

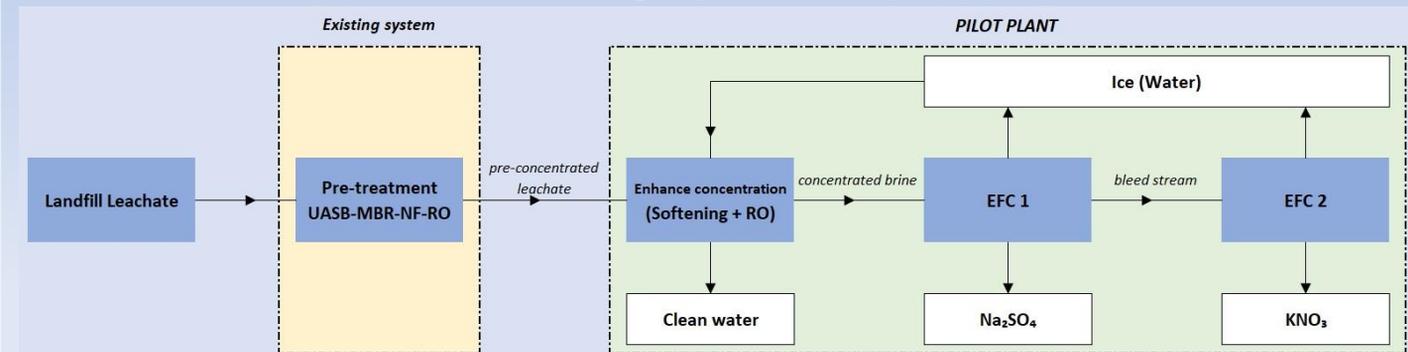
Eutectic Freeze Crystallization (EFC) plant for the treatment of landfill leachate

INTRODUCTION

Landfill leachate (LL) treatment poses an increasing challenge in China. The government regulations discourage the existing practice of recycling the LL brine to the landfill site. The LL brine, if untreated, will be increasingly difficult and costly to dispose. Through our JV partner in China, a Chinese company specialized in the development and treatment of various domestic and industrial wastewaters, we have developed a solution for (near) Zero Liquid Discharge (ZLD), using the innovative EFC technology.

DESCRIPTION

The existing landfill leachate treatment plant consists of a biological section of UASB and MBR process, followed by NF and RO for concentration. The biologically stable and pre-concentrated leachate is first softened and further concentrated using RO system. The concentrated brine leachate (5–6 wt%) is fed to the EFC 1 crystallizer (-14 °C). As temperature drops, ice starts crystallizing from the solution. Upon further cooling and with more ice production the concentration of sodium sulfate reaches saturation where it crystallizes, as Glauber, simultaneously with ice at the eutectic point. The mixed ice and salt slurry is fed into the EFC static separator where the ice fraction floats and the salt fraction precipitates. Subsequently, the ice and salt slurries are fed to two separate centrifuges, where the solid fractions are filtered. The filtered ice is fed to an ice melting section, where it melts and its cold is recovered. The molten ice (water) is recycled to the upstream RO and a very clean water is produced for reuse purposes. A bleed stream is extracted from the process to prevent the crystallization of other salts with Glauber. This bleed stream is fed to a EFC 2 (-25 °C) where potassium nitrate salt is recovered (mixed with small amounts of Glauber salt). A small bleed stream is extracted from the second EFC stage to prevent chloride precipitation.



PILOT PLANT

A pilot plant has been constructed to demonstrate this process. The pilot plant has intake capacity of 24 t/day. It is currently being operated with very promising early results showing matching real performance to the designed process, in both quantity and quality of products. Water is produced from the EFC process at TDS of 0.5wt%. The first stage showed successful crystallization and recovery of clean Glauber salt.

The Eutectic Freeze Crystallization (EFC) technology supplied by COOL Separations BV (CS) is a **very competitive solution for ZLD**, that provides a number of benefits:

FEATURES OF THE EFC TECHNOLOGY

- Efficient treatment for LL streams with the production of separate clean salts and reducing the disposal costs considerably
- Lower capital and operational costs for up to 40% compared to evaporator crystallizers:
 - Total installed costs of the treatment plant are cheaper due to the low temperature of operation and absence of exotic construction material (very low corrosion rates)
 - The operation costs are cheaper because water freezing consumes much less energy than evaporation, therefore reducing the CO₂ emissions
- Low temperature operation, no scaling or corrosion issues, no need for chemical additives.
- Easy to operate, much less sensitive in handling variations in the feed stream quality compared to evaporative processes.
- Low energy consumption, only requires electrical energy. The electrical energy consumption is estimated at 23 kWh/ton feed.
- Modular skid-mounted units, for fast commissioning and easy scale up possibilities.



TREATMENT OBJECTIVES

The key target in the treatment of the concentrated stream (RO brine of 180 t/d) is zero liquid discharge (ZLD). The main requirements of this ZLD treatment are:

- » 1. Produce clean water from the waste stream
- » 2. Produce (at least) one clean salt product
- » 3. Ease of operations