Elucidating the Role of Ultraviolet Weathering and Biofilm Formation on the Adsorption of Micropollutants onto Microplastics
Kartik Bhagat, Civil, Environmental and Sustainable Engineering
Mentor: Francois Perreault, Assistant Professor
School of Sustainable Engineering and Built Environment

Introduction

There is a knowledge gap between the microplastic models used in controlled laboratory investigations and the microplastics observed in the environment. Microplastics’ surface chemistry and morphology are altered by aging, which can be caused by sunlight, and this has an impact on their interactions with pollutants. In order to offer an environmentally appropriate model that can be employed in laboratory conditions, we build a process to generate and age microplastics to mimic the surface chemistry of the microplastics found in the environment. Moreover, the fact that microplastics evolve in the environment under the influence of physicochemical and biological processes, with ultraviolet (UV) irradiation being one of the most important factors, is a critical knowledge gap in our capacity to predict the adsorption of contaminants by microplastics.

Materials and Methodology

Lab-generated microplastics

Ultraviolet Weathering:
• 4 Hours
• 4 Hours with an addition of H₂O₂ (10%)

Biofilm Formation:
• Model Biofoulant: P. aeruginosa.
• Biofilm grown for 5, 10 and 15 days.

Results and Discussions

Changes in adsorption with ultraviolet weathering and biofilm formation

Increasing carbonyl index for lab aged microplastics

HDPE

C=O (1716 cm⁻¹)

-C-H₃ (720 cm⁻¹)

Carbon index (R.U.)

Increasing adsorption for both contaminants

MB

PPE

MB Phenanthrene

Adsorption significantly different at day-15

No change in adsorption affinity

For favorable MB, electrostatic and complexation interactions

For unfavorable Phenanthrene, Octanol-Water Partitioning coefficient

Conclusions

• Aging of microplastics by UV light or oxidants lead to an increase in the adsorption capacity of microplastics through changes in surface chemistry and morphology.
• Hydrophobic contaminant prefers hydrophobic surfaces rather than accumulating in biofilm.
• Biomass plays a major role in the charged contaminants adsorption.

References