MEMBRANE PERFORMANCE VS PROCESS PERFORMANCE: WHAT SHOULD WE ENHANCE?

Patricia Luis, Université catholique de Louvain, Belgium
Patricia.luis@uclouvain.be

Key Words: mass and heat transfer, pervaporation, membrane distillation

Membrane technology has demonstrated enough potential to compete with conventional systems that are governing the industrial sector already for decades due to their maturity and well-known operation. Examples are distillation, absorption, extraction, crystallization, etc, operation units that are carried out typically in columns or tanks that can be replaced by much more compact and energetically efficient equipment using membranes. There is a large variety of works, results, conclusions, and self-interpretations that can be found in the literature on membrane processes that show some technical viability. But those results and conclusions may be misinterpreted if the final industrial context is not considered properly. Focusing on the membrane performance will lead to different conclusions as those obtained when we are focused on the process performance. Thus, a key issue that arise in this ocean of results is: what should the objective be: high membrane performance or high process performance?

This presentation aims at addressing the main differences between these two aspects. Once this difference is understood, the research can be addressed and focused appropriately, and the applicability of the studied systems can be really identified. Two technologies are shown as example: pervaporation and membrane distillation.

Pervaporation is a separation technique based on the partial vaporization of compounds through a (commonly) non-porous membrane (dense membrane). The membrane acts as a selective barrier between the two phases, the liquid feed solution and the vapor phase permeate, and the driving force for the separation is the difference in the partial pressures of the components on the two sides of the membrane. The selectivity of the separation is given by different transport rates of the molecules through the membrane as a result of different solubilities and diffusivities of the components. Thus, the presence of azeotropes or difficult mixtures does not affect the efficiency of the separation and it makes pervaporation as a very attractive alternative to distillation. The performance of pervaporation can be done in terms of permeabilities (or permeances) and selectivities (oriented towards membrane performance), or in terms of fluxes and separation factors (oriented towards process performance), and how the interpretation of results is done may lead to very different conclusions (Luis *et al.,* 2013; Luis & Van der Bruggen, 2015). On the other hand, membrane distillation is also considered as an alternative to conventional distillation but in a different way. In this case, the separation is determined by the thermodynamic equilibrium, like in distillation, but a lower energy consumption is envisaged. The selected operating conditions have a very significant effect on the membrane and process performances, but differently. Evaluating the mass and heat transfer coefficients is the only way to study the differences and design a process with an industrial orientation (Ruiz Salmón *et al*.)

References :

Luis P., Degrève J., Van der Bruggen B., 2013. Separation of methanol – n-butyl acetate mixtures by pervaporation: Potential of ten commercial membranes, Journal of Membrane Science, 429, 1–12.
Luis P., Van der Bruggen B., 2015. The driving force as key element to evaluate the pervaporation performance of multicomponent mixtures, Separation and Purification Technology, 148, 94–102.
Ruiz Salmón I., Janssens R., Luis P. Mass and heat transfer study in osmotic membrane distillation for CO_2 valorization as sodium carbonate, submitted.