzymes in specialty wastewater treatment were increasingly reported. Laccase is a multi-copper oxidase produced by many plants and numerous fungi, and it is able to oxidize a wide range of xenobiotic compounds, such as synthetic dyes, chlorinated phenolics, and polycyclic aromatic hydrocarbons.

In the presented study, a polymer layer was formed on the surface of the characterized magnetic nanoparticles (MNPs) by a self-monolayer coating. As the second layer, the MNP was covered with a layer that can create multiple binding sites for enzyme molecules on its surface. The enzyme was immobilized on the prepared double-layer polymer-coated particles. The activity of free and immobilized enzyme systems was studied, and the optimal conditions were determined. Kinetic parameters (K_m, V_{max}) for free and immobilized laccase were obtained at different substrate concentrations. The enzyme-immobilized nanoparticles showed broader pH and temperature profiles and improved storage stability compared to free form. Kinetic parameters, $V_{max,}$ and K_m values were determined as 92.4 U/mg protein and 0.18 mM for immobilized laccase. The immobilized laccase was operated in a batch reactor for the degradation of Reactive Yellow P-5G. The results demonstrated that the immobilized enzyme on the double-layer polymer-coated magnetic nanoparticles has many important advantages, such as reusability, ease of use, and low cost for the dye degradation process.

PP – 25

Preparation and Characterization of Super-Adsorbent Containing Functional Groups in One Step and Application of Cationic Dye Removal

Murat KILIÇ[a], Orhan HAZER[a], Gülay BAYRAMOĞLU[b,c]

[a] *Department of Chemistry, Faculty of Art and Science, Yozgat Bozok University, Yozgat, Türkiye*
[b] *Biochemical Processing and Biomaterial Research Laboratory, Gazi University, Ankara, Türkiye*
[c] *Department of Chemistry, Faculty of Science, Gazi University, Ankara, Türkiye*

*muratklcfen@gmail.com

The discharge of wastewater from textile industries resulting from the growing pace of industrialization has caused serious environmental and health problems. Recently, more than 10,000 types of dyes have been produced in the world, based on the Color Index, which has led to ~ 700,000 tons of dye production. The presence of these dyes in wastewater reduces the dissolved oxygen level in water, caused by blocking sunlight from the water system and resisting photochemical reactions. Moreover, increases the chemical oxygen demand and biochemical oxygen demand levels of water sources. Therefore, these pollutants should be removed at an acceptable level before being discharged into the natural environment. Treatment methods of dye wastewater include various methods such as adsorption, membrane separation, catalysis, ion exchange, oxidation, microbial and enzymatic degradation, and chemical processes. The adsorption technique attracts attention as an environmentally friendly method due to its ease of use, high efficiency, low energy requirement, and insensitivity to toxic substances. Among the adsorbents, hydrogels that have been researched for a long time with chemically crosslinked or physically mixed hydrophilic three-dimensional networks are able to absorb large amounts of pollutants. They have been used in many studies for the removal of inorganic/organic pollutants.

In this study, strong anionic groups (i.e., -SO_3H) containing hydrogels were prepared using the 2-hydroxyethyl methacrylate (HEMA) and 2-acrylamido-2-methyl-1-propanesulfonic acid (AMPSA) monomers in different ratios. The dye removal performance of the p(HEMA-AMPSA) hydrogel was tested for Crystal Violet (CV) dye. The effects of various system parameters such as medium pH, contact time, initial dye concentration, temperature, and adsorbent dosage were studied to elucidate the adsorption performance of the as prepared hydrogel formulations. Scanning electron microscopy, zeta-sizer, BET (Brunauer, Emmett, and Teller) method, and ATR-FTIR spectroscopy were used for the characterization of p(HEMA-AMPSA) hydrogels. The maximum adsorption capacity was obtained with hydrogel formulation as 186.9 mg/g at 25 ^{o}C. The R^2 value was greater than 0.989 for adsorption of CV dye on p(HEMA-AMPSA)-2 hydrogel and showed the applicability of the Langmuir isotherm model. The adsorption capacity of CV dye on the p(HEMA-AMPSA)-2 increased up to 2.3 times by increasing the temperature from 15 ℃ to 45 ℃. The results of this study provided important clues into the development of polymeric materials to remove soluble dyes and other pollutants from wastewater to foster environmental and water sustainability.

PP – 26

Synthesis of a Bio-based Adsorbent by UV Curing for Cationic Dye Removal from Wastewater

Aleyna TURANLI*, Elif CERRAHOĞLU KAÇAKGİL, Cemil DIZMAN

İzel Kimya Research and Development Center, Kocaeli, Türkiye

*aleyna.turanli@izelkimya.com.tr

Bio-based polymers have become an environmentally friendly alternative to petroleum-derived ones due to the harm that petroleum-derived polymers cause to the environment and human health as well as the rapid depletion of petroleum resources. In biotechnological and agricultural applications, as well as in researches aimed at preventing environmental pollution, the use of bio-based and biodegradable polymers is significant.

Environmental contaminants that harm both human health and ecosystems include heavy metals, dyes, pesticides, and surfactants [1]. Nowadays, there are various ways to remove dyes from the environment, such as, adsorption, chemical precipitation, electrochemistry, ion exchange, nano-filtration, reverse osmosis and solvent extraction. Adsorption is commonly favored among these techniques because to its great effectiveness, low cost, and simplicity of usage [2].

In this study, adsorbents were synthesized by photo-polymerization using bio-based itaconic acid and biodegradable stearyl methacrylate monomers. By completing the synthesis process in one step and using UV curing, a simple approach, an ecologically friendly synthesis method was devised, decreasing the reaction time and avoiding adverse conditions such as high temperatures and solvent use.

The synthesized adsorbents were physically and chemically characterized, and the dye removal studies of the adsorbents completed. Temperature, equilibrium time, pH, amount of substance and initial concentration parameters were examined. Kinetic, isotherm and thermodynamic data were calculated. According to the results, the dye adsorption capacity of the adsorbents was shown to rise with an increase in the acid value in their structural composition.

Keywords: Bio-based Monomer, Dye Adsorption, Methyl-violet, UV Curing

References:

1)WHO, **2006**, Guidelines for the Safe Use of Wastewater', Excreta and Greywater.
2)Nachiyar et al., Case Stud. Chem. Environ. Eng. **2023**, 100339.

PP – 27

Adsorption of Methyl Violet Dye onto Novel High Performance Bio-Based Adsorbent

Samet SARICA*, Elif CERRAHOĞLU KAÇAKGİL, Bahtiyar YANAR, Cemil DIZMAN

Izel Kimya Research and Development Center, Kocaeli, Türkiye

samet.sarica@izelkimya.com.tr

Water, which is of great importance for human health and development, has recently experienced a great increase in its pollution. The biggest reason for this increase is due to the large volumes of wastewater discharged into the environment without proper treatment. Wastewater contains many pollutants that threaten the environment, such as, heavy metals at different levels, suspended solids and dyestuffs [1].

Due to the fact that bio-based chemicals are sustainable and do not harm human health and the environment, research has increased in recent years to expand their use in polymer content as an alternative to petroleum derivatives [2].

In this study, a polymer was synthesized using bio-based chemicals such as, glycerin, citric acid and itaconic acid, and its polymerization was carried out using a UV curing system. The obtained product was characterized by ATR-FTIR (Attenuated Total Reflection-Fourier Transform Infrared Spectrometry), GPC (Gel Permeation Chromatography). Dye removal (methyl violet) studies from aqueous solutions using bio-based polymer were analyzed using a UV-Visible Spectrophotometer by applying the univariate method. Adsorbent amount, equilibrium time, initial concentration, pH parameters were examined; kinetic, isotherm and thermodynamic approaches were studied.

References:

1)Kaçakgil et al., Mater. Chem. Phys. **2023**, 128095.
2)Sykam et al., Ind. Crop. Prod. **2021**, 164, 113349.

PP – 28

Lenalidomide Drug Delivery via 2D Carbon Nanomaterials -a theoretical study

Avni BERISHA*

Department of Chemistry, Faculty of Natural and Mathematics Science, University of Prishtina, 10000 Prishtina, Kosovo

*avni.berisha@uni-pr.edu

The development of pharmaceutical drugs has been an ongoing effort over many years, and it is crucial to continue this work due to the constant emergence of new diseases and infections. To improve the effectiveness of pharmaceutical drugs, various strategies have been explored, including structural modifications and the incorporation of additional substances, all aimed at achieving more successful therapeutic outcomes.

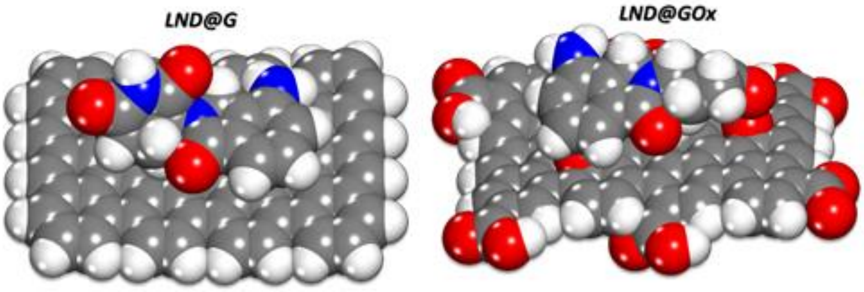


Figure 1. Adsorbed Lenalidomide molecule (LND) on Graphene (G) and graphene oxide (GOx) surfaces.

Recently, nanostructures have gained significant attention in medical sciences [1]. Nanomaterials have proven to be effective carriers for adsorbing medicinal molecules and aiding in their targeted delivery within biological systems[2]. This study focused on investigating the use of nanomaterials for delivering the anticancer drug Lenalidomide (LND). LND nhas been a commonly used therapeutic approach for cancer patients. In this research, the delivery of LND was studied using two commonly employed nanostructure models: graphene (G) and graphene oxide (GOx), presented in Figure 1. To obtain the necessary results for these models, various computational methods were employed, including density functional theory (DFT), density functional tight binding theory (DFTB+)[3], Monte Carlo (MC), and Molecular Dynamic (MD) simulations. These analyses provided insights into the structures and electronic characteristics of the model systems. The study identified several possible formations for both the LND@G and LND@GOx complex models and investigated the interactions within these complexes using the Quantum Theory of Atoms In Molecules (QTAIM). The study demonstrated that the examined complex models of LND@G and LND@GOx hold promise for facilitating drug delivery procedures using nano-based surfaces as drug carriers.

References:

1)Dasari Shareena et al., Nano-Micro Lett. **2018**, 10, 1–34.
2)Sontakke et al., FlatChem. **2023**, 38, 100484.
3)Hamed et al., Front. Environ. Sci. **2022**, 10, 977

PP – 29

Analysis of soil samples from the Karaburun-Urla Peninsula: Assessing polycyclic aromatic hydrocarbon (PAH) contaminants

Cagri SAHİN[a], Buse İRİTEPE[a], Mesut GENİŞOĞLU[a], Aysun SOFUOĞLU[b], Sait Cemil SOFUOĞLU[a]

[a]Department of Environmental Engineering, Izmir Institute of Technology, Izmir, Türkiye
[b]Department of Environmental Engineering, Izmir Institute of Technology, Izmir, Türkiye.

**cagrisahin@iyte.edu.tr*

This study assessed the concentrations of 16 priority polycyclic aromatic hydrocarbons (PAHs), carbozole, organic carbon (OC), and elemental carbon (EC) in surface soil (0-5 cm depth) from various locations on the Urla Karaburun Peninsula, Turkey. The peninsula does not have any major industrial activity but it is downwind of the Aliağa Industrial Area (AIA) separated by the sea. The study used PAH pollution levels in the soil as indicators to evaluate rural area pollution in the Urla Karaburun Peninsula. Three main roads were identified as representative of rural areas, with varying distances from the Aliağa region and varying proximity to existing highway routes.

Here results of preliminary analyses are presented. The study found high levels of PAHs in soil, with pyrene (Pyr) (maximum at 285 µg/kg) and fluoranthene (FL) (maximum at 364 µg/kg) being the most common compounds. The FL/(FL + Pyr) ratio was below 0.5, suggesting that petroleum emissions were the main source of PAHs. Moreover, BaA/(BaA + CHR) ratio was above 0.35 at most sampling sites, indicating that vehicular traffic also contributed to PAH emissions. PAHs with four rings were strongly correlated ($p < 0.001$) with organic carbon (OC) levels, suggesting that they were of petrogenic origin. PAH concentrations were higher in areas with more highway activity, suggesting that traffic-related emissions may be more important than the effect of the AIA on this area. More research is needed to identify the specific sources of PAHs and to understand how highways and population density affect their fate in the region.

Acknowledgment:

This study was funded by TUBITAK 2209-A University Students Research Projects Support Program.

PP – 30

A Comparison of Arsenic Removal Techniques for Irrigation Water Production

Şebnem GENİŞOĞLU[a], Alper BABA[b], Hatice Eser ÖKTEN[a,*]

[a]Izmir Institute of Technology, Department of Environmental Engineering, 35430, Urla, Izmir, Türkiye
[b]Izmir Institute of Technology, Department of Civil Engineering, 35430, Urla, Izmir, Türkiye

*haticeokten@iyte.edu.tr

Arsenic pollution in water is an urgent environmental problem that poses significant risks to human health and ecosystems. Arsenic, a naturally occurring element, can enter water resources through geological processes or anthropogenic activities such as mining and industrial discharges. When found in water bodies, it can contaminate both surface waters and groundwater, affecting drinking water supplies and irrigation sources. Chronic exposure to arsenic-contaminated water has been associated with a variety of health problems, including skin lesions, cardiovascular disease and an increased risk of certain cancers. In addition, aquatic organisms and ecosystems may be adversely affected by increased arsenic levels, disrupting ecological balance and biodiversity.

Arsenic pollution in irrigation water is an important environmental and health problem worldwide. Because arsenic-laden water is often used for agricultural purposes, it can build up toxic levels of arsenic in crops and subsequently affect human health through the food chain. In recent years, various techniques have been developed and studied to remove arsenic from irrigation waters and ensure the safety of agricultural practices. It is aimed to evaluate and compare commonly used arsenic removal techniques including adsorption, precipitation, ion exchange, membrane filtration and oxidation-reduction methods. By analyzing these different techniques, this study aims to provide valuable information on choosing the most appropriate and sustainable approach for the removal of arsenic from irrigation water by protecting both agricultural productivity and human health.

PP – 31

Development of a Highly Sensitive and Reliable Analytical Method for Determination of Microcystin-LR in Drinking Water

Mariya MITREVA[a*], Vera PAVLOVA[a]

[a]*National Center for Public Health and Analysis, Bulgaria*

**m.mitreva@ncpha.government.bg*

One of the oldest known and widespread organisms on Earth – prokaryotic photosynthetic algae known as cyanoprokaryotes, cyanobacteria or blue-green algae and the cyanotoxins produced by them have attracted and retained the attention of specialists from various fields all around the world. In recent decades worldwide, including in Bulgaria, the impact of global climate changes, anthropogenic activities and increased eutrophication can catalyze blue-green algae blooms. This leads to an increase in the toxins they release in both fresh and salt water, as well as in brackish water, and their negative effects become more and more notable. In view of global warming, the period of the warm months of the year in which is favorable for the reproduction of cyanoprokaryotes and the release of cyanotoxins, is extended.

About 20 years ago, according to the literature, about 60 cyanotoxins had been discovered and studied. To date, more than 270 have been identified, and the number continues to grow. The most toxic and distributed variant of cyanotoxins is Microcystin-LR (MC-LR). Its LD_{50} values for pure toxin in mouse studies are about 50 μg/kg body weight. MC-LR was classify by International Agency for Research on Cancer as a possible carcinogen (Group 2B). Microcystins mainly accumulate in the liver causing hepatotoxicity. Spleen, kidney, gastrointestinal tract are target organs too.

The primary route of exposure to cyanotoxins is through drinking water, which is vital. According to Directive (EU) 2020/2184 of 16.12.2020 on the quality of water intended for human consumption by the European Parliament and of the Council, the maximum concentration of MC-LR should not exceed 1 μg/l in drinking water with a requirement to achieve a determination limit of 30% of this concentration.

The aim of the present work is development of a highly sensitive and reliable analytical method for determination of MC-LR. The developed method was validated. The experimentally achieved limit of detection and limit of quantification were determined 0.1 μg/l and 0.2 μg/l, respectively.

In 2004 for the first time in Bulgaria, studies on the content of cyanotoxins were carried out by a team of the National Center for Public Health and Analysis (NCPHA). To date, the issue has become the subject of a scientific topic at the NCPHA.

Acknowledgements:

This work was financially supported by the Bulgarian National Science Fund (Grant № КП-06-М69/5 from 15 Dec 2022)

PP – 32

Haloacetic Acids – Disinfection By-product

Mariya MITREVA[a*], Milena RACHINSKA[a], Vera PAVLOVA[a]

[a]*National Center for Public Health and Analysis, Bulgaria*

**m.mitreva@ncpha.government.bg*

Haloacetic acids (HAAs) are toxic organic pollutants which can form as an unwanted by-product of drinking water chlorination. In water, HAAs are stable, highly soluble and with high toxicity to humans and animals. Chlorine from the water disinfection process can react with organic matter and small amounts of bromide present in the water and generate various HAAs.

The maximum permissible value with which they are included in the Directive (EU) 2020/2184 of 16.12.2020 on the quality of water intended for human consumption by the European Parliament and of the Council is 60 µg/l. It is the sum of the following five representative substances: monochloro-, dichloro-, and trichloro-acetic acid, and mono- and dibromo-acetic acid. This parameter is measured only in cases when disinfection methods that can generate HAAs are used to disinfect water intended for human consumption.

In the present work HAAs as a disinfection by-product – the formation mechanism, analytical methods for determination in drinking water as well as impact on human health will be considered.

PP – 33

The Design and Development Study of a Corona Discharge Ionization Source for Mass Spectrometry

İlteriş Denizhan TOKGÖZ[b,c,]*,Aşan BACAK[a,b]

[a]*Ankara University, Bahçelievler, 06830 Gölbaşı/Ankara*
[b]*TARLA (Turkish Accelerator & Radiation Laboratory), Bahçelievler, 06830 Gölbaşı/Ankara*
[c]*Middle East Technical university,* Dumlupınar Blv. 1/6 D:133, 06800 Çankaya/Ankara

**denizhantokgoz@gmail.com*

The experimental setup of Flow Tube Chemical Ionization Mass Spectrometry (FT-CIMS) currently employed in the Atmospheric and Environmental Chemistry Laboratory (AECL) at Turkish Accelerator and Radiation Laboratory (TARLA) enables to observe reactions under atmospherically relevant conditions (pressure, temperature, concentration, etc.) and it measures the molecular composition of a given sample. FT-CIMS consists of elements namely; a flow tube, chemical ionization region, and a mass analyser[1]. Reactions are carried out in the flow tube. For the mass spectrometer to make measurements, the molecules leaving the flow tube must be ionized. Mass spectrometry measures the mass/charge (m/z) ratio of ionized molecules with a mass analyser contained with in the vacuum housing[2]. Many ionization methods can be used as the ionization source. Some of the widely used ionisation methods for state of the science reaction kinetics experiments are polonium-210, corona discharge, and ionisation radiation (VUV lamps, etc.). Corona discharge is an electrical discharge caused by the ionization of a fluid such as air surrounding a conductor carrying a high voltage. We present Turkey's first purpose design molecular ionization source. Our unit consist of differentially pumped two stages which are primary ionization and sample ionization volumes. Differential pumping allows most of the preliminary ions of precursor gas (SF_6^-, CH_3I^-) progresses to the sample ionization stage. This molecular ionization source is designed and developed by AECL research. In this design, the corona discharge takes place between two tungsten wires, in presence of Nitrogen and SF_6 molecules injected through the inlet placed on the Anode line. First N_2 molecules negatively charged by the e^- cloud flowing towards ground to create N_2^- ions, through though the complex reactions with SF_6 molecules SF_6^- ions will be created which act as ionization precursor and ionizes any product and reactant molecules within the ionisation region. Thus, it allows the measurement of reactants and products. AECL also aims to share it's research results with users from industry and agriculture. Recent research claims that the corona discharge treated water provides nutrition for plants and extends freshness and improves general health. For instance, when water is enriched with nitrogen it helps vase flowers to live longer[3]. Our future research aim is to integrate our ionization unit to our FT-CIMS experimental setup to make a detailed study on the chemical composition of the corona discharge treated water, and continue to improve our knowledge on corona discharge.

References:

1)Bacak, A., Nottingham Trent University, Institute of Natural Sciences, Department of Chemistry and Physics, Nottingham. **2004**.
2)Hoffmann, and Stroobant, 'İon sources', in *Mass spectrometry: Principles and applications*. 3rd edn. Chichester, John Wiley & Sons, **2007**.
3)Wong et al., Processes **2023**, 11, 2213.


EnviroChem