Whitepaper

MICROPLASTICS

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Where does the microplastic problem come from and how does it influence us?

In the last six decades, humanity has produced around 8.352 billion tons of plastic. Most of it is now in landfills or directly in our natural environment. In fact, only 9% of the plastic used today is recycled. (Statista 2019)

Plastics or polymers, including terms such as plastic and microplastics - are one of the causes of our global environmental pollution. Floating plastic continents in the oceans, plastic bag-eating turtles, dead whales with stomachs full of plastic garbage are discoveries of recent years, which have experienced great medial distribution and attention.

On the one hand, the high visibility of macroplastic pollution may increase the public's attention. On the other hand, however, the options for action to combat and avoid it are limited in their feasibility for the individual. Effective approaches include appropriate waste management systems, meaningful recycling concepts, as well as water purification systems, which remove the plastic particles and large plastic parts from the ecosystem.

Nowadays it is estimated that between 4 and 12 million tons of plastic enter the seas and oceans annually. (Jambeck 2015)

Via this entry path, so-called secondary microplastics are released. Here, the particles are formed from large plastic parts by different processes (degradation, slow crushing, etc.). In the case of primary microplastics, the particles are introduced into the environment directly in their original form (for example via cosmetics or the use of microplastic beads as fillers).

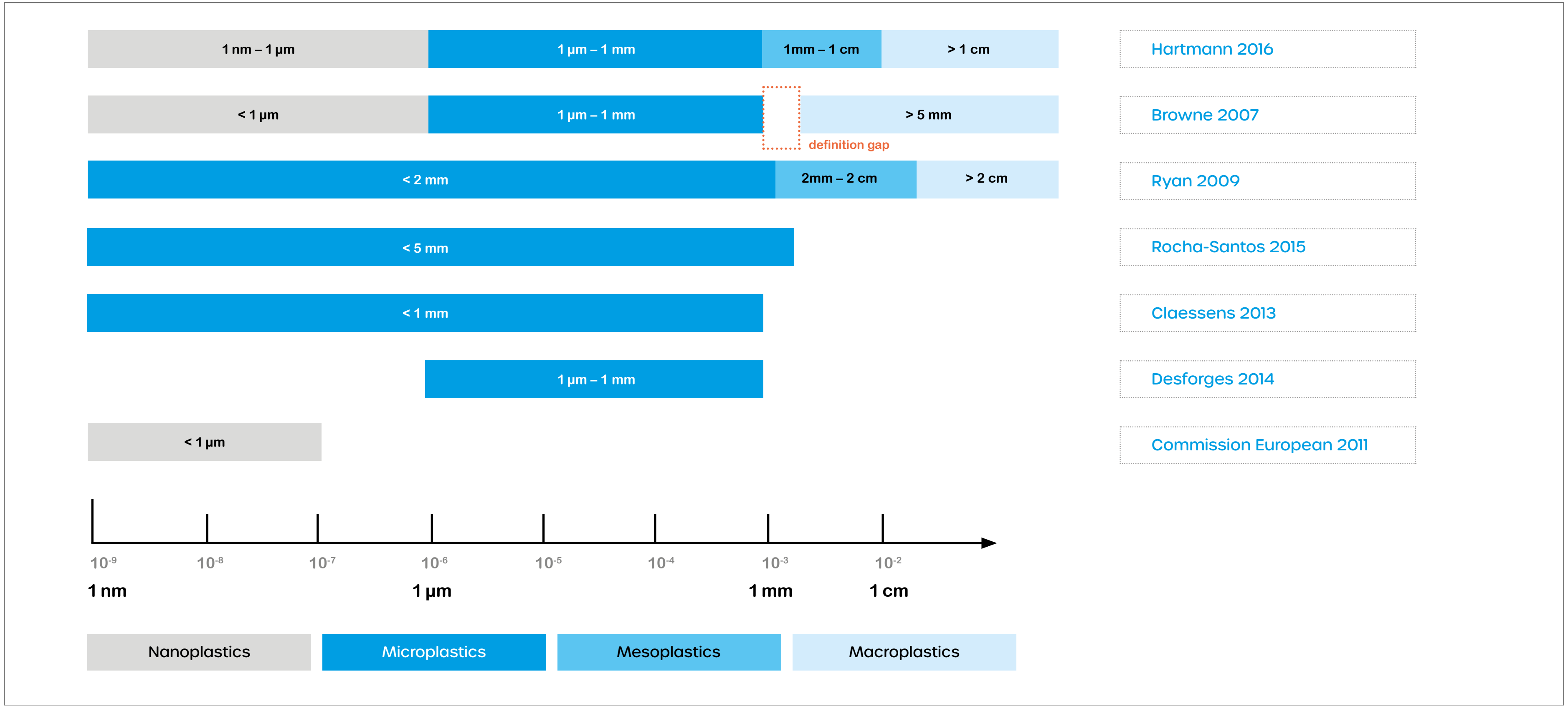
The term "microplastic" was officially introduced by Thompson et al. as they drew attention to the growing problem of the release of plastic into the oceans in 2004. (Thompson 2014)

The word has since received increasing attention among scientists, authorities, politicians, people like you and me and the media. (Provencher 2018)

The definition of microplastics generally refers to small plastic fragments smaller than 5 mm in size. In fact, we talk about microplastic particles. However, there is neither an official definition nor complete agreement among the authors.

This is similar with nanoplastics. The term can be used as a lower limit for these microplastic particles and describes particles in dimensions smaller than 100 nm (i.e. nanometers, 10^{-9} m). However, analytics is currently failing in this area because these particles are 1) difficult to find in these size ranges and 2) even more difficult to detect. (Silva 2018)

Studies in the area of microplastics sometimes show considerable differences in terms of the size of the particles considered. The terminology differentiated depending on its effects.



Different Scientists - Different Definitions: On the subject of microplastics, many currently have their own opinion (original compilation of: Picó und Barceló 2019)

Many types of plastics have been found in significant quantities in certain maritime areas and are, therefore, anchored in public awareness. Although the distribution and impact of these plastics in freshwater systems is well-researched, it is poorly understood by the public. (Eerkes-Medrano 2015, Li 2018)

Scientists for an OrbMedia study analyzed numerous tap water samples from more than a dozen nations. A total of 83% of the samples were contaminated with plastic fibers. The USA had the highest contamination rate of 94%. Lebanon and India had the next highest rate. The lowest contamination rate is found in European countries, including the United Kingdom, Germany and France. However, it is still 72%. The average number of fibers found in each 500 ml sample ranged from 4.8 in the US to 1.9 in Europe. (OrbMedia 2017)

A review of publications on microplastics in recent years shows a significant increase in the number of publications in the field of microplastic analysis, precise procedures and methods for detection, as well as in the areas of pathways, avoidance strategies and the analysis of the effects of substances on the living environment and their hazard identification (ecotoxicology, risk assessment). These studies are concerned with the determination of microplastic particles in the water, how they get there, how they can be avoided or contained, and what effects they have on humans and the environment.

Solutions for removing microplastic particles from the water are currently being discussed only sporadically. Research activities in these areas are usually limited to state-of-the-art filtration technology. Many scientists communicate their ideas, approaches and results on the basis of laboratory experiments. The transfer to real applications is seldom or only at a later stage the focus of university research. Wastewater treatment plants are one of the major sources of microplastic input into the environment. They represent suitable starting points for the development and implementation of new technologies for the removal of microplastic contamination. Several studies examined the ability of conventional and innovative wastewater treatment technologies to remove plastics. These studies show that conventional treatment reduces a high percentage of microplastic particles (between 90 and 98%). However, when communicating this result, the fact is neglected that while most of the microplastic particles are removed from the water, they enter the sewage sludge and, through its use in the agricultural utility path, enter the ecosystem again.

It is therefore not an efficient elimination of microplastics, but a carryover or a shift of the problem from the aquatic to the terrestrial area. The microplastic particles are still present unless they land in the monocombustion and become carbon dioxide and water. However, this is not the most efficient approach for using the valuable sewage sludge (Note: Sewage sludge can be used as a fertilizer because of its relatively high nitrogen and phosphorus content on agricultural soils or in landscaping measures provided they have low levels of pollutants). (Lares 2018, Talvitie 2017, Michielssen 2016)

A method for the sustainable protection of sewage sludge and the removal of microplastics from wastewater should therefore include the separation of the systems and thus the prevention of redistribution within the environment.

Solutions for microplastic removal

Focus: Wastewater treatment plant

Wastewater is one of the major sources of microplastics in the aquatic environment due to the enormous volume of water that is constantly being discharged. Solutions at this point are therefore necessary and at the same time bring the potential for a big lever. The problem of the accumulation of microplastic in sewage sludge also carries a high risk.

The microplastic does not disappear as a result of the agricultural use of sewage sludge contaminated with microplastic particles, but rather a far-reaching distribution in the soil ecosystem results. Recent processes in the field of wastewater technologies include the pH-induced agglomeration and subsequent removal of particles from water. (Wasser 3.0 PE-X®)

The two-step process involves localization and aggregation of microplastic particles (250-350 µM) in a physicochemical process. This method is applicable in the field of wastewater as well as in other water systems. It can, in addition to microplastics, also be used for the removal of other micropollutants. (Publiction list)

This patent pending process relies on the large increase in particle size, regardless of the pH of the aquatic environment, which is due to the addition of hydrophilizable inorganic-organic substituted silicon derivatives. The resulting silicon-based microplastic aggregates (particle size after aggregation 2-3 cm) can be easily removed, for example by using sand trap. This method proves to be transferable and reproducible from the laboratory scale to the industrial scale and to saline environments. (Schuhen 2018)

With Wasser 3.0 PE-X®, efficient microplastic removal becomes possible for the first time. The process is scalable, adaptable and combinable. So not only can the microplastic load in waters of all kinds be significantly reduced, but also variable freshwater and saltwater environments benefit from this process by preventing the entry of microplastics and dissolved micropollutants (pharmaceuticals, pesticides, etc.) in the ecosystem.

More information about Wasser 3.0

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A Youtube video explains the principle of microplastic elimination.
This is available here.

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