Microfiber Shedding: Hidden Environmental Impact

By Kilara Le

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If a ray of sunlight shines through a window and one looks closely, there are many small fibers, or microfibers, floating in the air. They may be synthetic in origin or natural fibers such as cotton, wool, or hair; however, most are shed from textile materials used in our homes and clothing. While somewhat ethereal when revealed by a sunbeam, once microfibers enter the water system through cleaning or rainfall, they are swept into our streams and oceans and become part of the aquatic environment. Many of these synthetic microfibers, just like larger pieces of plastic waste, are not biodegradable. They are migrating across the globe and creating what Nicholas Mallos, director of the Trash Free Seas Program at the Ocean Conservancy, describes as, “one of the most abundant sources of plastic pollution in the ocean.”
Understanding the Problem

As his job title suggests, Mallos is involved in bringing awareness to this most-recently recognized crisis in the marine environment, which parallels the issue of visible plastic pollution. The latter has gained greater public attention and awareness over the last few years from ominous photos of floating “plastic soup” and from brands such as adidas’ Ultraboost Uncaged Parley shoes that incorporate recycled plastic made from ocean waste. He says that, unlike the larger plastic pieces floating in the ocean that are often a result of poor waste collection and management, particularly in rapidly developing economies, microfiber pollution has been traced to wastewater sources, a lot of it likely shedding from clothes in washing machines used in developed economies.

Ecologist Mark Brown was one of the first to make this connection with his research, according to Steph Karba, environmental researcher at Patagonia Inc. Studies conducted by other global researchers confirm that with every washload of clothes, fibers are released. Most wastewater treatment facilities have filtration technologies with capture rates ranging up to 99%; however, due to the significant volume of daily wastewater entering plants, the 1% that is not captured can result in a lot of fibers escaping into the local environment.

Where do these fibers end up? “They have been identified everywhere from aquatic life: in rivers, oceans, deep coastal sediment, and throughout the water column,” says Karba, “to on land where wastewater sludge has been applied, and, more recently, fibers have been identified in atmospheric deposition.” A lot more research needs to be done on this, she adds, “the wearing and tearing (or shedding) of a jacket as you move around your home needs to be more closely looked at.”

Then there is the issue of chemistry, says Beth Jensen, senior director of sustainable business innovation at the Outdoor Industry Association (OIA) as, “often clothing has a chemical coating, and when the garment sheds, the fibers still have the chemicals on them, which then make their way into waterways and marine life.” The microfibers are out there, but their impact on the health of organisms up and down the food chain in many cases is still unclear. As the industry drives research to better understand this and explore possible solutions,
“we also want to make sure that we are not replacing current fabrics and chemistries with regrettable substitutions,” she adds, especially ones that may be even worse for the environment.

Karba was part of a study at the University of California, Santa Barbara’s (UCSB) Bren School, which looked at shedding based on the type of washing machine used and the age and quality of the garment washed. They found that the use of a top-load washing machine resulted in over 5 times as many fibers being released than a front-load machine and that older, lower-quality jackets shed more fibers as well.
Another study, led by Chelsea Rochman, examined the prevalence of fiber and plastic waste in a variety of fish species and bivalves bought commercially from markets in Indonesia and California, USA. In both sample locations, in the guts of the seafood, anthropogenic (manmade) waste was found. In 28% of the Indonesian fish, there were plastic fragments (60% of the waste), plastic foam (37% of the waste), plastic film (2% of the waste), monofilament (1% of the waste), and 0 microfibers. In the guts of 25% the US fish and 33% of the bivalves (Pacific oysters), there was anthropogenic material as well. The research team found textile fibers (80% of the waste), plastic film (10% of the waste), plastic foam (3.33% of the waste), and plastic fragments (3.33% of the waste).

All these research projects give further insight into the behavior of different types of textiles, and where fibers end up, but more studies are needed, says Jensen. The community of microfibers stakeholders, including the outdoor industry, is now collaborating to identify the knowledge gaps and prioritize the most efficient ways to fill them, as quickly as possible. The industry, “needs to better understand all of the different leakage points, where they are coming from and what role water treatment plants and other stakeholders can play,” Jensen says. She adds that we need to ask, “What are impacts at end of life on marine life and humans, and where does this issue truly fit with all the other supply chain issues?”

Types of anthropogenic debris in market fish products sampled from Indonesia and the United States. The pie charts above show the percentage of each type (i.e. plastic fragments, fibers, plastic film, plastic foam and plastic monofilament) of anthropogenic debris found across all fish sampled from Indonesia (top) and the United States (bottom). Images show examples of each type of debris found. Scale bars on all pictures are set at 500 µm.

Figures courtesy of Chelsea Rochman.
What is the Industry Doing?

The issue of microfibers is of great interest and concern to many outdoor brands and their supply chains. “This problem is potentially the textile equivalent of automobile tailgate emissions—and, because we know that fibers shed from fabrics, we now have to design the Prius of the fabric world,” says Karba, “and to do that, we need to better understand how to test fabrics in a standardized, rapid fashion.”

OIA has a Sustainability Working Group subgroup focused on microfibers that has created a resource library to map the landscape of organizations, researchers, and institutions that are looking at both impacts and possible solutions. As an industry group, they are “working with researchers to define what information the industry needs, and then from there, we hope we’ll be able to more effectively allocate resources to address this issue,” says Jensen.

To define and identify, the industry needs to quantify. “Do we as an industry need to figure out what a minimum plastic particle threshold is, and then design products based off of that?” muses Karba.

“Since the issue is so complex and requires so many members from different levels of the supply chain, can organizations put aside competitive attitudes and work together?” asks Karba’s colleague, Heather Shields, testing and standards engineer, Technical Knits, at Patagonia Inc. “Can people share ideas and methods that they create versus keeping them close to their chest?”

Shields is working with AATCC Committee RA100, Global Sustainability, to make recommendations as they develop a wash test method for microfibers released during home laundering. This is one of the big gaps in the industry—the ability to quantify and measure fiber shedding—according to Jensen. For this new test method, AATCC committee members...
are looking at using an accelerated laundering machine, which is currently used for AATCC Test Method 61, Colorfastness to Laundering: Accelerated. This machine can test up to 20 swatches at a time and the committee is currently exploring how to construct the test specimens and set up the wash settings in a way that best correlates to home laundering. Recreating studies with full washing machines is also something that people in the industry are looking at.

What is needed in the short term and long term is a two-pronged approach. First the industry needs to look at, “mitigation and cutting off that pollution vector,” for fabrics that shed microfibers, says Mallos. “How do we capture them and prevent them from entering into the environment?” He adds that, “It’s not a silver bullet, but it’s something we can do in the short term.” For the long term, Mallos says that, “We need to look at materials and how they are designed, and take a holistic approach to identify the perfect suite of solutions to maximize the reduction of shedding.”

Furthermore, new research being done needs to take into account the broader range of stakeholders and textile companies that are a major piece of the puzzle, says Mallos. “They need to come to the table and communicate with the leading researchers in this space in developing a list of priority research questions.”

“We need their input to inform and ensure that this research is not done in a vacuum and it is applicable for their processes,” adds Mallos. For the new AATCC test method being created, “We want this to be able to be tested at the mill level, allowing them to test the same material with different attributes,” says Shields.

Identifying a solution will require the continued dedication of stakeholders across the supply chain and them working together to understand the causes, do further research, and find solutions through discussions and collaboration.

**Educating Consumers**

One of the issues with raising awareness about microfibers, says Mallos, is that, “there is a massive pollution problem that you can’t actually see,” not unlike air pollution. Part of the broader notion of educating the public is “highlighting some of the major sources such as clothing, tires, sheets, and other products that are unintentionally contributing to this.”

When the enormity of the issue is considered, it can seem like a gloom and doom scenario. However, “the important thing is to look at what could make an impact and be an interim solution,” says Mallos.

One item available for consumers to purchase is the Coraball, which is the brainchild of the Roasalia Project for a Clean Ocean and mimics the filtration capabilities of coral. When put into the washing machine, it traps fibers while still allowing water to flow through it. The fibers can then be removed from the ball. It doesn’t catch every fiber, but many households, each capturing a percentage of fibers, could make a big difference.

Patagonia will soon be selling the Guppy Friend bag (at cost), a filtration bag that synthetic clothes can be zipped into while in the washing machine or while hand washing. The bag catches fibers, preventing them from getting into the wastewater system. Patagonia has also invested in a waterless textile and apparel laundering company called the Tersus Solution. Tersus’ technology uses liquid carbon
dioxide to clean clothing, and is essentially a closed loop washing machine that doesn't dissipate fibers or the chemistry on them into wastewater.

Concerned consumers can also purchase and install a Wexco washing machine filter that captures fiber waste as well as dirt and other particles and prevents them from entering wastewater facilities and septic systems.

Part of the Solution

All of these experts and organizations are clear that they are not advocating for the elimination of synthetic fibers and are supportive of the attributes and functionality enabled by synthetics. In addition, “Some NGO’s will say just avoid synthetic fibers—but this is actually misleading, as often natural fibers are blended…or there are other issues associated with them, such as pesticide use, water use, or animal welfare issues. So, that approach is looking myopically at this issue,” remarks Jensen.

“All materials have impacts. We need to think about how can we keep [items of apparel] in use as long as possible, while avoiding these unintended consequences and waste streams,” says Jensen.

While many gaps remain between what is known and not known about microfiber shedding, the search for a solution—or several solutions—is underway. And it's clear that everyone can be a part of that solution.

Kilara Le is a Raleigh, NC, USA-based writer and consultant, specializing in the apparel industry. www.linkedin.com/in/kilaralittle

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