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Hong Kong wastewater treatment plant increases energy efficiency and reduces carbon emissions with Decanter upgrade

Wastewater treatment, Hong Kong

A sharp focus on energy efficiency was central to the Hong Kong Drainage Service Department's decision to upgrade its decanter centrifuge technology at the Sha Tin Sewage Treatment Works; it was key in its selection of Alfa Laval's ALDEC G3 VecFlow™ to achieve this aim.

The Sha Tin Sewage Treatment Works is situated at the mouth of the Shing Mun River and covers 28 hectares. Run by the Drainage Services Department, it serves a population of 700,000, producing approximately 280,000 cubic metres of sewage per day and total 120 tonnes of sludge per day.





The replacement, in 2020, of two Alfa Laval ALDEC 706 decanters with ALDEC G3 VecFlow models for sludge dewatering is now generating a 40-percent energy reduction and lowering overall CO₂ emissions by 285 tonnes annually as part of an ongoing sustainability strategy at the Sha Tin site.

“Since 1998, we have been on a journey to change the face of wastewater treatment to improve the water quality and optimize the operation,” says a spokesperson for the Sha Tin Sewage Treatment Works. “In the 1980s, we had issues with red tide during spring; an algae formation of a reddish colour that can cause health issues.”

The more recent supply constraints of fresh water in Hong Kong have prompted the Sha Tin Sewage Treatment Works to look intensely at how they can optimize energy consumption and waste production to minimize the impact on the surrounding environment.

“Increasing the energy efficiency of our operation with the Alfa Laval decanters, reducing electricity consumption throughout the sewage treatment process and generating electricity from biogas produced in the digesters on site are some of the measures we have implemented to minimize our impact on the environment and reduce carbon emissions,” concludes the spokesperson at Sha Tin Sewage Treatment Works.

“We have eight dewatering and five thickening machines at this site,” Regional Sales Manager Raymond Yau explains. “The customer is in the process of upgrading. So far, they have replaced two dewatering machines with the ALDEC G3 VecFlow. The VecFlow feed zone injects sludge in a way that has minimal effect on the flow inside the decanter bowl; reducing turbulence by more than 44 percent and lowers overall power consumption.”



VecFlow™ Technology: Optimize your wastewater sludge dewatering and sludge thickening. The new Alfa Laval ALDEC G3 VecFlow™ sludge decanter centrifuge delivers outstanding performance in wastewater sludge thickening and dewatering.

“The interesting thing on this site is that we have the old machines, and we have a new slimline G3 machine and the VecFlow so we can measure them side by side,” continues Steen Rosenbom, Global Sales, Water & Waste, BU Decanters. “Raymond has built an excellent relationship with this customer over the years, enabling us to do this detailed measuring. Now that we have analysed the results, we can see a power saving of 40 percent and a slight improvement in cake dryness; but the main driver for the customer is the power saving from upgrading to the decanter with VecFlow.”

With the power saving, the decanter uses only 5 percent of electricity generated in a combined heat and power (CHP) plant that burns biogas collected during the sludge treatment process.

“The output of electricity from the CHP is not enough for the whole plant but reducing the energy consumption of the decanters by 40 percent plays a part in cutting the overall energy requirements at the plant – saving money and lowering CO₂ emissions,” Steen concludes.

As part of a broader focus on sustainability at Sha Tin Sewage Treatment Works, a maximum of 1,000 cubic metres of treated sewage water at the plant is reclaimed every day using filtration, membranes, and reverse osmosis technologies. Although not suitable for drinking, this water is fed into the system to meet non-potable needs such as plant cleaning, irrigation, and chemical dilution.



Emission savings:

By securing a 20 percent reduction in the energy consumption, the Aldec VecFlow solution has reduced the emissions of CO₂-equivalent by 285 tonnes.



Total cost of ownership

The combined reduction in the consumption of energy and polymer has been reduced by more than 20 percent, and the payback time on the added VecFlow feature is less than 2 years. With this Total Cost of Ownership was reduced by an estimated 10 percent.



Clean water

By 2050, it will require another 30 percent of clean water to sustain life for the 11 billion people likely to inhabit our planet (UN, 2019). Hong Kong is already one of the megacities at risk of severe water shortage. It may not be able to continue to rely on water supplies from the Dongjiang River to provide the bulk of its freshwater supplies. Also, the city lacks natural or constructed reservoirs for collecting rainwater.

Background: In 2022, Hong Kong's annual freshwater consumption was 1,027 million m³. The Sha Tin Water Treatment Work's design capacity is at 1.227 million m³ a day or 447.9 million m³ a year, which equals 19 percent of the total water consumption in Hong Kong.

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Membrane filtration: finding treasure in wastewater treatment

Wasterwater treatment, Norway



Sarpsborg
kommune

A municipality in Norway is looking at wastewater treatment from a completely new perspective – with a strong focus on operational sustainability and as an opportunity to capture important raw materials for reuse and recycling.

The Alvim treatment works in Sarpsborg, 88km south of Oslo, was built in the 1980s and processes sewage and wastewater from Sarpsborg municipality and that of nearby Årum in Fredrikstad.

Population growth and ongoing business development, together with increasingly strict water-treatment regulations to combat rising nutrient levels in Oslo Fjord, prompted a need to futureproof the plant in terms of capacity and discharge water quality – but the municipal authorities haven't stopped there.

“The Alvim treatment plant will become a high-tech ‘resource factory’ that meets existing and future treatment requirements,” explains a spokesperson for the Sarpsborg municipality. “We are no longer looking at wastewater as a problem but as a raw material for resource recovery.

The new and upgraded Alvim treatment plant will not only clean sewage in a better way. It will also enable us to optimize the recycling and reuse key elements, such as nitrogen and phosphorus, to the benefit of people, animals, and nature.



Also, the recovery of valuable resources will be done in a safer way so that they are looped back into use for e.g., fertilizers.”

The municipal leaders decided on a membrane bioreactor (MBR) solution with membranes from Alfa Laval.

Once completed, the expanded facility will have a service capacity of 105,000 people, equivalent at an average treated flow of 1,200 cubic metres per hour.

It will be one of Norway’s first large membrane bioreactors (MBR) and the largest in the world, utilizing Alfa Laval’s membrane technology.

The contract was entered between the Malmberg AS and the municipality of Sarpsborg in July 2022. The Norwegian company Malmberg is the main contractor in partnership with Alfa Laval and Operon from Suomi. The total contract value is 85 mill NOK. “Concern over nutrient levels in water released into Oslo Fjord has prompted changes in legislation, and the region is looking hard at its wastewater treatment,” explains Alfa Laval’s Emmanuel Joncquez, Global Technology - Application Engineer. “The deciding factor for the authorities in Sarpsborg was the quality of the effluent at the end of the MBR process – particularly regarding the removal of nitrogen and phosphorus.”

Sustainability was a key element, and to deliver on this, the upgraded plant will include several features, including solar panels, a micro power plant, and a heat pump. The plant will also use biogas to produce electricity and heat. In addition, chemical use will be minimized, and water transport infrastructure will be optimized. The aim is for the site to be self-sufficient in energy and heat, with any surplus offered to nearby industries, such as district heating. “One game-changing aspect relates to the removal of phosphorous from the wastewater by means of a biological process rather than chemical precipitation,” says Emmanuel.

“We will develop the Alvim treatment facility to meet all existing and future requirements,” says a spokesperson at the Sarpsborg Municipality. “In the future, requirements for cleaning microplastics, drug residues, pesticides, and environmental toxins may become a reality. Furthermore, recovery of phosphorus and nitrogen, utilization of fossil-free energy in the form of biogas, recovery of heat in wastewater, as well as production of electricity will also be very important.”

In Europe, Switzerland is generally considered to be the most progressive country in terms of a policy response to the preservation of water quality, says Emmanuel. “We expect new EU regulations to step into force in 2024 with respect to the removal of micropollutants. So, this collaboration with Sarpsborg gives us important insight into how we can offer the best available technology to meet the challenge.”

EUR 8.2 million has been set aside to complete membrane filtration as part of the plant upgrade and expansion, and it is scheduled to be on stream in 2026.

Water savings



Alfa Laval’s membrane bioreactor enables Sarpsborg Municipality to meet new regulations for water quality in Oslo Fjord:

- free of suspended solids
- 95 percent removal of phosphorus in the outlet
- 75 percent removal of nitrogen

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Raising the bar to protect groundwater

AlfaFlash evaporation technology, China

AlfaFlash evaporation technology is proving to be a game-changer for water conservation for a system builder in China specializing in the treatment of leachate – the water that comes into contact with the waste stored in a landfill.

Xiamen Jiarong Technology Corp., Ltd is a leader in landfill leachate decontamination in China and one of Alfa Laval's business partners – removing suspended solids and harmful impurities, such as PFOS, nitrogen and heavy metals, from the leachate in a process that is strictly regulated to prevent groundwater and environmental pollution.



The company provides turnkey solutions and services for municipalities across China. Unhappy with the results from conventional existing shell-and-tube evaporation system, the company approached Alfa Laval to develop a solution.

Sales Manager Nick Wei believed the answer lay in Alfa Laval's AlfaFlash technology despite no established reference in this application. Strong cooperation and a high level of confidence in competences between the two companies, based on long experience with Alfa Laval's membrane technology, meant that Jiarong was willing to install **AlfaFlash** in a turnkey landfill leachate treatment project at a site in China's third biggest city, Chongqing. The processing scale of the project treatment is 1,000 tonnes/day in the early stage and about 500 tonnes/day in the later stage (after the completion of the existing stock treatment).

"Initially, they regarded this as a pilot project," Nick explains. "Commissioning took place in March this year, and after a month, they rang me and said the performance was far beyond their expectations. So, they agreed to purchase 10 sets of the AlfaFlash system within two years."



The Alfa Laval AlfaFlash plate flash evaporator concentrates high-viscosity, high-fouling and shear-thinning fluids – with the lowest possible power consumption in an extremely compact installation.

The AlfaFlash technology is one step in a process that utilizes ultra-filtration, reverse osmosis, decanter separation, and/or vacuum drying. At the end of the entire process, the liquid condensate is of high enough quality to either be reused or released into the environment while a specialist contractor for safe disposal removes the residual dry solids.

"Our technology saves the customer a lot of time and money," Nick says. "Compared to the competitor, the quality of the condensate is cleaner and easier to handle. According to the test data provided by Jiarong, the condensate generated by the AlfaFlash evaporation system has about 4 times fewer pollutants than when using competitor equipment, and it is easy to meet the national emission standards through subsequent advanced treatment."

And there are several other benefits. For example, the evaporator can run for up to 20 days before cleaning, whereas the previous shell-and-tube evaporators needed to be cleaned every two to three days. It also requires fewer chemicals upstream in the process,

reducing both the environmental impact and the operating cost." "Our takeaway from this cooperation is that the AlfaFlash evaporator technology in this application is well-suited for the treatment of leachate at other landfills," Nick says.

According to a company spokesperson at Jiarong, there are more than 1,700 large and small landfills nationwide in China. However, since 2003 the Chinese government has restricted the increase in landfills while supporting the development of incineration plants. Therefore, since 2003 new landfills have been few and far between, and the proportion of incineration plants has risen. As a result, the amount of waste processed by waste incineration plants should have exceeded the amount of waste in landfills – especially considering that many landfills have entered a closure period, which means that the overall leachate production is decreasing yearly.

With the end of Covid-related lockdowns, Jiarong feels confident in the continued growth of its business and is actively promoting the AlfaFlash evaporation system to other similar applications.



Preservation of groundwater

The processing scale of the project treatment is 1,000 tonnes/day in the early stage and about 500 tonnes/day in the later stage (after the completion of the existing stock treatment).



The removal of contaminants

Chemical	Measure	Feedstock	Condensate
Calcium (Ca2+)	mg/l	464	
Magnesium (Mg2+)	mg/l	976	
Chloride (Cl-)	mg/l	27,253	
Sulphate (SO42-)	mg/l	32,040	
Silica (SiO2)	mg/l	59.9	
Total Dissolved Solids (TDS)	mg/l	73,230	
Conductivity	µS/cm	99,400	195
Chemical Oxygen Demand	mg/l	3169	554
Ammoniacal nitrogen (NH3/NH4)	mg/l	5,423	86
pH	S.U.	6.24	9.72



Technology shift

From conventional existing shell-and-tube evaporation system to Alfa Laval's AlfaFlash evaporators. Open landfills are common in most parts of the world outside Western EU countries and have long been a major concern due to the hazards and impact on the environment, health and livelihood of people and animals. In India, most landfill sites are typically dumping grounds in low-lying areas where waste is used to fill them – hence the name "landfill". Landfills typically lead to excessive groundwater pollution, methane gas emissions and fire hazards (Source: **UN Habitat**).

According to www.atlas.d-waste.com, there is a considerable number of landfills with the potential to damage groundwater in many parts of the world. While the data on the exact magnitude of the challenge in China and India remain sketchy, it is clear that the US challenge is overwhelming, says Patrick Horner, Global Sales Manager for Zero-Liquid Discharge at Alfa Laval.

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