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EurEau

Briefing Note

Microplastics and the water sector

Current knowledge, challenges and possible solutions

Summary

This briefing note consolidates the current knowledge on microplastics relevant for the water sector. It considers microplastics that are directly emitted by land-based sources to the aquatic environment and may pass through waste water treatment infrastructure and/or pollute drinking water resources. The note defines challenges and possible solutions as part of the larger debate on microplastics in the environment.

Microplastics are man-made particles found in the environment and that can make their way to oceans and into surface waters which may be used for drinking water production. Evidence of microplastics in water for human consumption is sporadic and not systematically based on recognised analytical methods.

The available evidence suggests that **microplastics at current concentration levels do not pose a risk to human health**.

Waste water is not a source of microplastics. Rather, the **waste water treatment infrastructure, including sewerage pipes, combined sewer overflows (CSOs) and effluents from waste water treatment plants (WWTPs), is a pathway for microplastics to the aquatic environment**. Several studies point at CSOs as one of the most common pathways for microplastics to enter the aquatic environment.

Only a minor share of the total microplastics released from various sources enter waste water infrastructure. Conventional WWTPs can efficiently remove up to 80-95% of microplastics, mostly in the preliminary and primary treatment steps. Part of the microplastics found in soil can be attributed to the use of sludge as an organic fertiliser, but other sources, such as **air deposition and mineral fertilisers, seem to be equally important**.

Requiring **additional action at the end-of-pipe would therefore offer very limited benefits but come at a high cost**.

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Control at source measures are both more sustainable and effective. They bring direct benefits for the water sector through fewer microplastics in drinking water resources, waste water and sludge and other residual products. Therefore, **control at source is key for the sector to deliver the circular economy**.

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1. Introduction

Microplastics are widespread and have been found in marine environments, surface water, in soils, in the air we breathe, in some of the food we eat (shellfish, honey, salt), and even in beer. The number of microplastic particles in groundwater is deemed to be negligible[1]. The potential impact of microplastics on public health and ecosystems is a growing public concern and has been high on the agenda of decision makers for some time. With growing global use of (micro-)plastics, their release to the environment is expected to increase.

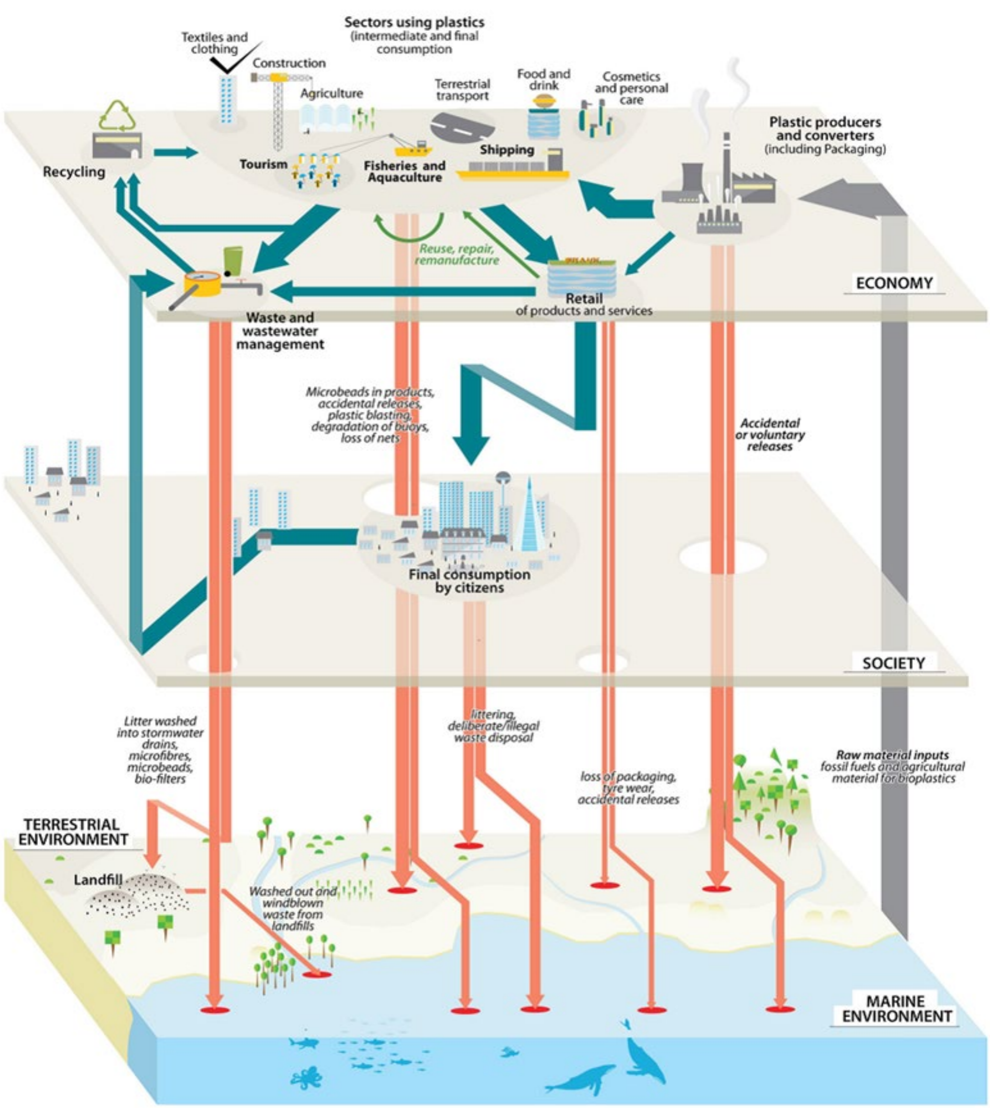
There is currently no internationally agreed definition of microplastics. The ECHA (European Chemicals Agency) defines them as any (synthetic) polymer or polymer-containing solid or semisolid particles that are not liquid or gas and having a size smaller than 5 mm in at least one external direction. Hence the definition refers to four criteria to be fulfilled simultaneously (substance, state, morphology and dimension)[2]. Primary microplastics are intentionally added to products. Secondary microplastics are unintentionally released during the use or the subsequent life-cycle stages of plastic-containing materials and goods through wear and tear (broken down into ever smaller pieces).

Microplastics can be directly emitted by land-based sources to the aquatic environment but may also result from poor waste management or the degradation of larger plastic waste (littering). The contribution of the latter to the global microplastics problem, especially in the marine waters, might be more important[3].

Directly emitted microplastics can be primary microplastics, such as from personal care products (also called 'microbeads'), industrial abrasives, paints and coatings and detergents, or secondary microplastics originating mainly from tyres, road markings, textiles and building paints, and/or pre-production pellets unintentionally emitted through accidental spills. On the European scale, Eunomia estimates direct secondary microplastics emissions from land-based sources to the environment at about one million tonnes per year, with about half of it stemming from automotive tyre abrasion. Eunomia also estimates that 28% of all microplastics released from products may end up in surface waters[4].

[1] 2019, Mintenig et al., Low numbers of microplastics detected in drinking water from ground water sources. Science of the Total Environment 648, 631-635.
[2] https://echa.europa.eu/documents/10162/13641/note_on_substance_identification_potential_scope_en.pdf/6f26697e-70b5-9ebe-6b59-2e11085de791, p3.
[3] 2014, Sundt, P. et al. Mepex, Sources of microplastic pollution to the marine environment, Mepex report for Norwegian Environment Agency.
[4] 2018, Hahn, S. et al. Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products, Eunomia final report.

How plastic moves from the economy to the environment



Source: SAPEA, 2019: [A scientific perspective on microplastics in nature and society]

And what about nanoplastics?

This briefing note does not address nanoplastics, often referred to as plastic particles in the <100 nm size range. The main reason is that research is at its infancy, detection methods are not yet available and nanoplastics have not yet been detected in natural aquatic systems. Further work is necessary to determine the sources, fate and effects of nanoplastics[5].

[5] 2015 Koelmans A.A., et al., Nanoplastics in the aquatic environment, critical review, Bergmann M. et al. (eds.), Marine Anthropogenic Litter, chapter 12.

2. Current knowledge and challenges

Discussions on the presence of microplastics in the water cycle and their impact on health and the environment are largely based on a wide range of studies with unknown reliability. We have seen more research in the last years and solutions are being proposed, but knowledge is still incomplete on several aspects that are relevant for sound policy making and adequate risk assessment for drinking water supply.

EurEau has compiled a significant number of studies, references and short notices related to microplastics from Europe and around the world. A partial list for the period 2014-2019 is included in Annex A.

2.1. Sampling and analytical methods for detection and quantification of microplastics

At present, a standardised test method for analysing microplastics in water, wastewater and sludge does not exist. There is no recognised international protocol for sample preparation (sampling, extraction, purification) and different analytical techniques for identification (polymer identification, particle size and mass) are applied (FT-IR (micro)-spectroscopy, Raman micro-spectroscopy, field flow fractionation, TGA-GC or pyr-GC, TEM/SEM, optical microscopy).

Without standardised sampling, analytical methods nor agreement on the measuring unit (weight per volume versus particles per volume), quantification results cannot be compared between studies and no overall assessment of the amount of microplastics in the environment is possible. This results in the inability to identify the most important sources of microplastics in the environment and quantify their impact. Furthermore, existing analytical methods are both labour-intensive and costly making comprehensive monitoring very difficult.

EurEau welcomes activities being undertaken by the WHO and others to define an appropriate methodological framework. Should it be necessary to establish standards and regulations for microplastics, sampling and analytical methods will need to be developed from the research level (IR/SEM) to enable large-scale and rapid analysis. The activities in the frame of the three-year MiWa project (funded by the German ministry of education and research, BMBF), the inter-calibration exercises organised by the Global Water Research Coalition (GWRC) and the JPI Oceans project BASEMAN are good examples of steps towards method harmonisation. However, more methods are being developed by universities and research institutions, each having their strengths and weaknesses. Clearly, we have to work towards one internationally agreed and standardised analytical set of methods that allows comparisons of analytical results.

As microplastic particles are widespread in the air, it is very difficult to avoid cross contamination of water samples, and this could have influenced the results of some studies on drinking water.

To have a proper and complete description of microplastics in the waste water cycle, the analysis should not be based on particle counts only (as in most studies), but also on mass and the characterisation of the type of microplastics. High particle numbers are not necessarily associated with high particle mass and therefore are not a significant contribution to the total amount of suspended solids, and vice versa. The number of particles is not a consistent measure compared to mass, as illustrated in a comparison of mass and particle counts by ten Danish WWTPs[6]. Moreover, due to the variable nature of waste water, the number of samples should be statistically significant.

Even with a standardised procedure, this will be a challenging, long and expensive procedure which does not allow for a routine monitoring system to be established. Finally, a detailed analysis of the fate of microplastics and a mass balance along different treatment steps in the WWTP is difficult to perform because waste water and sludge are complex matrices for microplastics analysis.

2.2. Impact of microplastics – risk assessments

Microplastics are largely resistant to biological degradation and may also act as vectors for bacteria and viruses as well as persistent, bio-accumulative and toxic contaminants (PBTs) from the environment. Some plastics based on fossil sources are bio-degradable (PCL, PBS, PES), whereas some 'bio-plastics' are not biodegradable (PE, Nylon11).

The impacts of microplastics likely depends on their chemical composition and, possibly, their structure or shape. It has been suggested to scale types of microplastics based on the risk of increased pollution levels. Such rankings of microplastics might help in prioritising actions.

Following a review of existing literature, the Science Advice for Policy by European Academics (SAPEA) wrote in a recent report[7] for the European Commission "the best available evidence suggests that microplastics and nanoplastics do not pose a widespread risk to humans or the environment, except in small pockets". However, SAPEA also hints at knowledge gaps and the risk that the situation could change if current release levels would not be reduced.

Several recent toxicological and eco-toxicological evaluations of microplastics by international authorities address both environmental effects and potential human health effects. Interactions of microplastics with biota and effects on the aquatic ecosystem and on humans are being studied in the MiWa project[8]. Several studies are also conducted in the frame of the implementation of the EU Marine Strategy Framework Directive.

A risk analysis on microplastics present in the marine environment, based on estimations from the past (1950-2016), present (2018) and future (2100) global plastics production and effect data from literature, indicated that no adverse impact is

[6] 2018, Simon et al. Quantification of microplastic mass and removal fi rates at wastewater treatment plants applying Focal Plane Array (FPA)-based Fourier Transform Infrared (FT-IR) imaging, Water Research 142, 1-9.
[7] SAPEA, 2019: A scientific perspective on microplastics in nature and society
[8] https://www.wrh.tu-berlin.de/miwa/menue/miwa/.

to be expected from microplastics in the water column nor in the sediment, up to the year 2100. With current plastics production, beaches will become unsafe earlier (2040). The microplastics problem in oceans appears mainly to be confined to hot spots[9].

As regards the impact of microplastics on freshwater ecology, some studies already indicate their detrimental impact on fish productivity and physiological processes for fisheries and aquaculture[10], as well as on birds, benthic organisms and zooplankton, but the available data remain limited.

In soil, less plastics have been found than assumed in theoretical calculations. This may be because sun light, but also worms, degrade plastics. In any case, there is a greater chance of degradation in soil than in water, due to the presence of good microflora in soil and many organisms and fungi that can degrade polymers.

Therefore, while currently there is no evidence that microplastics are harmful to our health, further research is necessary to determine the real toxicological impact of different types of microplastics in different concentrations. This would be of crucial importance for drinking water suppliers if microplastics were found at the tap which is unlikely to happen thanks to the treatment steps already in place to remove suspended solids. To conduct a full risk assessment of the presence of particles, it is essential that the water service providers have accurate and robust scientific guidance on the health risks associated with the consumption of microplastics in drinking water.

WHO and EU experts should provide the scientific guidance needed to establish a risk assessment for drinking water before considering any regulatory steps.

2.3. Sources and pathways

Waste water is not a source of microplastics. Rather, the waste water treatment infrastructure, including sewerage pipes, combined sewer overflows (CSOs) and treated waste water are a pathway to the aquatic environment, mainly for 'microbeads' from personal care products, wet wipes and fibres from washing synthetic clothes (i.e. fleece). Based on estimations for Europe (Eunomia, see reference 4), microfibres from synthetic clothes represent about 2-6% (18-46 thousand tonnes per year) of the total amount of emitted secondary microplastics. How many of these microplastics bypass the waste water infrastructure and end up in the aquatic environment is still unclear. Eunomia estimates the emissions of microfibres to water bodies at 8-24 thousand tonnes per year in Europe. Overall, only a minor share of microplastics released from various sources (mainly textiles and tyres) may end up in sewer networks.

Research studies and tests carried out by water service providers are finding microplastic particles in waste water in the form of small plastic pieces or micro-fibres.

[9] 2018 Everaert, G. et al., Risk assessment of microplastics in the ocean: Modelling approach and first conclusions, Environmental Pollution 242, 1930-1938.
[10] 2017 Lusher et al., Microplastics in fisheries and aquaculture. Status of knowledge on their occurrence and implications for aquatic organisms and food safety. Food and Agriculture Organization of the United Nations (FAO) 2017: 615, http://www.fao.org/3/a-i7677e.pdf.

The quantification of sources and pathways is still ongoing. A Danish study[11] indicated that synthetic textiles/washing machines and personal care products, industrial dish washers and industrial wheel washing with plastic granules are sources of microplastics in waste water.

Microplastics are also identified in sewage sludge (see page 11).

Several studies point at storm water as one of the most significant means for microplastics to enter water bodies and the ocean, especially through abrasion particles from car tyres and road markings[12]. Storm water run-off might be connected to sewers and hence tyre wear from roads might also end up in WWTPs. However, the impact of storm water flowing into combined sewers or the loss of microplastics through storm water or CSOs is largely unknown. The Eunomia study considers some average key factors in their overall modelling of the pathways/sinks along the sewerage system pathway:

- 10% release of the microplastics via CSOs
- Estimated ratio of combined vs separated sewers = 50:50.

However, these assumptions should be reconsidered in the frame of local situations in different countries. With this, the fate of microplastics among other particles created by car tyre abrasion through the waste water pathway is an unsolved question, which should be addressed by future studies. One is ongoing in Sweden. Moreover, most particles from tyres measure below 20µm, but very few studies have investigated particles below 20µm[13].

As outlined above, microplastics arrive in the aquatic environment through many pathways and, consequently, they can be found in surface waters used for drinking water production. Some publications hint at a small number of microplastic particles in drinking water. However, evidence is sporadic and not systematically based on recognised analytical methods. Recent research studies rather suggest that there are no significant concentrations of microplastics in drinking water[14,15].

2.4. Role of WWTPs in capturing microplastics

WWTPs are not intentionally designed for microplastics removal, although particle removal is one of the basic functions. Studies indicate that microplastic quantification and retention rates within WWTPs largely depend on sample preparation (filtration cut-off), on the treatment process used and on operational conditions. Moreover, most studies are based on particle counts. Hence, retention rates largely differ among studies and should be interpreted with caution. The Eunomia report refers to an average

[11] 2017 Vollertsen, J. and Hansen, A.A., Microplastic in Danish wastewater, Sources, occurrences and fate, Danish EPA report No 1906.
[12] 2017 Tumlin, S., Sweden Water research, Microplastics, Report from an IWA Sweden conference and workshop in Malmö, November 8-9.
[13] Both Dall'Osto et al. (2014) and Mathissen et al. (2011) in their studies report most particles from car tire abrasion between 10 and 100nm.
[14] 2018 Uhl, W. et al., Mapping microplastic in Norwegian drinking water, Norwegian Water report.
[15] 2018 Aarhus University Danish Centre for Environment and Energy, Analysis of Microplastic Particles in Danish Drinking Water, Scientific Report No. 291.

retention rate of 53-84% across Europe, but this figure is based on questionable choices to estimate removal efficiency. A more detailed analysis leads to the following general conclusions for current removal at WWTPs:

- Conventional WWTPs (typical activated sludge plants) can be quite efficient in microplastics removal from the water line with retention rates of 80% up to 95%, most probably attained in preliminary and primary treatment steps (if present) (see reference 9). With additional polishing steps, up to 99% removal can be reached.
- The reported removal rates are largely based on particle numbers and may give different results as compared to those based on particle mass due to different behaviour of different types of microplastics. However, the overall removal rate seems to be very high regardless of particle count or mass (see reference 4).
- The removal efficiency appears to depend on the size of the particle. Smaller filtration cut-offs result in lower retention rates[16]:
    - MPs > 300µm: 97-99%
    - MPs between 10-300µm: 80-90%.
- The impact of the particle size needs further research. Particles > 55µm seem to settle better than smaller particles, which might be more buoyant. On the other hand, their specific density needs to be considered. There are indications that particles < 100µm are usually integrated in sludge flocs.
- WWTP across the EU apply different treatment stages and technologies. Consequently, removal efficiencies vary between countries and plants.
- In certain cases, lower removal rates might be linked to higher waste water dilution.
- The large variability of influent flow and composition in combination with few and low absolute numbers of microplastics results in problems to obtain representative samples and, consequently, leads to high statistical variability of the samples.
- According to a Danish report, by far the most common plastic material in raw waste water appears to be polyamide/nylon. However, a more recent study refers to polypropylene and polyethene as the most common polymers (see reference 4).

A more detailed analysis of removal technologies is included in chapter 3.

In conclusion, considering the observed average retention rates in connection with the small amount of microplastics that enter the WWTP as compared to the total estimates of microplastics, end-of-pipe action is an ineffective way to prevent microplastics from entering the natural water environment.

[16] 2015 Österås, A.H, et al., Screening of organic pollutants in sewage sludge amended arable soils, Swedish EPA report.

2.5. Microplastics in sewage sludge and impacts on soil

A significant part of the microplastics that enter WWTPs are captured by the screens in the beginning of the process[17,18], or caught in grit traps and the fat skimming stages (if in place). Depending on the country, the fate of these microplastics is most often incineration or landfill. The remaining microplastics most probably end up in the primary sludge if a primary settler is in place or in the secondary sludge. There are suggestions that microplastics degrade to a certain amount in the digesters[19] but more research is needed to confirm this.

The complexity of the measurements mentioned above does not allow to precisely quantify the microplastics content in sewage sludge. Data from Danish and Swedish studies refer to 0.025-0.042 mg microplastics per g of dewatered sludge, or 0.02-0.04% of the total dry matter content.

High-quality sewage sludge complying with legislative requirements is currently used as a fertiliser for 50% of the all sludge production in Europe. A Norwegian study estimated, based on the average prevalence of microplastics in sewage sludge and its present application, that in Norway, over 500 billion microplastic particles are annually released into the environment via the application of sewage sludge through agriculture, on green areas and by soil producers[20]. Questions are being raised by regulators applying the precautionary principle.

However, the risk to disseminate microplastics should be balanced against the positive aspects of bringing organic matter and nutrients on farmland, even more so as there are other significant microplastics pathways to the soil.

- The ECHA estimates that between 5,400 – 39,700 tonnes of microplastics are directly released to soils through controlled release fertilisers, fertiliser additives, treated seeds and capsule suspension pesticides[21].
- Current farming practices may use plastic films which generate microplastics if not properly collected and recycled.
- Air deposition, even in remote areas, seems to play a significant role. Scientists found out that, in the French part of the Pyrenees Mountains, 365 microplastic particles per square meter are falling from the sky every day. Particles seem to be transported through the atmosphere over a distance of up to 95 km[22].

The relevance of alternative pathways is confirmed by the results of research projects in Denmark and Sweden from 2018. They show that there is no difference in the level of microplastics concentrations comparing farmland with and without the addition of

[17] 2016 Carr, A. et al., Transport and fate of microplastic particles in wastewater treatment plants, Water Research 91 (15), 174–182.
[18] 2016 Michielssen, M.R. et al. Fate of microplastics and other small anthropogenic litter (SAL) in wastewater treatment plants depends on unit process employed, Environ. Sci.: Water Res. Technol. 2, 1064
[19] 2017 Mahon, A.M. et al., Microplastics in sewage sludge, Effects of treatment, Environmental Science & Technology, 51 (2): 810–818.
[20] 2017 Lusher, A.L. et al., Mapping microplastics in sludge, NIVA Report 7215-2017.
[21] ECHA, 2019, Annex XV Restriction Report - Proposal for a Restriction for intentionally added microplastics (table 15).
[22] 2019 Steve Allen et al., Atmospheric transport and deposition of microplastics in a remote mountain catchment, Nature Geoscience, volume 12, pages339–344.

sewage sludge as fertiliser[23].

The concentration of microplastics in farmland from the Danish study (see reference 8) is very low, approximately 10mg/kg.

Again, concerns over microplastic concentrations in sewage sludge applied to farm land can best be overcome by reducing microplastics release to the sewer network through effective control-at-source measures.

3. Possible solutions - removal technologies and additional measures for water services

3.1. Drinking water treatment

Drinking water intended for human consumption goes through treatment processes that remove a wide range of impurities prior to distribution to customers. The extent of this treatment depends on the source of the water.

Drinking water protection areas are established to protect groundwater from contaminants in the water catchment area. As microplastic particles are deposited on soils, they would be retained by the natural filtration capacity of the soil as for many other particles. Of course, some soils are more porous such as karstic soils, but finally the strategies water companies have developed to remove particles other than microplastic particles from groundwater (e.g. to remove turbidity) should be effective for microplastic particles too.

Surface water for drinking water production typically requires a more intensive treatment than groundwater, which often needs little or no additional treatment. Treatment processes for surface water have always been applied with the objective of removing living or inert particles in the same size range as microplastic particles by physical treatment steps such as sedimentation, coagulation – flocculation, flotation, filtration. So the physical processes in place for treating surface water to remove small (e.g. Cryptosporidium, algae) and large particles would be effective for microplastics too. There too, turbidity measurements and other monitoring tools help to control the removal of all kind of particles in the micron range.

As a result, with present practices, microplastics are effectively prevented from entering drinking water treatment works. Water companies nevertheless carry out their own risk assessments. This is facilitated by accurate and robust scientific guidance on the health risks associated with the consumption of microplastics.

[23] 2018 Ljung et al., Microplastics in the water and nutrient-cycle.

3.3. Waste water treatment

Microplastics (1–5,000µm), as compared to suspended solids in conventional WWTPs (50-500µm), are particles, hence their removal in WWTPs relies on settling and/or filtering technologies.

To date, there is little systematic testing and practical experience as to how the removal of microplastics is affected by the operational performance and the conditions of current technologies. Few studies have tried a detailed assessment of which treatment steps retain the most microplastics. Based on particle count, Murphy et al. (2016) suggests that the most important treatment steps are grit and grease removal (45%) and primary settlement (34%). Michielssen et al. (2016) also studied the removal rates at different treatment steps by particle counts and suggests that preliminary (mechanical) treatment removes 35-59% of microplastics and primary treatment another 23-53%. Carr et al. (2016) similarly found that most microplastic particles were removed in the primary treatment zones and further suggests that effluent discharges from both secondary and tertiary waste water treatment steps only show a slight improvement on the total microplastics reduction in effluent.

An on-going Swedish study, at Rya WWTP shows that up to 20% of the microplastic mass in the influent was removed by the 2mm bar screens. Effluent microplastic concentration is estimated to be in the range of about 1% of Total Suspended Solids in the effluent. Further analysis of tyre particles is on-going during 2019.

Following the observed retention of microplastics in several WWTPs, additional measures to increase microplastic removal may involve measures at the plant itself, such as adopting screens as the first step of the plant or enhancing primary or secondary clarifier performance by dosing polymers. In the frame of the optimisation of the existing infrastructure, waste water operators should exchange existing data from WWTPs to increase knowledge on:

- total mass removal rates
- removal at different treatment steps
- types of microplastics.

Adding an extra filtering step after the conventional WWTPs should be seen as a solution in specific cases only, since most studies demonstrate very high removal rates at the preliminary and primary treatment processes. Estimates for extra costs for additional treatment with disc filters, sand filtration, micro-filtration or membrane bio-reactor range from 0.08 to 0.20 EUR/m^3 (including investment and operational costs). Considering a total amount of about 23-38 billion m^3 of waste water for the whole of Europe, this means an extra cost of 1.84-7.6 billion EUR per year. This is a very expensive solution considering that only about 10%-15% of the total amount of microplastics released into the environment arrive at the inlet of a WWTP and hence the impact of additional treatment on the total emissions of microplastics would be as low as 0.5-3%. Furthermore, considering that the waste water treatment asset life is very long (25-40 years+) and investment cycles are slow, installing new equipment across the EU could take decades.

3.4. Options for urban drainage systems

Due to its local character, there is a lack of valid data for the contribution of combined sewer systems and CSO's to microplastic release. Filling these knowledge gaps would be useful.

Disconnection of sealed roads/areas from sewer systems are ongoing in many member states in the frame of coping with storm water and CSO's. However, unless the stormwater is treated, tyre and road marking particles could be released directly into the aquatic environment. Installing filtering solution could be technically feasible but is economically not viable.

Nature-based solutions such as green roofs, retention ponds and reducing sealed surfaces will slow down or delay storm water run-off and potentially lower CSO's. These measures go beyond the responsibility of waste water operators and require visionary urban planning but would be a more sustainable solution.

3.5. Sludge treatment

The separation of primary and secondary sludge, where applicable, could be a preventing measure to limit the release of microplastics to soil.

Technologies to separate all microplastics before they are captured in sludge are unrealistic today. However, as already mentioned: screens, grit traps and fat skimming probably remove a substantial share of the microplastics prior to their capture in sludge.

Recent studies from Ireland (see reference 15) suggest that anaerobic digestion may reduce microplastics retained in the sewage sludge. This may be due to either breaking them down to particles smaller than the detection limit of the applied approach, or to biological degradation. Bacterial digestion of nylon has been shown in environments with sufficient nylon[24], but this needs further investigation. Furthermore, the role of digestion is not yet clear regarding aspects such as thermophilic digestion or mesophilic digestion, the effect of retention time in the digester, the difference between serial and parallel operation, content in the reject water etc.

4. Regulatory framework

There is currently no comprehensive regulatory framework for microplastic controls that address all sources of microplastics and puts control at the source as a priority.

Several initiatives are being taken at European or national levels, some of which are listed below.

[24] 2007, Gautam et al.

	Primary microplastics	**Secondary microplastics**	**Oxo-degradable plastics (not only microplastics)**
Products	Cosmetics, detergents, paints, cleaning products, pharmaceuticals (nano-capsules), cosmetics, fertilisers, detergents	Tyres, synthetic textiles, pellet loses , plastic dust from shredders or dust from handling of plastics in landfills …	Agricultural films, rubbish and carrier bags, food packaging, landfill covers
Policy	EC to finalise the REACH Annex XV restriction dossier concerning the use of intentionally added microplastic particles to consumer or professional use products of any kind *(Source: ECHA)*	~ EU to improve monitoring / mapping of marine litter, incl. micro-plastics, using EU harmonised methods ~ EU to examine policy options for reducing unintentional release of microplastics from tyres, textiles and paint (e.g. minimum requirements for tyre design (tyre abrasion & durability) and/or information requirement (incl. labelling), methods to assess microplastic losses from textiles and tyres, combined with information (possibly labelling), minimum requirements, R&D funding ~ EU to develop measures to reduce plastic pellet spillage (certification scheme and / or BAT document under the IED) ~ EU to evaluate the UWWTD: assessing effectiveness as regards microplastics capture and removal ~ Member States to pursue and implement cross-industry agreements to reduce release of microplastics in the environment *(Source: European Strategy for Plastics in a Circular Economy)*	~ Directive on the reduction of the impact of certain plastic products on the environment (single-use plastics directive, 2019) prohibits the placing on the EU market of oxo-degradable plastics

5. The way forward - what can policy makers, scientists and water operators do?

EurEau recognises that microplastics are found in drinking water resources, but especially in waste water and sludge. Although current exposure levels to microplastics do not seem to lead to health risks, we are concerned about the potential long-term effects on public health and ecosystems. However, current knowledge and proposed solutions suggest that the water sector cannot be the main sector responsible for solving the microplastics problem and bearing the associated costs. The waste water infrastructure is not a source of microplastics but one of the many pathways of microplastics to the environment, though a very moderate one.

The following actions, involving many stakeholders and taking into account the polluter pays principle, are key to tackle microplastics.

5.1. Source control of microplastics

Control at source is the most sustainable and effective tool to prevent microplastics ending up in the environment. Implementing it will bring direct benefits to the water sector through fewer microplastics in drinking water resources, waste water and sludge and other residual products. It is key for the sector to deliver a circular economy.

In many cases, source control of microplastics will not be easy, but several actions are already ongoing at the European or national levels:

- Ban of plastic bags
- Regulatory and financial incentives to encourage eco-design of products
- Proposed restriction of intentionally added microplastics
- A Dutch initiative for car tyres and industrial abrasives.

These actions should be accompanied by labelling and awareness raising campaigns.

EurEau strongly promotes the principle of extended producer responsibility (EPR) to tackle micropollutants, but also microplastics, if control-at-source measures are insufficient. Applying this principle, manufacturers that affect the water cycle (and the environment) through their products, would have to finance mitigating measures at other life cycle stages. It would put the cost at the right place, not on the water consumers.

In the framework of EPR, the European Commission should impose more stringent measures, such as:

- introducing compulsory environmental risk assessment for all products containing plastics with exposure to the water cycle
- requiring mitigating actions from washing machine producers, textiles producers, dishwashing, washing of tyres, retailers etc.
- obliging plastics producers to contribute proportionally to the upgrading of the waste water infrastructure, and in particular WWTPs, if no other solution is possible.

5.2. Research

Although the water sector is not the source of the problem, cost-benefit analyses of all possible solutions may indicate the (waste) water sector as part of the solution in specific circumstances and covered by EPR arrangements.

Finding the most cost-effective solution should be based on risk assessments in combination with options to optimise the existing infrastructure or, if efficient, to add additional treatment steps.

As a matter of urgency, additional scientific research and guidance are needed on:

- **Analytical and sampling methods**
  There is an urgent need for a standardised test method and agreed units of measurement to make direct comparisons and interference of conclusions possible. In the framework of possible standards and regulations for microplastics, analytical methodologies should be in place that enable large scale and rapid analysis, hence support should be given to harmonisation exercises (e.g. from GWRC).
- Develop and agree a clear **classification of microplastics**.
- Establish **evidence base for presence/absence of microplastics in drinking water**
- **Toxicity/eco-toxicity of and risks associated with microplastics** in drinking water, treated wastewater, sludge or soils.
- **Sources and routes into the environment,** including the water cycle and sludge route.

  It is essential that the routes and fate of microplastics in the environment and their potential detection at costumer taps are fully understood and mapped and the sources identified so that appropriate preventive measures and/or barriers can be put in place. Furthermore, more knowledge is needed on the impact of combined sewers and CSO's, for example regarding micro-rubber particles.
- **Long-term fate and impact of microplastics** in the soil and the aquatic environment.
- Gaining a better **understanding as to how microplastics in the waste water influent can be prevented from ending up in the sludge**.
- **Innovative technologies at WWTPs** that also consider other pollutants removal. Innovative technologies to secure removal of microplastics from sludge are seen by some stakeholders as an important tool, but are not considered by the waste water sector as realistic in the foreseeable future.
- Innovative technologies to **support source control**, e.g. for laundry washing and textile manufacturing.
- Investigate and quantify the **plastic usage by the water sector** in order to determine if alternative management and treatment options are available to minimise plastic usage.

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Annex A

List of publications (2014-2019)

2014 Lechner, A. et al., The Danube so colourful, A potpourri of plastic litter outnumbers fish larvae in Europe's second largest river, Environmental Pollution 188, 177-181

2014 Nerland, I.L. et al., Microplastics in marine environments, Occurrence, distribution and effects, NIVA report 6754

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2014 Talvitie, J. et al., Do wastewater treatment plants act as a potential point source of microplastics, Preliminary study in the coastal Gulf of Finland, Baltic Sea, Wat. Sci. Techn. Manuscript

2014 Van Echelpoel, W., Microplastics in a biological wastewater treatment plant, PhD

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2016 Michielssen, M.R. et al. Fate of microplastics and other small anthropogenic litter (SAL) in wastewater treatment plants depends on unit process employed, Environ. Sci.: Water Res. Technol. 2, 1064

2016 Miklos, D. et al., Mikroplastik, Entwicklung eines Umweltbewertungskonzepts, UBA report

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About EurEau

EurEau is the voice of Europe's water sector. We represent 32 drinking and waste water service providers from 29 countries in Europe, from both the private and the public sectors.

Our members are the national associations of water services in Europe. At EurEau, we bring national water professionals together to agree European water industry positions regarding the management of water quality, resource efficiency and access to water for Europe's citizens and businesses. The EurEau secretariat is based in Brussels.

With a direct employment of around 476,000 people, the European water sector makes a significant contribution to the European economy.