A growing concern for the textile and apparel industry, microplastic pollution is the subject of intense scientific research, not to mention media attention. Many questions remain as to how textiles shed microfibres, what pathways they take to reach the world's waterways and what happens to them once they are in an aquatic environment.

# The rising tide of microplastics

Microplastic and microfibre pollution awareness is rising globally. It has been the subject of many a documentary and has attracted widespread media attention, spurring the sportswear industry and its suppliers to address the issue. But the science, and with it reliable data and the development of validated testing protocols, follows a much slower time cycle. With each new research study and report, more questions arise: what contributes most, tyres or textiles? Are natural fibres less harmful than synthetics?

Knowledge of microplastic marine pollution took a significant step forward as a result of work conducted by Julien Boucher and Damien Friot for the International Union for Conservation of Nature (IUCN). Their research 'Primary Microplastics in the Oceans: a Global Evaluation of Sources', published in 2017, focused on primary microplastics of petrochemical origin. It found that nearly two-thirds (63.1%) of all releases come from two sources: the laundry of synthetic textiles (34.8%), followed by the erosion of tyres (28.3%). But the authors point out that their research did not include natural rubber. If it had, they estimate that tyres would contribute nearly half of all releases (46.2%). Textiles would then fall back to second place, while nevertheless remaining a significant contributor, of course.

## Natural versus synthetic

While polyester fleece was, at first, thought to be the main guilty party in microfibre shedding, there is mounting evidence that all fabrics shed microfibres and that natural fibres that find their way into the oceans do not degrade as much as expected. New data on the type of materials found in oceans has been brought to light by a team of researchers at the Marine Biology and Ecology Research Centre in Barcelona and Plymouth University in the United Kingdom ('The imprint of microfibres in southern European deep seas', published in November 2018 by *PLOS One*, a scientific journal).

The team developed a testing protocol that sought to remove all possible sources of contamination during the extraction, transport and identification of samples taken from six regions (the Cantabrian, Alboran, Catalan, Cretan, Levantine and Black Seas) and in depths of up to 2,000 metres. In the team's findings, cellulose was the most abundant (79.7%), followed by polyester (12.9%), acrylic (4.5%), polyamide (1.0%), polyethylene (1.0%) and polypropylene (1.0%). It concludes that "the main type of microfibre found in seafloor sediments was thus essentially not plastic but cellulose fibres, that consisted of both dyed natural cellulose (cotton, linen) and manufactured fibres composed of regenerated cellulose, for example, rayon."



*As part of its efforts to reduce its environmental footprint, German membrane manufacturer Sympatex is funding a study on a coating-based solution and working with Netherlands-based Plastic Soup Foundation.*

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*Polartec has engineered its new Polartec Power Air to reduce fibre shedding and plans to extend the concept to other fabrics.*

*Polartec*

These findings are backed by data collected by a research team led by Thomas Stanton at Nottingham University and published in *Science of the Total Environment* in February 2019. The paper, 'Freshwater and airborne textile fibre populations are dominated by natural, not microplastic, fibres', details the results of a twelve-month research project investigating microfibre pollution in the River Trent and atmospheric deposition within its catchment area. In the 223 samples collected, natural textile fibres made up 93.8% of the textile fibre population quantified. The authors are careful to point out that the biodegradability of natural textile fibres is believed to reduce their environmental threat. They also note that spectroscopy used identifying these invisible textile fibres may not be the most accurate method, drawing attention to one of the key problems here: what testing protocol and equipment is suitable to identify these tiniest of material scraps.

The presence of natural fibres has been found not only in oceans but also in the air we breathe through atmospheric fallout (settling dust). A report measuring these in Paris found that 50% of the fibres were natural (cotton, wool), whereas the rest were semi-synthetic, synthetic or mixed, as Joana Correia Prata, environmental researcher at the University Fernando Pessoa, in Porto, Portugal, told *WSA* in reference to a 2016 study. But she says: "The proportion of natural and synthetic fibres is unknown due to a lack of efficient identification procedures. These fibres of small sizes, or microfibres, are difficult to identify by microscopy and chemical characterisation requires expensive equipment capable of working at micro scale. Thus, new methods of microfibre identification are still being developed to allow a proper quantification of environmental contamination."

In her research paper 'Microplastics in wastewater: State of the knowledge on sources, fate and solutions', Ms Correia Prata outlines four specific ways in which the production of textiles can be improved to reduce the release of microfibres. These include: improving knitting techniques (Almroth et al., 2017); combining synthetic and natural textiles (Napper and Thompson, 2016); applying textile coatings (such as silicon emulsions; Cocca et al., 2017); and



*The new biodegradable recycled polyester filler developed by Primaloft will be introduced by Helly Hansen, Houdini, L.L.Bean, Norrøna and Vaude in the fall of 2020. It is designed to address the eventual end of life of a garment in an impactful way, according to PrimaLoft, while finding a solution for the industry-wide microplastics issue.*

*Houdini*

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*Seaqual is an innovative organisation that seeks to clean up the oceans, find recycling solutions for the waste retrieved and raise awareness at consumer level. It recycles ocean plastics into polyester fibres and plastics.*

Seaqual

eliminating loose fibres during production (Almroth et al., 2017). While she admits that it is impossible to prevent textiles from shedding fibres, she says it seems sensible "to reduce the release of fibres at source, such as in the production stage".

Several textile manufacturers have begun to address this issue. Thermal insulation specialist Primaloft is shifting its product ranges to biodegradable recycled polyester yarns to reduce their impact on the environment when released. Fleece manufacturer Polartec has adopted a similar strategy, shifting to biodegradable recycled polyester yarns, and it is also developing innovative knit structures designed to reduce shedding, as it claims its new Polartec Power Air does.

Sympatex, a maker of a polyester waterproof breathable membrane, is funding a research project on a coating that could reduce microfibre release. The study is conducted by the Polymers, Composites and Biomaterials Institute of the Italian Research Council (IPCB-CNR), an organisation headed by Maurizio Avella, who coordinated research that led to the launch of the Ocean Clean project by Dutch NGO Plastic Soup Foundation.

## The shores versus the deep sea

During a panel talk on ocean plastics at Performance Days last November, Christian Lott, a marine biologist, insisted that plastics all come from the land, and coasts should be the focus of ocean clean-up schemes. "Every tide delivers a new load of plastics that is relatively easy to collect compared to pollution at large or in the deep," he says. Others point out that greatest biodiversity is believed to be found in coastal areas.

The presence of cellulose microfibres in oceans does not surprise or concern Dr Jesse Daystar, chief sustainability officer at Cotton Incorporated. He points out that cellulose is a natural



*Parley for the Oceans, an NGO, has played a key role in raising awareness among brands and consumers as to the threat microplastics pose, teaming up with adidas for many of its campaigns.*

adidas

material, one of the world's most abundant polymers and present in pretty much all plants and trees. It is deliberately ingested by many life forms (as a source of food and fibre). It is also a component of textiles, paper and hygiene products. For example, toilet paper, which consists primarily of cellulose, is disposed of directly into water, and then travels for further degradation to wastewater treatment plants in places where this type of facility exists.

The cotton research and promotion organisation is involved in several microfibre research projects. One of these, a study by a research team at North Carolina University also funded by the Cotton Research and Development Corporation of Australia (CRDC), found that cotton and rayon microfibres do degrade in natural aquatic aerobic environments much faster than polyester microplastics. This study's findings are detailed in 'Microfibres generated from the laundering of cotton, rayon and polyester based fabrics and their aquatic biodegradation', published in *Marine Pollution Bulletin* in February 2019.

## Group action

As seen, the industry is actively supporting research studies. It is also collaborating widely so as to coordinate efforts.

Among the multiple stakeholder initiatives, the Plastic Leak Project is one of the more recent ones, launched in Paris in February 2019 by consulting firm Quantis and EA, an eco-design research centre based in Switzerland. It is supported by many companies, including adidas, Cotton Inc., Decathlon, Eastman and Sympatex as well as McDonalds. It intends to add microfibre leakage to standard Life Cycle Assessments (LCAs), to help the industry better understand its responsibility and make it possible to compare options. Laura Peano, a project manager at Quantis, says the guidelines for textiles will be

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tested at corporate and product development level, but the project will also be focusing on macroplastics from packaging and microplastics from tyre abrasion.

Textile Mission is an initiative coming out of Germany. It was launched in 2017 by the Federal Association of the German Sporting Goods Industry with research teams at the Niederrhein University of Applied Sciences in Krefeld and the Technical University of Dresden. Its partners in clothing and textiles include adidas, Polartec and Vaude along with detergent producer Henkel and washing machine manufacturer Miele. Results are expected to be published in August 2020.

Yet another collaborative effort, known as the Cross-Industry Agreement (CIA), was set up with three main objectives: define a test method, share knowledge and support industrial research. Its members include five industry associations: the International Association for Soaps, Detergents and Maintenance Products (A.I.S.E.), the European Man-Made Fibres Association (CIRFS), the European Apparel and Textile Confederation (Euratex), the Federation of the European Sporting Goods Industry (FESI) and the European Outdoor Group (EOG).

The Microfibre Consortium (TMC) is a member-based non-profit organisation that focuses on integrity, product development and manufacturing. This project grew out of a 2016 crowd-funding campaign, #DontFeedTheFish, launched by UK textile consultancy biov8tion. It is supported by the EOG and became a standalone organisation early this year, with Dr Katy Stevens, the EOG's head of CSR and sustainability, as its technical director, and Sophie Mather, material futurist at biov8tion as its strategic director and chair.

## The particulars of marine pollution

Ocean pollution researchers make a distinction between plastics and microplastics; the first are visible, the second virtually imperceptible, as they measure less than 5mm and may originate from textiles. Identifying the nature of these minute particles is proving to be difficult and requires high-tech testing equipment.

The distinction between primary and secondary microplastics is also often drawn in marine pollution studies. Primary microplastics are considered to be materials that enter the oceans in their manufactured state (such as cosmetic microbeads) or are the result of abrasion during use, as in the laundering of textiles or the erosion of tyres. The term secondary microplastics is used to describe large plastics that have broken down via photodegradation or other weathering processes.

For the moment, industry-led initiatives have taken precedence over regulation and legislation. Microfibre labelling bills in California and New York State were defeated last year, but the state of Connecticut did pass a law in May 2018 that included, among a series of environmental actions, the establishment of a working group on microfibre pollution. The California legislation would have called for brands to add a label to clothing containing more than 50% synthetic materials instructing consumers to hand wash the items instead of machine-washing them. A challenge both to manufacturers and to consumers.

Far from avoiding the issue, textile and clothing manufacturers are actively investing in research. It is admittedly difficult to implement any measure pertaining to choice of raw materials or processing methods in the absence of consistent and reliable data and testing protocols. Microplastic marine pollution is a priority for many and though awareness is high, solutions are slow to come to the surface.



*Outdoor brands, including Vaude, are backing bids to establish exactly what contribution fibres from clothing are making to the problem of microplastic pollution.*

Vaude

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