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Benchmarking Large-scale Hollow Fiber Hybrid Facilitated Transport Membranes for CO_2 capture from Low CO_2 concentration Sources

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Abstract

The growing demand for CO_2 separation solutions necessitates membrane technology that showcases high performances with very high upscaling efficiency due to the large market size. Additionally, emission sources with low CO_2 concentration flue gas (< 10 vol%) suffer from lower available driving force for partial pressure-driven separation. A clear need for breakthrough membrane technologies that operate under lower CO_2 partial pressures is evident, but such technologies also need to be upscalable and benchmarked at large scale.

Typically, gas separation membranes produced in continuous fashion, sealed into industrial modules at high packing density and surface area do not necessarily retain the same permeation properties as the bulk selective layer tested with a smaller area which are usually batch produced[1]. An efficient upscaling process for production of membranes including spinning, coating and module production is therefore necessary to translate technology into a successful separation process. Particularly, coating of selective layer is a crucial step where performances need to be reproduced in an upscalable production procedure.

Aqualung's facilitated transport technology benefits from the advantage of reactive CO_2-philic groups in the membrane selective layer enabling separation under non pressurized conditions and with low CO_2 feed gases. Over the past few years, Aqualung's focus has been to translate these performances to larger scale modules while simultaneously developing technology for resilience to industrially harsh conditions of deployment.

Herein, we present the first large-scale modules of hybrid facilitated transport membranes in hollow fiber configuration. These optimized modules showcase a packing density of up to 40% with an effective area target ranging from 2 to 8 m^2. Design, development and optimization of module properties to result in necessary separation performances (CO_2 recovery and CO_2 purity)

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will be presented and the technology will be benchmarked for low CO_2 concentration sources. Other industrially relevant benchmarks such as tolerance to acidic impurities like (H_2S, SO_2, NO) will also be presented.

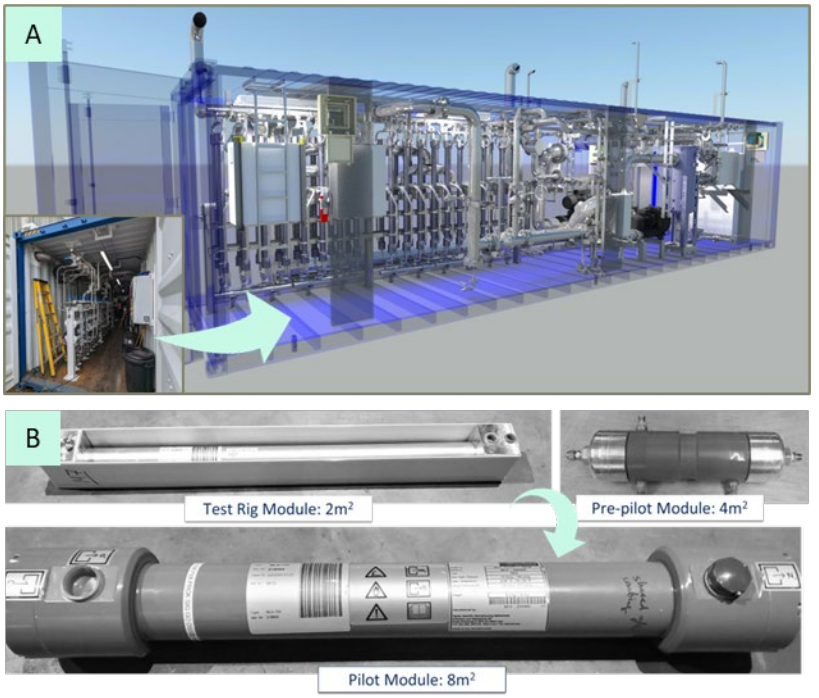

Fig1. (A) Pilot testing of HFTMs (B) Evolution of membrane modules

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