Workshop on Microplastics from Synthetic Textiles: Knowledge, Mitigation, and Policy

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Summary note

Tuesday 11 February 2020, 9:00-18:00

OECD Headquarters, Paris

The Workshop on *Microplastics from Textiles: Knowledge, Mitigation, and Policy* was held at the OECD Headquarters on Tuesday 11th February 2020 in the context of the annual OECD Forum on Due Diligence in the Garment and Footwear Sector. The purpose of this workshop was to gather experts from industry, academia, international organisations and NGOs to discuss options to mitigate microplastics pollution originating from synthetic textiles and its impacts on the environment and human health. A detailed agenda is included at the end of this document.

Disclaimer: this summary note synthesises key insights from the presentations given at the workshop and from ensuing discussions. This information has not been independently verified by the OECD nor agreed upon by all participants. As the workshop was held under Chatham house rule, this summary note does not identify individual speakers nor their institution.

Framing the challenge

The natural environment is widely contaminated with microplastics, which are defined as plastic fragments, particles, or fibres with a diameter smaller than 5mm.[1] Microplastics released into the environment persist for a long time and accumulate in natural habitats, only potentially degrading into smaller and smaller microplastics.

The pervasiveness of microplastics in the environment raises concerns for the impacts that this type of pollution may have on the environment and human health. There is evidence that aquatic species, from planktons to large marine mammals, commonly ingest microplastics. These are being transferred across steps of the food chain and up to humans via the ingestion of contaminated seafood. Additional exposure pathways for humans are the inhalation of airborne microplastics (e.g. emissions originating from vehicle tyres) and the ingestion of contaminated drinking water and food.

In addition to the degree of *persistence*, *accumulation*, *and exposure*, risks to ecosystem and human health also depend on the *toxicity* of pollutants. Laboratory experiments carried out on aquatic species have shown that exposure to microplastics pollution leads to several adverse health effects, ranging from blockages in the gastrointestinal system to reduced feeding efficiency. Also, chemical toxicity may emerge from known

[1] GESAMP (2016), *Sources, fate and effects of microplastics in the marine environment: Part 2 of a global assessment*. Science for Sustainable Oceans, http://www.imo.org.

European Chemicals Agency (ECHA) (2019), *Annex XV restriction report proposal for a restriction - intentionally added microplastics*, ECHA, Helsinki.

or suspected endocrine disrupting chemical additives present in plastics and other hazardous chemical substances adsorbed from the environment. Several knowledge gaps persist with regards to the modes of toxicity of microplastics, and especially of nanoplastics (< 1 µm), on humans.

The scientific community has advised for action to reduce, prevent, and mitigate microplastics pollution. For the moment, evidence does not indicate that current average concentration levels of microplastics in the natural environment pose harm to aquatic species and humans, except for some highly polluted areas where microplastics concentrations already reach critical levels. Yet, as our human population and dependence on plastics continue to grow at current rates, a steady increase in microplastics concentrations in aquatic environments is expected in the next decades. Action is required in order to mitigate the emissions of microplastics to the environment and prevent widespread ecological and human health risks.

Intervention will be required on all sources of microplastics and pathways into the environment. While the degradation of marine plastic litter is likely to be the major source of microplastics, mitigation actions also need to address microplastics emitted into the environment directly in the micro-size (e.g. microbeads present in cosmetic and personal care products, microfibres originating from synthetic textiles, tyre particles, microplastics originating from the application of paint). In this regard, several countries in recent years have implemented regulatory efforts to ban the use of microbeads, i.e. microplastics intentionally added to products such as cosmetics. Yet, there remains a large policy gap in terms of microplastics unintentionally released during the use phase of products (e.g. textile-based microfibres).[2]

In this context, taking action on textile-based microplastics is a priority for action. Employing currently available sampling methods, synthetic microfibres are the most common type of microplastics found in samples of the ocean surface and marine biota.[3] It is estimated that washing synthetic textiles may be responsible for up to 35% of total annual releases of microplastics to the oceans.[4] Regardless of the relative contribution of synthetic textiles, the sheer size of emissions is a reason of concern. We know that a single wash of a common laundry load of polyester clothing may emit up to 6 000 000 microfibres, depending on the type of garments and the laundry parameters employed. Between <0.1 and 0.5% of the total garment mass may be lost during a single round of laundering.

Entry points and potential for mitigation measures

Microfibers are shed from synthetic textiles along the entire lifecycle: from fibre and textile manufacturing, to garment manufacturing and finishing, to garment wearing and washing, to final disposal of textile waste – via either landfilling, incineration or recycling. As such, several entry points exist along the lifecycle of textile products for the mitigation of textile-based microplastics pollution, from the design of products to

[2] An exception is the French law approved in January 2020 mandating that, as of January 2025, all washing machines sold in France be equipped with a filter for synthetic microfibres.

[3] In the open ocean, lost or discarded fishing gear may also contribute to the generation of synthetic microfibres.

[4] Estimates of the contribution of textile-based microfibres to total microplastics pollution vary across different studies, depending on the regional scope of source data on emissions and on the characteristics of microplastics sampling experiments (e.g. selection of environmental media, methodologies employed for sampling and characterisation).

end-of-pipe clean up solutions. The workshop sessions followed the key stages of the textile lifecycle: design and manufacturing, use, clean-up.

Mitigation measures at the textile design and manufacturing phase

Test washing cycles for synthetic clothing show large differences in the degree of microfibre shedding of textiles: estimates vary from 700 000 to 6 000 000 microfibres shed for washes of a common laundry load. While some variation can be attributed to differences in laundry parameters used for washing and in the type of use consumers make of their garments, altering design and manufacturing of textiles and garments can affect shedding rates by up to 80-90%.

Several workshop participants highlighted that substitution away from synthetic fibres may not be a viable mitigation solution at scale for multiple reasons.[5] First, the production and use of natural fibres also bears significant adverse consequences on the environment (e.g. water use and pollution, land use, greenhouse gas emissions and use of hazardous chemicals). Second, natural-fibre fabrics often include non-biodegradable synthetic materials, as they may be blended with synthetic fibres even in small percentages to enhance certain characteristics, or treated with synthetic coatings. Further, while natural microfibres will tend to biodegrade more quickly in the environment, they may still act as a transfer medium for potentially hazardous chemical additives (e.g. certain dyes) to the environment and biota. Similarly, biodegradable synthetic fibres do not yet pose a feasible substitution solution to the problem. In addition to the issues raised above for natural fibres, employing fibres which tend to readily biodegrade in the environment may also come with a trade-off in terms of garment durability and resistance to microfibre shedding.[6] In general, R&D efforts should aim at finding and implementing design and manufacturing practices to improve the textile/fabric resistance to shedding.

All steps of garment production, from fibre manufacturing to garment manufacturing, may influence the shedding tendency of the final product. While there is consensus on the effect of certain best design and manufacturing practices in mitigating the shedding tendency, evidence is not conclusive for other parameters and further research is required.

Best practices at the level of fibre and yarn production are, for instance, process conditions which prevent fibre irregularities and preserve fibre yarn strength (e.g. lower temperatures during the melt spinning process), as well as the choice of continuous fibres rather than staple fibres to create yarns.[7] Dyeing can significantly influence the tendency to shed microfibres; in this regard, yarn dyeing should be preferred to garment dyeing. Certain mechanical and chemical finishing treatments, which work by creating a layer over the textile product to protect it and preserve its characteristics, may also have a great potential to increase the fabric resistance to shedding and pill formation.

[5] Synthetic fibres currently account for two thirds of total fibre use in global textile production.

[6] Clear definitions for the requirements of biodegradable textile materials (e.g. time required, degree of biodegradation) are still required.

[7] While we would expect a higher shedding performance of textiles made with recycled polyester fibres versus virgin polyester fibres, current evidence does not indicate that this is necessarily the case.

At the level of garment manufacturing, there is a mitigation potential for pre-washing and filtering to be carried out at the industrial level. Because certain types of fabrics (e.g. 100% polyester) release the highest amounts of microfibres during the first 5-10 washes, industrial pre-washing and filtering (e.g. at factory level) can collect these large quantities of microfibres before the products are sold on the market.

Mitigation measures at the textile use phase

Two types of mitigation solutions can be implemented during the use phase of garments: **best practices for maintenance and care** to mitigate microfibre shedding, and **technologies** to prevent the microfibres emitted during laundry from entering wastewaters.

Evidence has shown that parameters of textile washing process can greatly influence the degree of microfibre shedding of textiles. As the mechanical action generated during laundry favours microfibre shedding, it is recommended to run machines at full load, to use fabric softeners,[8] and prefer liquid to powder detergent in order to reduce mechanical action and the degree of shedding. Washing at low temperatures also mitigates the damage to the fibre structure. While there is consensus on the effect of certain washing parameters, more research is required to determine the influence of others (e.g. type of washing cycle, hand washing).

Several technological solutions are available to prevent the release of the emitted microfibres into washing machine effluents. Options include washing machine filters (which can be either standardised tools that can be added to the pipe of any machine, or built into washing machines before they are put on the market), and ready-to-use consumer products such as laundry bags which prevent microfibres from flowing into wastewater.

Several issues need to be taken into account when considering use-phase technological solutions. These are, for instance, the costs of implementation, the degree of additional maintenance costs for the consumer, user-friendliness, potential trade-offs with other desirable benefits (e.g. energy efficiency, duration of washing cycle, additional use of resources and generation of waste which comes with the filters), and disposal of the retained microfibres.

Currently available use-phase solutions generally only target synthetic microfibres emitted during garment washing and not the microfibres released during other stages of the use-phase.[9] Estimates vary, but up to 65% of the shed microplastics may be released during wear and drying into the surrounding aerial environments. Participants highlighted the fact that microfibres emitted into air generally cannot be retained by barriers further downstream (e.g. washing machine filters or wastewater treatment), and thus that adequate mitigation solutions should be considered also for this additional entry pathway into the environment.

[8] Using fabric softeners can decrease by more than 35% the amount of the released microfibres.

[9] Except to the extent that the employment of best laundry practices may prevent the release of microfibres during wear and drying as a consequence of fibre breakage occurring the laundry process.

End-of-pipe mitigation measures

Wastewater treatment effectiveness

Wastewater treatment plants (WWTPs) receive used water resources and purify them from pollutants originating from human activities (e.g. domestic, agriculture, industry, energy production) before they are reintroduced into the water cycle. Wastewater treatment generally involves three stages: the removal of settled and floating materials (primary treatment), the removal of dissolved and suspended biological matter (secondary), additional steps of chemical treatments and microfiltration (tertiary), and disinfection.

While conventional WWTPs are not designed to remove microplastics, some technologies already available to purify sewer-based wastewaters may effectively retain up to 99.9% of microplastics contained in the influent. The majority of microplastics (up to 98%) can be removed by primary and secondary treatment technologies.

Actual removal rates for microplastics contained in sewerage can vary widely across countries and regions. First, important determinants of the effectiveness of treatment are the type of **wastewater infrastructure and of technologies employed**. While certain OECD countries may have high rates of connectedness to wastewater treatment plants and relatively effective technologies in place to treat sewerage, in developing countries often only primary treatment is in place and connection to wastewater treatment infrastructure may not be available for all households. Second, treatment effectiveness in retaining microplastics may also depend on the **type and size** of microplastics present in the influent. In this regard, synthetic fibres are generally effectively retained during treatment (e.g. relatively to microbeads) due to their irregular shape and relatively larger size.

Higher capability to treat large quantities of wastewaters and higher effectiveness of treatment in retaining micro pollutants always bear higher **investments costs** in WWT infrastructure. Improvements in tertiary treatment tend to be particularly expensive. In general, where connectedness to wastewater treatment is low and where primary or secondary treatment is not in place, there is room for low-cost and cost-effective improvements in WWT efficiency. On the other hand, in countries where wastewater treatment connectedness is already close to 100% and WWT plants are already relatively effective at retaining microplastics, further marginal improvements in WWT technologies tend to be expensive and not cost-effective. However, as additional requirements for treatment of other micro pollutants (e.g. micro pollutants of emerging concern, pharmaceutical residues) emerge in the future, synergies in treatment effectiveness may justify investments in enhanced wastewater treatment to target multiple micro pollutants with the same technology.

Further challenge: management of wastewater sludge

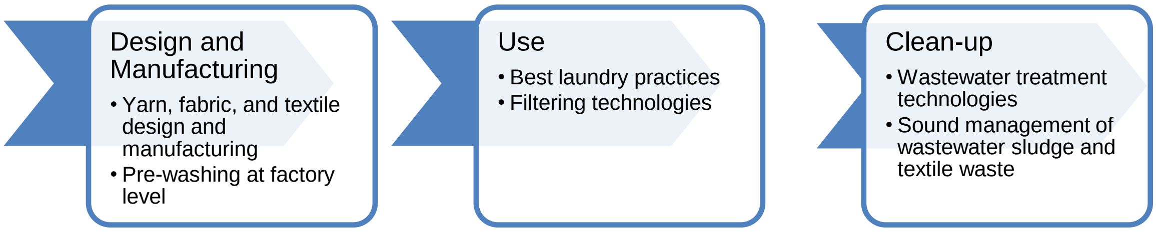
Mitigation action for microplastics pollution will also require improved management of sludge, i.e. the waste by-product of wastewater treatment containing the pollutants removed from the influent.[10] While sludge is in some cases incinerated to prevent the spread of pollutants present in wastewaters, it is common

[10] An area of current research is the potential for innovative treatment technologies to retain microplastics at an intermediary level, before microplastics settle in the wastewater sludge.

practice – both in certain OECD and developing countries – to treat wastewater sludge and reuse it in agriculture due to its high nutrient content and its beneficial effects on crops.

Available evidence has shown that common sludge treatment does not retain microplastics and that the use of sludge in agricultural applications leads to the contamination of terrestrial environments with microplastics commonly found in wastewaters and especially with textile-based microfibres.[11] This requires specific solutions to address this additional pathway of microplastics leakage in the environment.

Fig. 1 Entry points for mitigation action along the life cycle of textile products



The way forward

Policy action is needed to support the development and implementation of best practices and technological solutions which can mitigate microplastics pollution originating from the use of plastic polymers in the textile sector. Yet, several possible mitigation actions may entail additional environmental consequences. For instance, substitution away from fossil fuel-based inputs in textile manufacturing may demand larger use of water resources and land use change for the production of the natural resource base, and the use of filtering technologies generates additional needs for the management of the filters after their end-of-life as well as for the retained microfibres. At the same time, there is potential for synergies between actions to mitigate microplastics pollution from textiles and actions aimed at targeting other environmental consequences linked to textile production, use, and disposal – or, more broadly, aimed at prompting a transition towards a more circular textile sector. For these reasons, action on microplastics pollution needs to be embedded in larger policy frameworks aimed at addressing the environmental impacts of textile production, use, and disposal.

Further, a comprehensive policy framework addressing microplastics pollution should address both microbeads, which are intentionally added to consumer products, and all major sources of unintentionally-released microplastics (e.g. tyres, paints).

Due to the complex nature of microplastics emission from textiles, several interventions along the different lifecycle stages of textile products will be required. Generally, mitigation interventions as far upstream as possible are recommended to minimise the emission of microplastics in the first place and to reduce the

[11] Since the majority of microplastics are retained during the early stages of treatment, the use of sludge generated during primary treatment is particularly polluting.

need for mitigation further downstream across different entry pathways into the environment (e.g. wastewater treatment, airborne transfer, sludge application to land). At the same time, efforts upstream will need to be implemented with mid-stream interventions (e.g. use-phase solutions) and end-of-pipe solutions to mitigate microplastics emissions and manage the risk of pollution in the water cycle and environment.

Several areas for action were identified during the workshop:

- **Fostering research.** Participants highlighted the importance of continued funding research into the sources and drivers of emission, pathways into the environment, and impacts of microfibres (and other microplastics) to close knowledge gaps and inform policy decisions, as well as to foster research and development of innovative mitigation technologies.
- **Encouraging methods standardisation and data sharing.** Academic and industry-led initiatives exist at the international level to harmonise and standardise the available methodologies to measure microfibre shedding. The creation of a common database for findings of test washes would also contribute to fostering a better understanding of drivers of different microfiber shedding.
- Increasing **consumer awareness** and identifying ways to encourage the uptake of best practices for garment use.
- Creating **standards and protocols** to:
    - facilitate the sharing of information on the resistance to shedding of different textiles and garments and their overall **quality**.
    - test the effectiveness of the available filtering technologies (e.g. washing machine filters) in real life conditions.
- While it may be too early for that, **eco-labels** for textiles may be conceived to include indications of microfibre shedding. Different labelling schemes could be designed for B2B as opposed to B2C communication.
- As taxes on single-use plastic goods have become commonplace across OECD countries and as public awareness of the microplastics issue increases, it may be possible to think about similar market-based instruments applying to products which include synthetic polymers, even in small quantities.

Workshop Agenda

11 February 2020	
08:00 – 09:30	*Registration*
09:30 – 09:45	**OPENING REMARKS: AIMS, EXPECTATIONS AND STRUCTURE OF WORKSHOP** Interventions: Dr. Rodolfo Lacy, Director, OECD Environment Directorate Ms. Anna Brandt, Ambassador and Permanent Representative of Sweden to the OECD
09:45 – 10:15	**1. MICROPLASTICS: AN OVERVIEW OF THE LATEST SCIENCE** Presentation (20'): Prof. Richard C. Thompson OBE, Professor of Marine Biology, Director of the Marine Institute, University of Plymouth *"Microplastics in the oceans: sources, impacts and solutions?"* Q&A (10') ○ What is the contribution of the textile industry to microplastics pollution? ○ What are the future research priorities? ○ What are the consequences (economic, social and environmental) of business as usual?
10:15 – 10:45	*Morning tea*
10:45 – 12:15	**2. PREVENTING MICROPLASTICS LEAKAGE: THE ROLE OF TEXTILE DESIGN AND MANUFACTURING** Moderator Ms. Cristina Tébar Less, Acting Head of the OECD Centre for Responsible Business Conduct Panel interventions (40'): Ms. Laura Balmond, Programme Manager, Make Fashion Circular, Ellen McArthur Foundation *"Circular design for Fashion: Designing out waste and pollution"* Ms. Anne-Charlotte Hanning, Researcher, RISE Research Institutes of Sweden *"Looking for microplastic release hotspots from textiles: findings so far"* Prof. Ellen Bendt, University of Applied Sciences Niederrhein *"TextileMission: Development of functional textiles with reduced output of synthetic microparticles"* Dr. Paula Félix-De-Castro, Senior Researcher, LEITAT Technological Centre *"Influence of fabric properties and production process conditions on reducing microplastics release"*

	Mr. Christoffer Immanuel, Founder and Co-CEO, Organic Basics *"Real measurable impact"* Discussion and open Q&A (60'): ○ What opportunities are available (and in the pipeline) to mitigate microfibre shedding from textiles at the level of product design and manufacturing? ○ What would be the costs of implementation (both financial and organisational)? ○ How do potential microplastics mitigation strategies fit into the broader circular economy agenda for the textile sector? ○ What is the extent of microfibre shedding occurring during manufacturing?
12:15-13:15	*Lunch Break*
13:15-14:30	**3. MITIGATING MICROPLASTICS LEAKAGE DURING THE USE-PHASE OF TEXTILES** Moderator Ms. Hannah Leckie, Policy Analyst, OECD Environment Directorate Panel interventions (35'): Dr. Francesca de Falco, Research Fellow, Italian national Research Council *"Microplastic release from textiles: quantification and mitigation strategies"* Dr. Peter Ross, Vice-President of Research, Ocean Wise *"Tackling microfiber pollution at source: a solution-oriented partnership across public and private sectors"* Mr. Marko Schnarr, Officer for Resource efficiency, Environmental assessment and eco-labelling, Miele, and Issue Manager of the SG Microplastics, APPLiA *"Mitigating microfiber pollution: the home appliances perspective"* Prof. Andrej Kržan, Chief Research Officer, Planet Care *"PlanetCare filters for microfibres from washing: a solution for today"* Mr. Alexander Nolte, Co-founder, Guppyfriend Washing bag *"Behaviour change to STOP! Microplastics"* Discussion and open Q&A (40'): ○ What are best practices to mitigate the release of MPs during the use-phase of textiles? ○ What are the available technologies? How cost-effective are they? ○ What are the economic, technological, behavioural barriers to their roll-out? ○ How could policies support technological development and diffusion?

14:30 – 15:45	**4. CLEAN UP: REMOVAL OF MICROFIBRES FROM WASTEWATER AND BIOSOLIDS THROUGH WASTEWATER TREATMENT** Moderator Mr. Bruno Tisserand, Research Program Director for cities at Veolia, and Chairperson of the Committee on Economics and Legal Affairs, EurEau Panel interventions (35') Dr. Josiane Nikiema, Research Group Leader – Circular Economy and Water Pollution, International Water Management Institute *"Removal of microplastics during wastewater treatment: Challenges, opportunities and uncertainties"* Dr. Andy Booth, Senior Research Scientist, SINTEF Ocean, Norway "Solutions for removing microplastic from wastewater treatment plant effluents" Dr. Thibaut Saur, Research Engineer, Suez "Global assessment of microplastic pollution in wastewater treatment plants" Dr. Greet De Gueldre, Advisor Strategy, Aquafin, and Chair of JWG Pollutants, EurEau "Perspective of Flanders and EurEau on mitigation of microplastics from textiles through wastewater treatment" Discussion and open Q&A (40') ○ What is the efficiency and cost-effectiveness of different wastewater treatment technologies in the removal of microplastics? ○ What are the options to prevent the transfer of microplastics to soil via sludge application? What are the alternatives and trade-offs? ○ What is the potential of emerging, innovative solutions for the removal of microplastics from wastewaters and sludge?
15:45 – 16:15	*Afternoon tea*
16:15– 17:45	**5. DEVELOPING PRELIMINARY POLICY RECOMMENDATIONS TO TACKLE MICROPLASTICS POLLUTION FROM TEXTILES** Moderator Mr. Peter Börkey, Senior Policy Analyst, Environmental Directorate, OECD Panel interventions (40'): Mr. Marco Manfroni, Policy Officer, DG GROW - Textile, Clothing, Leather and Footwear sectors, European Commission *"EU policy agenda on plastic and micro-plastics from synthetic textiles"* Mr. Mauro Scalia, Director Sustainable Businesses, EURATEX *"Informed decision making to tackle microfibre leakage"*

	Ms. Kerstin Bly Joyce, Environmental Economist, and Ms. Lena Stig, Sustainable Plastic Use, Swedish Environmental Protection Agency *"Swedish policy experiences and initiatives to reduce microplastics from textiles"* Mr. Alex Cavadias, Manager, Coatings and Solvents Section, Products Division of Environment and Climate Change Canada *"Canadian Approach on Plastics and Microfibers"* Ms. Mary Creagh, Former Chair of the UK House of Commons Environmental Audit Committee *"Fixing fashion: clothing consumption and sustainability"* Discussion and open Q&A (35') ○ What are the key entry points to implement mitigation solutions for microplastics pollution from textiles? ○ What are the most appropriate policy tools to prevent the leakage of textile-based microplastics into the environment? ○ What are the priorities for policy-makers and the industry? ○ Who should pay for the cost of microplastics pollution? How should this be calculated? Who should bear the costs of mitigation and clean-up? ○ What policy responses are currently being implemented to manage microplastic pollution from textiles? What lessons can be learned?
17:45 – 18:00	**CLOSING SESSION** Final remarks from the OECD: Take-home messages and next steps
18:00	*Workshop adjourns*