Water Re-use in the Hydrometallurgical Industry

Environmental considerations along with economical benefits of the water re-use have triggered the interest of the industry to develop a new ZLD technology for the treatment of liquid effluents.

GEA Messo PT developed a hybrid ZLD process for an 80 m^3/h effluent from a Molybdenum production facility containing among others ammonium sulphate, sodium chloride, as well as magnesium and potassium sulphates. The hybrid process consists of a pre-treatment section with brine purification, followed by a RO pre-concentration and further concentration in a falling film MVR evaporator. A dedicated crystallizer and the solid separation complete this process, which, except for this solid waste only produces pure water for re-use in the production facility.

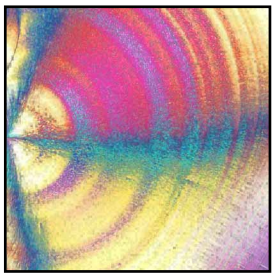
This development project was executed in close co-operation with the membrane department of GEA Wiegand GmbH. While existing technology is rather sensitive to incrustations, the present process is specifically designed to remove hardeners and fouling components in front of the concentrations units. The use of RO instead of evaporation allows a significant cost reduction and improves overall process economics.

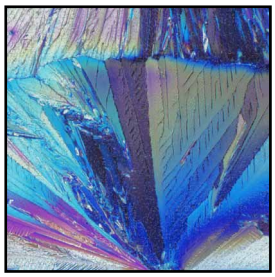
In order to proof the new process, laboratory and pilot tests were carried out, initially at the GEA Messo PT laboratory and then later at the client's site on a larger scale. Major focus was on the proper precipitation of the alkaline earth metal (Ca^{2+} and Mg^{2+}) as this represents an essential pre-condition for the reliable use of the membrane and the evaporation process. Due to the selective removal of such alkaline earth metals the falling film evaporator could be operated in an un-seeded mode, thereby simplifying overall process complexity. Process design was proven by de-tailed test works and shows an excellent precipitation of Calcium and the other membrane endangering components, like e.g. colloidal SiO_2, Mn and Fe.

With its experience in process development work, its existing laboratory facilities and its practical experience as a world wide plant constructor GEA Messo PT is the partner in developing your custom made Zero Liquid Discharge process for your specific waste water.

Zero Liquid Discharge (ZLD)

Treatment of Effluents





Pilot plant: brine purification section

Process Engineering

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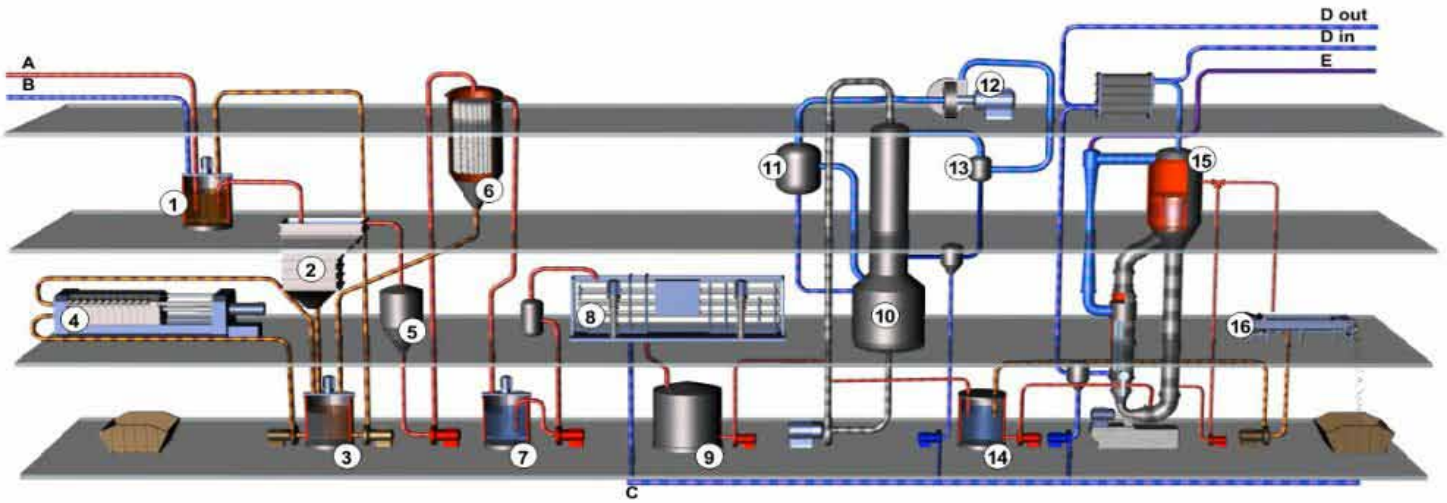

1 Reaktor (Carbonate precipitation)
2 Lamellar thickener
3 Slurry tank
4 Chamber filter press
5 Buffer tank
6 Candle pressure filter
7 Buffer tank
8 Reverse osmosis package
9 Buffer tank
10 Falling film evaporator
11 Droplet separator (demister)
12 Radial fans for MVR
13 Saturator
14 Buffer tank
15 FC Crystallizer
16 Belt filter

A Feed Solution
B Sodium carbonate solution
C Condensate
D Cooling Water
E Steam

Process Description

The waste water is delivered from an existing storage basin to the carbonate precipitation tank 1.

Soda ash solution is added there proportionally to the quantity of waste water. The precipitation vessel 1 is equipped with an agitator to obtain a homogeneous suspension.

The suspension is given to the lamellar clarifier 2 for the separation of the precipitate. The underflow is collected in the stirred tank 3 and from partially returned to the precipitation tank 1. The balance stream is pumped to the filter press 4. The filtrate from the filter press is returned to the lamellar clarifier, whereas the filter cake is for disposal.

The solution overflow is collected in the overflow tank 5 and pumped to the candle fine filter 6. The underflow suspension of this fine filter is returned to the lamellar clarifier 2, whereas the filtrate is given to the stirred acidification tank 7, where sulphuric acid is added to eliminate the excessive soda ash. The CO_2 generated is blown off.

A RO plant 8 is foreseen to concentrate the amount of waste water already by a concentration factor of around 6. The RO consists of a candle type polishing filter, the high pressure pumps, the re-circulation pump and the battery of membrane modules with connecting pipes, valves and fittings. The permeate is delivered at battery limit and the con-centrate is collected in the intermediate vessel 9. From there the concentrate is pumped to the thermal concentration plant.

The first evaporation step, which is a falling film evaporator 10 with the demister 11, is operated by mechanical vapour recompression 12, where the pre-concentrated solution is further concentrated near to saturation. The second step, the crystallization stage 15, is heated by the means of a thermocompressor system.

The pre-heated RO concentrate is fed into the re-circulation line of the falling film evaporator 10. The vapours formed by evaporation are passing a demister, are re-compressed and after de-superheating with condensate 13 re-used to heat the system. The condensate is handed over at battery limits. The falling film concentrate is collected in the stor-age tank 14 and from there fed to the evaporative crystallizer. This is constructed as forced recirculated crystallizer (FC-type) 15.

A part of the evaporated vapours are re-compressed for heating purposes by the means of a thermocompressor, the rest is guided to a surface condenser (plate type). The condensate is withdrawn and handed over at battery limits.

The mixture of salts (mainly some ammonium and sodium salts) becomes supersaturated due to the water evapora-tion and gets crystallized forming a crystal slurry. The crystal slurry is withdrawn to the vacuum band filter 16 for separation of the crystals from the mother liquor. The mother liquor filtrate is returned to tank 14 and, thus, fed back to the crystallizer.

The recovered filter cake is for disposal.

Pilot plant: RO unit section

Next Steps...

For more information regarding this technology and your specific configuration requirements, please contact us at: info.geamesso.de@geagroup.com or phone +49 2065 903-0.