

MAY
2020

CASE STUDY

sofi
FILTRATION

WATER AND ENERGY RECOVERY FROM FLUE GAS CONDENSATE



OVERVIEW

Waste-to-energy plant in Tampere, Finland, is incinerating 160.000 tons of municipal solid waste annually. Power plant is equipped with the latest state-of-the-art technology.

Plant features include semi dry system scrubber to purify the flue gas, and water condenser to condensate the flue gas humidity into liquid water and therefore increase the plant energy output. W-t-E plant performance has been good. Among majority of emission limits, realized emissions have been less than 1% of what was stated on environmental permit. In addition, partly due to the smooth operation of the power plant, waste fees in Tampere region are the lowest in Finland.

CHALLENGE

Even though the plant performance was outstanding regarding to the emission purification and energy efficiency, W-t-E plant operator faced challenge with the excess amount of flue gas condensate water. Water generation designed for 7 - 17 m³ / hour, and the maximum temperature was up to 85 °C. Total suspended solids of the water varied between 10 and 20 milligrams per liter whereas the conductivity was 400 - 2.500 microsiemens per centimeter. Due to the characteristics of water, discharging it was out of question. Condensate water generation formed a bottleneck,

preventing operator to increase the plant capacity. Operator wanted the water conductivity to be under 200 µS / cm to be able to re-use the water in the process. Water needed to be treated in high temperature to allow the maximum heat recovery.

SOLVING THE CHALLENGE

W-t-E operator contacted Sofi Filtration to solve the issue regarding the excess amount of condensate water. Sofi's technical team made a draft of the water purification system and tested Sofi Filtration's technology to treat this specific water.

First, 50-liter sample of condensate water was sent to Sofi's laboratory in Espoo. Test run was performed with the water and the results were positive. Sofi Filter was able to remove majority of the suspended solids and the self-cleaning system of the filter, consisting of ultrasonic cavitation and compressed air assisted water backpulse, was able to keep the filter element clean of dirt and particles.

Next, small scale Sofi pilot filter was tested at the actual settings in W-t-E plant. The test confirmed Sofi's good performance. Customer was able to feel secure that Sofi Filtration's technology is suitable to solve the challenge of excess amount of condensate water.

SOLUTION

Sofi Filtration provided a turnkey solution to treat the condensate water so that it can be re-used in the process.

The system consisted of Sofi Filter system as a pre-treatment unit to remove the suspended solids and reverse osmosis unit to reduce the water conductivity according to customer's requirements.

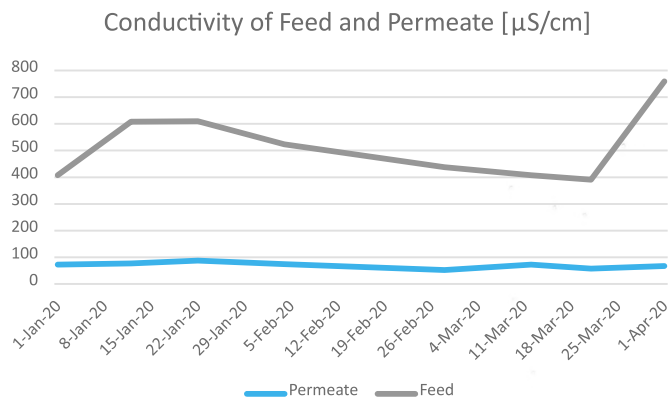
2 x Sofi SF1000 microfilters that acted as a pre-treatment system were equipped with sintered metal mesh elements. Filters included self-cleaning ultrasound system. Periodic ultrasonic pulse loosened particles which were stuck in the elements' surface and a backwash combined of air and water flushed the particles away from the system. Reject water was fed into the lower water circulation of the scrubber whereas the permeate water was led further to reverse osmosis unit.

Reverse osmosis unit consisted of 4 pressure vessels each with 4 x 8040 high temperature membranes. System had as well antiscalant dosing system to prevent the inorganic scaling of the membranes, and concentrate recirculation to increase the velocity of concentrate water on the reverse osmosis membrane surface and therefore reduce the fouling.



RESULTS

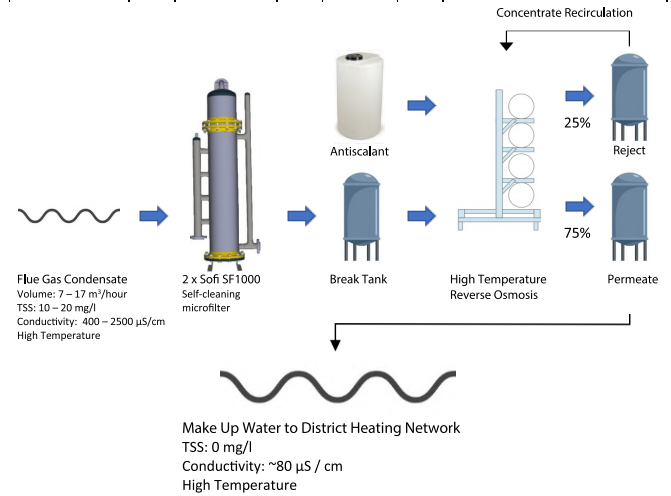
Sofi Filtration process (microfilter + reverse osmosis) purifies approximately 75% of the condensate water to be re-used. Permeate water is free of solid particles and the water conductivity is around 80 $\mu\text{S} / \text{cm}$ which is well below the limit of 200 $\mu\text{S} / \text{cm}$ set by customer.



Feed and Permeate Water Conductivity in year 2020

Purified water is used as a make-up water in district heating network. Water is purified, deaerated, and fed into heating network, at around 80 °C which allows efficient heat recovery without extra investment in heat exchangers.

In addition, customer doesn't need to add any municipal water into the process, further saving in costs.



Energy consumption for water purification unit is approximately 3 kWh per cubic meter of purified water.

For comparison, in case water is heated from 20 °C to 80 °C to be fed into district heating network, heat energy consumption would be approximately 70 kWh per cubic meter of water.

Customer has been very satisfied with the performance of Sofi Filter + reverse osmosis unit. Water purification system not only solved the issue with excess condensate water but as well provides make-up water to the district heating network and increases the power plant energy output by 5 - 10 %.

Customer estimated that the payback time of the whole system has been less than one year.

CONTACT US

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