

**Cooperative Work is needed between Textile Scientists and Environmental Scientists to Tackle the Problems of Pollution by Microfibers**

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It is clear that plastic pollution is a severe problem in the ocean. Photographs document beaches all around the world covered with plastic bottles, bags, straws, etc. (e.g. Gregory 2009, figs 1-3). Billions of pieces of plastic are floating in the oceans. Their effects are also sufficiently well-known: marine animals swallow them or get tangled up in them, which causes many of them to die. Hundreds of scientific reports (Gall and Thompson, 2015; Rochman et al., 2016) demonstrate the many ways in which plastic is maiming and killing marine animals. One particularly insidious form of plastic pollution that does not appear in the pictures is *microplastics*, which are tiny pieces ranging from a few millimeters in size down to microscopic. Microplastics come from various sources including the breaking-up of larger plastic pieces, pre-production pellets, and microbeads that are added to personal care products for their abrasive qualities. Microbeads have been banned in personal care products in some countries, including the US, Holland and Canada (Indy100.com) By far, the most abundant type of microplastic in the oceans (and freshwaters) are microfibers (approximately 85%, Carr, 2017). The predominant source of these microfibers is synthetic clothing; a single garment may shed thousands of microfibers in washing machines whenever it is washed

(Napper and Thompson, 2016; Hernandez et al. 2017). The microfibers are so tiny that they are generally not trapped in washing machine filters, but instead, flow out with the rinse water. Although many of them are trapped by sewage treatment plants, billions are released in the wastewater. Their numbers in the rivers and oceans are in the trillions or quadrillions – and, being plastic, they do not break down. Recently, microfibers have also been detected as “fallout” from the air; apparently, they are also shed from clothes while they are being worn (Dris et al., 2016). Furthermore, synthetic fibers have been recently detected in human lung biopsies (Prata, 2018). They have also been found in freshwater lakes (Wagner et al, 2015) drinking water (Orb Media 2017) and soil samples (Machado et al. 2018), so it would appear that they are ubiquitous. However, to date, most of the research has been done in the marine environment because they were initially detected there.

Initially marine scientists thought they would float since they are so tiny, and sampling was concentrated in water near the surface. But it was subsequently learned that microplastics are found throughout the water column and on the bottom, even in the Arctic sea ice and the deepest trenches of the ocean, several miles below the surface (Courtene-Jones et

al., 2017). Microparticles of all shapes attract chemical pollutants from the water. Furthermore, they get eaten by small animals (e.g. plankton) and other (larger) animals that consume plankton by filtering the water, such as clams and oysters. Some filter-feeding animals, including corals, have been found to actually prefer to eat microplastics instead of “real” food (Allen et al. 2017). Since microfibers (with their attached chemical pollutants) are passed up the food chain, any seafood meal will probably contain some of them.

There is growing evidence that eating microplastic has negative effects on the physiology and health of marine animals, although the ecological consequences of these effects are not yet clear. In some small shrimp-like animals, microplastics block the digestive system and reduce the amount of “real” food they eat (Au et al, 2015). In that study, microfibers were more damaging than other types of microplastic particles, possibly because the fibers remained in the animal’s gut for a longer period of time. When microfibers are eaten by small fish, they can physically block the digestive system, interfere with feeding, cause injury, and change the animals’ behavior (Jovanovic et al., 2017). Additional concerns arise because microplastics attract chemical pollutants from the water and can be a route for toxic chemicals to move into organisms (Batel et al. 2016), although there are other ways the animals can acquire these chemicals, such as direct uptake from the water or from their food. Some freshwater animals are also capable of ingesting microplastics, which results in significant reductions in their feeding rates and alterations in their anatomy (Murphy and Quinn, 2018). The potential for humans to consume microplastics in seafood is practically certain (Santillo et al. 2017), but what that implies for our health is unknown.

Marine scientists and other environmental scientists are continually learning more about the entry, movements, and effects of microfibers on many species, and finding out in greater depth about the problems they

cause in the environment, but we need textile scientists to help find solutions to the problems. Some people are developing devices to put in washing machines that will collect microfibers before they get pumped out. While this is a good beginning, it will be necessary to motivate people to buy and use these devices and it is not likely that the devices will make a major dent in the problem.

A large part of the solution should ultimately lie at the beginning of the process – the manufacture of synthetic fabrics in the first place. Fiber and textile scientists have the expertise to help solve the problem by modifying the way that synthetic fabrics are made so they won’t shed (as many) fibers. We propose that workshops be planned that would bring together textile scientists and environmental scientists to discuss these issues and devise paths to follow to work together toward solving this major environmental problem.

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