UNIVERSITY OF TWENTE. | Surface Technology and Tribology

MSc Assignment

Contact and friction experiments to mitigate risks of underground CO2 storage

Climate change and global warming due to the release of carbon into the atmosphere is among the biggest dangers faced by mankind. One important step in in capturing the excess carbon and store it safely and permanently is injecting the CO2 back into the oil and gas reservoirs and salt mines where they precipitate into carbonate rocks over time. However, such artificial methods of subsurface CO2 storage require a clear understanding of the interaction of CO2 with reservoir rocks made up of calcite and pore fluids like water. This is key to preventing hazards of leakage and induced seismicity resulting from reactivation and slip of faults in rocks (see figure (a)). To prevent any leakage and slip in the rocks we must study contact and slip (friction) in rock specimens in CO2 and water/ moisture rich conditions by performing experiments on small rocks grains in the lab. In doing so, we can characterize the interfacial properties of reservoir rocks like wettability, adhesion and friction, useful as inputs for large-scale reservoir models.

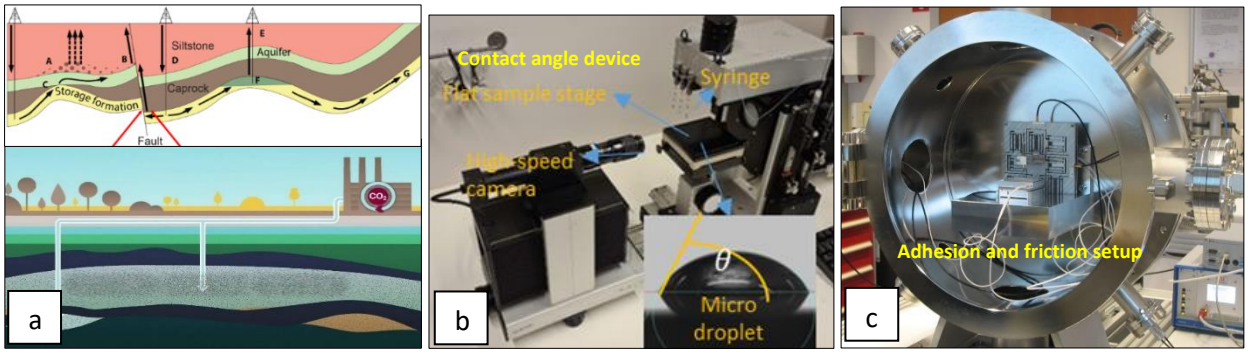

Figure (a) Underground CO2 storage, (b) Contact angle setup, (c) Adhesion and friction setup at STT lab.

Approach

The main **aim** of the research is *to study the effect of CO2 and moisture content on friction and adhesion between calcite specimens*. Contact angle gives a measure of the surface energy and wettability between rock surfaces. The wettability of CO2 in rocks, determines its flow in the porous medium (rocks). The (pull-off) force to separate contacting bodies (rock grains) is a measure of adhesion force. In presence of an interfacial water layer, both van der Waals and capillary forces contribute to the adhesive forces. The adhesive and shear forces vary with grain sizes and determine friction force between calcite specimens.

Research group and potential

The ***Surface Technology and Tribology*** (STT) group will organize the research with a focus on surfaces and interfaces in an engineering context. Studying friction of calcite is key to designing tools for limestone drilling as well. The research will be done in collaboration with research groups at TU Eindhoven and TU Delft working on multiphase flow and rock deformation with applications to future energy transitions.

Project tasks:

1. Literature survey on adhesion and friction in Calcite.
2. Design a dedicated climate chamber for the contact-angle and the adhesion/friction devices.
3. Perform contact-angle measurements in the climate chamber varying humidity and CO2 content.
4. Perform adhesion and friction tests using calcite grains and sheets.
5. Analyzing and discussing the obtained results
6. Writing a scientific report

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