

I. Ruiz Salmón, K. Simon, P. Luis; Osmotic and thermal membrane distillation for CO₂ valorization as carbonate crystals. Journée Jeunes Chercheurs 2016, 6th October, Louvain-la-Neuve, Belgium. (poster)

Abstract:

Membrane contactors are shown as a promising technology to be applied in the industry. Conventional processes, such as stripping, liquid–liquid extraction operations, crystallization and phase transfer catalysis may be performed with this technology. In fact, traditional equipment as evaporators or crystallizers may be progressively substituted in many cases by membrane configurations because of their advantages: operational flexibility, controlled and known interfacial area, linear scale-up, compact and less energy-consuming. Obtaining crystals with membrane contactors is one of the new areas of research. The membrane's role is to act as a non-selective barrier able to permit the mass transfer between two phases produced by the driving force (difference of concentration, temperature and/or pressure between phases). Crystallization will take place because of the saturation of the feed solution when the water leaves the feed by permeating through the fibers.

Crystallization of Na₂CO₃ using a membrane contactor is proposed in this work as the last stage of a whole integrated membrane system for the capture of CO₂: the general objective is to capture CO₂ from flue gases and to convert it into a valuable product (Na₂CO₃) by using NaCl solution as the only material source. Previous works proved the technical viability of this approach. This work gives a step forward by evaluating membrane distillation to crystallize Na₂CO₃ when a temperature gradient and an osmotic solution are involved.

The hollow fiber membrane contactor Liqui-Cel® Extra-Flow 2.5 x 8 (Membrana GmbH, Germany) was used as membrane crystallizer. The effect of concentrations, flowrates and temperatures of both feed solution (Na₂CO₃) and osmotic solution (NaCl) was researched.

Results of mass transfer coefficients and transmembrane fluxes allowed characterizing the system and Na₂CO₃·10H₂O crystals were obtained. Furthermore, the resistance-in-series model was applied in order to characterize theoretically the mass and heat transfer on the membrane distillation-crystallization plant. Finally, the influence of the variation of the surface area was evaluated. Thus, the best operating conditions to minimize the required membrane area and energy/material consumption can be determined.