Waste water solutions

When it comes to industrial wastewater, extraordinary problems need extraordinary solutions, explains Samir Fayyad.

After a major petrochemical company in Saudi Arabia completed its main product process design and development, they realised that a very important issue was left unattended, namely the plant's difficult wastewater stream. The 9000 kg/hr waste was predominantly 4.5 percent sodium sulphate, along with other chemical COD/BOD such as (acetophenone, cumene, dimethylbenzyl alcohol, phenol, acetone, alpha methyl styrene, formaldehyde, formic acid, methanol, ketones, acetol, sodium acetate, and sodium formate) in various concentrations ranging from 30 to 5000 ppm.

The wastewater presented a challenge to the client, as it was something more than expected. The discharge limits were specified as up to 2000 ppm of TDS and Suspended Solids, 150 ppm of phenol, and 800 ppm of TOC.

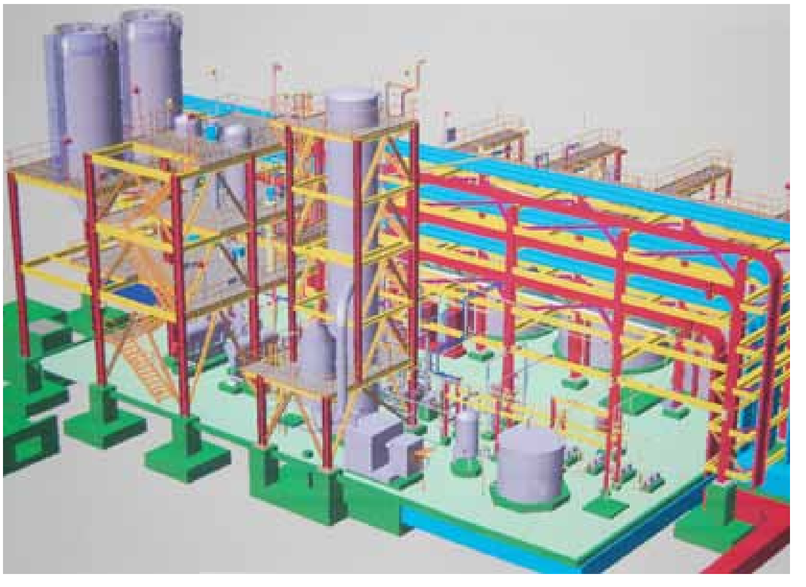
The concentration levels indicated above rendered an initial proposal to use RO unviable since the high inlet COD, solvents, and organic chemicals would foul or damage the RO membranes.

AES engineers started working on alternative treatment methods. A direct biological treatment for the incoming waste was not feasible due to the elevated feed salinity. This could hinder the biological growth of activated sludge and result in insufficient treatment. With this in mind and the exclusion of the RO technology, a valid option was thermal evaporation.

A two-stage evaporation process was selected. The wastewater is initially introduced to a falling film evaporator (FFE) followed by a vacuum cooling evaporative crystalliser (VCEC).

A mechanical vapour recompression fan is used to pressurise the steam vapour, heating it up and forming more vapour. The slurry from the FFE with 20 percent dry solids content is flashed in the sealed VCEC crystalliser running under vacuum. The sudden change in pressure causes more water to evaporate from the slurry, raising the concentration and forming crystals of sodium sulphate salts. The vapour flashed in the VCEC is condensed and sent along with the FFE condensate to the biological treatment.

A progressive cavity pump moves the slurry from the VCEC tank to a specially constructed pusher centrifuge to raise the solids content more than 90 percent, the crystals chutes down to a fluidised bed drier where it totally dries and then is pneumatically conveyed to powder storage silos to be stored waiting to be emptied into the next dry powder bulk transfer truck. The sodium sulphate crystals now have a commercial value and can be sold to other industries such as glass manufacturing.



Samir Fayyad is a Vice President, Technical at AES Arabia, a water and wastewater treatment company in Riyadh, Saudi Arabia. An experienced professional with more than 15 years' experience in designing projects and solving problems related to water treatment and reuse both in the private and oil & gas sectors. Clients served include Aramco, Sabic, PDO, JGC, SNC-Lavalin, Snamprogetti, PDO, QP, Total, and many others. For more information, please contact Asad Iqbal Khan, Manager, International Sales: +966 555 207569, asad_khan@aesarabia.com

An ejector is connected to the FFE vents and creates a slight vacuum removing any escaping gases and non-condensables. The mixture is pumped to the biological treatment section preventing possible ambient air emissions from fugitive gases.

The condensate collected from the evaporation steps is pumped through a plate and frame heat exchanger heating up the cooler incoming wastewater and is distributed to four long-retention biological reactor tanks.

High concentration of activated sludge is maintained in the biological reactor tanks (around 12,000 ppm.) This high concentration, coupled with the long retention time, helps break down the refractory COD and reduce the toxicity through dilution with the bulk volume of water in the bioreactor tanks.

Two subsequent membrane bioreactor tanks (MBR) are used to extract treated water from the biological system, which can either be re-used in the plant or disposed-of safely.

The plant has state-of-the-art design features and offers a cost-effective and reliable total solution to a stubborn wastewater problem while meeting environmental regulations and the clients set discharge criteria. ■