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Whalen Symposium Abstract

Background

As the plastic industry has grown, so too has the spread of environmental pollutants due to plastic. Plastics disposed in landfills or oceans break down due to weathering and become microplastics, which are loosely defined as plastics with a diameter smaller than 5 millimeters [2]. Microplastics frequently come from the break down of commonly used consumer products, such as water bottles, milk jugs, and plastic bags. Additionally, microplastics are manufactured specifically in industrial cleaners and exfoliating cosmetics, including soaps and scrubs [1]. One German study found that microplastics larger than 1.2 μm occur in concentrations between 64,000 and 88,000 particles per cubic meter in coastal waters [2].

Since plastics auto-fluoresce, or have the innate ability to glow brightly when exposed to light, fluorescence microscopy can be useful as a first screening method for identification of microplastics when mixed in with other particles. However, extended exposure to the light source changes the molecular structure of the fluorescing molecules, resulting in a process known as photobleaching. Photobleaching causes the molecules of plastics to lose their ability to fluoresce, therefore altering physical measurements. For example, the edges become very faint after photobleaching and may cause the size of the microplastic to be measured incorrectly. This research began with a study of the effects of photobleaching on microplastics. Five types of plastic were used from different recycling categories, since they each have a specific molecular configuration and may be affected differently by photobleaching.

After completing this photobleaching project, I had gained a serious personal concern in the pollution of microplastics in the environment. I therefore focused subsequent research on investigating the detrimental effects of microplastics. Plastics have been known to adsorb some chemicals to their surface, thereby transporting these chemicals through water systems where they are a danger to the ecosystems [3]. The next part of this research project was to analyze the adsorption and emission of four different toxic chemicals: triclosan, 17α-ethinyl estradiol, metolachlor, and bisphenol A.

Methods

For the photobleaching part of the project, the plastics had to be broken down from full-size plastic products to the appropriate size of less than 5 mm in diameter in order to accurately fit into the category of microplastics. A metal file was used to obtain very small pieces from the the full-size recyclable plastic products (water bottles, plastic bags, etc.). These microplastics were laid out on a slide and illumated with a laser, which photobleaches them. After a thirty-minute photobleaching period, which was recorded by camera through a microscope, photos were taken to determine if there was any recovery of fluorescence.

For the toxin adsorption and emission part, the microplastics were extracted from skin care products containing plastic microbeads. The microplastics were submerged in each of the four chemical solutions, and an ultraviolet-visible spectrometer was used to take data at

several time increments following submersion. The spectrometer determined the concentration of each solution. If the concentration had gone down from the initial value, then that indicated that the microplastics had adsorbed some of the chemical. The microplastics were then taken out of the solutions and placed in distilled water. The water was analyzed to see if the microplastics were re-emitting any of the chemicals.

Conclusion

While fluorescence microscopy is a very useful method for studying microplastics, photobleaching must be taken into account. The data showed that significant loss of fluorescence occurs very quickly, relative to the amount of time samples are typically illuminated while taking data. The intensity level of the laser as well as the time of illumination both have a measurable effect on the magnitude of photobleaching.

Results on the toxin adsorption and emission are still being collected and will be presented in the talk.

Bibliography

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