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CO₂ / H₂ SEPARATION BY MULTISTAGE H₂ SELECTIVE AND CO₂ SELECTIVE MEMBRANES: A PROCESS SYNTHESIS STUDY

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Hydrogen purification from pre-combustion gas mixture, such as generated by coal gasification plants (IGCC), is of major interest given the very large production potential offered by this production strategy. Basically, different hydrogen purification technologies are possible, such as gas-liquid absorption in physical solvents, adsorption (PSA) or membrane processes. The feed mixture typically contains 60% H₂ and 40% CO₂ under high pressure (ca 50 Bar). A high purity H₂ and high purity CO₂ is typically aimed, in order to simultaneously enable hydrogen use and carbon dioxide storage or use.

Interestingly, membrane processes can show a H₂ (e.g. polyimide) or CO₂ (e.g. rubbery block copolymers) selectivity. This peculiarity addresses a key process engineering question: what is the most cost effective solution that combines H₂ and CO₂ purity when the two types of membranes are available? This problem has been investigated thanks to a dedicated, tailor made Process Synthesis computer-aided system, in order to identify the optimal process structure and operating conditions with the minimal production cost [1]. Two different commercially available membranes (Sepuran from Evonik and Polaris from MTR) have been taken for the simulation purpose. The results obtained for H₂ purity of 90 and 99%, with or without carbon capture constraints will be detailed and discussed. The interest of combining the two types of membrane will be critically analyzed.

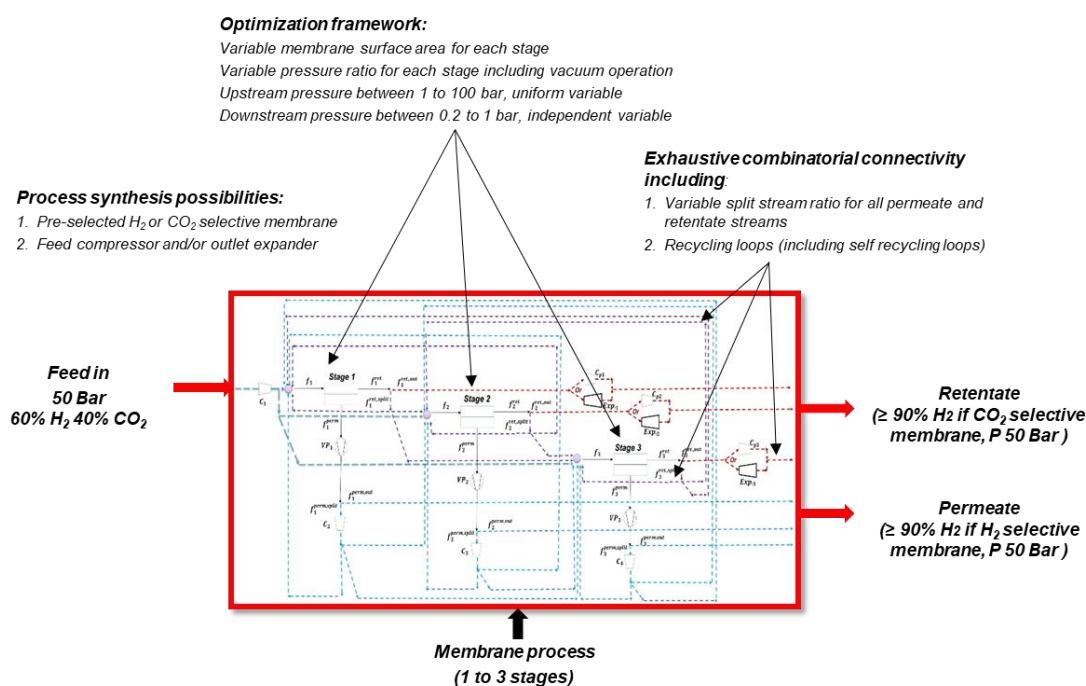


Figure 1. Overview of the Process Synthesis study.

[1] Optimal process design of biogas upgrading membrane systems: Polymeric vs high performance inorganic membrane materials Bozorg, M. et al, Chemical Engineering Science, 2020, 225, 115769

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