Laboratory of Anaerobic Microorganisms

Research activities

Laboratory of Anaerobic Microorganisms (LAM) was founded in 2015 as part of the Department of Experimental Biology, Section of Microbiology at Masaryk University in the Czech Republic.
From the very beginning, the LAM focused on the field of biogas production, building on more than fifteen years of experience. Since 2017, thanks to cooperation with the energy sector, we have been working on projects related to the environment of underground gas storage (UGS) facilities. We focused on the targeted **production of green methane from hydrogen and carbon dioxide** in UGS facilities intended to serve as bioreactors. Our analyses confirmed the presence of methanogenic archaea in UGS that are capable of producing methane from hydrogen and carbon. However, the presence of methanogens in UGS is not suitable for **hydrogen storage**, which is another part of our research focus, in conjunction with **microbiologically influenced corrosion (MIC)**, which poses a threat to the gas infrastructure.

Our technical expertise

Services offered:

- **Assessment of microbial communities in UGS and their methanogenic and corrosive potential**
- **Testing and simulation of UGS methanation or hydrogen storage in high pressure reactors**
- **Evaluation of the microbiologically influenced corrosion rate of the samples**
- **Complete analysis of changes in gas composition and microbial changes during high-pressure tests**
- **Monitoring of microbial changes during the in-situ tests**

Available infrastructure:

- **Anaerobic cultivation**: anaerobic glove box COY, high-pressure fermenters (3.5 L, 10 L, 80 bar), micro fermenters, gas mixing station, temperature-controlled incubators
- **Analytical equipment:** GC Agilent (FID, TCD), fluorescence/confocal microscopes, UV/VIS spectrophotometers, plate readers (Tecan Infinite 200 Pro), HPLC-RID/UV-VIS and HPLC GPC-DAD (Agilent 1260 Series), centrifuges
- **DNA sequencing**: Illumina MiniSeq, Nanopore MinION
- **Supporting equipment:** freezers, autoclaves

Contact

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Lab Website

Publications and Projects

The **LAM** has long been involved in the production of biogas, the improvement of biogas quality, anaerobic degradation processes, but also in the reduction of methane emissions from livestock farming.

One of our main objectives is **underground microbial methanation and hydrogen storage**. Through our participation in various projects in the energy sector, we have written several publications on this topic and presented our results at various conferences.

The following scientific publications and projects illustrate the laboratory's expertise in the field of hydrogen storage and CO_2 utilisation:

Publication	Vítězová M., Onderka V., Urbanová I., Molíková A., Hanišáková N., Buriánková I., Vítěz T., Novák D., Lochman J., Machálková M. & Javůrek J. **In situ field experiment shows the potential of methanogenic archaea for biomethane production from underground gas storage in natural rock environment**
2023	Environmental Technology & Innovation, 23, 103253 doi: 10.1016/j.eti.2023.103253

Publication	Hanišáková N., Vítězová M., Vítěz T., Kushkevych I., Kotrlová E., Novák D., Lochman J. & Zavada R. **Microbiological insight into various underground gas storages in Vienna Basin focusing on methanogenic *Archaea*.**
2023	Frontiers in Microbiology, 14 doi: 10.3389/fmicb.2023.1293506

Publication	Buriánková I., Molíková A., Vítězová M., Onderka V., Vítěz T., Urbanová I., Hanišáková N., Černý M., Novák D., Lochman J., Zeman J., Javůrek J., Machálková M., Dengler L. & Huber H. **Microbial Communities in Underground Gas Reservoirs Offer Promising Biotechnological Potential.**
2022	Fermentation, 8(6), 251 doi: 10.3390/fermentation8060251

Publication	Molíková A., Vítězová M., Vítěz T., Buriánková I., Huber H., Dengler L., Hanišáková N., Onderka V. & Urbanová I. **Underground gas storage as a promising natural methane bioreactor and reservoir?**
2022	Journal of Energy Storage, 47 doi: 10.1016/j.est.2021.103631

Conference	Vítězová M., Hanišáková N. **The cultivation of strict anaerobes from various UGS samples**
2023	VAAM BigBang...Microbes! - Workshop on Cultivation of the Uncultivationables! Cologne, Germany

Conference	Vítězová M., Buriánková I., Hanišáková N., Černý M., Onderka V., Chladil M., Vítěz T. **Microorganisms in an aquifer environment**
2019	European biotechnology congress 2019 in Valencia, Spain doi: 10.1016/j.jbiotec.2019.05.125

Conference	Vítěz T., Onderka V., Chladil M., Vitězová M. **Production of biomethane in a deep rock aquifer**
2019	European biotechnology congress 2019 in Valencia, Spain doi: 10.1016/j.jbiotec.2019.05.124.

Conference	Hanišáková N. **Cultivation of methanogens from environmental samples**
2019	Workshop on Gas in Biotechnology 2019 in Vienna, Austria ISBN: 978-3-900932-60-2

Conference	Molíková A., Hanišáková N., Vítězová M., Buriánková I., Černý M., Vítěz T., Chladil M., Urbanová I., Onderka V. **Characteristics of deep aquifer methanogens as key elements in reservoir methanation**
2019	The Biomania Scientific Meeting & EUSynBioS Symposium 2019 in Brno, Czech Republic ISBN: 978-80-210-9373-7

Research project	**Reservoir microbial methanation 1st and 2nd phase**
Activity	The evaluation of the potential of different UGS facilities in the Czech Republic for the underground bio-methanation process. The assessment of microbial changes during the upscaling process, monitoring of gas composition changes, and observation of microbial changes during the **in-situ field experiment** of underground methanation.
Duration	2018-2020
Funding institution	innogy Gas Storage, s.r.o, RWE Gas Storage, s.r.o., Gas Storage CZ, s.r.o.
Research project	**Microbial analysis of deep reservoir waters**
Activity	• Microbiological analysis of deep seabed water from seven objects • Analysis of the status of methanogenic archaea and sulphate-reducing bacteria by culturing and sequencing isolated DNA
Duration	03/2022-12/2022
Funding institution	NAFTA a.s., Slovakia
Research project	**Simulation of natural gas storage with hydrogen addition in underground gas storage**
Activity	• Long-term cultivation of reservoir water in two high-pressure laboratory fermenters • Microbial analysis of reservoir water based on DNA isolation and sequencing • Measurement of the gaseous products produced during the laboratory simulation
Duration	09/2023-12/2023
Funding institution	NAFTA a.s., Slovakia