Water Workshop 2025

Measures for reducing the amount of microplastics in the environment

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Microplastics

Elementary notes

Microplastic is a growing source of concern of scientists and citizens:

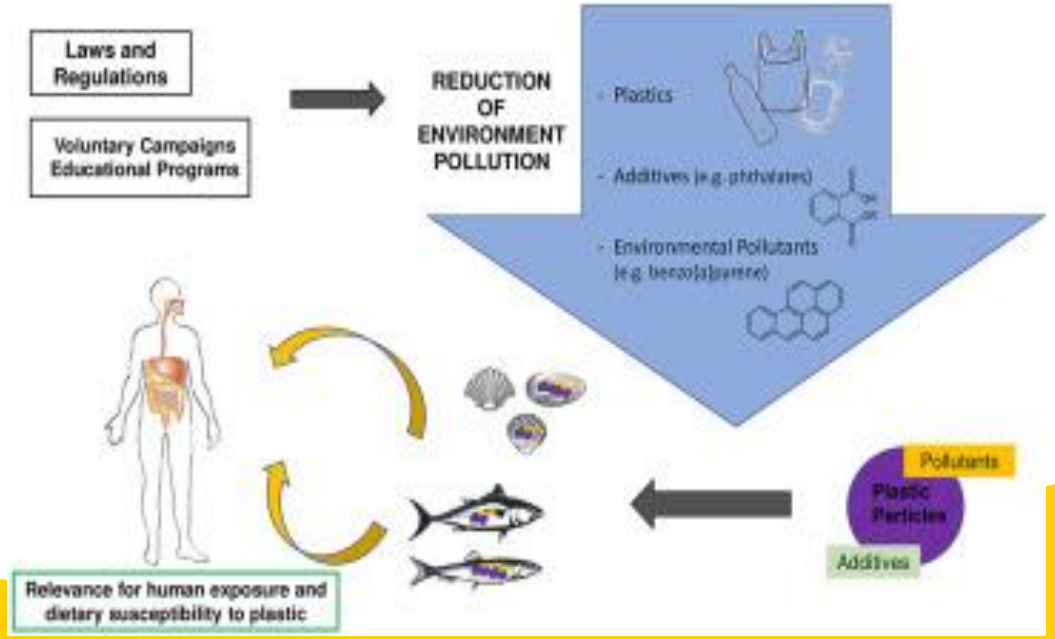
- Small particles are spread across every corner of the globe, from the ocean's depths to the mountain peaks
- All eco-systems are affected, and no food chain is untouched
- Tiny plastic particles are persistent, very mobile, and extremely hard to remove from nature

Microplastic pollution also has negative impacts on economic sectors that depend on healthy soils and on clean, plastic-free rivers and oceans.

Elementary notes

As part of the European Green Deal, the EU has taken measures to fight against microplastic pollution on all fronts.

EU is strongly advocating for deliver legally binding instruments to end plastic pollution; regulation measures are in direct relation with the sources of pollution.



Existing acts

2018 - *EU Strategy for Plastics in a Circular Economy* identified the need for more scientific research and solutions for clarifies problem of MPs pollution.

2020 - as a follow-up action of the *European Green Deal* , the *Circular Economy Action Plan* committed the Commission to minimizing the presence of microplastics in the environment by:

- restricting intentionally added microplastics in products;
- addressing unintentional releases of microplastics by developing: standardisation, certification and regulatory measures as well as harmonising methods for measuring their releases.

2021 - in Action plan: ‘Towards zero pollution for Air, Water and Soil’ , the Commission proposed that, by 2030, the EU should reduce (intentional and unintentional) microplastic releases into the environment by 30%.

The Zero Pollution Action Plan

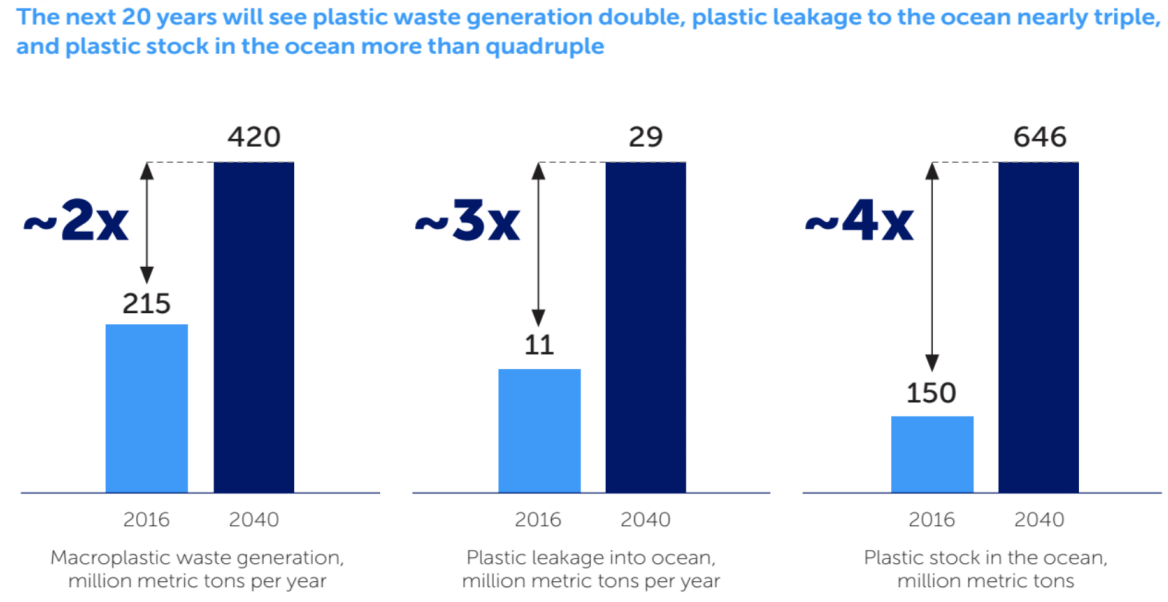
The Zero Pollution Action Plan set a target on reducing MPs releases by:

- reducing plastic pollution (as these degrade into microplastics)
- restricting the use of intentionally added microplastics to products
- reducing unintentional microplastic releases

Target 1: Reduce by more than 55 % the health impacts (premature deaths) of air pollution
Target 2: Reduce by 30 % the share of people chronically disturbed by transport noise
Target 3: Reduce by 25 % the EU ecosystems where air pollution threatens biodiversity
Target 4a: Reduce nutrient losses by 50%
Target 4b: Reduce the use and risk of chemical pesticides by 50%
Target 4c: Reduce the use of the more hazardous chemical pesticides by 50%
Target 4d: Reduce the sale of antimicrobials for farmed animals and in aquaculture by 50%
Target 5a: Reduce plastic litter at sea by 50%
Target 5b: Reduce by 30% microplastics released into the environment
Target 6a: Reduce significantly total waste generation
Target 6b: Reduce residual municipal waste by 50%

1. Unsustainable consumption and improper disposal of plastic products

- Most of this pollution comes from larger garbage known as macroplastics
- The stocks of accumulated plastics in water bodies are projected to more than triple
- By 2060 plastic leakage to the environment is expected to double to 44 million tonnes a year



The Waste Framework Directive

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

Prohibits the leaving, dumping or uncontrolled management of waste.

Requires Member States to identify products that are the main sources of littering, and take measures to prevent, combat and clean up all types of waste from such products

Requires the separate collection of plastic waste and contains targets on the preparing for reuse and recycling of municipal waste, which contains increasing amounts of plastics

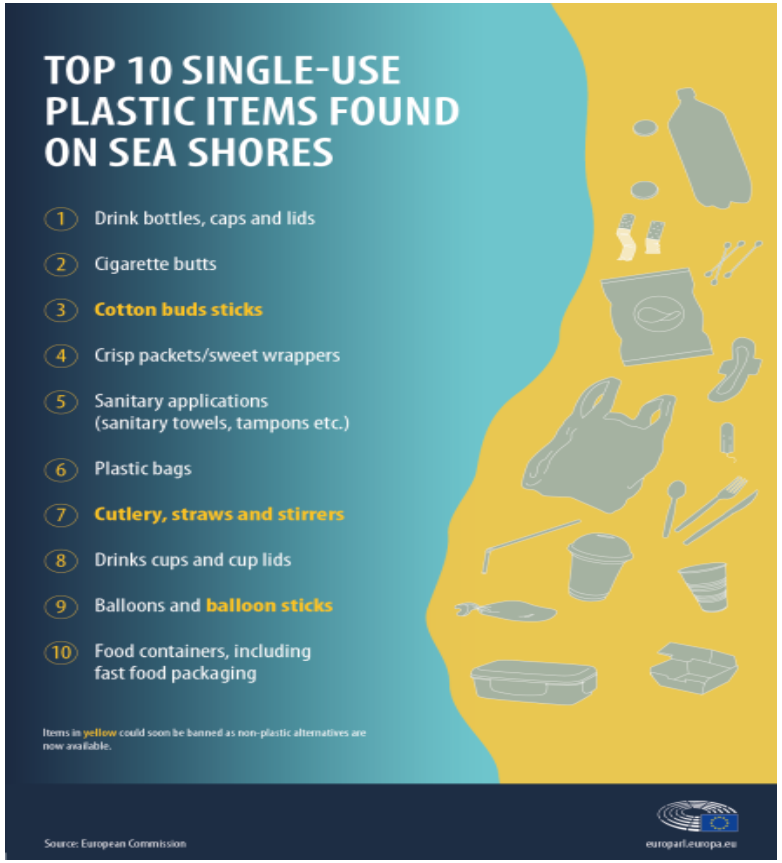
EU Directives and Regulations

2018: **Directive 94/62/EC on packaging and packaging waste** - significantly **increased the recycling targets for plastic packaging waste** to ensure that waste is returned to the material loop and used as a resource.

2019: new **REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on packaging and packaging waste**, repealing Directive 94/62/EC - includes measures **to increase reuse and recyclability of packaging, as well as targets for recycled plastic content**, which aim to reduce waste, further boost the supply and demand of plastic waste and in this way minimize its leakage in the environment.

2019: **DIRECTIVE (EU) 2019/904 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the reduction of the impact of certain plastic products on the environment** - covers the most littered single-use plastic products and fishing gear

2023: **REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on circularity requirements for vehicle design and on management of end-of-life vehicles** - includes also **targets for plastic recycling and recycled content**.



The Single-Use Plastics Directive include **market restrictions, consumption reduction measures, product and marking requirements and awareness raising**

bans **products made from oxo-degradable plastic**, which does not properly biodegrade in the environment

Source: Joint Research Centre, European Commission (2017)

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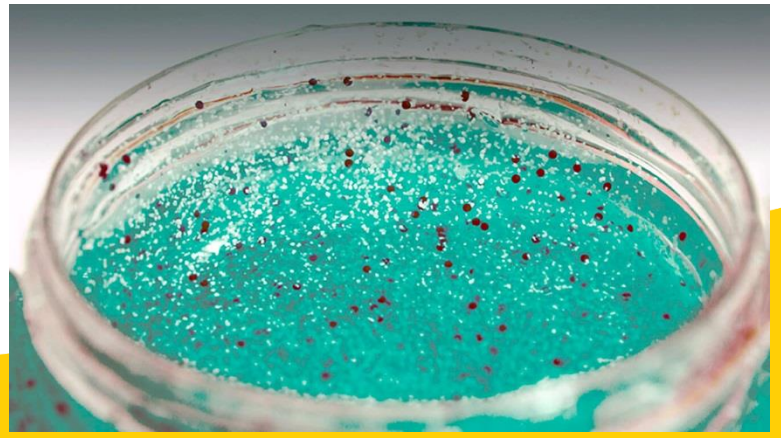
2. Products with intentionally added microplastics

Every year around 145 000 tonnes of microplastics are deliberately added to a range of products placed on the market including cosmetics, detergents, paints, fertilisers, plant protection products and products used in the oil and gas industry.
Microplastics are also used as the soft infill material on artificial turf sports pitches.

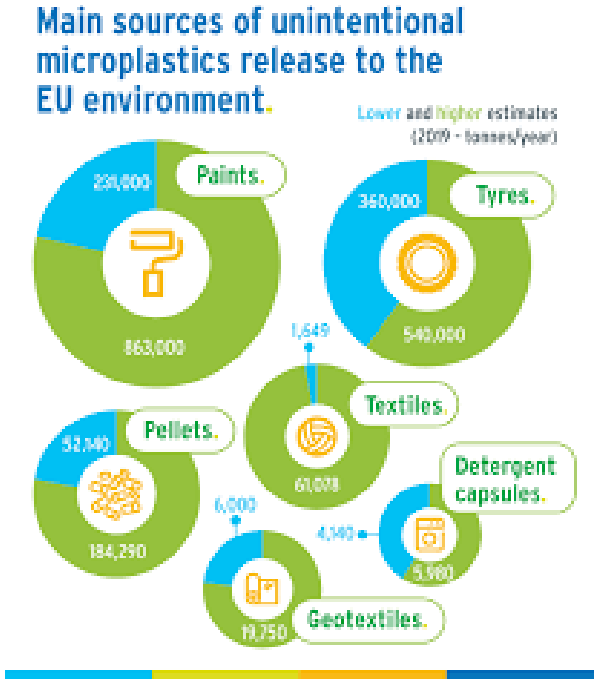
To avoid or reduce releases of MPs, the EU adopted a wide-ranging restriction on microplastics in products placed on the EU market under the EU legislation on chemicals ('REACH').

Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the ***Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH****)*

This restriction is expected to prevent the release of around 500 000 tonnes of microplastics over twenty years.



3. Unintentional release of microplastics



Paints (including coatings), tyres, plastic pellets, synthetic textiles, geotextiles, detergent capsules – main source of unintentional release of microplastics.

Between 0.7 and 1.8 million tonnes (up to 600 Olympic-size swimming pools) of microplastics are estimated to be unintentionally released into the environment every year in the EU.

EU Proposals of Regulations

The Commission presented a proposal for a **Regulation setting requirements to prevent plastic pellet losses to the environment**. Under this proposal, operators manufacturing and handling pellets will have to comply with mandatory requirements, building on the industry's OCS (Operation Clean Sweep® (OCS)) initiative and the Recommendation of the Convention for the Protection of the Marine Environment of the North-East Atlantic on pellet losses.

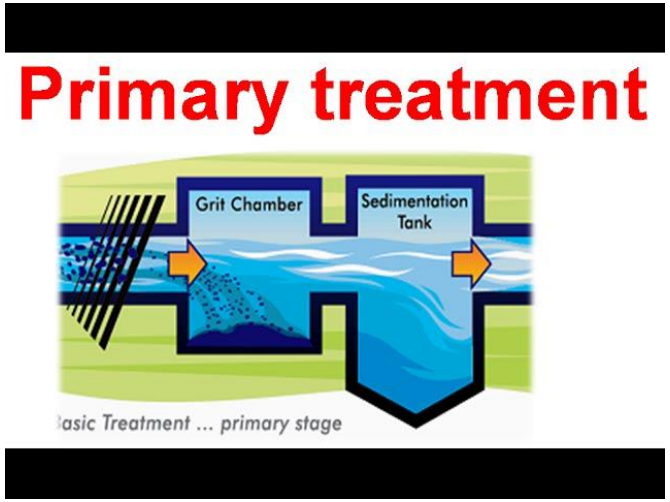
The Commission proposal for the EURO 7 Regulation (Proposal for a **Regulation on type-approval of motor vehicles and engines and of systems, components and separate technical units intended for such vehicles, with respect to their emissions and battery durability**) provides for the establishment of tyre abrasion limits for tyres to be placed on the EU market.

Policies to Reduce Microplastics Pollution in Water Focus on Textiles and Tyres
POLICY HIGHLIGHTS

- **Source-directed interventions**, such as the sustainable design and manufacturing of textiles, tyres, and complementary products (e.g. washing machines, laundry detergents, road surfaces, and vehicles), to minimise the tendency of products to contribute to microplastics generation;
- **Use-oriented interventions**, such as the uptake of best use practices (e.g. ecodriving and best laundering parameters) and mitigation technologies (e.g. microfibre filters), to reduce preventable releases into wastewater and diffuse entry points;
- **End-of-life interventions**, such as separate collection schemes and waste management practices, to prevent waste leaking into the environment and potentially contributing to microplastics generation;
- **End-of-pipe interventions**, such as improved wastewater, storm water, and road runoff management and treatment, to retain the emitted microplastics before these reach water bodies.

Removal of microplastics in the WWTPs (wastewater treatment plants)

While some microplastics are released straight into the environment, many find their way into wastewater. Wastewater treatment plants are considered major sources of microplastic pollution in aquatic and terrestrial environments.



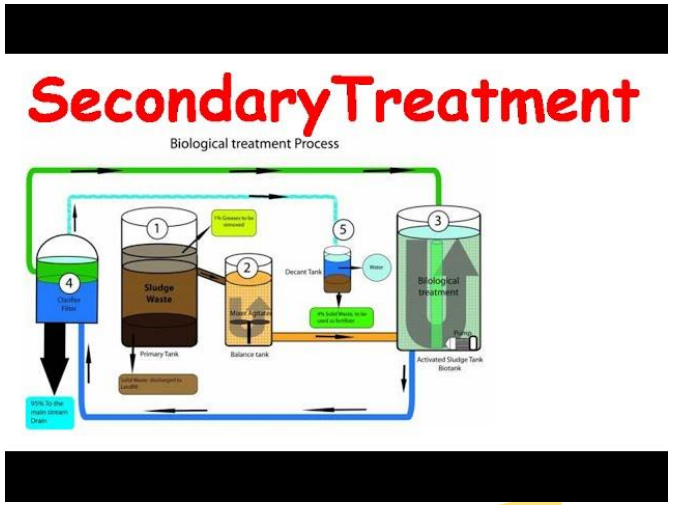
Preliminary and primary treatment

- achieving efficiencies of up to 70–98%
- successfully remove larger MPs
- more effectively remove fibers from wastewater than fragments

Removal of microplastics in the WWTPs (wastewater treatment plants)

Secondary treatment

- involves biological processes like activated sludge, which can remove a significant percentage of microplastics
- the efficiency depends on the size and type of microplastics and the specific treatment technologies used.
- the largest portion of removed microplastics is trapped in the sewage sludge, which can then contaminate terrestrial ecosystems.



Membrane bioreactor system - eliminated MPs primarily by microbe intake and the development of effluents
Biofilter technology - the MPs smaller and lower densities particles entered the biofilter treatment unit, had better microplastic extraction efficiency
Coagulation/flocculation - can aid in the removal of up to 90% of MPs
Dissolved air floatation - has the potential to be an effective method for MP removal
Magnetic extraction - eliminating tiny MPs was shown to be superior

Removal of microplastics in the WWTPs (wastewater treatment plants)

Tertiary treatment

- may give significant extra polishing in the elimination of MPs
- further improve removal rates, with membrane processes being particularly effective at capturing smaller particles that remain after earlier stages

Chlorination and the UV-oxidation - the attack of chlorine on MPs was not entirely successful, chlorine has the potential to break old ties while forming new ones

Ozonation - the ozone technique of treatment can change the physio-chemical characteristics of the polymers, 90% of MPs were eliminated by ozonation after a 30-min processing period

Membrane filtration – depend on the pore size of the ultrafiltration membrane

Activated carbon filtration - useful tool for eliminating MPs in low quantities.

Interreg Co-funded by the European Union
IPA Hungary - Serbia
Microplastics

Water Workshop 2025

MICROPLASTICS Project

MInimizing CROssborder water contamination of microPLASTICS

Task:
Pilot actions will design and test filtration solutions for wastewater treatment (after tertiary WWT)

A filtration method will be tested in two WWTPs (Sombor and Baja), with efficacy measured.

Expected results:
Proving the effectiveness of the filtration method through MPs analyses and replicating successful results across the region, providing sustainable benefits to communities and environments.

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Technologies of Microplastic removal from environment

Biological approaches

Bioremeidation - slow and inefficient process for persistent pollutants such as MPs (complex polymeric structures that resist microbial attack)

Phytoremediation - little evidence of the degradation of MPs, weak adsorption or environmental changes

Chemical degradation

Advanced oxidation processes (AOPs) - chemical that can degrade MPs because of its high redox potential

Chemical additives - generation of hydroxyl radicals and sulfate radicals, have the potential to break down MPs into smaller fragments or mineralize them

Emerging and innovative technologies

Microbial enzymes - accelerate biochemical reaction without being consumed in the process

Bio-based adsorbent - these materials, including heavy metals, organic compounds, and MPs (MPs), are highly effective in removing pollutants from environmental waters and soil systems.

Nanotechnology - interact with MPs at the molecular level, can adsorb large quantities of MPs onto surfaces, capturing even particles below 10 µm.

Artificial intelligence (AI) - AI leverages algorithms (machine learning (ML) and deep learning (DL)) to analyze large datasets, identify patterns, and make predictions or automated decisions.

Conclusion

- ✓ The balance between effectiveness, environmental safety, and feasibility in large-scale applications is crucial in determining the most viable MP removal strategies.
- ✓ The integration of multiple technologies may present a more holistic approach, addressing the limitations of individual methods while enhancing overall performance.
- ✓ Compostable, biodegradable packaging is one of the sustainable alternatives to which the packaging industry is turning to address the environmental problem of waste generated by conventional plastic
- ✓ Education about microplastics is crucial to raising public and policy-maker awareness of their prevalence in the environment and the potential harm to human and ecosystem health, fostering motivation for solutions

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