

// TAILORED MEMBRANE TECHNOLOGY - OPTIMIZED FISCHER-TROPSCH SYNTHESIS BY A HIGHLY EFFICIENT MEMBRANE SYSTEM

Ref-Nr: TA-HZG-EP2727979

HINTERGRUND

Biomass gasification has attracted a remarkable interest from the scientific and industrial communities for decades, since it allows the sustainable reuse of an important residual material.

Gasification of biomass for syngas (CO and H₂) generation is becoming increasingly attractive. This has in turn increased the interest in FTS, since syngas can be processed further to produce hydrocarbons by means of FTS.

Irrespective of the gas source, the compositions of the gas mixtures of the different gas streams are strongly influencing the yield of FTS and the quality of the reaction product. Hence, the concentrations of gas components present in the process, as CO and H₂ require a fine control.

The presented technology represents a complete membrane separation system for the optimization of the output and performance of FTS facilities.

LÖSUNG

The presented system is based on an arrangement of membrane stages placed at sections of a typical FTS production process where gas separation is required. This modular property defines a very flexible system, adaptable to special requirements.

The permselective nature of the employed membrane materials allows for the targeted removal of components from gas mixtures, provided that a partial pressure driving force is applied. Hence the membrane technology can adjust the concentrations of the gas mixtures up- and downstream of the FTS reactor. This allows for a higher conversion of CO₂ in the FTS reactor and an alternative for separation the product without the need of complex absorption, adsorption or cryogenic distillation technologies.

The different membrane materials employed allow for the preferential permeation of CO₂, H₂ and H₂O vapor or higher hydrocarbons. This ensures that undesired components are kept at low concentrations, not-used reactants are



TUTECH INNOVATION GMBH

Dr. Francisco Blanco
040-766296587
blanco@tutech.de
<https://tutech.de/>

ENTWICKLUNGSSTAND

Machbarkeit

PATENTSITUATION

EP EP2727979 erteilt
US US9090520 erteilt

CATEGORIES

//Energietechnik //Synthesen und
Verfahrenstechnik //Chemie

recycled and products are separated.

Multiple tests have proven the stability of the membranes in laboratory scale (H₂-selective), pilot plant (CO₂-selective) and industrial (higher hydrocarbon selective) operating scenarios.

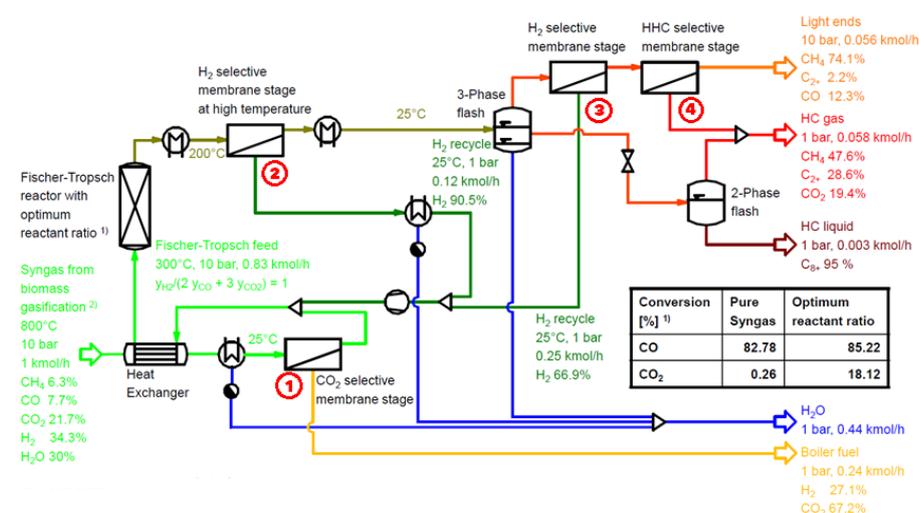
Description of the membranes/separation steps:

1) A CO₂ and H₂O selective membrane treats the feed gas prior to directing it to the reactor. At this step, part of the CO₂ is separated and a gas mix with a defined reactant ratio made available for the reactor. This step improves the general efficiency of the reaction inside the reactor and fosters the conversion of CO₂.

2) The second membrane, placed downstream of the FTS reactor, pulls valuable, unreacted H₂ under high temperature out and allows its recirculation through the reactor. It also removes part of the generated H₂O from the process. This step optimises the use of the not reacted reactants and facilitates part of the required water separation.

3) The third membrane separates H₂ from the remaining hydrocarbon gas. The separated H₂ can be recycled as well.

4) The membrane at the latter stage allows for a first separation stage between other valuable products such as propylene, which represents an additional exploitable product, from lighter gases.



Scheme of the system including the membrane positions, identified in red circles. The numbered positions match the description in the "Solution" section

(process design example).

VORTEILE

Individual membrane separation stages have successfully been investigated in laboratory and pilot scale. The system is however not limited to FTS and can be implemented into other processes as well. Examples are the separation of CO₂ from flue- and biogas or the separation of higher hydrocarbons from industrial off-gases.

The polymeric membranes and the presented procedure have been specifically developed to improve the performance of current FTS production plants and effectively generate high-quality reaction gas mixtures.

On the basis of the high interest in XTL technologies, this invention opens the door to an upgrade of existing plants and/or design of new facilities employing flexible membrane technology.

We present here a highly versatile system that allows a convenient adaptation to the variations in the process, as fluctuations in the syngas composition or the reaction outlet streams.

Furthermore, the space requirements for a system equipped with membranes are typically lower compared to separation units used in existing FTS-facilities without the requirement of additional separation agents as solvents and the associated regeneration stages.

The presented innovation offers the possibility to improve the performance of FTS and XTL production plants.

ANWENDUNGSBEREICHE

- Fischer-Tropsch Synthesis
 - Biomass gasification
 - XTL (GTL, BTL, ...)
-

SERVICE

The development of this procedure and multilevel membrane system relies on the solid expertise of the Helmholtz-Zentrum Geesthacht, and is available for licensing and further research and development.
