1st Post Combustion Capture Conference

CO_2 capture from post combustion gas by employing membrane technology – experimental investigations for pilot studies

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A FSC (fixed site carrier) membrane is developed for CO_2 capture in post combustion gas. It has high enough permeability and selectivity towards CO_2 to be used for the post combustion gas where the driving force (low CO_2 concentration and pressure) is usually considered too low for membrane application. Test results from different stages of scale-up, will be presented.

Keywords: CO2 capture; post combustion; membrane; scale-up; modelling; facilitated transport

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1. Introduction

Membrane science and technology are already recognized as powerful tools for process integration and intensification by decreasing equipment size, lowering energy consumption and minimizing waste generation [1].

The intrinsic simplicity of membrane CO_2 separation suggests many advantages compared with the amine CO_2 absorption technology due to reduced equipment size & footprint, expected lower energy consumption, no need for potentially hazardous extra chemicals which are used in the amine absorption technology, etc. The membrane gas separation is already a proven technology, but the trade-off between permeability and selectivity has been making it difficult to apply membrane technology for commercially large scale and it has been usually considered that there is not enough driving force for membranes to work properly because of the relatively low CO_2 concentration and pressure in the post combustion gas.

MEMFO (membrane research group at NTNU, Norway) has been developing CO_2 separation membrane based on facilitated transport by FSC (fixed-site-carriers) in polymer for many years [2, 3]. In the FSC membrane, the amino group is covalently bonded to polymer backbone giving a good stability and the amino group reacts with CO_2 reversibly in the presence of water vapor in the post combustion gas and the transport of CO_2 is even more enhanced by enhanced mobility of CO_2 in water vapor swollen membrane. So the FSC membrane has a promising performance of high flux as well as high selectivity in favor of CO_2 where the trade-off does not apply any more and it is believed that it has high enough performance to be applied for the post combustion CO_2 capture.

For a successful application in commercial scale, MEMFO has been testing the membrane with lab & pilot scale facilities and investigating the influence of process parameters on evaluation of energy demand, equipment sizing and CO_2 capture cost by modeling and simulation.

2. Test of FSC membrane for CO_2 capture in a small lab and a scaled-up pilot set-up

The FSC membrane performance has been tested both in a small lab-scale and a much larger pilot scale test set-ups at MEMFO. The membrane performance may have some changes during scale-up due to various factors such as different module design with changed internal gas flow paths, changed stage-cut with different contact time of gas with membrane, difference in preparation method between scaled-up and small lab-scale membranes, etc. In this presentation CO_2 separation performance of FSC membranes for CO_2-N_2 mixture gas (post combustion gas) is to be presented in different scales and under different process conditions. The various parameters during scale-up which may influence the membrane performance will be discussed.

3. Techno-economic evaluation

Based on the result from the above mentioned tests in different scales, a techno-economic analysis of FSC membrane has been done for some different scenarios, for example, 2 membrane stages and recycles [4]. This analysis will be presented in a separate talk, please look for the presentation of Dr. Arshad Hussain.

References

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