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Editors:
Ljubiša Balanović
Dejan Tanikić

18-21 October 2023, Bor Lake, Serbia

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PREFACE

On behalf of the Organizing Committee, it is a great honor and pleasure to welcome all esteemed participants of the 54th International October Conference on Mining and Metallurgy (IOC 2023), scheduled to take place at the picturesque Bor Lake, Serbia, from October18th to 21st 2023.

The collaborative efforts of the University of Belgrade, the Technical Faculty in Bor, and the Mining and Metallurgy Institute Bor have meticulously organized this year's IOC. Our focus remains unwavering on showcasing the latest research findings and advancements in geology, mining, metallurgy, materials science, technology, environmental protection, and other engineering disciplines. Our primary objective is to foster a dynamic environment where academics, researchers, and industry professionals can come together to share their knowledge, experiences, and innovative ideas while exploring opportunities for collaborative research endeavors.

Our conference agenda is rich and diverse, encompassing plenary sessions, engaging invited lectures, technical presentations, enlightening oral and poster sessions, informative technical tours, a diverse exhibition, and memorable social gatherings. At the heart of this event lies our strong commitment to sustainable development within the mining and metallurgy sector. We are dedicated to exploring ecologically conscious methodologies, responsible resource extraction practices, and cutting-edge technologies that reduce the industry's environmental impact and enhance the well-being of local communities.

The conference proceedings comprise 129 papers authored by individuals from universities, research institutes, and industries in 22 countries. We are proud to welcome participants from Bosnia and Herzegovina, Bulgaria, Canada, China, Croatia, Germany, Greece, India, Iran, Kazakhstan, Libya, North Macedonia, Montenegro, Morocco, Romania, Russia, Slovakia, South Africa, Spain, Turkey, United States, and, of course, Serbia.

We are excited to host the 8th International Student Conference on Technical Sciences (ISC 2023) as part of IOC 2023. This event offers students from Serbia and the wider region a unique chance to showcase their research and discuss the future of their fields with experts.

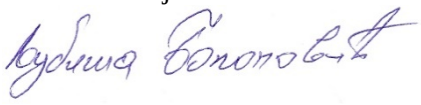
We sincerely thank the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia for their generous financial support. In addition, we express our profound gratitude to all our sponsors, exhibitors, and friends of the Conference for their contributions and unwavering support for playing a pivotal role in ensuring the success of IOC 2023.

We would like to express our heartfelt thanks to all authors, committees, reviewers, speakers, and chairpersons for their invaluable contributions in shaping IOC 2023.

We look forward to welcoming you to the 55th International October Conference on Mining and Metallurgy (IOC 2024), which will be held in October 2024.

On behalf of the 54th IOC Organizing Committee,

Prof. dr Ljubiša Balanović



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MICROPLASTICS

Aleksandar Cvetković, Žaklina Tasić, Marija Petrović Mihajlović, Maja Nujkić[1], Milan Radovanović, Ana Simonović

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Abstract

This paper is an illustrated review of the microplastics phenomenon which is caused by human activity and has global reach. Microplastics are insoluble solid particles in the range of sizes between 1μm and 5mm. There can be a further divide into larger macro- and meso- plastics and smaller nanoplastics. Regardless of the size all microplastics can carry adsorbed toxic materials like insoluble organic materials and heavy metals. With these materials microplastics can integrate themselves into the food chain and though it come in contact with the human body where desorption of toxic materials can takes place. It is difficult to recognize the type of microplastics, only with the employment of different recognition methods a sample of microplastics can be correctly identified. The removal of microplastics can be carried out with classic methods or with bioreactors.

Keywords: *Microplastics, Adsorption, Toxicity*

1. INTRODUCTION

Microplastics are materials that originate from a wide number of plastics with their polymers like: polypropylene (PP), polyurethane (PU), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polystyrene (PS) and the most represented type of plastic polymer, polyethylene (PE). These polymers are just the most common types which comprise the majority of microplastics in circulation [1].

2. RESULTS AND DISCUSSION

2.1 Plastic degradation and formation of microplastics

A microplastics particle is defined as a particle that isn't soluble and is in the range of sizes between 1μm and 5mm, but in nature the sizes can be smaller than 1μm and bigger than 5mm. Its origins can be divided into primary and secondary microplastics. The first origin is tied to the production of plastic objects or plastic pieces that already to have the range of sizes that would define them as microplastics. The second origin is tied to the degradation of larger plastic parts through the effects of natural and biological factors [2]. Secondary origin of microplastics occurs through the action of abiotic and biotic factors, where abiotic factors are UV radiation, pH values, temperature, salinity, concentration of different compounds and others, while biotic factors depend on the organisms that can emit enzymes and other chemicals that degrade plastics and its polymers [2].

The degradation of plastics to the level of microplastics and beyond begins with the mentioned abiotic factors which prepare the plastic surface for the attack of microorganisms that can degrade the plastic polymer through enzyme use. The impact of microorganisms on plastic can be divided into four stages: biodegradation, biofragmentation, bioassimilation and mineralization. Microplastic particles are being created through the whole process of plastic degradation, starting from the abiotic factors and continuing throughout the stages of biotic factors. UV light in combination with oxygen has the greatest effect on the plastic polymers. By synergetic action oxygen combines to the polymer and creates hydroxylic and carboxylic groups or can cut the polymer into smaller chains. Further synergetic effects come in place after microorganisms begin to degrade the plastic with enzymes [3, 4].

The enzymatic degradation cuts the polymer down to its constituents or to other pieces that require other enzymes to be further degraded. Microorganisms use the products of enzymatic degradation as a carbon source and implement them into their metabolic cycle in the assimilation stage, after which the final result of plastic degradation are carbon-dioxide and water in the mineralization stage [5]. The above discussed origins and creation of microplastics are given on the upper part of Figure 1. below.

2.2 Adsorption and desorption of toxic materials on to and from microplastics

Microplastics have a large specific surface because of their size and numbers, and in combination whit the properties of plastic makes them good vectors for a substantial amount of toxic compounds, most commonly insoluble organic species and heavy metals. Adsorption of toxic compounds takes place in different mediums that are contaminated with them. From there microplastics can transport these toxic compounds to uncontaminated environments or organisms and the human body. One of the ways contaminated microplastics can come in contact with the human body is through the food chain, where organisms on the bottom of the chain consume contaminated microplastics and transport them up through food into the human interior. These microplastics differentiate by size and only the smallest particles make it to the organs like the brain. The majority concentrates in the digestive tract where the properties of the medium can desorb the toxic compounds and damage to the tissue can take place [2, 6, 7].

2.3 Microplastics type detection and removal from waste water

Microplastics are difficult to characterize because of their various characteristics and a large amount of polymers that comprise them. A sample of microplastics can contain thousands of microplastic particles. The process of identification can employ the recognition of specific properties that are tied to the polymer like its density, the color of smoke after burning or the melting point. But the best results can be obtained by using laboratory methods that can give a deeper insights in the chemical structure of the polymers in question, and are often used in sequence to get the best insight into the aforementioned structure that indicates different polymers. These methods can be destructive like gas chromatography–mass spectrometry (GC-MS) and thermogravimetric analysis (TGA) or non-destructive like Fourier-transform infrared spectroscopy (FT-IR), which can be most commonly seen in use when it comes to microplastics detection and identification [8 - 10].

2.4 Brief segment about removal of microplastics from waste water

Removal of microplastics from wastewater and water in general is important because it represents one of the primary ways for microplastics dispersion. Likewise microplastics that are contaminated can get into the human body through drinking water. There are several methods that can be utilized for microplastics removal like filtration or sedimentation which are classical water treatment methods. In contrast, bioreactors are relatively newer and utilize bacteria in the process. Namely, in bioreactors microplastics come in contact with bacteria that can create biofilm on their surface which can be sedimented of filtrated [11, 12].

The mentioned processes are given on the bottom part of Figure 1.

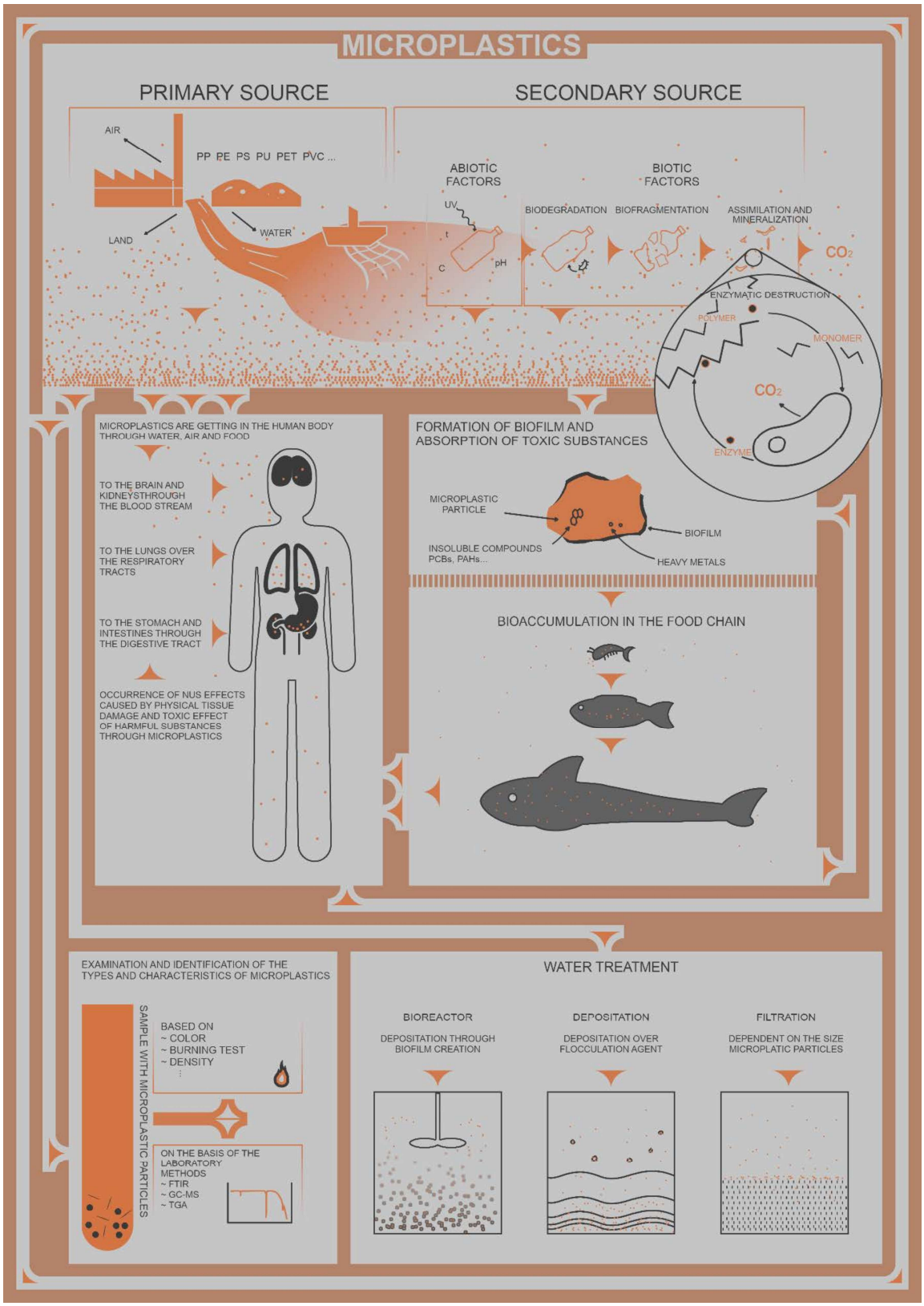

Figure 1 - Illustration of the creation and movement of microplastics based on the work

3. CONCLUSION

Microplastics are a diversified field that is in constant flux when it comes to the evolution of the microplastics problem in nature and in industry, as well as in the scientific research on the topic. Only in the coming years the problem can manifest itself as a true burden to humanity or a passing problem.

GNU IMAGE MANIPULATION PROGRAM was used for the illustration of Figure 1.

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