# Membrane based $CO_2$ capture from an IGCC power plant – a systematic methodology to identify cost-competitive membrane properties

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## Abstract:

$CO_2$ capture from fossil based power plants and industrial capture will be an important technology in a future carbon-constrained energy scenario. In this context, polymeric based membrane systems are seen as a promising alternative to "mature" technologies such as amine based capture systems. While there has been extensive research in membrane development, process design and identifying optimal membrane properties for post-combustion capture systems, there is very little literature available on application of such membranes for pre-combustion capture systems.

$CO_2$ capture in pre-combustion systems involves separating $CO_2$ from a syngas stream consisting predominantly of $H_2$ and $CO_2$. In addition to $CO_2$ recovery ($CO_2$ capture rate), $H_2$ recovery is an important parameter in the system. Since $H_2$ is a valuable product, loss of $H_2$ will reduce the overall process efficiency and economics. The separation can be realised with either a $CO_2$ or $H_2$ selective membrane.

The Attainable Region methodology is a novel graphical design approach developed to provide a consistent evaluation of membranes and cost-optimal multi-stage post-combustion capture processes [1-3]. It has been subsequently automated by implementing a numerical model for the methodology. The attainable region analysis and its numerical version were extended for pre-combustion $CO_2$ capture as a part of this work. This is used to plot the attainable $CO_2$ and $H_2$ purity for a given membrane to identify suitable membranes for the process.

The Attainable Region approach is used to design membrane based $CO_2$ separation processes for an IGCC process. The methodology is further used to develop a map of suitable membrane properties for $H_2$ and $CO_2$ selective membranes that can compete in term of cost with a standard Rectisol process for $CO_2$ capture. This map will provide targets for membrane development for this application.

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**References**

[1] K. Lindqvist, R. Anantharaman, Chemical Engineering Transaction, 2014, 39.
[2] S. Roussanaly, K. Lindqvist, R. Anantharaman, J. Jakobsen, Energy Procedia, 2014, 63, 217-224.
[3] S. Roussanaly, R. Anantharaman, K. Lindqvist, H. Zhai, E. Rubin, Jounal of Membrane Science, Accepted.