Penn scientist says polyester causes microplastics load

Polyester and other synthetic fibres like nylon are major contributor to microplastics load in the environment, according to a Penn State materials scientist, who suggests switching to biosynthetic fibres will solve the problem. Unlike natural fibres like wool, cotton and silk, current synthetic fibres are petroleum-based and are mostly not biodegradable.

"These materials, during production, processing and after use, break down into and release microfibers that can now be found in everything and everyone," said Melik Demirel, Lloyd and Dorothy Foehr Huck Endowed Chair in Biomimetic Materials.

While natural fibres can be recycled and biodegrade, mixed fibres that contain natural and synthetic fibres are difficult or costly to recycle.

Islands of floating plastic trash in the oceans are a visible problem, but the pollution produced by textiles is invisible and ubiquitous. In the oceans, these microscopic plastic pieces become incorporated into plants and animals. Harvested fish carry these particles to market and, when people eat them, they consume microplastic particles as well.

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Demirel suggested four possible approaches to solving this problem at the 2019 annual meeting of the American Association for the Advancement of Science in Washington, DC. The first is to minimise the use of synthetic fibres and switch back to natural fibres such as wool, cotton, silk and linen. However, synthetic fibres are less expensive and natural fibres have other environmental costs, such as water and land-use issues.

Because much of the microfibre load that ends up in water sources comes from laundering, he suggested aftermarket filters for washing-machine outflow hoses. Clothes dryers have filters that catch lint – also microfibre waste – but current, front-loading washing machines usually do not.

"Capturing the microplastics at the source is the best filtering option," said Demirel.

He also notes that bacteria that consume plastics do exist, but are currently at the academic research phase, which takes some time to gain industrial momentum. If bacteria were used on a large scale, they could aid in biodegradation of the fibres or break the fibres down to be reused.

While these three options are possible, they do not solve the problem of the tons of synthetic fibres currently used in clothing around the world. Biosynthetic fibres, a fourth option, are both recyclable and biodegradable and could directly substitute for the synthetic fibres. They could also be blended with natural fibres to provide the durability of synthetic fibres but allow the blends to be recycled.

Derived from natural proteins, biosynthetic fibres also can be manipulated to have desirable characteristics. Demirel, who developed a biosynthetic fibre composed of proteins similar to silk but inspired by those found in squid ring teeth, suggests that by altering the number of tandem repeats in the sequencing of the proteins, the polymers can be altered to meet a variety of properties.

For example, material manufactured from biosynthetic squid ring-teeth proteins, called Squitex, is self-healing. Broken fibres or sections will reattach with water and a little pressure and enhance the mechanical properties of recycled cotton as a blend. Because the fibres are organic, they are completely biodegradable.

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The Army Research Office, Air Force Office of Scientific Research and the Office of Naval Research supported the squid-inspired biosynthetic material. Demirel is the co-founder of a company planning to commercialise Squitex. (SV)

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