Pushing Archaea to the limit: Pathway to sustainable biomethanation.

JOHANNES KEPLER UNIVERSITY LINZ

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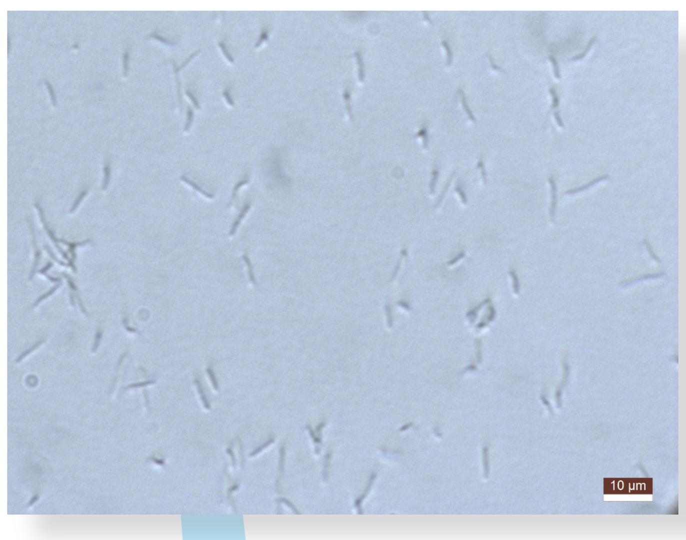
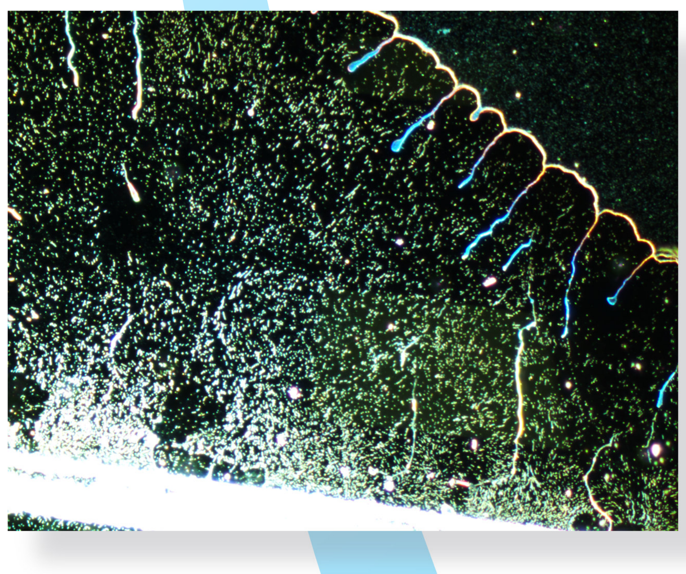




Conclusion

With our newly developed bioreactor system we demonstrate:

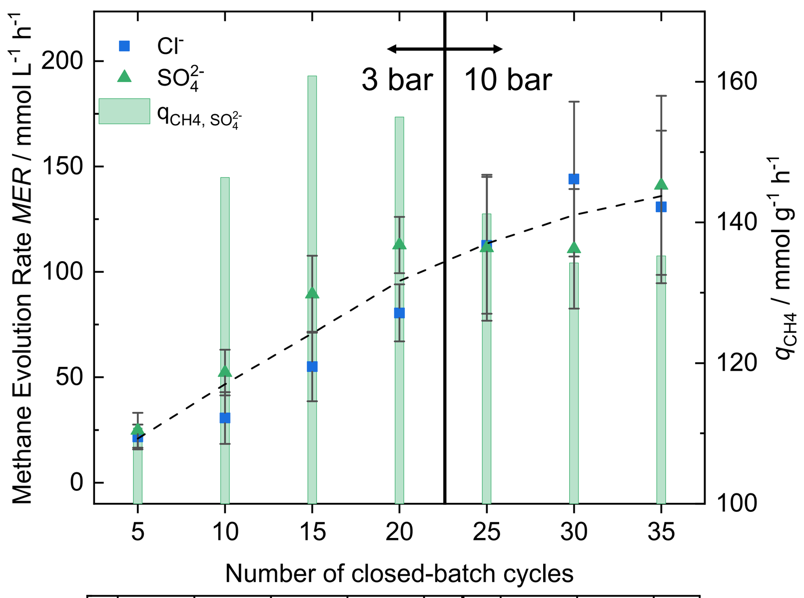
- ✓ **Successful Cultivation:** Effective closed-batch cultivation of *M. marburgensis* on sulfate-based growth media for biomethanation.
- ✓ **SBRS-II Performance:** Successful performance test of the newly developed bioreactor system.
- ✓ **High Methane Evolution Rate:** Specific methane evolution rate exceeding 100 mmol g^{-1} h^{-1}.
- ✓ **Stable Growth Under Pressure**: Demonstrated stable growth of *M. marburgensis* up to 10 bar.
- ✓ **Improved Media Safety:** Successfully replaced toxic and steel-corrosive chlorides with non-toxic and less corrosive sulfates.
- ✓ **Scalability:** Sulfate-based media enabled easier operation for larger-scale applications.

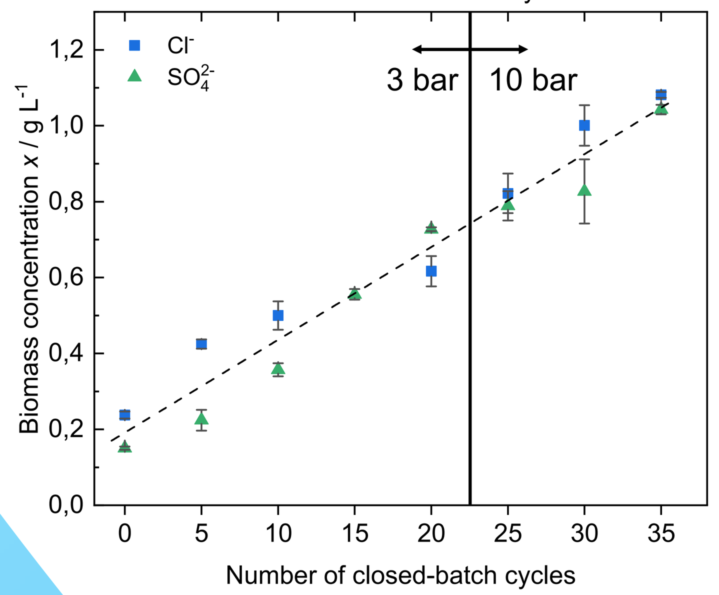
Introduction

The goal to limit global warming, as outlined in the Paris Agreement, necessitates a substantial reduction in greenhouse gas emissions. Given the complex nature of this challenge, it is evident that a singular technological approach will be inadequate to meet these ambitious targets. Instead, a holistic strategy is required, that uses a combination of existing, developing, and emerging technologies. Among these technologies, biological methanation is proving to be a promising route to sustainable solutions [1-3].

Our research is focused on the industrial application of a high-pressure biological methanation process using *M. marbugensis* as a model organism. Optimizing efficacy demands attention to factors such as long-term performance, process stability, and easy operation.

Results

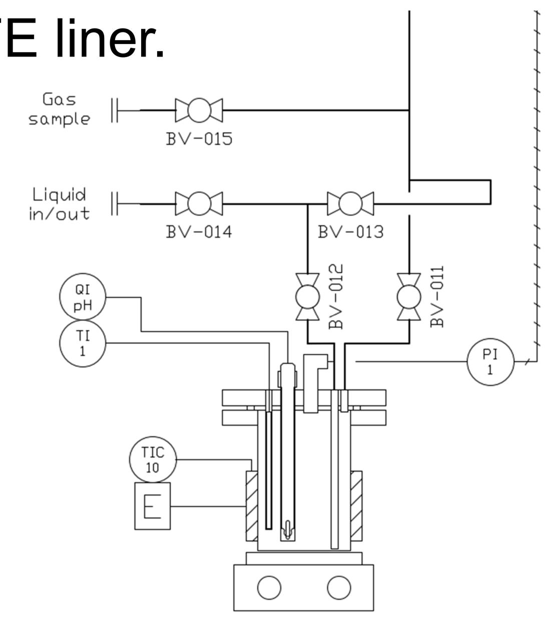


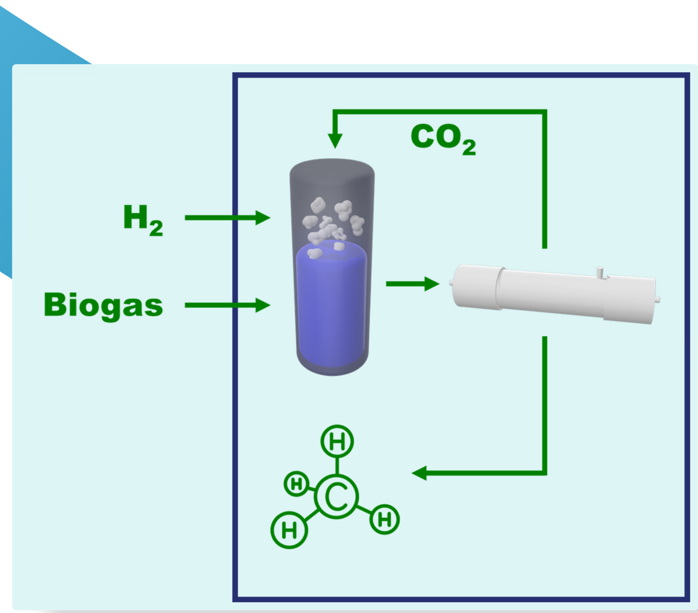


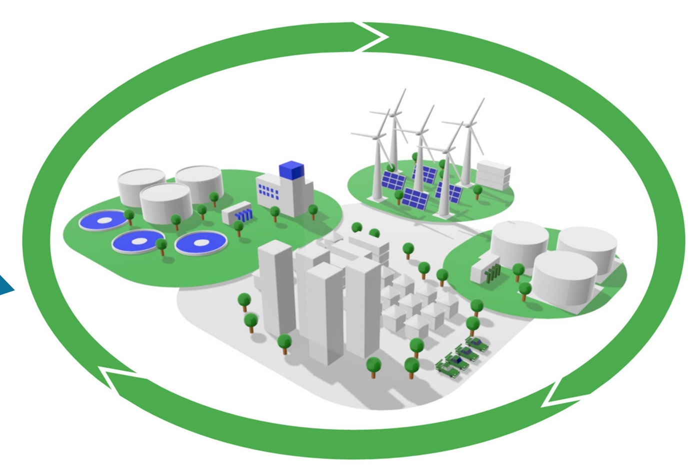
- Experimental series to compare chloride-based standard media with sulfate-based media.
- Both media resulted in high volumetric methane evolution rates (*MER*) at 3 bar and 10 bar conditions.
- Achieved stable biomass growth with both media under 3 bar and 10 bar conditions.
- Recorded a maximum specific methane evolution rate (q_{max}) of 160 mmol g^{-1} h^{-1} and a maximum turnover rate (μ_{max}) of 0.625 h^{-1} using sulfate-based media.
- The SBRS-II system delivered approximately 10-fold higher *MER* rates compared to previous benchmarks [4].

Simultaneous BioReactor System – Gen. 2 (SBRS-II)

- 4 identical stainless-steel reactors with PTFE liner.
- Each reactor operates independently via a predefined pressure control program.
- Live temperature and pH monitoring.
- Pressure data saved on SD card for post-processing.
- Capable of gas and liquid sampling.
- Operating range (with pH probe): 0 - 17 bar(a) and 135 °C







Topics to collaborate

- High pressure archaea biotechnology
- In-depth physiological studies of methanogenic archaea at high pressures
- Model building

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Get in Touch

More about FlaeXMethane

Johannes Kepler University Linz, June 2024

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References

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