Contribution ID: **274** Type: **Oral Presentation**

Experimental observation of microbial growth using a microfluidics approach

Tuesday, 23 May 2023 14:45 (15 minutes)

For a successful transition towards renewable energy resources, hydrogen is playing an increasingly significant role. In order to have a sufficient amount of hydrogen available to meet the demand, it has to be stored in suitable facilities. The storage of hydrogen in subsurface porous media is considered to be a viable option. The most promising sites are currently used as underground gas storages. Natural gas usually contains a certain amount of CO2 which can remain in the porous media and methanogenic archaea tend to be present in the remaining residual water. This poses challenges to a potential underground hydrogen storage. When the microbes come into contact with a gaseous H2-CO2 mixture they consume it, resulting in the production of CH4 and water according to Sabatier (1913). In this study, the microbial behavior and the measurement of produced gases is experimentally examined and observed.
The experimental setup consists of two inline pressure sensors, two syringes, one micromodel representing a uniform porous structure with a porosity of 28 % and a permeability of 10 D, a micromodelholder, a microscope and a micro gas chromatograph (micro GC). A liquid mixture of culture media and methanogens (in this experiment methanotermococcus thermolithotrophicus) is prepared in a Hamilton 10ml glass syringe and injected into the micromodel which has been placed under the objective of the microscope equipped with various magnification lenses and a high-precision camera. The microchip is heated up to a temperature of 65℃, which is considered to be optimal for the growth of this type of archaea. Simultaneously, two Hamilton 8ml steel syringes are filled with a gaseous mixture of 80% H2 and 20% CO2. When the micromodel is completely saturated with the media-microbes-mixture, the H2-CO2 mixture is injected into the microchip, resulting in a two-phase saturation. The objective of the microscope is positioned at selected locations on the microchip near a gas-liquid interface. Over time, images with a transmitted light and reflected fluorescence light at a 40-time magnification are taken. The analysis of the images is conducted with the MATLAB image processing tool box.
The results of the image processing show that in the presence of hydrogen and carbon dioxide, the number of microbes grow with time. Initially, the microbes tend to be in a lag phase which lasts for a few hours. After this phase, they start to grow and their number increases. After converting nearly all of the gas, the microbes stop growing. Produced methane has been detected by the micro GC. In general, the stated experimental procedure provides the opportunity to examine the microbial behavior under the influence of hydrogen and carbon dioxide on a pore scale.

Participation

In-Person

References

Sabatier, Paul (1913): La Catalyse en Chimie Organique. Paris: Librairie Polytechnique

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

Germany

Acceptance of the Terms & Conditions

Click here to agree

Energy Transition Focused Abstracts

Primary author: Mr LÜDDEKE, Christian Truitt (Clausthal University of Technology)

Co-authors: HAGEMANN, Birger (Clausthal University of Technology); Prof. GANZER, Leonhard (Clausthal University of Technology); Mr STROBEL, Gion Joel (Clausthal University of Technology)

Presenter: Mr LÜDDEKE, Christian Truitt (Clausthal University of Technology)

Session Classification: MS11

Track Classification: (MS11) Microfluidics and nanofluidics in porous systems