Contribution ID: **330** Type: **Poster (+) Presentation**

Understanding dynamic pore-scale interactions for underground hydrogen storage through high resolution 3D X-ray imaging

Monday, 31 May 2021 19:35 (1 hour)

Reducing the carbon footprint and the commitment to achieve net-zero targets will be the drivers of global environmental and energy policies in the years to come. Clean energy sources could soon become the premium choice for power generation and transportation. Hydrogen is an important clean and promising alternate energy option that is growing rapidly. Blue hydrogen is made from natural gas through the process of steam methane reforming coupled with CCS, while green hydrogen is produced from water using renewable power. Especially for the latter, there can be a mismatch between production and consumption, requiring intermittent storage in periods of low energy demand, that can be utilized in periods of high energy demand. Clean hydrogen can be stored in large volumes in underground formations, such as salt caverns, depleted hydrocarbon reservoirs and saline aquifers.

Although storage of gas in underground reservoirs has been vastly studied and implemented for natural gas and to a certain extent CO2, hydrogen storage poses its unique challenges due to its distinctive physical and chemical properties. Hydrogen is more prone to microbiological reactions, has a higher diffusivity and mobility and can have several chemical interactions with the subsurface fluids and rock formations, especially in the presence of clays. All these factors need to be considered before designing an underground hydrogen storage facility. Limited data is available on the feasibility of underground storage of hydrogen for extended periods of time and pore-scale interactions with reservoir fluids and rocks is still not well understood as there are no studies conducted to visualize or observe these interactions.

Recent advances in X-ray μCT to image multiphase flow in porous media and perform in-situ measurements, has allowed to visually observe and quantify the complex pore-scale displacement events occurring under reservoir conditions. These images and measurements have contributed enormously to developing the correct strategies for hydrocarbon recoveries and CO2 storage, and to comprehend the interactions between multiple reservoir fluids at different conditions.

Aiming to achieve a similar level of insight for hydrogen storage, this study discusses pore-scale imaging experiments to capture the interaction between hydrogen, reservoir fluids and rocks. These experiments allow us to visualize the flow patterns as hydrogen is injected into the porous rock in the presence of brine, and to measure in-situ contact angles ascertaining the wettability at different points in porous media. Understanding the interactions between hydrogen and brine can be the first step towards designing an underground hydrogen storage facility in aquifers or depleted hydrocarbon reservoirs. Our research aims to provide an initial indication about the trapping mechanisms and therefore storage efficiency that will occur when large scale hydrogen injection is implemented on the field-scale level. Further research is planned to understand these interactions under different pressure, temperature, and salinity conditions, and using different flow parameters.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

Acceptance of Terms and Conditions

Click here to agree

Newsletter

Student Poster Award

Yes, I would like to enter this submission into the student poster award

Primary authors: JANGDA, Zaid (Heriot-Watt University); Dr SINGH, Kamaljit (Heriot-Watt University); GEIGER, Sebastian; BUSCH, Andreas (Heriot-Watt University)

Presenter: JANGDA, Zaid (Heriot-Watt University)

Session Classification: Poster +

Track Classification: (MS1) Porous Media for a Green World: Energy & Climate