

Textile and Apparel Industry Addresses Emerging Issue of Microfiber Pollution

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Introduction

Plastics in our waterways, their impact on marine wildlife and the ecosystem, have been of concern and reported on for many years (Buchanan, 1971; Carpenter, Anderson, Harvey, Miklas, & Beck, 1972; Carpenter & Smith, 1972). More recently, microplastics (plastic fragments less than five millimeters in diameter) have been found around the world in the ocean and other waterways. There has been increasing concern regarding a microplastic subcategory referred to as microfibers. Microfibers have a fibrous shape and are less than five millimeters in length and being synthetic in nature (Hartline et al., 2017). Microfiber pollution is an emerging issue and research is ongoing by those in the environmental sciences, textile sciences, apparel technology, apparel brands and retailers to better understand and mitigate the associated impacts. Numerous researchers have identified issues related to microplastic pollution (Geyer, 2018, Thompson et al. 2004, Browne et al. 2011) and succinctly summarized by Weiss (2017). Although much attention has focused on the microfibers in our waterways, they are also prominent on land and in the air. Like many of today's global challenges, this is a complex issue and to develop effective solutions it will require expertise from different scientific disciplines to investigate

this issue. Collaboration among the many disciplines will be necessary to develop a better understanding of the underlying causes and propose feasible solutions to address this concern.

The textile and apparel industry is relatively complex and many disciplines are involved in the development and design of fibers, fabrics and textile containing products (Cao, Zhang, Kim & Keng, 2005). Textile products are diverse in nature as are the markets in which they are found. As an industry, there is increased awareness, attention to, and programs underdevelopment to address microfiber release as it influences the microplastic pollution issue. Throughout the industry, a multipronged approach with several foci including short term and long-term goals. In the short term, strategies to eliminate microfibers released from textile products from entering the waterways are under evaluation. As traditional laundering of apparel and home textiles was identified as a source of the microfibers entering waterways, mitigation and reduction would include shifts in textiles laundering recommendations and the implementation of procedures/processes to effectively capture those fibers released. For the long term, it will be necessary to take a more holistic, systematic approach including evaluation of material design, apparel design and recommended after purchase care procedures

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that will optimize the reduction of fiber release and capture of released fibers during the material lifecycle. An essential component in effectively addressing the issue will be the collaboration among stakeholders identifying practices for adoption, and then scaled across not only the textile and apparel industry, but also related industries including appliance manufacturers, wastewater treatment facilities and participation of the consumer.

Since microplastics were identified in the environment in 2004 (Thompson, et al.) and then microfibers directly linked to the textile and apparel products in 2011 (Browne, et al.), research has focused on developing a better understanding of the problem by evaluating the data available and creating data in an organized, collaborative fashion to generate credible data for study. Eumonia (2016) estimated that the annual microfiber release from textiles (apparel) into the marine environment was 0.19 million tons annually. Currently the understanding of movement of microfibers into the oceans, freshwater systems, air and terrestrial environment is very limited (Geyer, 2018).

Work throughout the Textile and Apparel Industry

There are a number of retailers, brands and organizations working collaborative toward sustainability in the supply chain. A few umbrella organizations including The Sustainability Consortium, Sustainable Apparel Coalition, The Textile Exchange, American Apparel and Footwear Association, Outdoor Industry Association, European Outdoor Group, and the National Council of Textile Organizations, are working collaborative with retailers, brands, environmental scientist, and others in the textile and apparel supply chain to gain an understanding of the fiber release mechanism and the entry of microplastics/fibers into waterways. This paper will report on some of the recent and current efforts. It is important to note, that the memberships of several the organizations here include representatives from many textile and apparel companies at all levels of the supply chain as

well as those who provide third party services. Collaborative efforts are more effective when they are developed in safe non-competitive spaces, the work is on shared issues, and there is the goal to develop more sustainable practices with reduced risk.

The *Outdoor Industry Association* (OIA) has been a long time leader in addressing environmental issues through their Sustainability Working Group (SWG) where the goals are to share the best sustainability practices, develop better products, and drive meaningful change. (OIA) As early as 2015 they recognized the connections between microplastics and microfibers to apparel products and within the SWG, a subgroup focused on microfibers was created and resources were, and are currently being developed. One resource of this group included the identification of organizations, researchers, and institutions that are investigating both impacts and possible solutions. Another resource is a microfiber toolkit available for download from the OIA website. (OIA) In July of 2018 an OIA Microfiber Research Cohort was launched which is a collaborative effort with the European Outdoor Group Microfibers Consortium. The SWG working group meets regularly and provides updated information. They have partnered with other groups around the world, like the EOG who have a shared interest and stakeholders. In March 2018, the OIA Microfibers Task Force identified the following four focuses for next steps: 1) Developing standardized test methodologies for fabric/fiber shedding, 2) Collecting, sharing, and implementing best practices in the production process, 3) Communicating externally industry work plans and next steps, and 4) Fostering key partnerships (Jensen, 2018)

The *American Associate of Textile Color and Chemists* (AATCC), an association that serves the textile and materials industry professionals highlighted the topic as a cover story “Microfiber shedding: Hidden Environmental Impact” in the September/October 2017 AATCC Review acknowledging microfiber release as a critical issue. (Le, 2017) In November

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2017, the AATCC Global Sustainability Technology Committee, RA100 with the scope “To disseminate and exchange knowledge on current developments and industry practice in the fields of sustainability, human health, product safety and the environment for the textile and its supplier industries; and to provide a forum for discussion of related federal and state legislation, and rules and regulations of government agencies.” (AATCC, 2018) began focusing their efforts on this topic. Work includes the development of a standard test method to quantify the fibers released; examination of various textile constructions and their impact on fiber release including fiber content, yarn construction, fabric construction and finishes; laundering and care procedures and their impact on fiber release; and communication with appliance manufacturers regarding home laundering equipment are all topics of discussion within this group. The committee has regularly scheduled conference calls and in-person meetings semi-annually. There are currently 55 committee members from textile brands, manufacturers, universities, retailers, research institutes, and others contributing to this effort.

The American Apparel and Footwear Association (AAFA) represents more than 1,000 companies in the apparel, footwear, accessory and retail supply chain including textile suppliers, testing labs, manufacturers and retailers. In addition to other goals, they provide insights on emerging issues and a collaborative forum for discussion of best practices and innovation. Identifying microfiber pollution as a critical issue, they provided a webinar on this topic in September 2018 that was open to the industry. (AAFA, 2018)

TextileMission, a joint project that began in September 2017, aims to reduce the micro-plastic particle release that originates from man-made synthetic fibers. The project is funded by the German Federal Ministry of Education and Research. Companies within the textile and apparel supply chain including Adidas AG, Henkel AG & Co, KG, Polartec., LLC, VAUDE Sport GmbH &

Company (Kolberg, 2017), WWF Germany, National Association of the German Sporting Good Industry, BSI, Hochschule Niederrhein Textile and Clothing faculty, and Miele & Cie, KG are key partners. (Kolberg, 2017).

In 2014 the LIFE-MERMAIDS - Mitigation of microplastics impact caused by textile washing processes was funded in part by the European Union. The multidisciplinary consortium includes partners from CNR, National Research Council, Leitat, Plastic Soup Foundation, and Polysistec. The objective of this project was to contribute to the Mitigation of the environmental impact of microplastic particles resulting from laundry wastewater. (Avella, 2014)

In 2017, the Coastal Ocean Research Institute (CORI) launched a comprehensive microfiber study and have funding from various sources including Mountain Equipment Co-Op, ArcTeyx, Patagonia, and REI. The desired results of this research is to be able to identify a brand or specific piece of clothing that shed a specific microfiber found in the environment. The aquarium’s ocean pollution research program director and senior scientist Peter Ross will lead the yearlong project. (O’Connor, 2017)

In reviewing some of the efforts, COIR and LIFE-MERMAIDS specifically, their research teams seem to be lacking textile scientists from the academy that would be able to provide a theoretical understanding of the textile products, actions and properties that enhance and inhibit microfiber release. This would include details on the chemical composition and physical characteristics of the fibers, yarn structure, fabric structure, chemical and/or mechanical finishes, seam and stitch impacts. Although there are representatives from apparel brands and retailers, the research would be strengthened with contributions from experts in this discipline. As this is a global issue, the European Outdoor Group (EOG) has also expressed concern and interest in this area. They note the importance of including those with an in-depth knowledge of textiles as being better suited and are encouraging the

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textile industry to lead research on fiber loss. (O'Connor, 2017B)

New Technologies and Eco-Friendly Materials

CiCLO is a new textile technology that allows polyester to biodegrade more like natural fibers in conditions found in wastewater treatment plant and landfills. Intrinsic Textiles Group developed this technology; they recently partnered with Parkdale Advances Materials, a division of Parkdale Inc., forming a joint venture. The technology is a proprietary additive to Polyethylene Terephthalate (PET) during extrusion that enables biodegradation of the fiber at rates similar to that of natural fibers such as wool (Ferris, 2018).

Mango Materials is developing a polyhydroxyalkanoate (PHA) based biodegradable plastic compatible with other natural textile materials. It is a biopolyester that will biodegrade in both industrial and natural environments (Mango Materials, 2018).

Vaude is actively involved in the consortium project "TextileMission" with the goal to reduce the environmental impact of microfibers. They are investing the use of wood-based fibers (Lyocell), and blending milk based fibers (QMILK) with wool fibers to produce their QMILK-felt. (VAUDE, 2018)

Developments to address the release of microfibers/plastics

New research must consider a broader range of stakeholders including textile and apparel companies that are incredibly important in addressing this issue. Regarding textile companies, Nick Mallos Director of the Trash Free Seas Alliance stated, "They need to come to the table and communicate with the leading researchers in this space in developing a list of priority research questions." and "We need their input to inform and ensure that this research is not done in a vacuum and it is applicable for their processes," (Le, 2017). Heather Shields, the chair of the AATCC RA 100 Committee, said regarding the committee work, "We want this

to be able to be tested at the mill level, allowing them to test the same material with different attributes," (Le, 2017). Identifying a solution will require the continued collaboration of stakeholders throughout the supply chain in an effort to understand the causes, continue research, and recommend solutions through discussions.

The Way Forward

It is critical that that a multidisciplinary collaborative approach be used to address the issue of microfiber release into the environment. The global textile complex and related consortiums are addressing microfiber release concerns through continued research to develop a better understanding of the release mechanism, pathways to the environment, the development of innovations, and application of technology to mitigate the initial fiber release. Textile scientists working in the academy, industry and consortiums are addressing this issue and looking for partnerships with other disciplines and industries to develop and move best practice solutions forward. The textile scientist can provide insight on fiber chemistry, yarn production and performance, fabric production and performance, chemical and mechanical finishing, and apparel construction necessary in developing and through understanding of the release mechanism. Working collaboratively with those in other areas including environmental science, waste water treatment, appliance manufacturers and consumers, the ability to develop materials to meet the aesthetic and performance demands of society, while having zero net impact on the environment, is possible and exciting.

References

Avella, M. (2014). LIFE - MERMAIDS - Mitigation of microplastics impact caused by textile washing processes. Retrieved from http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4973&docType=pdf

- Browne, M. A., Crump, P., Niven, S. J., Teuten, E., Tonkin, A., Galloway, T., & Thompson, R. (2011). Accumulation of microplastic on shorelines worldwide: sources and sinks. *Environmental science & technology*, 45(21), 9175-9179.
- Bruce, N., Hartline, N., Karba, S., Ruff, B., Sonar, S., & Holden, P. (2016). Microfiber pollution and the apparel industry. *University of California Santa Barbara, Bren School of Environmental Science & Management*. Retrieved from [http://www.esm.ucsb.edu/research/2016Group Projects/documents/PataPlastFinalReport.pdf](http://www.esm.ucsb.edu/research/2016Group%20Projects/documents/PataPlastFinalReport.pdf)
- Buchanan, J. B. (1971). Pollution by synthetic fibres. *Marine Pollution Bulletin*, 2(2), 23. doi: [10.1016/0025-326X\(71\)90136-6](https://doi.org/10.1016/0025-326X(71)90136-6)
- Cao, N., Zhang, Z. M., To, K. M. C., & Ng, K. P. R. (2005). Structures of textile-apparel supply chain: concepts and cases. *Journal of Dong Hua University (English Edition)*. Retrieved from <https://core.ac.uk/download/pdf/84389926.pdf>
- Carpenter, E. J., Anderson, S. J., Harvey, G. R., Miklas, H. P., & Peck, B. B. (1972). Polystyrene spherules in coastal waters. *Science*, 178(4062), 749-750. doi: [10.1126/science.178.4062.749](https://doi.org/10.1126/science.178.4062.749)
- Carpenter, E. J., & Smith, K. L. (1972). Plastics on the Sargasso Sea surface. *Science*, 175(4027), 1240-1241. doi: [10.1126/science.175.4027.1240](https://doi.org/10.1126/science.175.4027.1240)
CrossRef Google Scholar
- Eunomia. (2016, June). Plastics in the Marine Environment. Retrieved from https://safety4sea.com/wp-content/uploads/2016/06/Eunomia-Plastics-in-the-Marine-Environment-2016_06.pdf
- Ferris, A. (2018, September 12). Parkdale Mills and Intrinsic Textiles team up to reduce synthetic microfiber pollution and textile waste. Retrieved from <https://www.parkdalemills.com/2018/09/12/parkdale-mills-and-intrinsic-textiles-team-up-to-reduce-synthetic-microfiber-pollution-and-textile-waste/>
- Geyer, R. (2018, March 12). Microfibers in Context: Global plastic production, use, and releases. [Webinar]. In AATCC RA100 Webinar Series.
- Hodgson, N. (2015, July 2). Microplastics, Microfibers, Pollution and...The Outdoor Industry. Retrieved from <https://outdoorindustry.org/article/microplastics-microfibers-pollution-and-the-outdoor-industry/>
- Horwitch, R. (2018, September 12). Microfiber Discharge: What should you do? [Webinar]. In AAFA Webinar Series. Retrieved from https://www.aafaglobal.org/AAFA/Events/Event_Display.aspx?EventKey=WEB180912&WebsiteKey=49c45f4d-69b3-4c66-823a-6d285960fed2
- Jensen, B. (2018, March 20). Microfibers and the Outdoor Industry. [Webinar]. In AATCC RA 100 Webinar Series.
- Kolberg, A. (2017, September 13). Initiative against Micro-plastic Release in Environment Sporting Goods Manufacturers Conduct a Research in Collaboration with Two Universities and an Environmental Organisation. Retrieved from https://csr-report.vaude.com/gri-wAssets/pdf/News-2017/Press-Release_TextileMission_13.09.2017_en.cleaned.pdf
- Le, K. (2017). Microfiber Shedding: Hidden Environmental Impact. *AATCC Review*, 17(5), 30-37.

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MangoMaterials. (n.d.) Retrieved from <http://mangomaterials.com/application/s/>

MERMAIDS. (n.d.) Retrieved from <http://life-mermaids.eu/en/>

O'Connor, M.C. (2017, May 25). Your Fleece Jacket Pollutes the Ocean. Here's the Possible Fix. *Outside*. Retrieved from <https://www.outsideonline.com/2179411/your-fleece-jacket-pollutes-ocean-heres-possible-fix>

O'Connor, M.C. (2018, August 16). As Synthetic Microfibers Infiltrate Food, Water and Air, How can we Prevent Future Release?. *GreenBiz*. Retrieved from <https://www.greenbiz.com/article/microfibers-infiltrate-food-water-and-air-how-can-we-prevent-future-release>

Outdoor Industry Association (OIA). Retrieved from <https://outdoorindustry.org/sustainable-business/>

RA100 Global Sustainability Technology. (n.d.) Retrieved from https://members.aatcc.org/4DCGI/committees/Roles.html?Action=Show_Comm_Roles&CommCode=AATCCR_A100&Name=Officers&Status=Active

Thompson, R. C., Olsen, Y., Mitchell, R. P., Davis, A., Rowland, S. J., John, A. W., ... & Russell, A. E. (2004). Lost at sea: where is all the plastic?. *Science*, 304(5672), 838-838. Retrieved from <https://www.jstor.org/stable/3836916>

VAUDE. (n.d.) Retrieved from <https://www.vaude.com/en-INT/>

Weis, J. S. (2018). Cooperative Work is Needed Between Textile Scientists and Environmental Scientists to Tackle the Problems of Pollution by Microfibers. *Journal of Textile and Apparel, Technology and Management*, 10(3).

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