Elucidating the Role of Ultraviolet Weathering and Biofilm Formation on the Adsorption of Micropollutants onto Microplastics

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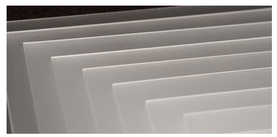
Introduction

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



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Lab-generated microplastics

Ultraviolet Weathering:

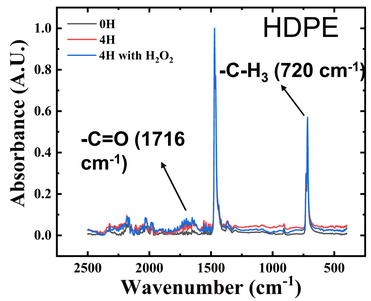
- 4 Hours
- 4 Hours with an addition of H_2O_2 (10%)

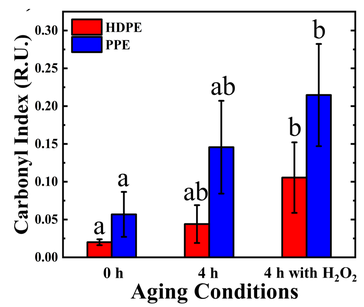
Biofilm Formation:

- Model Biofoulant: *P. aeruginosa.*
- Biofilm grown for 5, 10 and 15 days.

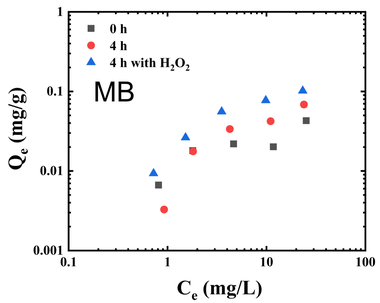
Results and Discussions

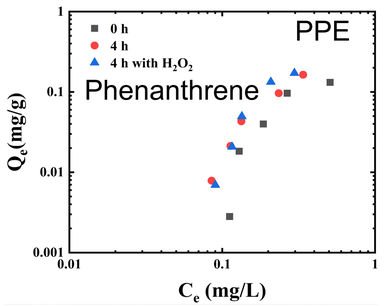
Changes in adsorption with ultraviolet weathering and biofilm formation



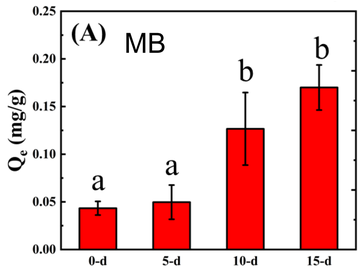


Increasing carbonyl index for lab aged microplastics

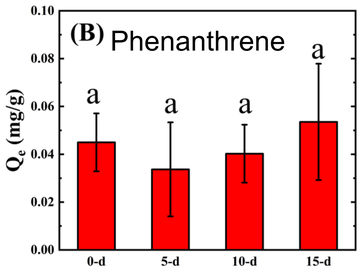




Increase in adsorption for both contaminants

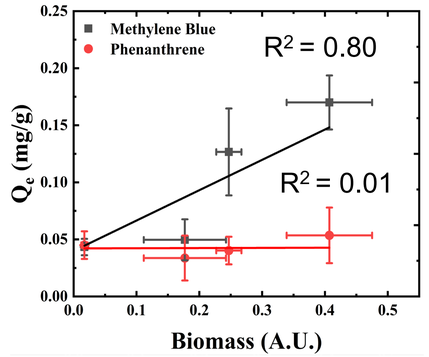


Adsorption significantly different at day-15



No change in adsorption affinity

Results and Discussions



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

Bhagat, K, Barrios A.C., Rajwade, K, Kumar, A, Oswald, J, Apul, O.G., Perreault, F. Aging of microplastics increases their adsorption affinity towards organic contaminants. *Chemosphere*. 2022 .Volume 298, P-134238

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