Characterization and optimization of growth media for biological methanation

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Introduction

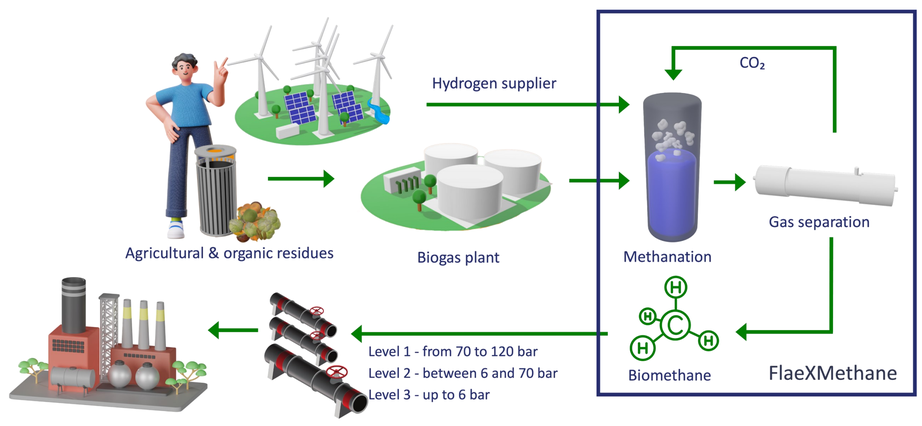
Our research is embedded within FlaeXMethane's Biogas Booster Technology, which aims for utilizing biomass from any source to generate biomethane. CO_2 from biogas and renewable hydrogen are converted into biomethane by biological methanation using archaea.

The organisms are suspended in a liquid nutrient medium, which consists of various salts of different concentrations. Decoupling of gas production and biomass growth, depending on the nutrients available to the organism or their concentrations, have been reported in the literature [1-3]. Current research is aimed at determining the biological requirements of individual nutrients and based on this, optimizing the nutrient medium offered to the organism.

Generate Know-How for Scale-Up

Where we want to go

- Lab-Scale fermentation with high cell densities around 10 g L^{-1} and high pressure around 10 - 16 bar(a)
- Scale-Up towards continuous and stable high throughput methanation system
- Defined and controllable process parameters



Lab-Scale atmospheric pressure fermentation

2 L continuously stirred bioreactors for small scale fed-batch and continuous cultivation of methanogenic archaea.

H_2/CO_2 are fed at atmospheric pressure at defined rates.

Liquid medium can be dosed at a certain rate.

Lab-Scale high pressure batch fermentation

Four 0.5 L parallel continuously stirred bioreactors for batch cultivation capable of pressures up to 16 bar(a).

H_2/CO_2 are fed according to a pre-set pressure at a ratio of 4:1.

Cultures with liquid medium must be prepared previously.

Lab-Scale high pressure continuous fermentation

2 L continuously stirred bioreactor for small scale batch, fed-batch or continuous cultivation capable of pressures up to 16 bar(a).

H_2/CO_2 are fed via MFC's according to a defined flow rate.

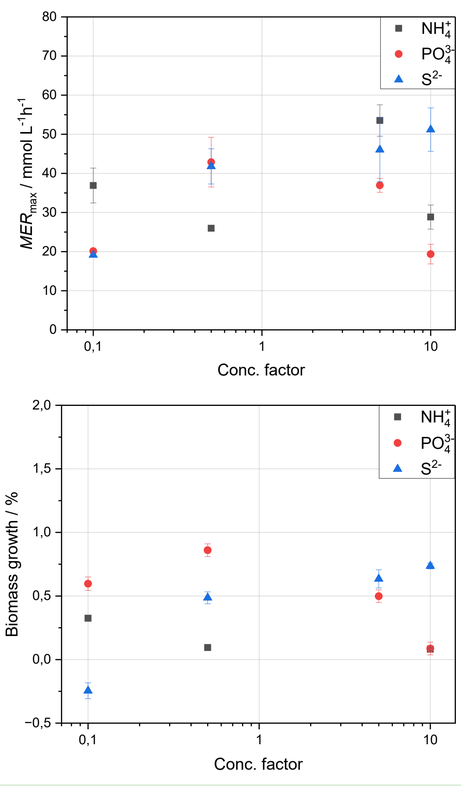
Liquid medium can be dosed at a certain rate.

Collaboration for Scale Up ?

Towards an industrial application of biological methanation it is necessary to have an in-depth understanding about each component of the organisms growth medium and its role in the metabolism.

What we know so far

- Experiments on variation of macro nutrient concentrations are based on literature known medium [4].
  - Increasing *MER* and biomass growth at increasing S^{2-} concentrations
  - No clear trend for increasing NH_4^+ concentrations
  - No improvement of *MER* or biomass growth for higher PO_4^{3-} concentrations
- Trace elements have significant effects on MER and biomass growth at atmospheric conditions



Questions to be solved

- Is the amount and ratio of the individual growth medium components sufficient for high pressure methanation
- Are uncoupling effects of growth and methane production industrially controllable
- Is the implementation of high cell densities connected to a predictable behavior
- Is it possible to establish models and / or simulations for high cell density / high pressure methanation

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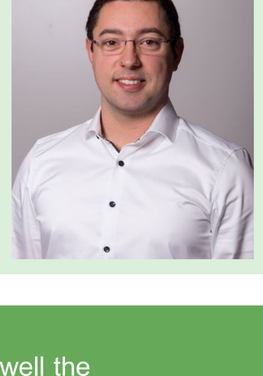
Get in Touch

More about FlaeXMethane



Topics to collaborate

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

Acknowledgement

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References

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