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ADSORPTION OF ORGANIC POLLUTANT ON MICROPLASTIC PARTICLES

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Introduction

Plastic pollution is currently a pressing global problem. While plastic products improve the quality of human life, almost half of plastic production worldwide generates a substantial amount of waste, causing a negative impact on the environment due to their improper disposal. Coupled with the accelerated growth of the global population, plastic production has increased dramatically in recent decades, from 1.7 million tons in 1950 to about 322 million tons worldwide in 2015. Plastic waste is found in all aquatic environments around the world, in seawater and oceans, it is estimated that about 80% of plastic pollution comes from terrestrial sources. Microplastics have been defined as "plastic particles with a size lower than 5 mm". Hydrophobic organic compounds present in aqueous matrices have a high tendency to combine with sediment particles. With analogous physical properties and higher hydrophobicity than naturally occurring organic matter, microplastics have a high uptake capacity of hydrophobic pollutants up to 100 times higher, and can affect the fate of hydrophobic organic pollutants in the environment. For this reason, the sorption behavior of hydrophobic organic compounds by polymers has attracted the attention of researchers; the main contaminants being polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), other derivatives with benzene rings in the structure (dioxins, DDT), metals and other persistent, bioaccumulative and toxic substances.

Materials and methods

A standard mix of analytical purity (Ultra Scientific, USA) containing 15 PAHs was used for the analysis of polycyclic aromatic hydrocarbons. For polychlorinated biphenyl compounds analysis, a certified analytical standard was used: PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 153, PCB 180, purchased from Dr. Ehrenstorfer GmbH (Germany). Chromatographic purity solvents used in the study, such as acetonitrile, hexane RESI quality were acquired from Merck and J.T. Baker respectively.

Results and conclusions

Polycyclic aromatic hydrocarbons adsorbed on microplastics present in surface waters were identified and quantified by GC-FLD technique, and polychlorinated biphenyls were identified and quantified by GC- μ ECD technique using hexane as extraction solvent. Surface water samples were taken from the Olt River, upstream,

downstream and Ramnicu-Valcea (P1-P4) and Slatina (P5-P7) wastewater treatment plants, in September and November 2020. For the detection of microplastics present in surface waters, the samples were filtered through fiberglass membranes with a pore diameter of 1.6 µm.

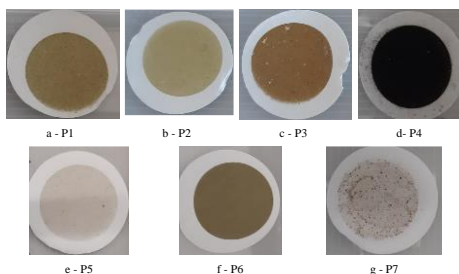


Fig.1. Images of glass membranes used for surface water filtration (P1-P7)

For the extraction of PCBs and PAHs adsorbed on microplastics (MP) accelerated solvent extraction (ASE) method was used. The 1.6 µm glass filters used to filter the 3L of surface water (P1-P7) were introduced into the stainless-steel cell, and the remaining volume in the cell was completely filled with diatomaceous earth. After the sample cells were loaded into the ASE system, extraction was performed by filling the cell with solvent before heating. Approximately 10 mL of hexane was used to perform the extraction. Simultaneously, 500 mL of surface water (SW) was extracted into a separatory funnel with a volume of 20 mL of hexane, stirring the phases for 3-5 min. The organic phase was separated and anhydrous sodium sulphate was passed over to retain water traces. The organic extract was concentrated under a stream of nitrogen to a volume of about 1 mL.

Table 1. HAP and PCB concentration levels detected in surface water am microplastics

Analytes	P1		P2		P3		P4	
	SW	MP	SW	MP	SW	MP	SW	MP
	Concentration (ng/L)							
ΣHAP	3.8	7.8	10.3	230	12.7	108	27.2	265
ΣPCB	4.7	6.2	26.6	44.3	12.9	19.8	27.9	75.2
Analytes	P5		P6		P7			
	SW	MP	SW	MP	SW	MP		
	Concentration (ng/L)							
ΣHAP	2.4	90.9	6.3	181	9.7	21.7		
ΣPCB	2.7	7.5	20.4	63.4	11.1	78.8		

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