Filtration as an effective and near-term solution to reduce the release of microplastics in the environment.

Authored by:
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Contents

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Introduction

The United Kingdom has already taken major steps to reduce plastic pollution. Despite this progress, the potential environmental impacts of all plastic pollution, including microplastics, remain a source of concern. MP Alberto Costa has proposed a Microplastic Filters (Washing Machine) Bill that would require manufacturers to install microplastic-catching filters in new domestic and commercial washing machines.

We support this private members Bill and believe it could serve as an influential example of best practice globally. Microplastics have been on the political agenda across the world recently with the EU, France and various states in the US, exploring solutions that will reduce this environmental pollution - including legislating for washing machine filtration.

Alberto Costa's Bill will support the UK Government's Plan For Water[1], which aims to tackle harmful pollutants such as microplastics.

Microfibre filtration technology is readily available to solve the problem and being led by a number of British companies already working with international partners. By introducing this Bill the UK has the opportunity to show significant leadership in tackling microplastic pollution and support a number of British green technology innovators.

A recent poll found that 71% of UK respondents agree that the government should mandate for filtration.[2]

This whitepaper calls for the mandate of filters in new washing machines as the only effective, near-term solution to reduce the release of microplastics in the environment and presents three innovations that have been tested to high standards and are available now for commercial or industrial use.

This is part of a wider call for systemic change in the industry, which looks at policy and regulatory action to disincentivise synthetic textile production and hold those producers accountable for the impacts of their products.

What are microfibres and why are they harmful?

Microfibres (fibres less than 5mm) from synthetic textiles are polluting our environment and contributing to the global plastic crisis. It's estimated that UK laundry alone generates an average of 17,234 tonnes of microfibres each year (250g per person), weighing the equivalent of around 1,500 double-decker buses.[3]

Natural, man-made cellulosic and synthetic materials all shed microfibres. However, synthetic textiles are now thought to be the most prevalent source of primary microplastics found in the world's oceans.[4]

Domestic laundering of textiles is being increasingly recognised as a notable source of microfibre pollution.

Microplastics are a pervasive environmental problem; they have infiltrated the most pristine locations on Earth, from Antarctic sea ice[5] to the guts of marine animals inhabiting the deepest ocean trenches.[6] They have been found in drinking water[7] and food systems.[8] It is estimated that 5.6 million tonnes of synthetic microfibres were emitted from clothes washing between 1950 and 2016, with half of this amount being discharged between 2006 and 2016.[9]

According to a report by the Ellen MacArthur Foundation, based on current trends, the amount of synthetic microfibres entering the ocean between 2015 and 2050 could accumulate to an excess of 22 million tonnes.[10]

It is reported that microplastic pollution has increased 10-fold since 2005, with over 171 trillion microplastic particles now floating in our oceans.[11] This figure was calculated from surface water data gathered between 1979 and 2019. Scientists predict this figure will increase a further 2.6-fold from 2016 – 2040.[11]

The negative impacts of microplastic pollution on wildlife have been widely documented. Synthetic microfibres, such as polyester and nylon, can impact animals' survival, growth and energy balance,[13] and reproduction.[14]

Microfibre vs Microplastic

Microplastic: Microplastics are small fragments of plastic that occur in the environment as a consequence of plastic pollution. Measuring anywhere between 0.1µm and 5mm (see figure 2) they can originate from a variety of plastic consumer products. Synthetic microfibres are considered microplastics.

Microfibre: The use of the word microfibre thoughout this document refers to textile fibres shed from clothing throughout a product lifecycle. Microfibres measure <5mm in length and >1µm and can be natural, man-made cellulosic or synthetic.

Synthetic fibres: Synthetic fibres are man-made polymers that are often derived from fossil fuels. These polymers include nylon, polyester and acrylics.

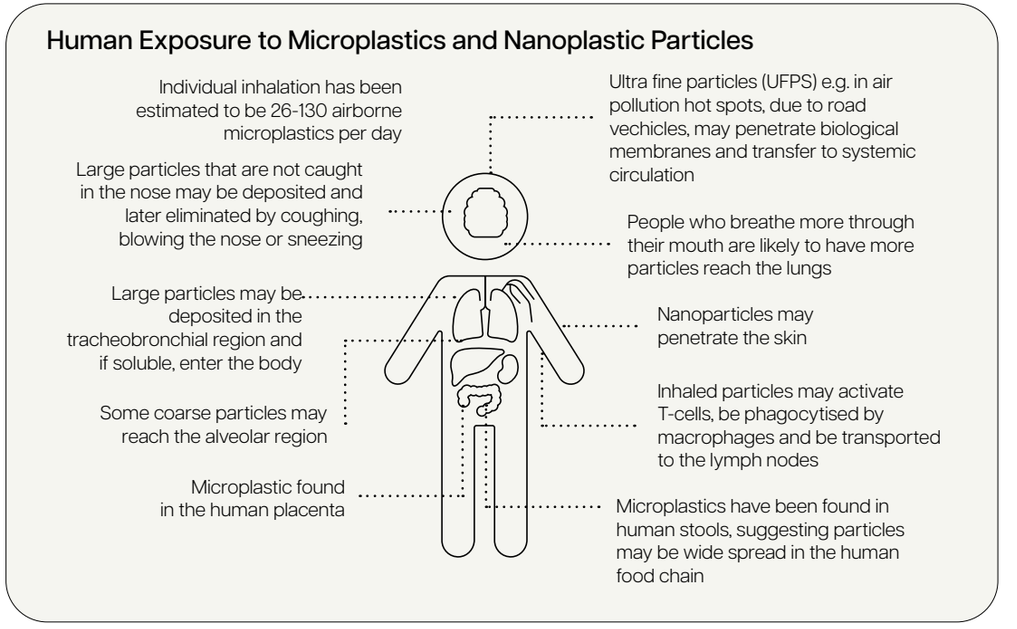
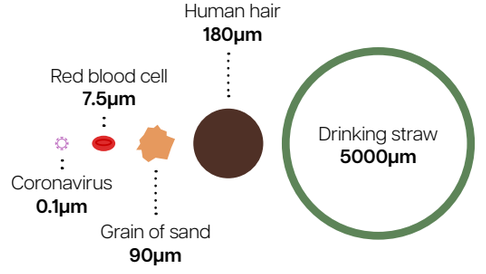


Figure 1: Human Exposure to Microplastics and Nanoplastic Particles (Credit United Nations Environment Programme (Unep). From Pollution to Solution - A Global Assessment of Marine Litter and Plastic Pollution).[12]

Microplastics are pervasive in the environment, but also in the human body. They have been found in stools[15], blood[16], lung tissue[17,18,19] breast milk[20], and the placenta[21]. Most recently, microplastics were found in the brain and have been shown to cause behavioural changes in mice.[22]

More research is needed to understand how microfibres impact human health. In laboratory tests, microplastics have been shown to cause damage to human cells, including both allergic reactions and cell death.[24]



µm = micrometre

Figure 2: Items comparable in size to a microplastic: Svalbardi. Microplastics Found In Drinking Water.[23]

A 2022 report by Plastic Soup Foundation presented a compelling range of studies highlighting potential health risks associated with microplastics.[25] For example, one study found that children under the age of 6 inhale 3 times more microplastics than an average adult and that children are most likely to be at risk from adverse effects of microplastics because their systems are developing.[26]

Further various studies suggest high exposure to microplastics may lead to dementia symptoms. A recent study from Duke University School of Medicine found that a high exposure to nanoplastics could affect a specific protein in the brain and could be the cause of changes linked to Parkinson's disease and other types of dementia. Parkinson's disease is now considered the fastest growing neurological condition in the world.[27,28]

Microfibre shedding and textiles

There are several sources of microfibres and various pathways through which they enter the environment. These include the production and disposal of textiles but also everyday acts such as wearing and washing our clothes.

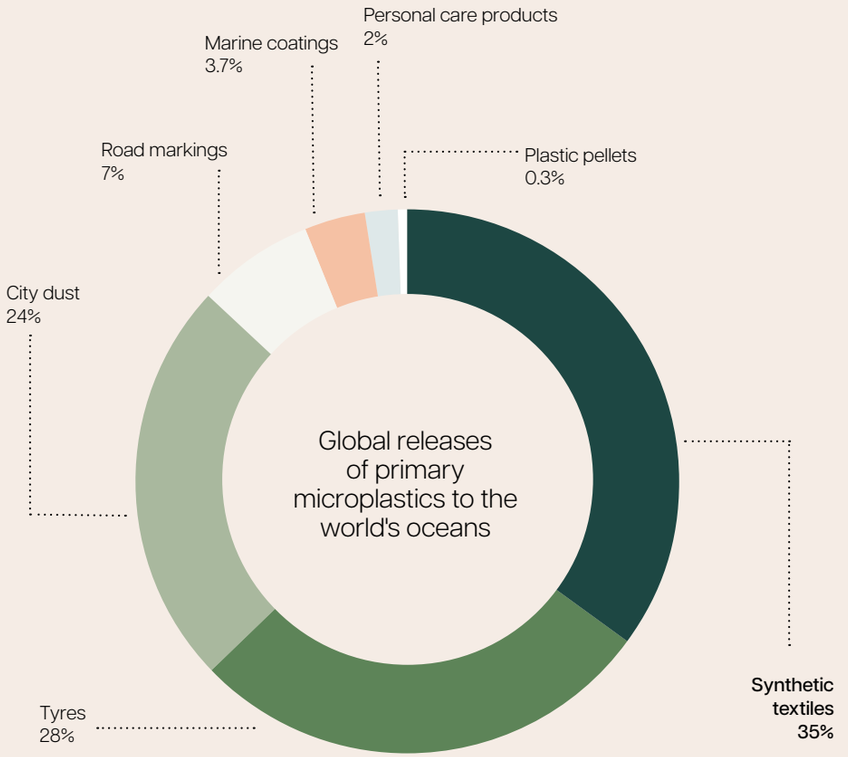


Figure 3: Global Releases of Primary Microplastics to The World Oceans
(Credit: International Union for Conservation of Nature[4])

According to a report by the International Union for Conservation of Nature, synthetic fabrics, such as polyester, acrylic or elastane, are the biggest source of primary floating microplastics in the world's oceans, accounting for 35% of the total.

Microfibres are released during textile manufacturing, everyday consumer activities (washing, drying, wearing) and the disposal of clothes. Studies show that most textile-based primary microplastics are released in the consumer use and laundry phases.[29,30]

Textiles shed microfibres during washing due to the effects of water, friction and abrasion, and detergents.[31] Shedding varies between fabrics and materials, but research shows that **some garments can shed hundreds of thousands of microfibres in a single laundry load.**[32]

Synthetic fibres are also so inexpensive that they have become ubiquitous in fast fashion.[33] They currently represent a 69% textile market share, and this figure is expected to reach almost 75% by 2030 (a total of more than 101 million tonnes).[33]

Growing demand for fast fashion and the proliferation of synthetic textiles means plastic microfibres are expected to increase. This is concerning due to the persistence of microplastics in the environment, which poses a serious ecological and public health risk.

Emerging concerns about natural microfibres

While we know that microfibres from synthetic textiles are seen as one of the major causes of microplastic pollution, there is increasing evidence that microfibres from natural sources, such as cotton and wool, may also be of environmental concern.

Natural fibres have often been overlooked and ignored despite the ecotoxicological risks posed by chemical dyes and finishes that are added to the fibres during processing. A study into the biodegradability of cotton showed that the time it takes for cotton to biodegrade would in part depend on the finishes applied during production.[34] Yet natural fibres may also not be as biodegradable as we once thought.

A recent project, Restorying Riverscapes, studied a 25cm sediment core from Rudyard Lake in Staffordshire, to investigate how the types and quantities of microfibres in our environment have changed over time. The study found cotton to be the most common microfibre type identified throughout the sediment core and natural microfibres in general persisted in the deepest and oldest layers of sediment samples taken.[35]

In addition, a 2021 study examined the effects of three types of microfibres on brine shrimp (Artemia franciscana). The results indicated that gut damage occurred in all exposure groups of synthetic and natural microfibres. This gut damage induced by all three microfibres eventually led to adverse effects and mortality for the shrimp, highlighting the harmful effects of microfibres, regardless of the polymer type[36]

Therefore, while microplastics originating from synthetic sources have been widely studied and addressed, the presence of microfibres from natural materials should not be overlooked.

A comprehensive approach to mitigating all types of microfibre pollution is necessary in order to minimize environmental impacts.

Microfibre shedding and textiles

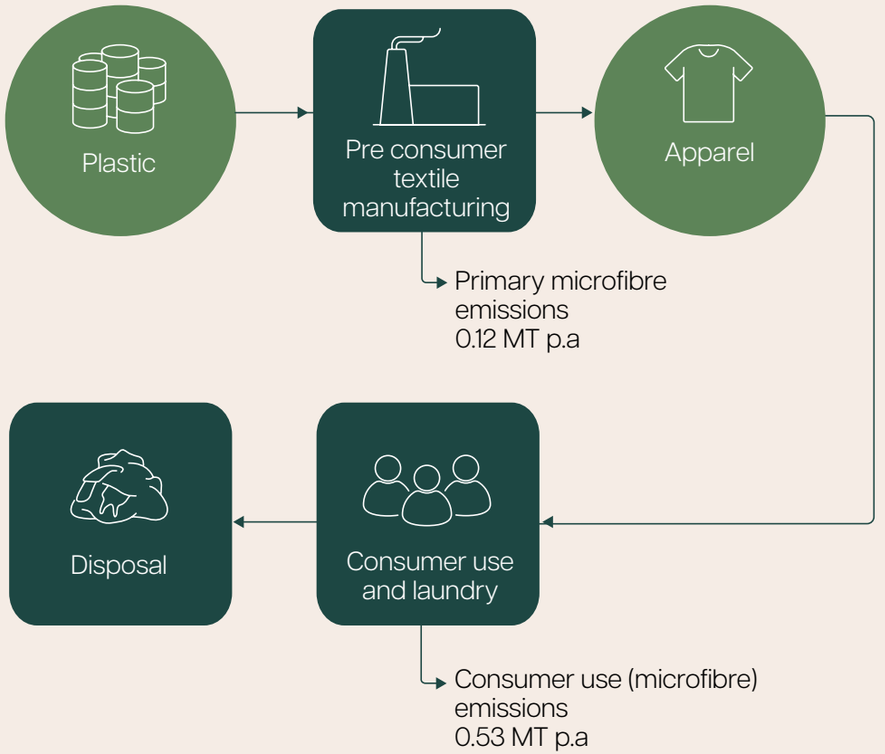


Figure 4: Release of Textile-Based Primary Microplastics
(Credit: The Nature Conservancy and Bain & Company[37])

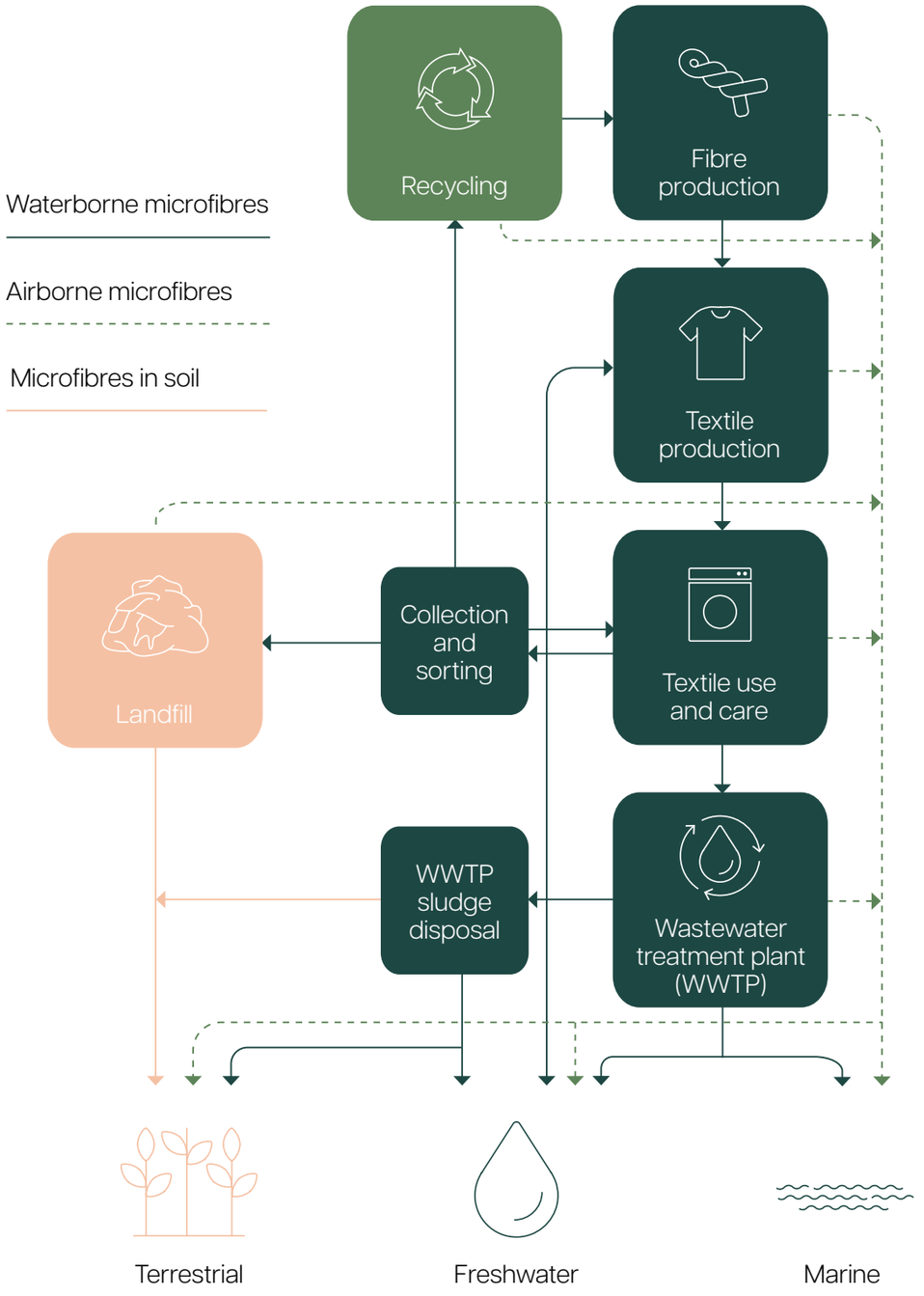


Figure 5: Microfibres Emitted Into the Environment During the Textile Production Chain
(Credit: UNEP Sustainability and Circularity in the Textile Value Chain).[31]

Solutions to microfibre pollution from textiles

A variety of solutions are needed to reduce the release of microfibres in the environment. The fashion and laundry industries must undergo significant transformations, with fundamental changes required.

There are a number of solutions already in development at differing levels of maturity. Whilst there is growing awareness and action in the fashion sector, recent research highlighted that of 46 of the largest fashion brands surveyed in 2021, none had detailed strategies of how they would reduce their microfibre impact and a quarter had no mention of microfibres at all on their website or in response to the research.[33]

There are a number of existing regulatory measures with the in UK relating to water and plastics, including The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, the 2018 ban on plastic micro-beads in products, extended producer responsibility measures, and the 2015 carrier bag levy. Yet, regulation specifically targeting microfibre release is nascent and underdeveloped.

The 2019 report commissioned by the Environmental Audit Committee (EAC), Fixing Fashion[38], cited microfibre pollution as problematic and proposed the following recommendation: "the Government should facilitate collaboration between fashion retailers, water companies and washing machine manufacturers and take a lead on solving the problem of microfibre pollution. In this section we highlight important remedies needed to mitigate microfibre pollution and their current status.

1 Reduction of synthetics

The fast fashion industry relies on cheap fossil-fuel based materials. Reducing the production and use of synthetic textiles should be a critical focus of any policy and regulatory action when looking at the fashion industry's impact on microplastic pollution. Synthetic fibres represent over two-thirds of textiles, which is is predicted to rise to 73% by 2030.[33]

Policymakers must implement measures that would lead to a reduction in synthetic fibres as a way of curbing fast fashion and reducing microplastic pollution.

Figure 6: Upstream and Downstream Solutions to the Microfibre Pollution Problem.

2 Material design

Upstream, one of the most effective remedies is textile redesign. Changes to the materials and production processes used by manufacturers are critical for reducing leakage of microfibres into the natural environment.

Research shows that woven fabrics release fewer microfibres than knitted ones into water when they are washed or into the air through everyday use.[39] Compact textiles, made up of high twist, high-density yarns and low hairiness, release fewer microfibres, as do those consisting of yarns made of continuous filaments instead of short staple fibres.[40]

But improving material design and manufacturing processes is still only in its initial phase and therefore cannot be considered a near-term solution to tackling the microplastic problem. Furthermore, the majority of existing clothes do not have these design features and therefore will continue to shed large amounts of microfibres. This solution requires a major mindset shift towards a more circular way to make and buy our clothes.

3 Wastewater treatment

Wastewater treatment has potential to be an effective long-term solution for reducing microplastics in the environment but currently it isn't fit for purpose. In developed countries, most wastewater goes through a wastewater treatment plant (WWTP) where it is treated before entering aquatic environments. WWTPs can be highly efficient at removing microplastics from final treated discharge through membrane bioreactors, rapid sand filtration and filters,[41] with removal rates ranging between 80 – 99%.[42]

However, as stated in the UK's Plan For Water,[1] in view of the large volumes of discharge in question, the remaining proportion still represents a significant volume and therefore environmental hazard. For example, a study on a modern treatment plant in the UK found that, despite the efficient removal rates of microplastics, 65 million microplastics were still being released into the receiving water every day from this one plant.[43]

Furthermore, **the majority of microplastics captured in wastewater treatment end up in sewage sludge,[44] which is commonly used as organic fertiliser.**[45] In the latter, this is a requirement of EU directives promoting a circular waste economy.

According to the water industry, around 78% of the UK's treated sludge – 3.5m tonnes [46] – is spread over agricultural land each year. Microplastics can penetrate deep into the soil profile, potentially contaminating groundwater or entering aquatic environments via runoff.[47] Microplastics have been found up to 90cm (35in) below the surface on agricultural fields where sewage sludge had last been applied 34 years ago.[48]

Even more worryingly, it is not uncommon for WWTPs to experience spills in which untreated sewage is discharged directly into water bodies. Water companies in the UK released untreated sewage for a combined total of 2.7 million hours in 2021, according to the Environment Agency.[49]

WWTPs process such a high volume of wastewater, that even a 1% failure to capture translates as an environmental and human health hazard.

It's been estimated that it could take multiple decades and cost up to £56 billion[50] to update the UK's current water infrastructure. In the meantime, microfibres will continue to enter water bodies during sewage spills and via broken and damaged infastructure, unless prevented at point of release.

4 Filtration

By contrast with longer-term production and disposal changes, microfibre capture solutions are effective and commercially available now.

Filtration is therefore the best applicable, near-term solution to deal with this ever-growing problem.

Microfibre filtration solutions

We have presented three innovative filtration technology solutions that are effective at reducing the microplastic problem and are available in the near-term.

1 PlanetCare

https://planetcare.org/

PlanetCare is a leader in microfibre filtering solutions. As early as 2019, PlanetCare put the **first purpose-built, retrofit, external microfibre filter on the market and now has several thousand users around the globe.** The retrofit filter is a passive device that fits all domestic-type washing machines. It is attached directly to the washing machine drain pipe and does not raise water and energy use. The filtration occurs in an exchangeable filter cartridge. Due to its innovative structure, the cartridge offers high fibre capture rates and has an extended lifetime before it needs to be replaced. The current replacement rate is once per month. Cartridges are part of a closed-loop circular, return-and-reuse scheme through which customers return used cartridges for refurbishing. Cartridge bodies are efficiently reused several times and fibre release is avoided due to controlled disassembly and cleaning. A benefit from this scheme is a faster ramp-up to waste quantities that can support a dedicated recycling process.

PlanetCare technology was tested in the Zero Microplastics Challenge conducted by the Swedish RISE Institute in 2020 where it was found to have "the best technical function for removing microfibres along with the lowest environmental impact". In a demanding test with fibres from a real washing process, the capture rate of the filter was 90 %.[51]

Based on the proven cartridge technology PlanetCare also offers a large-capacity microfibre filter adapted for use in commercial washing machines that require efficient fibre capture in a small-footprint. A sturdy and reliable filter adapted to high water flows.

PlanetCare is actively working on the development of an integrated filter for domestic washing machines that will be included in next-generation washing machines. The solution is characterised by an automatic function that is invisible to the user and requires no consumables. Users will only need to remove fibres as we do with tumble dryers, but at longer intervals. Work on industrialisation and integration into washing machines is currently underway with a target to have the new washing machines with integrated microfibre filtration on the market in time to meet first regulations in 2025.

PlanetCare has been a frontrunner in the efforts to establish microfibre filtration as a viable microplastic prevention method. They have raised awareness about microfibre pollution, working together with international organisations, NGOs and consumer groups and supporting policymakers in their efforts to put a stop to this pollution.

2 Matter

https://matter.industries/

Bristol based innovation company, Matter, is pioneering technology solutions for capturing, harvesting and recycling micropollutants.

With circular economy principles at the heart of its design, Matter's core technology is based on its patented 'self-cleaning' filter solution which uses a unique regenerative process to efficiently separate micropollutants from wastewater, whilst also eliminating the need for replacement disposable filters.

Matter's technology delivers high efficiency (capture rate), whilst minimising energy consumption and maintenance activity. Testing carried out in 2021 by the University of Glasgow, following the process set out by Napper et al. showed the filter had an average efficiency rate of over 90%.[52]

Matter's first commercial product is Gulp, a retrofittable filter that is compatible with all European domestic washing machines. Because the technology does not require replacement cartridges, there is no ongoing cost to maintain effective filtration – this significantly reduces the average cost per wash to the consumer compared to alternative filters. Usability has been prioritised to support continued use, and therefore maximise the impact of filtration. Gulp has also been designed for easy, flexible installation and works with both liquid and powder detergent.

Alongside Gulp, Matter is working with leading international appliance manufacturers to integrate their microfibre filtration technology into domestic and commercial washing machines. Through close engineering collaboration, Matter is helping these manufacturers to create the washing machines of the future, enabling them to meet future legislative and sustainability standards, whilst satisfying the increasing demands of eco-conscious consumers.

Beyond laundry filtration, Matter is delivering even greater impact through partnering with leading apparel brands, textile manufacturers and wastewater treatment providers to develop scalable filtration technology that can effectively address high-volume micropollution sources at scale.

Because Matter's self-cleaning technology does not bind the microfibre waste within the filter media, instead enabling it to be easily removed, the materials captured can be made available for re-use or recycling. The company is working with researchers and universities to develop new technologies for re-using captured microfibres as it aims to create a truly closed-loop system and keep this harmful pollution out of the environment.

3 Xeros Technology

https://www.xerostech.com/

UK-based green technology business, Xeros, has developed a patented filtration technology - XFilter (XF) which achieves a **99% microplastic capture rate** and is available at both a domestic and commercial scale.

The domestic version of the XFilter is available as either an external stand alone solution (XF^3), designed to function alongside any washing machine model, or as an internal filter (XF^1), which is designed to be integrated into any domestic washing machine during its manufacture. Both applications retain the same 99% microplastic capture rate and help trap the microfibres that our clothes release. To achieve the lowest lifecycle impact on the planet, the domestic XFilter is designed to last the lifetime of a washing machine with no replacement cartridges.

When the filter is full it can be easily removed to empty the trapped fibres into household waste (or recycling as and when this capability is developed) making it as simple as emptying the lint from your tumble dryer.

Independent tests, conducted by Hohenstein, a highly respected German testing institute for the textile industry, show it captures over 99% of microplastics.[53] The test analysed the retention rate of defined synthetic microfibres (microplastics) using an XFilter device that had been integrated into a washing machine.

XFilter is also very effective at capturing cellulosic fibres, which are chemically modified during the production process to be turned into clothing, reducing their ability to biodegrade. Studies show they can attract positively charged hazardous substances as well as pathogens.[54,55]

Cellulosic fibres, such as cotton, can be very challenging to filter. The smaller microfibres that break off from cotton escape more easily through filter mesh. In addition, the fragmented nature of the fibres means that as they are captured, they begin to form a 'cake' or film on the filter which leads to premature blockages, often before one wash cycle is even finalised. The XFilter technology is uniquely designed to minimise this film build-up – allowing much more time between emptying the collected microfibres.

XF^2, the industrial solution of XFilter, has the same effective capture rates as XF^1 but is designed to be compatible at a commercial scale. The XFilter can either be integrated directly into a commercial washing machine, or as a stand-alone unit that can be attached to a series of machines, or a whole laundry. The system incorporates a self-cleaning mechanism designed to last 60 wash cycles before it needs to be emptied. It only takes a minute to dispose of the fibres from the collection tray which is then put back into the XFilter to continue to collect further fibre fragments.

In the last 12 months Xeros has licensed their XF^1 technology to three European component suppliers to the washing machine industry. XFilter is engineered to work with any washing machine model to enable partners to scale this solution.

Xeros have also begun further exploration into larger scale industrial solutions for the textile industry.

Responses to the concerns about washing machine filters

Common objections to microfibre filtration are variously misconceived or a distraction from the clear, deliverable benefits these systems offer.

1

The microfibre problem should be addressed through textile design or through wastewater management systems.

Textile design is a necessary long-term solution but even with redesign, capture may still be necessary. For example, low-shedding materials may still shed a small amount of microfibres, or consumers may continue to use and wash older (high-shedding) clothing even after new designs are introduced. In addition, material design changes require a fundamental industry shift which will take time, with the fast fashion model (which prioritises cheap materials and rapid consumption of new clothing) showing no signs of slowing. The scale of the industry suggests this could take decades to implement.

WWTPs are very efficient at removing microplastics from final treated effluent, with removal rates of between 80 – 99%.[42] This still means an estimated 65 million microplastic particles are discharged every day in the effluent from each treatment plant[43]. The collected sludge is also often used as fertiliser[42,43] for agricultural land which raises the issue of hazardous microplastics contaminating soil and groundwater. It is not uncommon for WWTPs to experience spills in which untreated sewage is discharged directly into the environment due to the facility being under strain.[49]

It is clear that a near-term solution is required to stem the ongoing microfibre pollution problem while longer-term, fit-for-purpose solutions are developed.

2

Washing machine filters are an unjustifiable cost to mandate to consumers in the current economic climate.

Consumer willingness to pay for filters

Surveys indicate that consumers are willing to pay for washing machines with microfibre filtration technology, despite changing economic circumstances:

- PlanetCare's 2021 microfibre pollution survey on over 32,000 people found that 96.6% thought washing machines should already have filters that stop microplastic pollution and 84.8% would be willing to pay more for a filter.[56]
- An internal study conducted by Trinity McQueen in September 2021 of 2500 adults in the UK, Germany and France, showed that 95% would be willing to pay for filtration, with nearly half willing to pay an additional £70.
- In a 2020 study, 96% of respondents said they were interested in a product that tackles microplastic fibre pollution from domestic washing machines.[57] Cost was seen as a less important factor, but nonetheless something to carefully consider.
- A YouGov survey commissioned by the Marine Conservation Society found 81% of adults in Great Britain said they would support legislation requiring all new domestic washing machines to be fitted with microfibre filters.[58]
- A 2024 survey of UK adults found 82% of respondents would be willing to pay between £50 - £125 for a microfibre filter.[2]

Current Cost of filters

Industry are starting to bring washing machine filters to market as accessory products but the cost of filters are currently in excess of £100. This means they are out of reach for the majority of the public at present.

To distribute the product widely, which is necessary to tackle the microfibre issue, people from all socio-economic classes should be able to access the product. Mandating filtration would allow economies of scale and reduce the of price for individuals. A report commissioned by a well-regarded California economic firm, calculated the future cost of filtration at approximately $2 per household per year if manufacturers were to produce machines with integrated filters at scale[59]

Responses to the concerns about washing machine filters

3

Filters can have a negative impact on washing machine energy consumption and water efficiency

The majority of filters are passive and require very little additional energy and water to run.

- Filter specs and testing demonstrably contribute to an extremely small additional burden to the power consumption of the drain pump.
- In instances of active (motor-powered) filtration, in-house tests carried out at Xeros show the filter required an additional 0.0128kWh per wash cycle. This was compared to the energy use of an 'Eco 40-60 wash cycle' which was between 0.51kWh and 0.75kWh per cycle.

4

Consumers will be unwilling to take on the additional maintenance that comes with a filter.

Surveys indicate that consumers are willing to take on additional maintenance for washing machines with microfibre technology:

- A 2020 study investigating consumer attitudes towards filtration devices found that customers would be willing to spend an extra five minutes per cycle on the product. It also found that 95% of respondents would not mind cleaning the filter for 10 minutes every 15-17 washes.[57]
- A 2021 peer-reviewed study demonstrated that consumers were willing to collect lint captured by the filters and maintain them over 2 years.[60]
- Many consumers already capture and dispose of lint from dryers. Therefore, it is a valid assumption that consumers will also be willing to capture lint from washing machines.

5

There is no repeatable testing method for microfibre release available and that existing testing methods show variable results.

There are a number of robust and repeatable testing methods available which show consistent results:

- Hohenstein's analytical methods can determine the fibre release behaviour from textile surfaces and the fibre content in process and waste water.[61]
  - Quantification of fibre release and fibre length distribution with the Hohenstein method: Dynamic Image Analysis (DIA).
  - Gravimetric measurement of total abrasion by filtration according to the University of Leeds / Microfibre Consortium (UoL/TMC) method or AATCC TM212.
- The AATCC TM212-2021 test Method for fibre fragment release during home laundering, provides a standardized method for quantifying fibre fragment shedding. TM212-2021 results from extensive collaboration representing a broad range of stakeholders in the textile industry, public and private institutions, and technical experts in the Global Sustainability committee.[62]
- The Microfibre Consortium's TMC testing method quantifies fibre loss from fabrics which reflect that found in domestic laundering, during the initial washing cycle. Using ISO 105-C06 at its core, The Microfibre Consortium Test Method uses standard lab equipment and provides accurate comparable data, in a manner that can be scaled commercially across a range of facilities.[63]
- A 2020 study tested six devices to examine the efficacy of these devices at mitigating microfibre release from clothing during washing or capturing any microfibres released in the effluent.[51]
- A 2019 study ran wash trials at real scale were performed on commercial clothes by using a household washing machine in order to gain reliable data about the release of microplastics, and to identify possible influences of textile characteristics on the release.[64]

Responses to the concerns about washing machine filters

6

Filters that capture particles of 100 microns will clog, creating the need for bypass that will render them useless.

All of the solutions will either provide a warning signal to the consumer or instigate a machine stop, when filters need changing or cleaning.

If a filter is full mid cycle, the water may bypass the filter for that cycle to prevent damage to the machine but will not start again until the filter has been replaced, preventing a continuous bypass.

7

Washing machine manufacturers should implement microfibre solutions voluntarily.

While some manufacturers are introducing microfibre solutions to their products they are currently not required to meet any legal standards on filtration performance. Legislation would set high, ambitious standards ensuring manufacturers met satisfactory filtration rates.

Legislation would also stop companies from promoting unsatisfactory capture rates and prevent greenwashing.

Mandating filtration would create cost competition and economies of scale, reducing the cost to the consumer and increasing uptake.

In addition, legislation would set a deadline for industry adoption, ensuring that companies are taking meaningful action against microfibre pollution in a swift and timely manner.

8

This will be a new added waste stream that we don't know how to deal with.

Microfibre waste already exists and is processed through landfill or incineration. Therefore, this technology will not add a new waste stream.

Tumble dryer lint and dust particles in the vacuum cleaner also contain microfibres. Currently, it is preferable for these fibres to enter landfill or incineration as this ensures they are more contained and less likely to spread in the environment.

Research is being conducted by both academia and companies to find solutions to recycle, reuse and upcycle microfibres. This will however require a collection system to be in place.

In 2023, the University of Surrey and Xeros began research into upcycling microfibres captured through filtration into a useful and valuable carbon material, which can be used in various essential products such as batteries, solar cells and medical devices.[65]

PlanetCare offers a closed-loop takeback scheme to recover and manage the microfibres captured through its filtration technology. The recycled fibres are converted into insulation mats.[67]

Since 2021, Matter has been running its "Love Your Lint" programme offering consumers a return scheme for their tumble-dyer lint to be used for R&D purposes with over 1,000 consumers engaged. With the captured material, various example products have been produced to demonstrate recyclability, including composite "upcycled" plastics, insulation and the first steps towards a fully circular solution

Conclusion and call to action for legislators

Washing machine filters are the only available and effective solution that will reduce the release of microfibres into the environment in the short-term while longer-term solutions are developed.

By mandating washing machine filters, the United Kingdom could deliver on its existing frameworks relating to plastics and water pollution, including the Plan For Water, as well as the recommendations proposed by the Environmental Audit Committee (EAC) in 2019.

There are two critical and interlinked considerations for legislation that mandates washing machine filters:

1 Timeliness

Legislation to mandate washing machine filters must be brought into effect as soon as possible in order to have the biggest and most immediate impact on microplastic pollution.

2 Standards

The legislation must require a capture rate of at least 90% of microplastics for every wash cycle in order to have impact. The three solutions presented earlier in this whitepaper meet these standards.

Other important considerations for policymakers:

- Legislation must quickly determine testing processes (borrowing from industry best practices) and standards in an unambiguous way to drive clarity within the industry, and prevent further delay, obfuscation and loopholes.
- Legislation must not support or enable greenwashing. Misleading sustainability statements from washing machine manufacturers must be challenged vigorously.
- Industry-standard testing processes must be created in this space to ensure credible comparability and that consumers have confidence in the solution.

It's important to note that fast-acting legislation that allows for poor standards will not tackle the issue.

If Defra were to support these mandates, the UK would be showing real leadership in tackling microplastic pollution and supporting British green technology innovations.

The Plan For Water expects industry to develop low cost, effective microfibre filters on washing machines and encourage their effective use. However, whilst some washing machine manufacturers are taking proactive measures ahead of regulation, there is a number awaiting regulation before taking action. Timely, ambitious and robust legislation is therefore critical in moving the dial, accelerating innovation, and combatting the pervasive microplastic problem.

The conversations taking place around the UN Plastic Treaty in Paris in May and Nairobi in November last year, show that critical steps are already being taken to introduce binding global measures to tackle the environmental and health risks posed by microplastic and microfibre pollution by 2024.

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