An Initiative of the German Federal Ministry of Education and Research

Plastics in the Environment

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Evaluation of treatment processes for the removal of microplastics from industrial wastewater

A comparison of processes based on different criteria using benefit analysis

Wastewater treatment processes were identified as solution for microplastics emissions. Their performances were analyzed with experimental results as well as expert knowledge. Processes were evaluated in respect of stakeholder preferences.

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„Every wastewater treatment process has its particular advantages and disadvantages. A comparative evaluation creates transparency and supports the selection of suitable technologies for the individual conditions of industrial plants."

Dr. Eva Bitter, EnviroChemie

Treatment processes for wastewater from plastic producing and processing industry have been characterized based on economic, ecological and operational aspects. With the involvement of stakeholdergroups, individual priorities of the key-actors were pinpointed, the strengths and weaknesses of the technologies identified, and the most suitable processes determined.

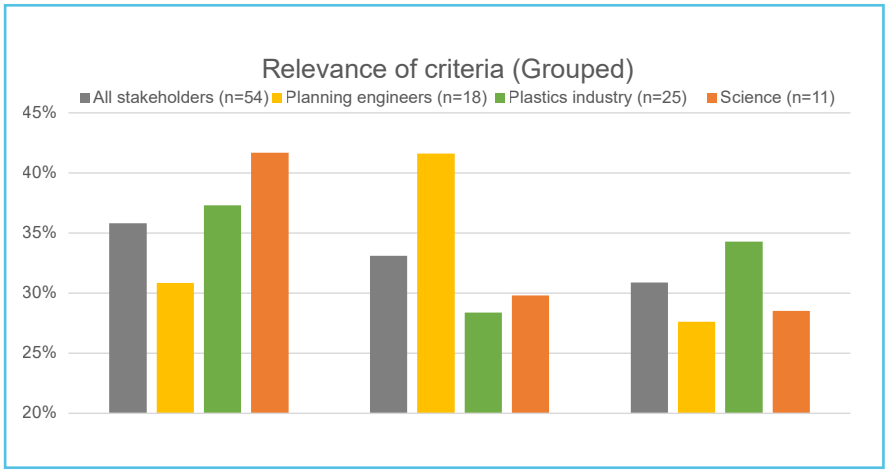
Which methods were evaluated?

The evaluation included 7 wastewater treatment processes that are feasible for plastic-processing facilities with an assumed reference wastewater flow of 100 m^3/d and approximately 1,000 mg/L of microplastics. These include:

- multi-layer filters
- ceramic and organic ultrafiltration membranes
- chemical flocculation and belt filtration
- chemical flocculation and flotation
- chemical flocculation and sedimentation tanks
- lamella separators and cloth filters as secondary treatment.

Multi-layer filters and organic ultrafiltration are particularly suitable for low solids contents of <1 g/L and belt filtration for high solids contents of >10 g/L. Membranes are primarily used for small particle sizes (<5 mm).

Fig. 1: Results of the stakeholder surveys on the relative relevance of evaluation criteria in the selection of new wastewater treatment processes.



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Research to evaluate methods for the removal of microplastics from industrial wastewater.

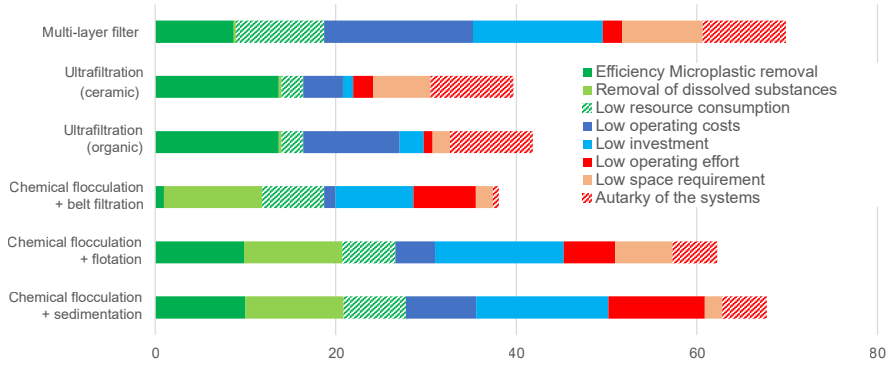
In the research project „EmiStop“, technologies to prevent industrial plastic emissions into the environment via the wastewater pathway were investigated, evaluated and optimized. Analytical results from laboratory, pilot and industrial scale facilities have been evaluated in a benefit analysis drawing on preferences of central stakeholders.

As a result, the most suitable treatment processes were identified and the strengths and weaknesses of the individual technologies were pointed out. The findings were summarized in a practical guide for the plastic industry to select appropriate methods to suit their individual conditions.

How were these processes evaluated for industrial use?

Experimental data and expert knowledge were used to characterize all processes in terms of economic (investment, operating costs), ecological (removal efficiency of microplastics and dissolved substances as well as resource consumption) and operational (operating costs, space requirements and autarky of the systems) aspects. The individual relevance of the criteria was determined by stakeholder interviews. The results showed, that removal efficiency and operational aspects are particularly important for the plastics industry. Planning engineers consider costs to be particularly relevant, while the scientific community focuses on ecological aspects.

Fig. 2: Benefit analysis for wastewater treatment methods from industrial plants producing and processing plastics



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Using benefit analysis to support selection of suitable processes.

The benefit analysis shows that, when taking into account all criteria and stakeholder preferences, multi-layer filters as well as flocculants in combination with flotation or sedimentation tanks are particularly well suited for industrial use (High value, see Fig. 2). Membrane treatment is a good choice when complete microplastic retention is required while lamella separators in combination with cloth filters are suitable when high microplastic retention with low resource consumption is desired and sufficient space and funding are available.

IMPRINT

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