TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

Institute of Chemical Engineering
Getreidemarkt 9/166, 1060 Vienna, Austria
Phone: 0043-1-58801-16600
sekretariat+E166@tuwien.ac.at
www.vt.tuwien.ac.at

Increased yield in biogas upgrading

Tailor-made process based on membrane gas permeation

Membrane gas permeation has been proving its worth as a robust technology for biogas upgrading. The documented advantages of the process over other gas upgrading technologies are its small dimensions, high level of operational safety, reliability and low energy consumption. Simple one or two-stage gas permeation systems are not normally capable of achieving optimum methane recovery of over 90% in economical operation. In practice this means that in simple gas permeation systems, approximately 10% of the methane contained in the bio-gas is not available for the end purpose.

Objective

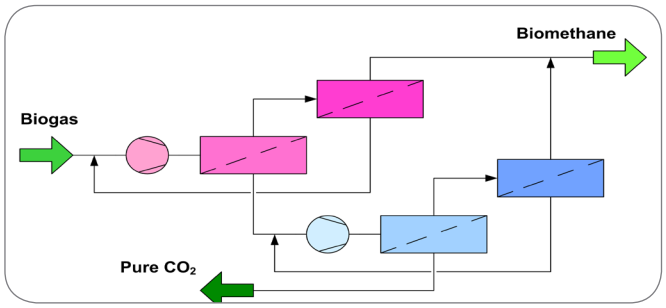
Prof. Michael Harasek and his research group "Thermal Process Engineering and Simulation" at TU Wien were going for a biogas upgrading based on membrane gas permeation. Their aim was to increase the methane recovery to over 99% whilst at the same time retaining the low level of energy consumption and small membrane area requirements.

Approaches

The research group determined multi-stage permeation configurations by applying numerical process modelling, validation and optimization via experiments. This approach has been based on both extensive practical experience of the research group in the field of biogas processing with membranes as well as in-house developments for the numerical process modelling and optimization. The numerical method combines a finite difference solver for the simulation of membrane gas permeation that has been validated in experiments a numerical Levenberg-Marquardt method for process optimisation.

More efficient and economic application of biogas in natural gas networks and gas vehicles is made possible by Know-how of TU Wien.

On the basis of this effective combination tailor-made, multi-stage systems can be identified and designed. The simulation assisted design allows to identify optimized permeator circuits and to ascertain the required membrane area dimensions at which the membrane yield will be maximised while simultaneously minimising energy consumption.

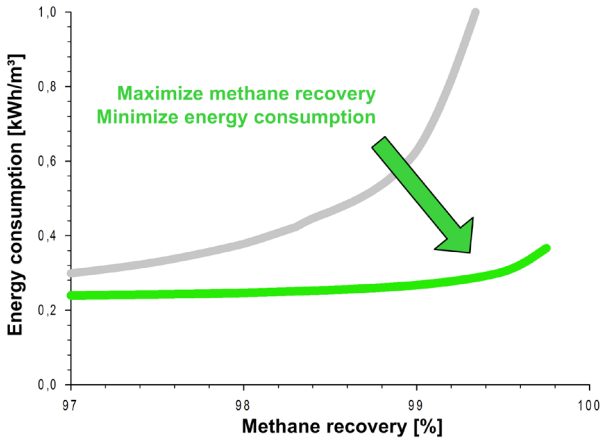


Scheme of biogas treatment by 4-stages of membrane gas permeation

Results

The result of the development is a range of optimised two, three and four-stage permeator configurations that are available to the user for consideration. The choice between the determined configurations is influenced by the key parameters of bio-gas upgrading, such as feed pressure in the gas line, targeted methane recovery, membrane properties and raw biogas composition.

In order to achieve highest methane recoveries economically, a four-stage device with two compressors, for example, can be used. This enables a methane yield of at least 99% to be achieved, if low-selectivity membranes are used.



Power consumption as a function of methane yield – today's technologies compared to design of TU Wien

The use of higher-selectivity membranes in this configuration leads to a further increase in the methane yield, up to 99.8%!

At the same time, the energy needed for the gas treatment can be reduced by up to 30%, to less than 0.2 kWh/m3.

Benefits for you

The know-how of the TU Wien delivers:

- Energy-optimized biogas recovery with optimal combination of methane yield, required process energy and investment costs
- Significantly higher methane yield than usual
- Easier compliance with standards for the production of bio-methane
- solutions for process integration
- solutions for gas pre-treatment
- solutions for lean gas treatment
- solutions for process automation

Point of contact:

Ass.Prof. Dr. Michael Harasek
TU Wien - Institute of Chemical Engineering
Phone: +43 1 58801 166202
Mobile: +43 664 6104922
michael.harasek@tuwien.ac.at
bio.methan.at