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Water & wastewater

Self-cleaning filter is key for Helsinki project

A tunneling wastewater project in Helsinki, Finland, found that its settling tanks did not provide sufficient total suspended solids reduction. In addition, the use of coagulants and flocculants to aid settling was not working, so a Finnish company was brought in and used a self-cleaning filter to solve the problem.

Finland's Sofi Filtration is addressing waters that are difficult to filter of 0.2 to 10 µm particles in concentrations that exceed those of commonly applied strainers, suction scan and disk filters. The company has been testing a wide array of industrial applications and the first commercial applications in Finland are for underground tunneling operations.

Large tunneling machines are used in urban areas for subways, roads and parking. All these operations have, water as a waste stream which must be discharged but, before discharge, the TSS level must be at below 300 mg/l.

The tunneling wastewater project in Helsinki was installed in the summer of 2015. The system that was already in place used settling tanks which did not provide sufficient total suspended solids (TSS) reduction below the 300 mg/l standard for direct discharge. In addition, the use of coagulants and/or flocculants used to assist settling was not working due to the cost, handling, operational complexity and environmental reasons.

Figure 1: The Sofi Filtration system on-site at a tunneling operation in Helsinki.

The client, tunneling contractor Kalliorakennus-Yhtiöt, used the Sofi SF1000 automatic self-cleaning filter with a 10 micron metal wire mesh. Two settling tanks were used with the Sofi filter. During the trial period, the filtrate flow rate was 18 m^3/h for the 1 m^2 filter element and the solids concentration averaged 410 mg/l. In the filtrate, the solids were reduced to levels below the acceptable discharge standard, typically less than 80 mg/l, with a 10 micron filter (Figure 2). Concentrate discharge was recycled back to the first feed tank where the accumulated settled solids were drained and hauled for off-site disposal.

The performance of the unit was established during a five-week trial period with the assistance of Sofi Filtration at the client's site. The system continues to be successfully used in the new tunneling project. Antti Matikainen, project manager of Kalliorakennus-Yhtiöt Oy said: "We are very happy with the system, especially since it is fully automatic and does not require our attention. It works really well

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and is reliable. Its installation has brought us significant value."

Technology

The competitive advantage for the Sofi technology lies in the use of high cross-flow velocities and a clean-in-place arrangement to remove high concentrations of very fine solids. Computational Fluid Dynamics (CFD) was employed to optimize the design of the product. A granted US patent protects the technology as well as the international patents.

A Sofi filter consists of a 1.5m long outer shell that encloses a cylindrical cross-flow feed sleeve, which narrowly surrounds a circular microfilter. Feed is introduced evenly along the length of the annulus formed between the shell and the cross-flow feed sleeve into which slotted orifices have been cut at an angle tangentially towards the filter. A combination of the annular feed and the tangentially oriented orifices causes the water to accelerate to 20 m/s as it flows over the metallic microfilter within the feed sleeve (Figures 3 and 4).

All the feed flows to the microfilter and particulates are retained on its surface. At timed intervals, an ultrasonic resonator, in the centre of the filtrate chamber, initiates a momentary resonation that radiates outwards to clean the microfilter by re-suspending impinged solids in the circulating flow. A brief backwash with 5-6 bar of a rapid pressure discharge is initiated after the resonation, during which the concentrated solids are discharged from the unit. Typical recoveries are 80% per stage but recirculation through process control valves or tanks can achieve much higher system recoveries.

Depending on the size of screen opening selected, a single unit with 1 m^2 filtration area can produce 5 to 35 m^3/h of filtrate. Systems are usually designed to operate at an 80% recovery with a feed pressure of 0.5 to 1.5 bar and recovery can be improved by using a second filter to screen the concentrate stream from the first unit.

Benefits

At a flow of 70,000 m^3/y for the filtration operation, the annual savings for the client was almost 200,000€ with original operating expenses of 1€/m^3 for the fresh water and 2€/m^3 for the wastewater as a benchmark.

The Sofi Filter system is fully automated to operate only when the settling tanks reach a certain level. It requires no chemicals or frequent bag-filter changes and no routine operator attention. These operating features give the construction company the freedom to focus on the tunneling work and not be distracted by water treatment. ●

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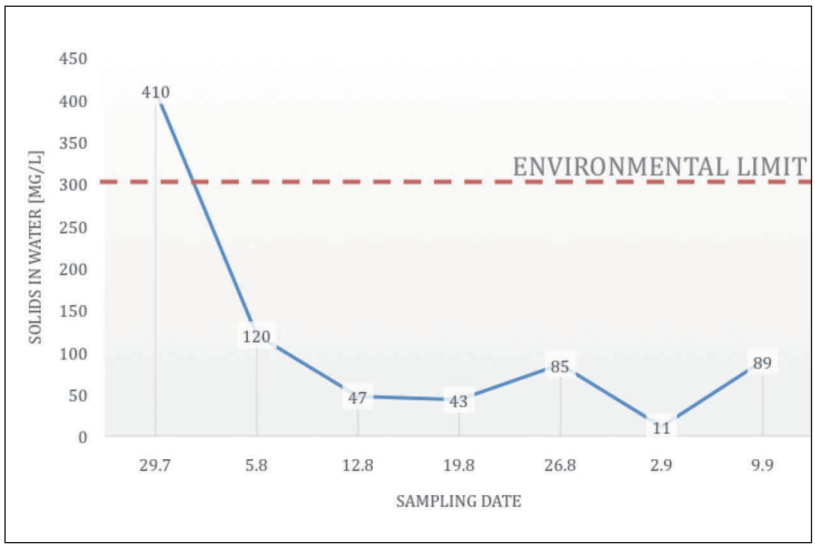

Figure 2. Performance data of Sofi Filtration 10-micron self-cleaning filter on tunneling wastewater.

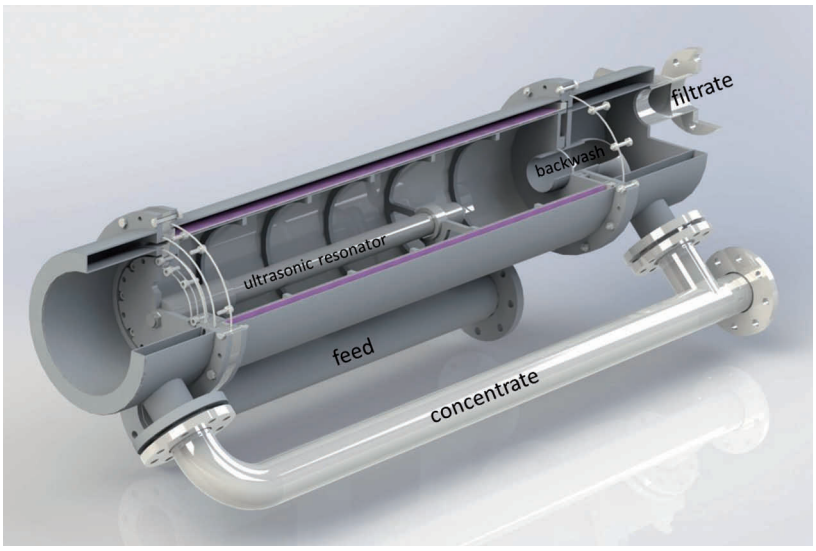

Figure 3. Cutaway view of Sofi filter.

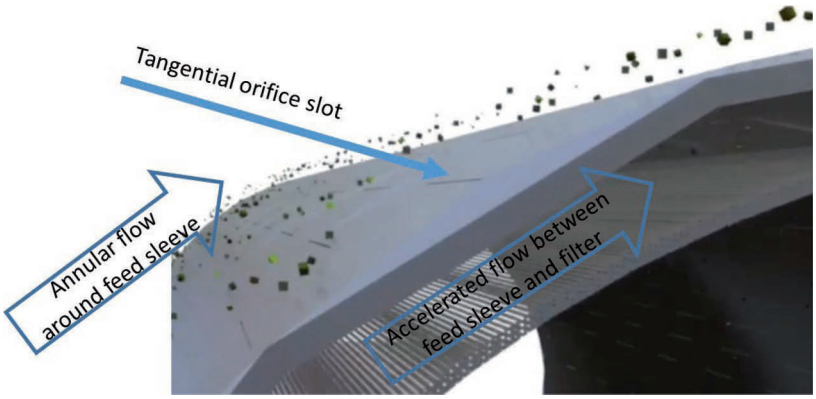

Figure 4: "Heart" of the Sofi Filter showing annular flow around cross flow sleeve with orifice slots to direct rapid acceleration of flow at the surface of the filter element.