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Abstract

Aerobic biodegradation in freshwater and marine environments of textile microfibers generated in clothes laundering: Effects of cellulose and polyester-based microfibers on the microbiome

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Abstract:
The accumulation of plastics in aquatic environments is a major issue for society. Among them, microplastics (MPs) are small plastic particles generally with less than 5 mm in size that represent a significant threatto the ecosystem. MPs have the potential to adsorb pathogens and pollutants on the surface due to their surface chemistry and high surface area. They can be transported quickly by the action of water currents across the globe and be ingested by marine fauna and transferred to other trophic levels; they have been found even in the human food chain.Home laundering has been identified as one of the primary sources of microplastics. The microfiber generation capacity of synthetic and natural-based fabrics and the main factors from the laundering process influencing the shedding mechanism have been studied. However, the biodegradability and persistence in the environment of these microparticles has not been well described.

In this study, the aerobic biodegradation of the most common textile fibers(cotton, rayon, and polyester) was studied under the action of microbes naturally found in aquatic environments, lake and seawater, and activated sludge at a low concentration from a wastewater treatment plant (WWTP). The interactions between the fibers and the microbiome in the test media were evaluated, combining aerobic biodegradation tests and next-generation sequencing targeting bacteria in the DNA extracted from the samples.

Under these conditions, the biodegradation potential was the same in all the experiments: Microcrystalline Cellulose (MCC) > Cotton > Rayon > Polyester/Cotton Polyester.Cotton yarns and rayon yarns were disintegrated entirely and highly assimilated by the microorganisms in each system. For cotton and rayon yarns, >70% biodegradation was achieved with activated sludge at low concentration and lake water, whereas in seawater, about 50% degradation was observed, for the finite length of time utilized. Polyester did not appreciably degrade. The biodegradation results herein indicate potential not absolutes in nature.

Biography:

Marielis Zambrano is a Ph.D. Candidate in the Department of Forest Biomaterials through the College of Natural Resources at North Carolina State University (NC State). She received her B.S. in Chemical Engineering from the University Los Andes in Venezuela in 2014. Marielis has experience managing multidisciplinary teams in international organizations in industry and academia. The sustainability has been the center of her career, and during her Ph.D. at NC State, she has worked with an environmental hot topic – the plastic contamination in aquatic environments, specifically, understanding the generation of microplastics or microfibers shed during the laundering of textiles and their fate in aquatic and marine environments. She did groundbreaking work on the impact of microfibers on the bacterial communities in natural settings such as lake and ocean waters, and currently, she is evaluating the effects of textile finishes on cellulose-based fibers on their environmental fate. Marielis is passionate about promoting the circular economy in our society to create a sustainable future.

Recent Publications:

1. Marielis C. Zambrano et al; Aerobic biodegradation in freshwater and marine environments of textile microfibers generated in clothes laundering: Effects of cellulose and polyester-based microfibers on the microbiome, 2020.
2. Marielis C. Zambrano et al; Microfibers generated from the laundering of cotton, rayon and polyester based fabrics and their aquatic biodegradation, 2019.

11th International Conference on Biopolymers and Bioplastics; July 27, 2020; Paris, France.

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