

TECHNOLOGY OFFER: INTEGRATED MEMBRANE REACTOR FOR ENHANCED METHANE STEAM REFORMING

OVERVIEW

Category: Membrane , Catalyst , Reactor , Process , R&D knowledge , Other

Benefit summary: Integrated membrane reactor for cost- and energy-efficient H₂-generation and syngas tuning by performing steam methane reforming at relatively low operating temperatures of 500-600°C.

Development status: Demonstration at pilot-scale (0.8 m² membrane area) in industrially relevant conditions.

IP status: Patent on reactor design: WO2012/112046A1

NOVELTY

- Technology benefit description:** The integration of heat supply, steam methane reforming catalyst and hydrogen separating membranes results in high methane to hydrogen conversion levels (> 90%) at relatively low operating temperatures (500-650°C). Lower operating temperatures result in higher energy efficiency due to lower heat demand and lower costs due to the use of less expensive reactor vessel materials.
- Technology uniqueness and comparison vs state-of-the-art:** The membrane reactor is unique due to the integrated design of catalyst and membranes, which results in a compact and cost effective reactor construction.

DEVELOPMENT

- Technology Readiness Level:** TRL 1 ; 2 ; 3 ; 4 ; 5 ; 6 ; 7 ; 8 ; 9
- Development status:** The reactor has been demonstrated at pilot-scale under industrially relevant conditions.

INTELLECTUAL PROPERTY

Patent / application N°	Title	Countries	Status	Priority date
WO2012/112046A1	Membrane reactor and process for the production of a gaseous product with such reactor	Worldwide	Published	18.02.2011

TECHNOLOGY PROVIDER

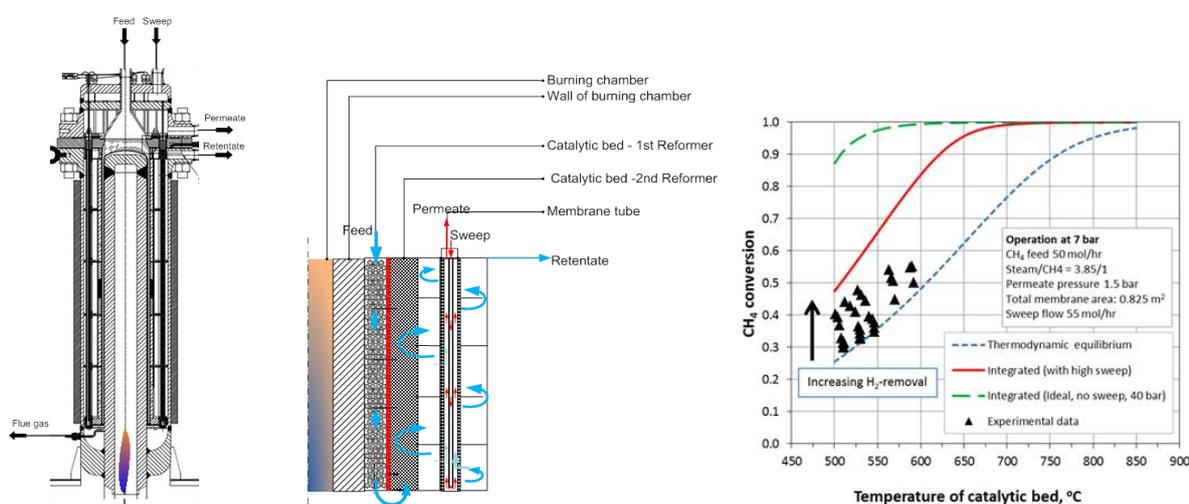
- Technology provided by:** ECN, Petten, The Netherlands
- Related expertise:** Membrane manufacturing, process integration (separation and catalysis), reactor design (conceptual and mechanical), reactor modelling, membrane and catalyst characterization and reactor testing (lab-, bench- and pilot-scale), process analysis.

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This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 263007.

TECHNICAL DETAILS

- Description:** A pilot-scale membrane reactor has been designed and constructed for demonstration of the concept of hydrogen separation enhanced steam methane reforming. The reactor consists of three sections, namely a burner section, and a primary and secondary reforming section (See figure below). The heat required for the endothermic steam reforming reaction is provided, by the centrally positioned burner, directly to the surrounding primary reforming section of the reactor. This catalyst section performs the partial conversion of methane to hydrogen, creating sufficient hydrogen pressure for hydrogen removal over the membranes at the entrance of the secondary reforming section. This secondary reforming section consists of a SR catalyst in a foam shape surrounding the primary reforming section and 24 Hysep® membranes located around the secondary reforming catalyst. The total effective membrane area is 0.82 m². The reactor is designed for operation with a feed stream (S/C=3-4) pressures up to 40 bar and temperatures in the range of 500-650°C. The H₂-production capacity is 2-5Nm³/hr, depending on the methane conversion level.



LICENSING

- Collaboration type sought:** Joint development with industrial partners towards pilot demonstration on industrial site. License on design technology package.
- Support provided:** Membrane manufacturing, reactor scale-up, support in on-site testing.

CONTACT DETAILS

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