Resum de Tesi Doctoral

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DNI/NIE/Passaport	46767061B
Nom i cognoms	Sandra Casas Garriga
Títol de la tesi	Valorization of brines in the chlor-alkali industry. Integration of precipitation and membrane processes.
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(Mínim 1 i màxim 4, podeu veure els codis a http://doctorat.upc.edu/doc/impresos/impres_codunesco2.pdf)

Resum de la tesi de 4000 caràcters màxim (si supera els 4000 es tallarà automàticament)

Reuse of brines in the chlor-alkali industry can be benefitial both in terms of new material source for the industry and environmental impact reduction of the brines disposal. In this thesis, reuse of Seawater Reverse Osmosis Desalination brine as well as potash mine brine is studied.

Seawater Reverse Osmosis from the El Prat Desalination Plant and potash mine brine from the Llobregat brine collector pipe were used for this study. These kinds of brines were chemically characterized using different analytical methods that had to be adapted to the high salinities of the samples. According to the composition results obtained and the literature reviewed, several treatments were evaluated to reach the membrane electrolysis process requirements of the chlor-alkali industry. Potash mine brine had high sodium chloride concentration and in consequence, only purification was studied.

Electrodialysis, nanofiltration and precipitation were studied for brines concentration and primary purification. Experiments in the laboratory and in pilot plants were carried out. Pilot plants were designed and operated to determine the optimal conditions to treat the brines and design a feasible system to valorize the brines in the chlor-alkali industry using membrane electrolysis cells.

Electrodialysis was demonstrated a feasible technology for SWD-RO brine concentration, as it concentrated the brine and at the same time produced some useful by-products that could be further valorized. Performance obtained was highly dependent on inlet temperature and current densities used. The optimal ED operation point was determined when working in a continuous mode at 0.5kA/m2 were 18L/h of 244 g/L NaCl with 0.16 kWh/kg NaCl energy consumption were obtained. A first purification of polyvalent ions was reached using ED.

Nanofiltration efficiently removed polyvalent ions from both brines studied. The optimal operation point was around 20 bar in both cases. In the pilot plant, pressures higher than 20bar could not be evaluated due to fixed inlet flow. Removal of sulphates, calcium and magnesium was higher than 90%, 50% and 70% in both brines studied whereas NaCl was only removed by 12% maximum at 20bar, which was benefitial for its reuse. Removal of minor elements was also studied and depended on ionic radii as well as ionic charge.

Precipitation using NaOH and Na2CO3 reagents was evaluated to remove calcium and magnesium from the brines at different inlet temperatures. Temperatures over 65ºC increased calcium purification performance, especially on SWD-RO brines which contained all the antiscalants of the RO process that avoided calcium carbonate and sulphate precipitation. In consequence, the amount of reactants needed to reach the optimal purification point was higher than the values reported in the literature. Nevertheless, purifications efficiencies higher than 95% could be obtained. Reactant order addition effect on the purification performance results obtained was not considered significant Precipitates obtained during the purification process could be further valorized.

Integration of membrane and precipitation process was needed in order to efficiently treat the brines studied. Finally, a mathematical model to predict the concentration performance and design future experiments was developed and validated with the results obtained in the pilot plant.

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