Interregional workshop on urban water management policies and practices to reduce microplastics leakage to the environment

PLASTECO
Interreg Europe

European Union
European Regional Development Fund

UmweltCluster Bayern

PLASTECO – SUPPORTING EU REGIONS TO CURB PLASTICS WASTE AND LITTERING

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INPUT PAPER

Contents

Executive Summary

This document is the first deliverable of PLASTECO Activity A3.1, which includes the organisation of an interregional workshop in Augsburg, Germany on 13th of May 2020. The workshop will aim to facilitate the interregional exchange of experiences and practices on urban water management policies to reduce microplastics leakage to the environment, as well as the discussion of common concerns during the workshop, to steer relevant policy planning and implementation. All project partners will participate with members of their stakeholder groups and external experts, to share successful practices on microplastics management and discuss/assess:

i. Common barriers and challenges to reduce microplastics leakage to the environment.
ii. Relevant best-practices/successful approaches of existing urban water management policies and practices to reduce microplastics leakage to the environment.
iii. How to decide when/where advanced wastewater treatment is necessary.
iv. Required changes in industrial practices and consumer behaviour as concerns microplastics discharges.
v. Solutions to minimise the restrained grade of microplastics particles during purification.

The input paper is structured as follows: Chapter 1 presents the scope of the PLASTECO project as well as the aims of this document. Chapter 2 describes the main characteristics of microplastics as well as barriers and challenges on their management; additionally, practices to reduce microplastics leakage to the environment are presented. Chapters 3 and 4 elaborate on the organisational issues of the workshop, providing a draft agenda to be distributed by the host organisation and suggested discussion topics. Finally, chapter 5 delivers guidelines on how to prepare the summary report.

1. Introduction

Plastics and microplastics waste leakage into marine and freshwater environments has become a common environmental problem [1]. Issues due to plastics in the aquatic environment are becoming much more widely understood; it is worldwide accepted as a serious pollutant that demands a great deal of time and money to clean up [2].

The PLASTECO "Supporting EU regions to curb plastics waste and littering" project aims to support participating territories to take steps for the necessary transition towards a "new plastics economy". PLASTECO focuses on advancements in waste management, eradication of single-use plastics from regional value chains, and spurring growth through innovation and cover the areas of waste management, public procurement, funding and investments, secondary raw materials and awareness raising. PLASTECO brings together 8 partners from 8 EU countries, supporting them in their effort to benefit from the momentum of the EU plastics strategy, and to achieve their goals in terms of protecting the environment, increasing resource efficiency, alleviating health effects, and boosting innovation, through joint policy learning efforts and exchanges of experiences.

The scope of this input paper is to facilitate the organisation of an interregional workshop on urban water management policies and practices to reduce microplastics leakage to the environment. The workshop will aim to facilitate the interregional exchange of experiences and practices as well as the discussion of common concerns to steer relevant policy planning and implementation.

To that end, the input paper will focus on identification of the most common barriers and challenges linked with the development and implementation of urban water management policies and practices to reduce microplastics leakage to the environment. It will also present relevant successful approaches of existing urban water management policies and practices to reduce microplastics leakage to the environment.

The paper will be distributed to partners three weeks before the workshop (tentative date: 13 May 2020). All project partners will participate with members of their stakeholder groups and external experts, to share successful management policies and practices to reduce microplastics leakage to the environment. During the exchange of experience visit in Germany, participants will have the opportunity to exchange views with their peers, familiarise themselves with existing policy measures and strategies and co-shape a common approach for policy improvement.

2. Thematic background

2.1. Microplastics: definition and properties

Plastic waste has become one of the greatest challenges to be tackled globally. Each year the world produces millions of tons of plastics, most of which are discarded directly after just one use. When combined with the habit of littering, this means that huge amounts of plastic waste end up scattered in the streets, or worse, in the oceans. Once plastic waste is released into the environment, it can be exposed to the natural elements, like the sun's radiation, wind, or rain. This, in turn, leads to plastic breaking up into smaller and smaller pieces, also known as fragmentation. The fragments of plastic will continue to break down over time into even smaller fragments until they have broken down so much that they cannot be seen by the human eye anymore. These tiny fragments of plastic are known as microplastics, and they have an enormous damaging impact on the environment.

Fig. 1. Microplastics in the environment [3].

Microplastics are defined as polymer particles <5 mm, including particles of nanosize [4,5]. Their amount in the aquatic environment has increased dramatically since 1950s [6]. The high increase in plastic production and consumption, unsustainable waste management practices, as well as the slow degradation of plastics are the main reasons for their accumulation in the aquatic environment. Two classifications of microplastics currently exist. Primary microplastics are any plastic fragments or particles that are already 5.0 mm in size or less before entering the environment. These include microfibers from clothing (textile fibers), microbeads, and plastic pellets [7]. Secondary microplastics are microplastics that are created from the degradation of larger plastic products once they enter the environment through natural weathering processes. Such sources of secondary microplastics include water and soda bottles, fishing nets, and plastic bags [8]. Both types are recognized to persist in the environment at high levels, particularly in aquatic and marine ecosystems.

Issues due to plastics in the aquatic environment are becoming much more widely understood and it is worldwide accepted as a critical pollutant that requires a great deal of time and money to clean up [9]. When microplastics wash down a drain, they are not removed by wastewater treatment and eventually create problems in the environment; spreading far across and throughout the ocean. It should also be mentioned that microplastics can be a transport vehicle for other undesired substances (e.g. PCB, PAH).

More specifically, as plastic waste breaks down in our environment, it becomes smaller and smaller and turns into fibers. These fibers can absorb toxic chemicals found in the water, such as plant pesticides or pollution from commercial ships. The microplastics then enter the food chain as organisms consume them, transferring these toxins into their bodies. These toxins translocate up the food chain until they are served on our plates [10]. The consequences of toxin-sorbed microplastics ingested by fish can be two-fold; exposure can be physical, causing tissue damage, or they can be chemical, resulting in bioaccumulation that causes liver toxicity [11].

Major sources of microplastics include:

- Agricultural runoff
- Aquaculture
- Cruise ships
- Ocean dumping
- Stormwater
- The shipping and fishing industries
- Urban runoff
- Waste management
- Traffic

Microplastics can be found everywhere in the ocean and coastal waters, shorelines, ocean seabed, and sea surface. Fig. 2 presents the conceptual diagram of microplastic sources and flows throughout and between anthropogenic, terrestrial, freshwater and marine environmental compartments [12].

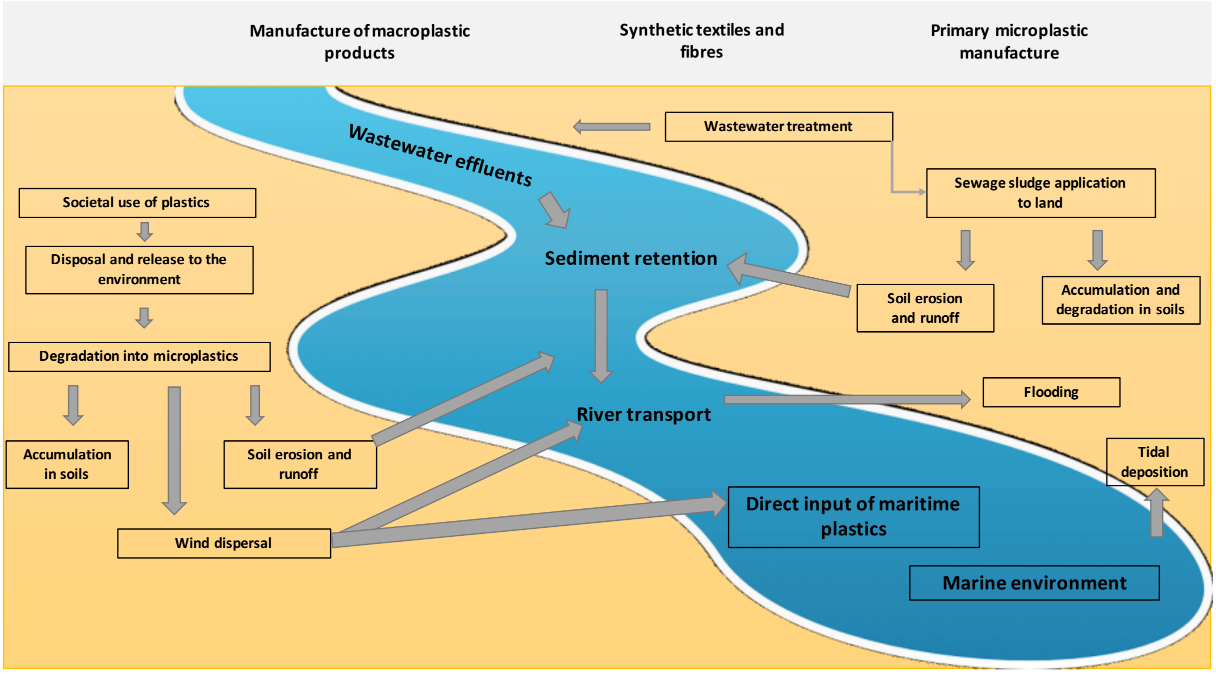

Fig. 2. Conceptual diagram of microplastic sources and flows (after [12]).

2.2. Barriers and challenges of urban water management policies and practices

Policy awareness on microplastics is rising; some of the most significant and worldwide acting international and intergovernmental bodies are debating about the global problem of environmental plastics (e.g., United Nations, G7, World Bank, World Economic Forum). Beyond that, the microplastics issue is already addressed in a few regulations and policy instruments at international and national level [13]. As most environmental microplastics result from incorrect disposed and fragmented plastic litter [14], microplastics management is closely tied to a range of policy areas. Regulatory responsibilities can change along the product life of a single plastic product and include plastic production and product design, trade and consumer behaviour, recycling and waste management (summarized as “land-based policies”), as well as wastewater management and water protection (“water-based policies”). Hence, the regulation of plastics is already considered in several directives, guidelines, agreements, etc.

While regulatory measures can be clearly addressed to one stakeholder at a certain stage of product life (e.g., producer, manufacturer, consumer, waste manager), it is more difficult to identify the correct addressee for plastics already released to the environment. So far, due to the complexity of this issue, it is not clear which (policy) areas have to act first, which concepts would be necessary, and what requirements are needed to promote actions beyond those already initiated.

Regarding aquatic environments, microplastics are mainly considered by marine science and policy. However, it is assumed that approximately 80% of marine debris is land based. Rivers are one of the entry pathways for microplastics into marine ecosystems, though the microplastics issue is not explicitly addressed in any regulation regarding freshwater environments so far.

It should be mentioned that the management of microplastics in aquatic systems is even more complex than the regulation of macroplastic litter. Knowledge gaps about sources, transport pathways, and volumes and the environmental fate of the small particles with their heterogeneous characteristics have to be filled, as well as adequate methods for a standardized freshwater monitoring of microplastics to be defined. The adaption of exposure and hazard assessment to evaluate the risk of freshwater microplastics as particulate stressors is one of the major challenges for regulation and management. Currently, essential yet unanswered questions include the ecological impacts of plastics on today's environment, as well as their long-term consequences [13].

It should be noted that there is little scientific data on the adverse effects caused by relevant environmental concentrations of microplastics. Usually, effects were detected in laboratory studies that have tested concentrations far above measured environmental concentrations. So far, only one study reports significant impacts of microplastics on fish larvae at concentrations found in coastal waters [15].

Dissolved chemicals

Usually, regulation of pollutants in freshwater systems refers to dissolved chemicals, which are different to particulate matter with regard to their environmental fate (e.g., homogeneous versus inhomogeneous distribution). Therefore, the transferability of regulatory options for dissolved chemicals to the issue of microplastics has to be critically evaluated (e.g. to include in waste water treatment plants specific types of filtration systems which not only filter chemicals but also microplastics). This represents a similar challenge known from engineered nanomaterials. The development of regulation strategies for microplastics should consider more options than the simple adaptation of the existing regulation strategies for dissolved chemicals or suspended matter. Possibly, entirely new regulation strategies for microplastics in freshwater need to be developed.

Critical issues to be tackled

Further research should be promoted to fill current knowledge gaps. More specifically, microplastics are a heterogeneous group of pollutants, hence a definition of regulatory (sub)groups is as important as the definition of microplastics itself in order to define management options more precisely. Furthermore, microplastics' management needs to be closely linked to the regulation of plastic production, consumption, and litter. Additionally, it is important to clarify entry pathways into aquatic environment, to define standardized methods for exposure and hazard assessment, and to work in an integrated approach.

An adequate regulation of environmental microplastics is a huge challenge for research and policy. As plastics influence all parts of society, single fields of science or policy cannot tackle this issue individually. During the lifetime of a single plastic product – from design and production to trade and consumption to the correct recycling or disposal at the end of its functional product life – regulatory responsibilities change. This provides various possibilities for regulators to intervene before plastics enter the environment. However, it requires an interdisciplinary coordination of measures on different statutory, political, economic, and social levels.

2.3. Practices to reduce microplastics leakage to the environment

Measures to reduce microplastics leakage to the environment can be classified as either **corrective** or **preventive**. A corrective action deals with a nonconformity that has occurred, and a preventive action addresses the potential for a nonconformity to occur. Strategies to solve the problem of microplastics pollution should focus on both source control (preventive action) and remediation (corrective actions). It should be noted that the workshop (topic: "urban water management") places specific emphasis on corrective measures.

2.3.1. Corrective measures

Wastewater treatment

Wastewater treatment plants (WWTPs) can act as a barrier but also as entrance routes for microplastics to aquatic environment. Conventional wastewater treatment with primary and secondary treatment processes can remove microplastics from the wastewater up to 99% and most of the microplastics are removed already during pre-treatment phases [16]. Despite of the high reduction ability, conventional WWTPs may actually be a significant source of microplastics given the large volumes of effluents that are discharged [16, 17].

Factors influencing microplastic removal

The primary mechanisms for removing microplastics during wastewater treatment is through agglomeration into biological flocs followed by separation using sedimentation, flotation and filtration [16, 17]. During these solid-liquid separation processes, microplastics are concentrated and transferred from the water phase into the solid phase. Due to the hydrophobic nature of microplastics, many are expected to be removed with fats, oils and greases in grease traps, sewerage systems and floating debris. Furthermore, documented studies in the literature have shown that filtration and other tertiary treatment stages can significantly reduce the total microplastics discharge. This removal is influenced by the surface characteristics of the microplastics (such as roughness, hydrophobicity and surface charge) as well as the size of the particles being filtered.

Advanced wastewater treatment

During the last decades, wastewater treatment has continuously been required to increase the quality of the final effluents. However, the technologies to improve the quality of the final effluent are not specifically designed to remove microplastics and do not necessarily remove microplastics from the effluent [18]. Few studies suggest, however, that with some advanced final-stage wastewater treatment technologies the removal of the microplastics from effluents can be further improved as some WWTP facilities have ineffective treatment practices or are not designed for optimal removal of microplastics [19].

It should be noted that, conventional treatment can remove particles smaller than a micrometer through processes of coagulation, flocculation, sedimentation/flotation and filtration. Advanced treatment can remove smaller particles. For example, nanofiltration can remove particles >0.001 µm while ultrafiltration can remove particles >0.01µm [20].

Furthermore, the development of bioremediation technologies to be used in WWTPs would also be critical. The microbial biodegradation of petroleum-based plastics has been evaluated since the 1970s. Several fungi biodegrade PE, PP and PS are generally considered non-biodegradable without heat or UV pre-treatment and can thus persist in natural environments for hundreds of years [21].

Studies assessing microplastics removal efficiency

- *Conventional wastewater treatment*

According to the literature, conventional wastewater treatment using primary and secondary treatment processes can effectively remove most microplastics from wastewater [20]. Removals of more than 90% have been reported, with most of the microplastics removed during pre-treatment and primary treatment stages [17]. A large Italian WWTP (400 million L/day) reportedly removed 84% of microplastics >63 µm [22]. However, the concentration of microplastics found in the influent wastewater was quite low, with an average of 2.5 particles/L in the influent and 0.4 particles/L in the effluent following screening, grit and grease removal, biological treatment, sedimentation, sand filtration and disinfection. Data from a Scottish WWTP recorded average microplastic concentrations of 15.7 particles/L (size 598 ± 0.89 µm) in wastewater influent. Treatment removed 98.4% of microplastic particles, with much of the removal taking place in the grease removal process [16]. In Turkey, assessments of two WWTPs recorded between 12–36 particles/L in the influent and 2–9 particles/L in the secondary effluent, with overall removal of between 54–92% for plastic particles classified from <100 µm to 5000 µm [23]. In a Finnish WWTP, pre-treatment and primary treatment removed 97% of microplastic particles, with activated sludge removing a further 7–20% for particles captured on sieves between 20–400 µm [17].

- *Advanced wastewater treatment*

A recent study [5] included all advanced final-stage wastewater treatment technologies for the removal of microplastics (>20 mm). The Membrane bioreactor (MBR) decreased 99.9% of the microplastics from primary effluent and gave also the lowest microplastic concentration in the final effluent. The Rapid (gravity) sand filters (RSF) removed 97%, Dissolved Air Flotation (DAF) 95% and Micro-screen filtration with discfilters (DF) 40-98.5% of the microplastics from secondary effluent during the treatments. Given the large volumes of effluents constantly discharged into the aquatic environments, microplastic pollution should be taken into consideration, when designing advanced final-stage wastewater treatment technologies and applying them into WWTPs. The treatments also removed all size fractions and shapes of microplastics. The smallest size fraction (20-100 mm) and textile fibers were the most common microplastic types before and after the final treatment stages. This highlights the need for final-stage technologies to remove particularly small size and fiber-like microplastics from effluents. Another study concluded that secondary and tertiary treatment processes were highly efficient in removing microplastics, with greater than 99.9% removal when samples were processed using a range of sieves with mesh sizes between 20–400 µm [24]. Tertiary filtration of wastewater from a German WWTP completely removed microplastics >500 µm, and removed 93% of microplastics smaller than 500 µm and 97.7% of plastic classified as synthetic fibres [25]. In another case of a highly treated wastewater, 0.28 particles/L (>25 µm) were identified after tertiary ultrafiltration and 0.21 particles/L (>25 µm) after reverse osmosis [26].

In 2019, a related work [27] observed higher removal efficiency at the WWTP employing primary clarification suggests that retrofitting secondary plants with primary clarifiers could improve microplastic removal, while also likely improving treatment of other contaminants of concern. Upgrading plants to include primary clarification is dependent on site-specific factors, such as existing plant design, service composition, service population, cost, and co-benefits which have to be considered before investments in capital improvements occur. The high loading of microplastics into wastewater treatment plants presents a point of intervention at the level of the individual consumer. Given information and opportunity, households' choice of clothing and cosmetics, washing machine models, washing agents, wash temperatures and frequency could collectively aim to reduce this microplastic source to wastewater treatment plants and ultimately, the environment.

2.3.2. Preventative measures

Research works have highlighted that in case waste management does not improve greatly in the near future, by 2025 the amount of plastic waste entering the oceans will increase by an order of magnitude [28]. Furthermore, it has been mentioned that waste management must be improved by 85% in the top 35% countries of mismanaged plastic waste to achieve a 75% reduction [28]. However, especially low and middle income countries should invest money and time so as to improve their waste management infrastructure [6].

As mentioned above, microplastics are a critical threat and sources are various. Two specific categories can be found, the primary and the secondary microplastics. Primary microplastics (for instance microbeads) used in personal care and cosmetic products (PCCPs) are an important direct source to the environment, especially if they are no treated by wastewater plants [29]. Secondary microplastics have numerous sources like fragmented packaging.

Generally, microplastics can be better managed in freshwater than in marine environments [30]. Wastewater treatment systems capable of capturing microplastics can decrease the input of microplastics to marine systems through rivers. These systems are not common in many developing countries [29].

The improvement of waste management is a critical short-term solution and should be source oriented (for example solid waste collection, good landfill management, recycling opportunities, plastic bag bans). Mitigation and awareness raising are also crucial.

Behavioural change

Regarding long term solutions, countries should move towards circular economy models. Characteristics of such an initiative are the reduction, re-usage, recycling, redesign and recovering of plastics through awareness raising [29]. Thus, **a behavioural change of consumers and producers (industrial practices) is vital**. More specifically, people can reduce the amount of plastics they dispose of by:

- Reducing single use plastics;
- Removing plastic microbeads from personal care products;
- Phasing out non-recoverable plastics;
- Using alternative materials such as biodegradable plastics or textiles;
- Buying reusable items rather than disposable ones. This can include reusable lunchboxes, plates, cups, eating utensils, and food containers instead of disposable items;
- Reusing items several times before throwing them away;
- Remove microplastics from washing agents;
- Choosing items that have the least packaging.

Table 1 presents sources, measurements, and strategies for upstream mitigation of microplastics.

Table 1. Tackling upstream microplastics [31].

Category	Source	Potential mitigation
Production	Microplastics in cosmetics and in washing agents	Removing them from products. Replace with benign alternatives.
	Mismanaged virgin plastic pellets	Regulate pellet handling. Operation clean sweep.
	Industrial abrasives	Improve containment and recovery

Commerce		and require alternatives
	Laundromat exhaust	Improved filtration
	Agriculture – degraded film, pots, and pipes	Improve recovery, biodegradable plastics
Consumer	Littering of small plastic items (cigarette filters, torn corners of packaging, small film wrappers, etc.)	Enforcement of fines for littering, consumer education, EPR on design
Waste Management	UV and chemically degraded terrestrial plastic waste	Improved waste management
	Sewage effluent (e.g. synthetic fibers)	Laundry filtration
	Combined sewage overflow (large items)	Infrastructure improvement
	Mechanical shredding of roadside waste during regular cutting of vegetation (mostly grass)	Better legislation and law enforcement

Conclusions

Concluding, international collaboration is needed to clean up plastic debris on the environment and to reduce the major source of microplastics. However, it should be mentioned that, remediation efforts of microplastics are important, but it can be only a short-term solution if the sources of plastics are not well addressed. It should also be mentioned that the costs associated with corrective actions can also be high. While both correction and prevention are needed, when it comes to the very preventable problem of microplastics, emphasizing prevention will produce greater results.

2.4. Indicative examples of best-practices/successful approaches to reduce microplastics leakage to the environment

Five successful approaches to reduce plastics leakage in Germany are presented in this section; Germany is in fact a leading example in terms of implementing such best practices.

1. Street wastewater keeps microplastics away from groundwater [32]

The treatment of contaminated street wastewater is of paramount importance for Hamburg. Dirt and pollutants, including microplastics (tire abrasion), heavy metals and organic pollutants, are released into the water via the street wastewater and affect water quality.

Recently, the State Office for Roads, Bridges and Waters (LSBG) implemented a cleaning system specially developed for Hamburg.

The special feature of this system is the first use of reed lamellas. With an investment volume of 1.1 million euros, the rainwater treatment plant (RWBA) in Hamburg is a pilot project and exemplary for other such measures. After a mechanical pre-cleaning, the biological cleaning takes place in a pool planted with reeds. The water purified in this way is seeped away into another basin for the formation of new groundwater. The rainwater catchment area for this plant is around 37.6 hectares. Around 70 percent of these consist of sealed surfaces.

The project is of high importance because contaminated street wastewater has so far been discharged unpurified. Every year, nine tons of pollutants, such as heavy metals, as well as tire abrasion (microplastics) and brake pads, are retained in contaminated sediments.

Fig. 3. The water treatment plant in Lurup - the pool is 66 meters long and 7 meters wide. The infiltration basin, planted with grass and reeds, has a volume of 1.6 million liters of water [32].

2. Microplastics on artificial turf pitches [33]

Organized sport in Germany is facing a major financial and organizational challenge because the European Chemicals Agency proposed a ban on the use of "deliberately added" microplastics at the beginning of the year. This also includes the plastic granulate for artificial turf fields. The year 2021 is currently the date for such a ban. The German Olympic Sports Confederation and the German Football Association have already positioned themselves and are demanding a transition period of at least six years.

The state government of Baden-Württemberg has set up a special program for the renovation of artificial turf as it no longer supports artificial turf fields filled with microplastics. The purpose of this is to replace the plastic granules that have previously been filled in artificial turf fields and are not biodegradable by ecologically harmless alternatives.
It should be noted that the plastic granules used up to now can enter the food chain through microplastics, thus they should be replaced by more environmentally friendly alternatives. More specifically, wind and rain distribute the granules in the environment, as the players carry them on their sports shoes and in their clothes. In the end, they end up in the food chain.

3. Bavarian initiative against microplastic [34]

In 2019, the Federal Council adopted a Bavarian initiative against microplastic additives in cosmetic products. With the application of the initiative, it can be ensured that microplastics in cosmetic products are completely dispensed with.
With the voluntary commitment of the manufacturers, the use of tiny plastic particles in cosmetic products has already been reduced, but these measures are still not enough. In its initiative, the Free State called on the federal government to work towards a ban on all microplastics in cosmetics in the European Union if its use was not completely terminated by 2020.
It should be mentioned that in 2014, Bavaria was the first country to launch a microplastics initiative based on research, measures and cooperation. The Ministry of the Environment is currently investing 1.4 million euros in studies on microplastics in food and water.

4. Tire wear mapping in Germany [35]

In the context of various environmental problems, tire wear has been a controversial topic for years: Wear has been shown to be one of the causes of fine dust pollution in cities and one of the largest sources of microplastics in the environment. Car tires lose substance over time and release tiny particles in the form of fine dust and microplastics. The joint project “Tire Wear Mapping” (funded by the Federal Ministry of Transport and Digital Infrastructure (BMVI)) examines the impact of tire wear on the environment across Germany. A digital planning and decision-making tool is being developed to enable the distribution, spread and quantification of tire wear.

More specifically, the project examines models and displays the spread of tire wear from the road into the air and water. The researchers use mobility, geo and weather data from the Federal Ministry of Transport and Digital Infrastructure (BMVI). Various methods are used for the evaluation of the data and the dispersion calculation: in addition to probabilistic modelling, a new approach based on neural networks. The data allow conclusions to be drawn, for example, at which points (highway vs. inner city) and under which conditions (weather) tire wear occurs particularly frequently. The distribution channels are visualized using GIS-based maps.
The project expands the knowledge base on the subject of tire wear in Germany and maps tire wear in Germany. In this way, it helps to objectify the environmental debates in this area and to identify possible solutions. Knowing tire abrasion hotspots enables targeted regulatory measures such as filter systems on road gullies, constructional measures or speed limits to be initiated. The project results are also implemented in a digital planning and decision tool that is continuously developed with the participation of external actors. The tool can help plan infrastructures inside and outside cities and thus contribute to reducing tire wear in the environment in the long term.

5. FibrEX: filter for textile microfibers [36]

In order to reduce the emissions of microplastics and synthetic microfibers into the environment, a special filter module for washing machines is being developed by Fraunhofer UMSICHT. This should be operated almost without pressure loss and should be made from biodegradable polymers. The particularly innovative approach results from the adaptation of biological models. The project follows on from existing work by Fraunhofer UMSICHT that has been dealing with microplastics since 2014.
It should be noted that fibers that get into wastewater during washing are at 10th place in Germany's microplastics emissions. In this way, they make a significant contribution to the pollution of the environment with plastics. FibrEX has set itself the goal of reducing microfiber emissions with the help of a filter for washing machines. The filter concept should be applicable to applications in textile factories, large laundries and for sewage treatment plants.
When washing, microfibers are mainly released from abrasion from synthetic clothing and get into the wastewater with the washing machine drain. The microfibers are not completely filtered out from sewage treatment plants, so that they flow into the water with the sewage treatment plant drain and can even emit into the air and soil via agricultural sewage sludge. So

far, there is no technical process or product for the retention of microfibers that get into sewage from washing machines and industrial manufacturing processes. Wastewater treatment plant operators are currently not experimenting with new filter technologies, but are instead relying on washing and manufacturing processes to be optimized to reduce microfiber release.

The development of the washing machine filter is very demanding since the filter itself should not lose any plastic particles and must be robust. In addition, it must not cause any additional technical or financial expenditure and must be able to be integrated into the existing washing machine system. For this reason, both material and process engineering aspects are examined. The focus is on the use of bio-based polymers. The materials are tested in a test facility and the filter process is optimized.

3. Organisational issues

3.1. Things you should know about Augsburg

Augsburg is a city in Swabia, Bavaria, Germany. It is a university town and regional seat of the Regierungsbezirk Schwaben. Augsburg is an urban district and home to the institutions of the Landkreis Augsburg. It is the third-largest city in Bavaria (after Munich and Nuremberg) with a population of 300,000 inhabitants, with 885,000 in its metropolitan area [37].
After Neuss and Trier, Augsburg is Germany's third oldest city, founded in 15 BC by the Romans as Augusta Vindelicorum, named after the Roman emperor Augustus. It was a Free Imperial City from 1276 to 1803 and the home of the patrician Fugger and Welser families that dominated European banking in the 16th century. The city played a leading role in the Reformation as the site of the 1530 Augsburg Confession and 1555 Peace of Augsburg. The Fuggerei, the oldest social housing complex in the world, was founded in 1513 by Jakob Fugger. In 2019, UNESCO recognized the Water Management System of Augsburg as a World Heritage Site [38].

3.2. Date and participation

The Cluster of Environmental Technologies Bavaria (UCB) will host the interregional thematic workshop on urban water management policies and practices to reduce microplastics leakage to the environment, in Augsburg, Germany. The workshop will last one day (13 May 2020) and all PLASTECO partners will take part, with members of their stakeholder groups and external experts. The PLASTECO Application Form (AF) foresees ~40 participants in total. The target audience include all those representatives of organisations and individuals that can be impacted by the project outcomes, and are interested in utilising project outputs and results to reduce microplastics leakage to the environment in own territory. The working language of the workshop will be English; participants, therefore, need to have a sufficient knowledge of the language to be able to fully participate in workshop proceedings and discussions.

Workshop details (indicative)	
Thematic Focus	Reduce microplastics leakage to the environment
Host Organisation	Cluster of Environmental Technologies Bavaria (UCB)
Date	13 May 2020
Venue	Seminar room 2nd floor of the “Hollbaus“ building
Address	Im Annahof 4, 86150 Augsburg
Number of participants	40 participants

3.3. Format

There is a number of different methods and techniques from which the organisers of interregional thematic workshops can opt from to support the practical process of participants' participation in workshop activities and proceedings. To facilitate knowledge sharing and capacity building, the interregional thematic workshop on urban water management policies and practices to reduce microplastics leakage to the environment, will be structured to deliver the following sessions: a) oral presentations and b) round table discussions.

Oral presentations are brief discussions of a defined topic delivered to a group of listeners in order to impart knowledge and stimulate debate. There are four different types of oral presentations: a) the informative presentations, seeking to convey information and promote understanding of an idea or concept, b) the demonstrative presentations, showing the process of how to accomplish a task or activity (e.g. how to decide when/where advanced wastewater treatment is necessary), c) the persuasive presentations, which aim to influence a change in the belief, attitude, or behaviour, stimulating the uptake of actions (e.g. change of consumer behaviour), and d) the motivational or inspirational presentations that are designed to create an emotional connection between the topic and listeners; while encouraging the latter to go after their personal objectives. Oral presentations will provide an opportunity for gaining an overview of the existing policy measures towards the reduction of microplastics leakage to the environment.

Roundtable discussions represent a flexible form of discussion employed at workshops and conferences to facilitate participants' interaction and exchange of ideas. A small number of participants is seated around a table to discuss in-depth a particular topic of interest (e.g. required changes in industrial practices and consumer behaviour as concerns microplastics), seeking to resolve issues of disagreement; extract useful conclusions and decide and plan future actions. Roundtables are considered an excellent format for providing and receiving targeted feedback, engaging in in-depth discussions, and meeting individuals/partners with similar interests. The roundtable discussion format allows participants to interact with each other, promoting networking and equal participation/contribution, triggering spontaneous conversations and allowing for faster decisions. Roundtable discussions typically contain 15 minutes of presentation, followed by 30 minutes of discussion and feedback.

Finally, the Annex provides a short feedback form, which the organiser could distribute to participants to fill in.

3.4 Agenda (draft version, prepared by UCB)

Interregional workshop on

urban water management policies and practices

to reduce microplastics leakage to the environment

within the framework of the Interreg Europe project PLASTECO

Wednesday, 13 May 2020

9:30 o'clock - 16:00 o'clock

Im Annahof 4, 86150 Augsburg

Seminar room 2nd floor of the "Hollbaus" building

Agenda

9:30 o'clock	**Registration and Coffee**
9:45 o'clock	**Welcome speeches** Alfred Mayr, Managing director of UCB Reiner Erben, Head of the environmental department of the city of Augsburg
10:00 o'clock	**Warm-up Games and presentation of the Agenda** Christina Zegowitz, UCB (Moderation)
10:15 o'clock	**Presentations of Experts with Q&A Session** • **Microplastic – invisible and everywhere** Pia Winterholler (Forum plastic-free Augsburg) • **Microplastic in wastewater treatment plants – state of the art** Prof. Schaum (Bundeswehr University Munich) • **Technology to remove microplastic from wastewater** Dr. Porkert, Start-up Ecofario • **Situation at the wastewater treatment plant (WWTP) in Augsburg** Klaus Stegmayer, Head of WWTP, City of Augsburg
12:00 o'clock	**Lunch break**
13:00 o'clock	**Presentation of a filter for washing machines** Leonie Prillwitz, student, winner of a youth science competition

13:15 o'clock	**World Café on the following topic** • Why are Microplastics a problem? • Major sources of microplastics • Common barriers and challenges related to the management of microplastics • Required changes in industrial practices and consumer behaviour • How to decide when/where advanced wastewater treatment is necessary • Solutions to remove microplastics in WWTP • Which policies exist on this topic in the PLASTECO regions • Examples of regional successful approaches to reduce microplastics
14:45 o'clock	**Coffee Break**
15:15 o'clock	**Presentation of the Results** One person of each world café table presents the results
15:30 o'clock	**Summary and Feedback round** What are the lessons learnt? What to take back home?
15:45 o'clock	**Time for pictures & Interviews** For the communication work for PLASTECO
16:00 o'clock	**End of workshop**

Optional

16:30 o'clock	**Sustainable city tour** Pia Winterholler (Forum plastic-free Augsburg)
18:30 o'clock	**Joint dinner**

4. Suggested discussion topics

This section provides a first, tentative suggestion on the topics to be presented and discussed during the PLASTECO interregional thematic workshop. This list is not final; it is subject to changes or updates (if necessary), upon review and feedback from the host organisation (UCB). The term 'thematic areas' refers to a broad theme, and the term 'topics' refers to the sub-themes in which the core theme is divided and will be part of the World Café session. Two distinct thematic areas have been identified for this session. Each thematic area is divided into a number of topics, around which the discussions of the workshops will revolve. During the World Café session, participants are expected to build upon the presented material of the invited speakers and the thematic background provided in the input paper, by providing new perspectives for the topics under examination.

Thematic Area A: The problem of microplastics

Participants will discuss the problem of microplastics in the EU, which is escalating in impact as a result of the increasing worldwide production of millions of tons of plastics, most of which are discarded directly after just one use. Furthermore, the definition and the major sources of microplastics will be presented. The discussion will include recent EU and national policy developments, and convene participants to debate on emerging policy issues related to management of microplastics within EU and in PLASTECO regions. The primary purpose is to stress the need for coordinated action on the management of microplastics, by highlighting the barriers and challenges that are common among EU countries, and for which shared solutions can emerge. It should be noted that the present thematic area will be based on the presentation of Pia Winterholler (Forum plastic-free Augsburg) as well on the provided thematic background of this input paper and A1.2 & A1.3 deliverables.

<u>Indicative topics to be discussed:</u>

1. Why are microplastics a problem? (see section 2.1)
2. Major sources of microplastics (see section 2.1)
3. Definition of microplastics (see section 2.1)
4. Which policies exist on this topic in the PLASTECO regions
5. Common barriers and challenges related to the management of microplastics (see section 2.2)

6. The need for coordinated action and transnational cooperation for effective microplastics management (see section 2.3)

Thematic Area B: Best-practices/successful approaches to reduce microplastics leakage to the environment

The participants will provide an overview of the corrective and preventive methods that can be employed for managing microplastics. They will also present best practices from successful control and reduction measures implemented by regional and local authorities across Europe, sharing their own experiences from actual implementation. The primary purpose is to help participants develop a good understanding on the best available methods for reducing microplastics leakage to the environment.

More specifically, this thematic area will focus on available advanced wastewater treatment technologies as well as on required changes in consumer and producer behaviour so as microplastics discharges to be eliminated. The presented thematic area will be based on (i) the presentations of the invited speakers: Prof. Schaum (Bundeswehr University Munich), Dr. Porkert (Start-up Ecofario), Klaus Stegmayer (Head of WWTP, City of Augsburg) and Leonie Prillwitz (student), (ii) as well as on the provided thematic background of the input paper and of A1.2 and A1.3 deliverables.

<u>Indicative topics to be discussed:</u>

1. Corrective and preventive measures (see section 2.3)
2. Examples of regional successful approaches to reduce microplastics (see section 2.4)
3. How to decide when/where advanced wastewater treatment is necessary (based on the presentations of the invited speakers as well as on the input of other participating experts)
4. Required changes in industrial practices and consumer behaviour as concerns microplastics discharges (see sections 2.2, 2.3)
5. Solutions to minimise the restrained grade of microplastics particles during purification (based on the presentations of the invited speakers as well as on the input of other participating experts)

5. Guidelines for the summary report

The final stage of the conduction of the interregional thematic workshop includes the preparation of a summary report by the hosting partner. The summary report is the key output of activity A3.1. The report will present the final outcomes of the workshop and will be used by project partners as the main input for diffusing the lessons learned within their organisations, and to promote storytelling. Summary reports are short written communication documents, which aim to convey information related to the discussions and activities carried out during workshop proceedings. The summary report should include the following aspects:

- Document the interventions of participants and the overall discussion within each session of the interregional thematic workshop.
- Draw conclusions from debate in each session of the workshop.
- Briefly present policy recommendations for the microplastics control based on the interventions of the participants and the conclusions drawn from the discussion.
- Present an evaluation of the workshop based on the comments and feedback from participants.
- Present the metrics of the workshop (number of registered participants, type of participants, duration).

The following guidelines have been developed to provide assistance and guidance to the host organisation (UCB) on how to summarise and present the main conclusions drawn from the workshop (in the format of a summary paper). In particular, the summary report should be drafted as follows:

Step 1: Start with a brief description of the workshop, the venue, the theme and the objectives of the workshop and provide some background information about the theme. Additionally, the report should contain the agenda of the workshop, the number of attendees and information about them, such as their name, field and affiliation (e.g. university, public authority, etc.) as well as information on the speakers of each session.

Step 2: Develop short summaries for each session of the workshop. The summaries should include a) the context and objectives of the session, b) the main points from oral presentations/keynote speeches, c) key argumentation from the interventions of participants, and d) conclusions and findings extracted from the overall discussion and interactive exercises.

Step 3: Review the evaluation forms. The author should summarise the key itches and ideas (as drawn from the forms completed by workshop participants), with regards to the themes / topics of the workshop.

Step 4: Present the main conclusions with regards to the following themes:

- The problem of microplastics and common barriers and challenges related to their management.
- Best urban water management practices/approaches to reduce microplastics leakage to the environment (corrective and preventive methods).

Step 5: Juxtapose the key arguments / conclusions drawn from the workshop with any relevant results and findings from PLASTECO thematic studies and guides on similar policy aspects. Identify convergences and divergences between findings.

Step 6: Provide guidelines on how to utilise the key conclusions drawn to steer relevant policy planning and implementation. The guidelines on how to integrate the lessons learnt, as well as any policy advice that may be derived from the analysis of evaluation forms, should be described in a way that is simple, brief, and easy to follow.

Step 7: Draft the summary report. The workshop summary report should be drafted in a clear and concise way, focusing on the conclusions drawn from knowledge sharing and consultation processes that took place during the workshop sessions.

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Cover image source: Lloyd Singleton, Microplastics—What’s the BIG deal? University of Florida Blog.

Annex - Feedback form

A feedback form will be given to participants to evaluate how effective the workshop was. This form is meant to capture participants' experience and identify whether the workshop has met their expectations and how they have benefitted from their participation in this event. Participants will be asked to provide a short assessment on the workshop and discuss the findings and lessons learnt, as well as the different perspectives brought on the table by the different participants during the exchange of experience and capacity building activities. The form will be distributed by the host organisation before the official end of the workshop; participants are encouraged to keep notes during presentations and panel discussions so they can better reflect to evaluation questions.

Workshop Feedback Form (draft version)

PLASTECO Interreg Europe European Union European Regional Development Fund

UmweltCluster Bayern

PLASTECO A3.1: Interregional workshop on urban water management policies and practices to reduce microplastics leakage to the environment.

Organised by the Cluster of Environmental Technologies Bavaria (UCB), Augsburg, Germany, 13th May 2020

Name:

Organisation:

Please answer the following questions, relevant to different aspects of the public consultation meeting, by rating on a 1 to 5 scale.

How would you rate the workshop's overall organisation?

1	2	3	4	5
Very poor	Poor	Average	Good	Very good
☐	☐	☐	☐	☐

Do you think that the time allocated to each topic was sufficient?

1	2	3	4	5
Too little time ☐	Not enough time ☐	Just enough time ☐	Sufficient time ☐	Ample time ☐

How would you rate the quality of the presented topics?

1	2	3	4	5
Very poor ☐	Poor ☐	Average ☐	Good ☐	Very good ☐

How would you rate the quality of the discussion during the workshop?

1	2	3	4	5
Very poor ☐	Poor ☐	Average ☐	Good ☐	Very good ☐

How relevant to your organisation's operations were the topics addressed?

1	2	3	4	5
Not at all ☐	Poorly ☐	Averagely ☐	Significantly ☐	In their entirety ☐

The workshop will lead to improvements in the proposed policies.

1	2	3	4	5
Strongly disagree ☐	Disagree ☐	Neither agree nor disagree ☐	Agree ☐	Strongly agree ☐

The workshop, as a whole, has been appropriate and productive.

1	2	3	4	5
Strongly disagree ☐	Disagree ☐	Neither agree nor disagree ☐	Agree ☐	Strongly agree ☐

One of the aims of the workshop was to exchange examples of good practice on microplastics leakage to the environment reduction. Could you please very briefly describe what aspects make these practices successful, worth further exploring and integrating in own region's initiatives and policies.

The workshop also aimed to steer relevant policy planning and implementation. Please summarise what you learnt about these policies and their implementation during the workshop (barriers and challenges faced, measures taken, results achieved).

What is the most interesting/useful information and findings that you are going to communicate within your own organisation and to competent authorities in your country?

Are there any issues related to the topics of the workshop that have not been addressed? Please briefly describe them.

Do you have any suggestions for the organisation of future workshops?