CO_2 Capture with Membranes: Lessons Learned from Field Trials in the USA

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To mitigate the harmful effects of global climate change, CO_2 emissions from industrial and power sources must be captured and either sequestered or utilized. Membrane technology is an attractive CO_2 capture option because of advantages such as energy-efficient passive operation, environmental friendliness (no hazardous chemical emissions, handling or storage issues), small footprint, and reduced water requirements. Despite these benefits, removal of CO_2 from industrial or power sector exhaust gases is challenging because these streams tend to have large flow rates with low CO_2 partial pressure driving force.

Over the last decade, MTR has worked on membrane materials and process innovations to address these CO_2 capture challenges. A CO_2-selective membrane designed by MTR, called Polaris, was scaled up to commercial-sized modules and tested extensively at the U.S. National Carbon Capture Center (NCCC) for both pre and post-combustion capture. A hydrogen-selective membrane, called Proteus, was also designed, tested, and found to be well-suited for pre-combustion capture schemes. Both of these membranes were evaluated on pilot systems at NCCC that allowed new membrane module designs and advanced membrane formulations to be validated under real world conditions. Among the many lessons learned from this testing is that when operated at a partial capture "sweet spot" (60 to 70% CO_2 removal), membranes have the potential to offer capture costs of less than US$40/tonne.

In this presentation, I will review the development of new commercial membranes through the lens of MTR's CO_2 capture program. Discussion topics will include the impact of membrane materials changes on module design and the importance of real world field testing. Future scale-up activities and the potential for break-through advances will also be examined.