Waste Water Treatment Plant Aarle-Rixtel in the Netherlands

CellCap Finescreen™ supported biological wastewater treatment for enhanced plant capacity

The social awareness of depleting resources leads to an increasingly cautious use of raw materials and more resource recovery. Hereby, a transition takes place from an economy of extraction, creation and discard of finite resources, towards a circular economy based on resources and products that are recycled. This circular economy is the basis of the project Screencap.

Screencap is an innovative collaboration between launching customer Water Authority Aa en Maas, technology developer CirTec BV and knowledge institute KWR Watercycle Research Institute, where the impact of finescreen technology on the downstream purification processes of a large scale wastewater treatment plant is examined over a long term period.

KWR, CirTec and Water Authority Aa en Maas enable a revolutionary change in current sewage treatment processes that offers great social, economic and environmental benefits. This change can be applied at many biological municipal wastewater treatment plants (WWTPs).

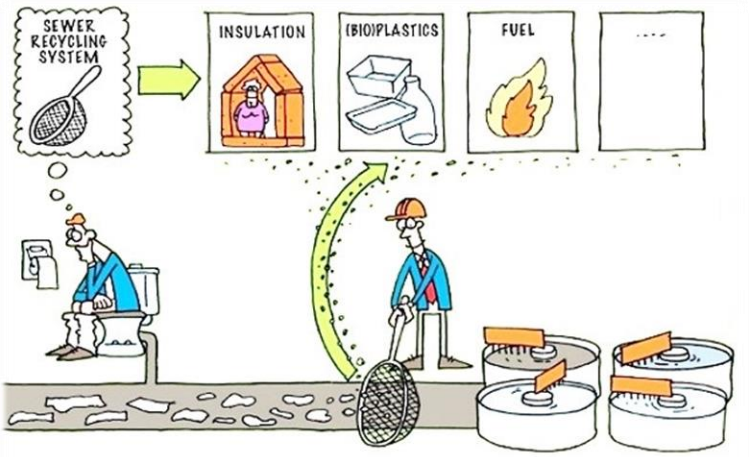
Screencap is a collaboration of:

Waterschap Aa en Maas

CirTec

KWR Watercycle Research Institute

Co-funded by the Eco-innovation Initiative of the European Union



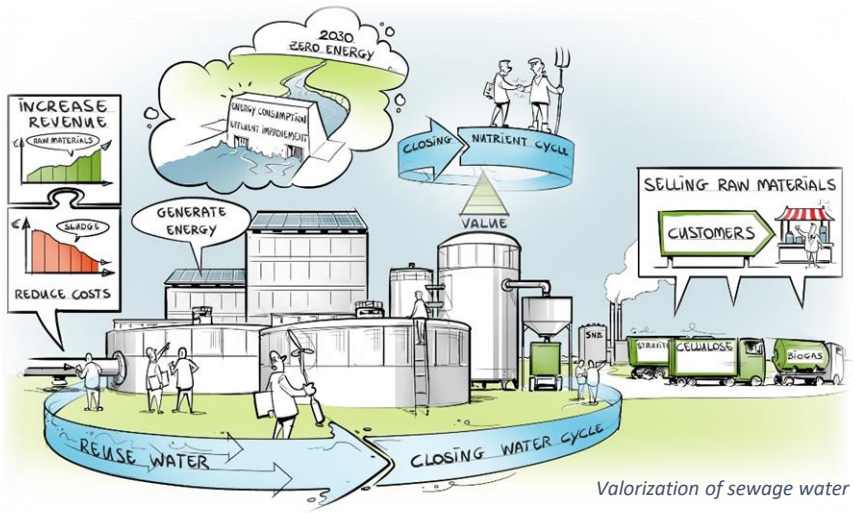
Graphical illustration of the working of finescreens

The essence of this innovative concept is the recovery of suspended solids from raw wastewater based on their particle size. Hereby a different fraction is captured than when using traditional separation technology (a primary settling tank) that are based on the density of the particle. By focusing on the particle size, a significant positive impact on the efficiency of downstream processes can be observed. In order to employ this technology, an existing CellCap finescreen technology has been adapted and optimized.

Summary of the results

Compared to current technologies, this concept has a number of significant advantages:

- Reduction of excess sludge volume
- Reduction of chemicals used
- Reduction of aeration energy
- Reduction of maintenance costs
- Increase of biogas production
- Smaller physical WWTP footprint
- Increased WWTP capacity

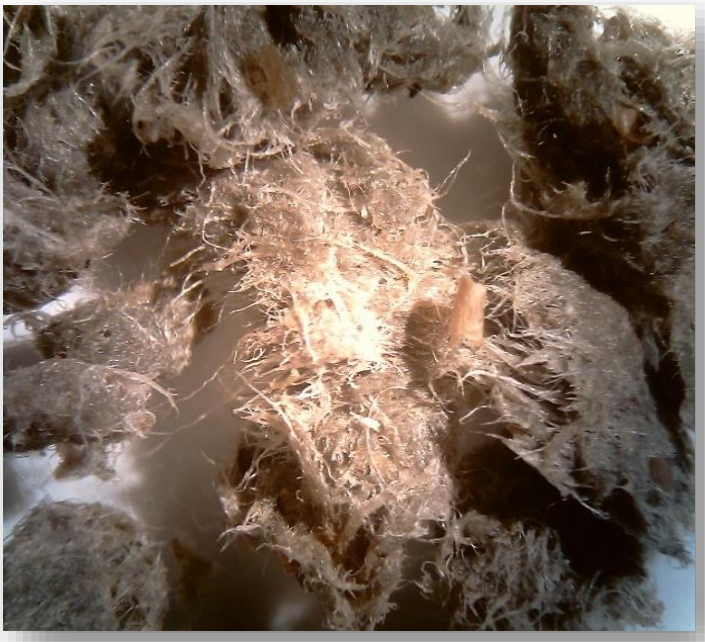


Valorization of sewage water

European relevance

This technology has been tested in several pilots across Europe. Most of these installations operate at a relatively small scale (demonstration scale). In this project the concept of finescreens is applied at full-scale at the WWTP Aarle-Rixtel, one of the larger plants in the Netherlands.

The benefit of the WWTP in Aarle-Rixtel is that the wastewater treatment consists of two identical purification lanes that can be operated independently from each other which allowed/enabled an objective comparison of the impact of the screening technology. This setup allowed an accurate comparison of the impact of the CellCaps on the downstream processes.



Cellulosic screenings from sewage water under the microscope

The installation

Within the Screencap project, a full-scale installation has been built at a municipal WWTP treating sewage water from 272,000 people equivalent (max. 14,000 m^3/h). This WWTP consists of two identical wastewater treatment lanes. Finescreens were implemented in only one lane, which allowed a clear performance assessment of the impact on the wastewater treatment process by monitoring and comparing the treatment characteristics of both lanes. A resource stream ("screenings") which mainly consists of cellulose and organic material is recovered by the finescreens. These screenings can be used as a source of energy: the biogas production of screenings is two to three times higher than that of sewage sludge. Screenings can also be used as a source of fibres, for example for the optimisation of the dewatering installation, or can be upgraded to a cleaned an hygienized cellulose as shown at the WWTP Geestmerambacht. The cellulose can be applied in roads and is a resource for the production of bio based building materials

CellCap finescreen installation at the WWTP Aarle-Rixtel in the Netherlands

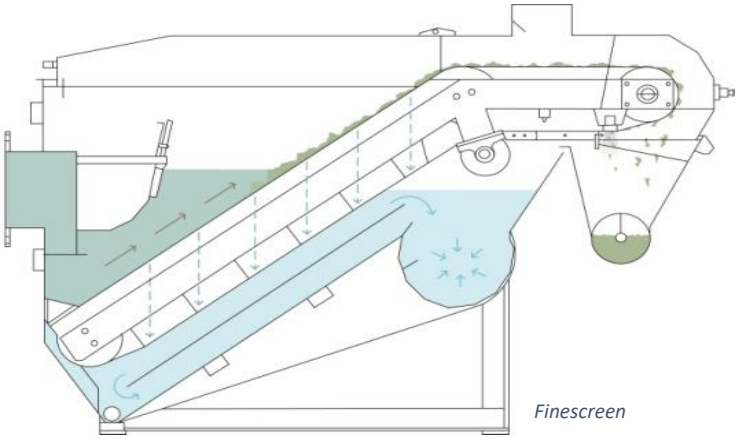
Place in the WWTP

The CellCap finescreen installation has been placed between the sand/fat and grease trap and the aeration tanks. The raw wastewater is pumped to the finescreens. The basic installation consists of eight finescreens with the possibility to expand to a final of ten machines. Here the water is divided over the finescreens and flows by gravity through the finescreens to the downstream existing biological treatment process. The collected screenings are dewatered and stored. The press water is returned to the water purification line of the wastewater treatment plant.

The CellCap finescreen

The CellCap Finescreen is designed for high efficiency solids removal from municipal and industrial wastewater streams. The finescreen is equipped with a filter cloth containing a mesh opening size of 30 to 840 microns depending on the application. The feed water is continuously fed into the unit in which the free water escapes through the mesh. The suspended solids that are retained by the mesh form a pre-coat which increases the removal efficiency by catching smaller particles.

The movement of the mesh is continuously, and the speed is controlled, based on the liquid level in the unit. The filtrate (screened water) is first collected behind the filter cloth in the frame and will be further treated in the wastewater treatment processes. The solids are removed from the filter cloth by a patented cleaning system (Airdoctor), using air pressure at the end of the filtration area.



Finescreen

Monitoring

The performance of the finescreen installation has been determined by measuring, sampling and analyzing all flows to and from the finescreen installation. Analyzed parameters are for instance the concentration of suspended solids, COD, BOD, nitrogen components and phosphorous components. From these results the removal efficiency for the different parameters has been calculated.

The impact on the waste water treatment process were determined by comparing the performances of AT1 and AT2. Attention points were effluent quality, energy consumption and sludge characteristics like dewatering, settleability, sludge composition and sludge production.

Performance of the finescreen installation

The calculated energy requirement for solely the finescreen installation is about 32 Watt per m^3 of treated water. In the case of WWTP Aarle-Rixtel, there is also energy required for pumping.

Screenings

Approximately 35 ton dry solids of screening material is harvested every month by the finescreen installation at WWTP Aarle-Rixtel. Dry solids content of the dewatered screening material is < 30% and could still be improved. Screenings consist of approximately 10% fat, 10% proteins, 10% inorganics and 70% fibers (mainly cellulose).

Impact on waste water treatment

With a "zero-measurement" an overview of several parameters and the performances of both purification lanes has been obtained. This supported the conclusion that both purification lanes were identical before the finescreens were taken into operation, so the impact of these finescreens could be studied by comparing AT1 and AT2 operational performances.

During the operation of the finescreen installation a lot of parameters in the active sludge tank (AT1) have been monitored and compared with the parameters of AT2. As expected, the required aeration energy in AT1 was lower, while the operational parameters like sludge volume index (SVI), nitrogen and phosphorus removal appeared similar in both waste water purification lanes.

Waste sludge produced from AT1 was lower than from AT2, while dewaterability was comparable. Since screening are removed before AT1, less waste needs to be treated, resulting in lower biological treatment demand and consequently 15% lower aeration requirement and 10% lower sludge production.

Conclusions

By removing solids on the basis of particle-size instead of density by state-of-the-art settlers, it is possible to remove suspended solids at a rate comparable with a pre-sedimentation tank. Screenings have different characteristics than settled primary sludge. Screenings contain significantly more cellulose fibers coming from toilet paper that, despite the energy content, do not easily convert in the biological, activated sludge, system. The not-converted part of the cellulose will build up in the biology as inert material, resulting in less bio-capacity and a higher waste flow of surplus sludge.

The organic load that is removed by a finescreen is not biodegraded aerobically (aerated), which saves approximately 15% of the energy for aeration. Aeration is the largest energy consumer at a WWTP. The far-reaching removal of suspended solids decreases the load to the biology, which results in a smaller footprint for the WWTP, less energy consumption and less excess sludge production. The operational performances of the two parallel purification lanes, with and without finescreens, were comparable.

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Waterschap Aa en Maas is a Dutch Water Authority within the Meuse River Basin located at the east side of the province Noord-Brabant. The Dutch water authorities (there are 22 in total) are regional government bodies that are among the oldest forms of local government in The Netherlands started by cooperation of inhabitants in the 13th century.

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With both proven and innovative technology, CirTec is able to provide appropriate solutions for a large number of environmental issues. Waste recycling, re-use of materials and recovery of low-grade energy are key to our solutions. Through research and collaboration, CirTec looks for new ways to solve existing problems in a more sustainable and economical way.

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KWR generates knowledge to enable the water sector to operate water-wisely in our urbanized society. KWR creates top-quality new knowledge through goal-oriented research and through KWR's extensive network. 'Bridging science to practice' is KWR's motto. The researchers work at the interface of science, business and society. Research focuses on four important themes: Healthy, Sustainable, Advanced and Efficient water.

Subsidy

The Entrepreneurship and Innovation Programme is part of the larger Competitiveness and Innovation Framework Programme (CIP) of the European Union that aims to increase innovation within SMEs and to improve their competitiveness. This project is co-financed by the European Union, through a grant under the CIP Eco-Innovation scheme.

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