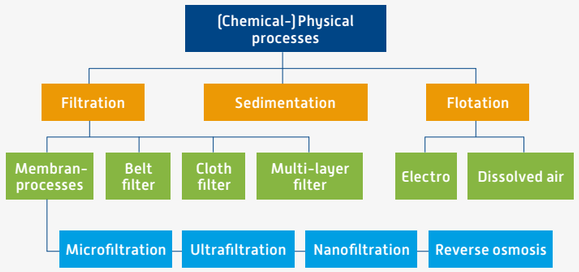
An Initiative of the German Federal Ministry of Education and Research

Plastics in the **Environment**

sources • sinks • solutions

Removing microplastics from industrial wastewater

Process improvements through the use of flocculants



Microplastics are of organic origin and can be found in wastewater in an undissolved state. Thus, filtration, flotation and sedimentation processes can be used to retain microplastics.

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„No two industrial wastewaters are alike; each is as unique as the production process from which it springs. Tailored solutions are therefore needed to remove microplastics."

Dr. Eva Bitter, EnviroChemie

Identification of input pathways has shown that microplastics can enter wastewater along the complete value chain (production - processing - shipping). Filtration, flotation and sedimentation processes are best suited to removing them from wastewater. The efficiency of these processes could be significantly improved by specially developed flocculants.

Separation efficiency of flotation and sedimentation processes increased to 99.9 %

Physical process technologies are typically used to remove particles from industrial wastewater. Ultrafiltration membranes have pore sizes in the range of approx. 0.01 - 0.1 mm and are therefore able to reliably retain microplastics (< 5 mm). Disadvantages include high costs for the membranes and a high energy demand compared to other process technologies.

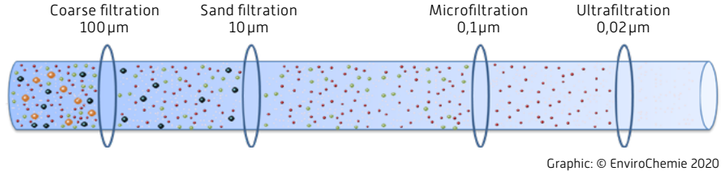
Flotation and sedimentation processes, on the other hand, are significantly more energy-efficient (at the expense of lower separation efficiency). However, by adding specially developed flocculants, the removal efficiency for microplastic particles could be increased to 99.9 %. Flotation and sedimentation processes thus represent a high-performance, low-energy and cost-effective alternative to filtration processes.

What should be considered when selecting the right process?

The separation efficiency of the processes depends largely on the wastewater composition, which in turn is determined by the production process.

The decisive factors for process selection are the types of plastics used in the production process, their density and particle size, the type and composition of additives and cleaning agents, as well as temperature, solids and surfactant content in the wastewater.

Filtration processes retain particles to varying degrees. Ultrafiltration is an absolute barrier to microplastics.



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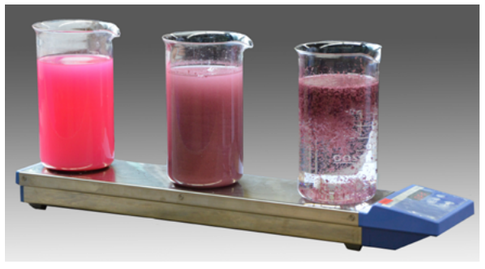
Evaluation of different technologies for optimized microplastic retention

In the research project „EmiStop", industrial plastic emissions were identified by means of innovative detection methods (Raman microspectroscopy, differential calorimetry, magnetic susceptibility) and technologies to prevent environmental input via the wastewater pathway were evaluated and optimized. For this purpose, various technologies (including flotation, sedimentation, and filtration processes) were investigated on a laboratory, pilot, and real scale with synthetic and real wastewaters, and special flocculants were developed. The results show sources of microplastics as well as process optimization potentials and serve as an assessment basis for decision makers.

Developing special flocculants: From beakers to large-scale industrial plants

In more than 1,000 flocculation tests, 9 flocculant combinations were investigated using 17 types of plastics in both synthetic and real wastewater. Tests ranged from laboratory to pilot and real scale. As a result, flocculants were successfully developed for PE, PA and PVC plastics. These transfer microplastics into larger agglomerates, which are easier to remove.

By adding flocculants, classical processes such as sedimentation and flotation separate microplastics with significantly greater efficiency.



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Quality assurance in flocculant production - flocculants for plastics PE, PA u. PVC are now available, others are being developed.

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