FRAUNHOFER INSTITUTE FOR MICROENGINEERING AND MICROSYSTEMS IMM

1 *40 feet mini plant container with climate control unit*

2 *Open burning natural gas*

MOBILE PLANT FOR NATURAL GAS SUPPLY

Fraunhofer Institute for Microengineering and Microsystems IMM

Carl-Zeiss-Strasse 18-20
55129 Mainz | Germany

Contact

Prof. Dr. Gunther Kolb
Phone: +49 6131 990-341
gunther.kolb@imm.fraunhofer.de

www.imm.fraunhofer.de

The supply with natural gas is linked to the natural gas grid. Heating systems, energy generation plants and natural gas fueling stations that are not connected to the natural gas grid can be supplied with liquefied natural gas. Assuming a sufficiently high delivery rate the boil-off in liquefied natural gas tanks is not a major problem.

There are, however, numerous applications in which the heat input related losses in the tank make any operation unattractive. For these applications a mobile plant concept was realized and developed still on smaller scale, which allows the conversion of liquid renewable energy carriers into natural gas. Methanol or ethanol can be stored without time limitations.

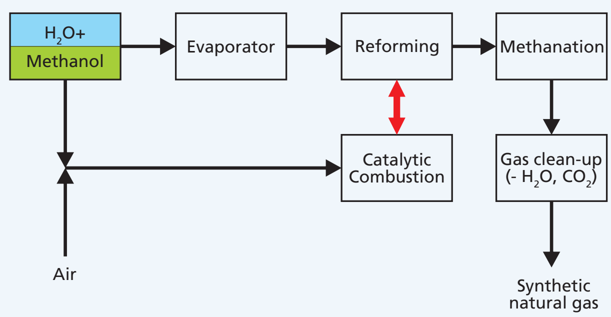
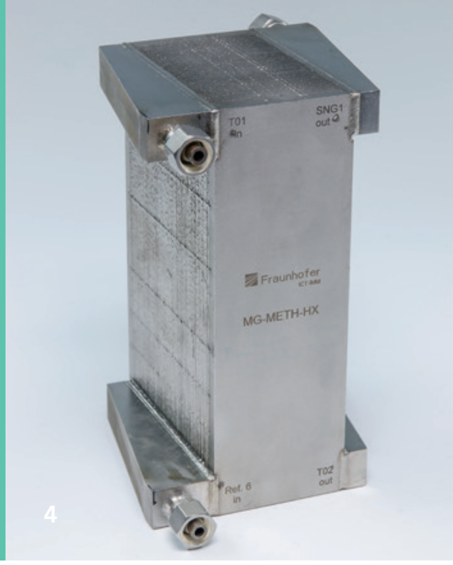


Fig. 1: Process scheme of decentralized natural gas supply



The plant concept comprises the following process steps:

1. Conversion of the methanol into syngas using a steam reformer. The reaction is endothermic and thus has to be supplied with energy. This is realized by the combustion of additional methanol. Both reactions are carried out in a microstructured plate heat exchanger allowing the direct coupling and the optimum energy transfer from the exothermic to the endothermic reaction. For the steam reforming of methanol we can rely on a proprietary catalyst (patented technology with proven durability under process conditions, see Fig.3).
2. Methanation of the carbon dioxide contained in the syngas to a methane-rich gas mix. This exothermic reaction requires an efficient removal of the generated heat being achieved in this case as well by a microstructured plate heat exchanger is cooled with thermo-oil.
3. The product of the methanation step is cooled and condensing water removed. The product is then further cooled and unconverted carbon dioxide removed by an absorber column.

By these means the resulting purified product has the quality of synthetic natural gas. In the scope of the process development the catalysts were optimized, the process design was developed, the reactors were designed and a small scale plant was set-up (see picture 3), which is controlled by automated software (see Fig.2).

The advantages of this concept are obvious:

- Unlimited availability of natural gas, also in case of only temporary demand
- Fully automated process, process control also possible with Siemens software
- Highly integrated process which can be installed in a containerized environment
- Utilization of microchannel reactor technology allows optimum compactness and heat integration of process flows

References

Wichert, M., Zapf, R., Ziogas, A., Klemm, E., Kolb, G., 2016. Kinetic Investigations of the Steam Reforming of Methanol over a $Pt/In_2O_3/Al_2O_3$ Catalyst in Microchannels. Chemical Engineering Science 155, 201-209.

Kolb, G., Keller, S., Tiemann, D., Schelhaas, K.P., Schuerer, J., Wiborg, O., 2012. Design and Operation of a Compact Microchannel 5 $kW_{el,net}$ Methanol Steam Reformer with Novel Pt/In_2O_3 Catalyst for Fuel Cell Applications. Chemical Engineering Journal 207-208, 388-402.

3 Small-scale demonstration of the process concept

4 Methanation reactor with integrated cooling by thermo-oil

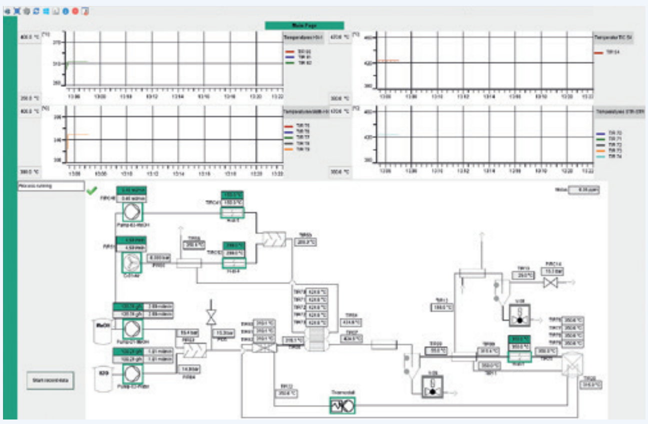


Fig. 2: Process scheme of decentralized natural gas supply

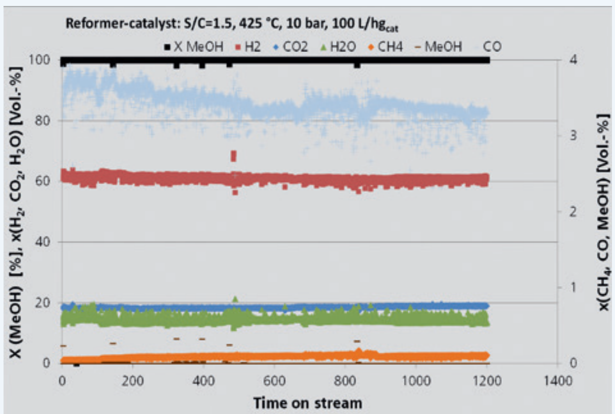


Fig. 3: 1,200 h long term test for a methanol steam reforming catalyst