Modeling of microbial interaction in degradable polymers under simulated water environment

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Nearly 80% of oceanic plastic waste is from land-based sources including degradable polymers. The recent trend towards the use of degradable polymers in the form of photodegradable and biodegradable polymers promises to be a sustainable solution to plastic pollution, whereas microplastics (MPs) impose higher ecological risk due to limited knowledge of its physicochemical properties and behavioral dynamics in the aquatic environment. This study is aimed at modeling the effect of the weathering process of degradable microplastics by plastic surface-based microbial communities. Source-specific degradable polymers with different weathering processes such as abrasion, solar radiation, microbial colonization, UV radiation, chemical, and thermal oxidation, and other environmental factors were assessed. Cluster analysis of efficient degradable microorganisms over MPs weathering conditions highlighted to understand the microbial kinetics. Simulation models are also used to mechanistically characterize and analyze the behavioral patterns of microorganism colonization of MPs and its weathering influence are discussed in detail. Multispecies microbial colonization is largely understudied and experimentally exhaustive to quantify, nevertheless, there is minimal literature on the parameterization of such models and more experimental work is needed to better optimize the parameters in these models for a broad range of microbial communities and microplastic leachate chemicals. This work not only provides a better understanding of the fate and behavior of degradable microplastics in the aquatic environment, but these findings also serve as a requisite to better design and optimize the essential parameters for experimental strategies for the development of environmentally friendly novel polymers.