SimConDrill
The project

The Federal Ministry of Education and Research (BMBF) is funding the project "Innovative Filter Modules for the Separation of Microplastics from Wastewater", in short SimConDrill. The project partners in SimConDrill aim to develop an innovative filter module that can remove microplastics from wastewater of sewage treatment plants. To achieve this goal, they have focused on developing technology to produce a new filter module that can separate out particles down to 10 µm.

Partner KMU-innovativ Mittelstand

Partner Fraunhofer ILT

Partner KLASS FILTER

Partner LaserJob

Partner OptiY

Partner LUNOVU Integrated Laser Solutions

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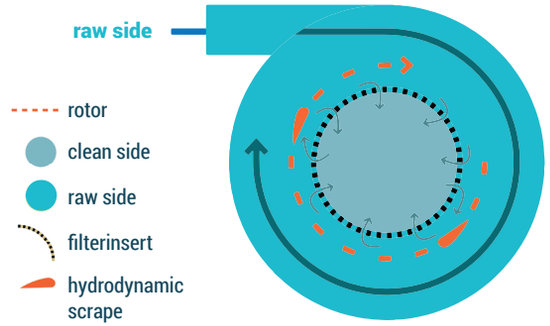
Innovative filter modules for the separation of microplastics from wastewater.

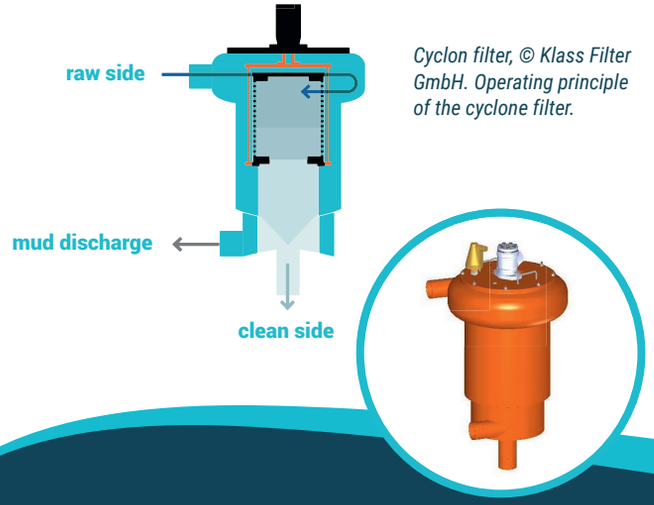
Cyclone filter

The cyclone filter from Georg Klass Filtertechnik provides the basis for the new filter generation, which enables large quantities of water to be filtered in continuous operation.

While water is pressed inwards through the filter, a rotor moves around the metal filter insert. As it moves around this insert, the rotor with its wing profile creates negative pressure, thus releasing large particles from the holes in the filter and preventing clogging.

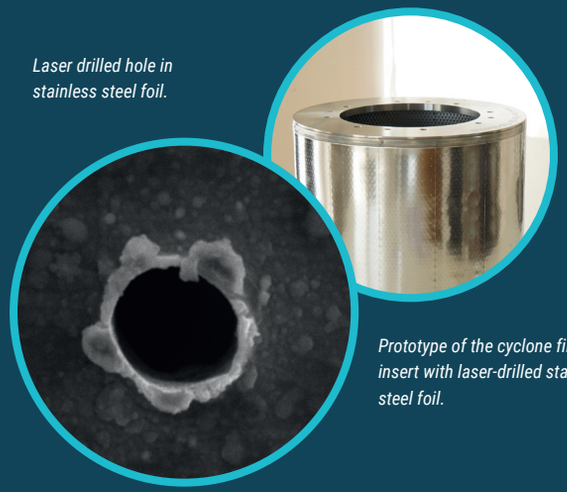
With a pore diameter of 100 µm the cyclone filter used so far achieves a nominal volume flow of 400 l/min. By developing a new filter insert with pore diameters < 10 µm, we have optimized the cyclone filter to separate, discharge and subsequently recycle microplastics.





Cyclon filter, © Klass Filter GmbH. Operating principle of the cyclone filter.

Laser drilled hole in stainless steel foil.



Prototype of the cyclone filter insert with laser-drilled stainless steel foil.

Laser percussion drilling

The throughput achieved with a filter module essentially defines how effective the entire filter is. This parameter depends on the pressure difference, the thickness of the foil, the hole size and the porosity of the filter. The Fraunhofer Institute for Laser Technology ILT together with LaserJob is developing a drilling process using an ultrashort pulse laser for the manufacture of fine-pored filter modules. With this process, holes down to 1 µm in diameter can be drilled in stainless-steel foils, in contrast to conventional methods. Since the achievable porosity depends on the foil thickness and the conicity of the holes, their arrangement on the foil must be optimized, taking production-related boundary conditions into account. In order to increase economic efficiency, Fraunhofer ILT is also investigating the use of multi-beam processing with more than 100 partial beams. In order to coordinate all the process parameters as well as possible and to select suitable machining strategies, the institute is developing a process simulation combined with the OptiY optimization software. It developed the laser drilling process, optimized it on a small scale and then transferred it to large filter surfaces at LaserJob, which will produce the prototype.

Quality control

The precise manufacture of the filter inserts is a requirement for them to function as desired. The quality control takes place during the drilling process and recognizes the successful drilling of each individual hole. The measuring system is developed by Fraunhofer ILT in collaboration with LUNOVU and uses the light that is emitted during the drilling process. The signal of a photodiode array returns a characteristic change when the drill hole is completed so that each hole can be reliably detected.

Evaluation

After a successful development phase, the prototype of a cyclone filter is being produced with a pore size of 10 µm. The SimConDrill cyclone filter will be tested with test fluids and in a sewage treatment plant on real wastewater. Samples will be taken and analyzed for their microplastics composition and particle sizes by an independent, accredited test laboratory. By means of laser light diffraction, the size distribution of the solid particles in the filtrate will be determined in a range from 0.01 to 3,500 µm. The liquid sample will be measured with a combination of pyrolysis, gas chromatography and mass spectrometry, a combination that can recognize the different microplastic particles.

The cyclone filter will be the last treatment step before the water exits the sewage treatment plant. For the test setup the filter will be placed in a separate circuit, parallel to the flow. The separation from the total flow allows a defined maximum flow rate for the cyclone filter and also prevents flooding or contamination of the wastewater in case of a defect (e.g. a torn metal foil).