2020-2021

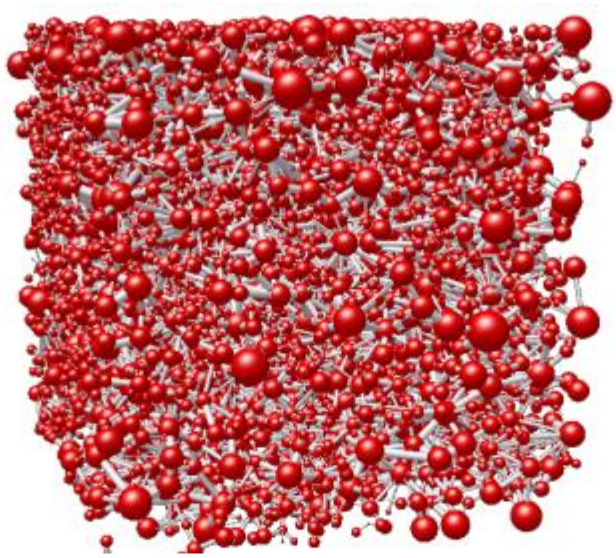
Fluid-redistribution in micromodels: The specialization project and master will conduct micro-model flooding to investigate the effect of ageing on fluid redistribution. The specialization project will be a literature review on ageing, together with initial testing of the micro-model setup. In the master project the candidate halt a drainage of a water-filled micro-model. During such prolonged halts, the candidate will investigate changes in contact angles and redistribution of oil. Supervisor: Haili Long-Sanouiller.

The effect of water quality on imbibition: Running Amott-tests on a larger set of (carbonate-)core samples to evaluate the effect of different water composition on imbibition at elevated temperatures. This project will be a continuation of a previous experimental program. The specialization project will be to upgrade the current experimental setup. The master thesis would be a continuation of the specialization project: The candidate should measure the spontaneous imbibition from core samples at irreducible water saturation, by placing the core samples in Amott cells containing water with different composition and at high temperature. A possible second master student will investigate the field scale effect of injection water quality through reservoir simulations. Supervisors: Carl Fredrik Berg and Ole Torsæter

Molecular dynamics simulation of Haines jumps: The aim of this project is to combine molecular dynamics simulations with analyses based on irreversible thermodynamics in order to determine the entropy production in Haines Jumps in a model system. The candidate will conduct molecular dynamics simulations of a single Haines jump through a pore throat. The model will consist of a two-component system of Lennard-Jones particles to simulate two immiscible fluid phases with different wetting properties with respect to the pore. The simulation will be conducted so that the non-wetting phase will advance through the pore. From such simulations the student should estimate the pressure and velocity profile at different time steps, and thereby estimate the amount of energy dissipated from viscous flow induced by the Haines jump. The energy dissipation from individual Haines jumps should be compared to the energy dissipation in macroscopic two-phase flow. These simulations will be conducted by modifying an existing code base written in Fortran. Supervisors: Carl Fredrik Berg and Bjørn Hafskjold (Professor, Dept. of chemistry).

Segmentation of phases in experimental images of fluid flow using machine learning: Natural porous media has a complex geometry at which fine features like small channels coexist beside larger features like ordinary pores. The geometry becomes further complicated when two fluids occupy the pore space. The traditional segmentation methods may suffer uncertainty in resolving the small channels and fluid-fluid interfaces. These feature could be averaged out by the surrounding larger features. In this project, the possible improvement in segmentation by machine learning will be investigated. The work can be started by introducing different types of noise (salt and pepper, streaks, rings etc. or convolution of these) in synthetic images, and attempting to recover the original images using traditional methods and machine learning techniques. The project can be developed by applying the experience in the first step in segmentation of pore or fluids in experimental 2D micro-model images and further on in 3D X-ray tomography images. The student should be familiar with Python where there are modules and libraries for machine learning. Supervisor: Hamid Hosseinzade Khanamiri

Thermodynamical based primary drainage: In this project the candidate should develop scripts for simulating primary drainage based on thermodynamics, either in grid models or in network models of porous media. For the network model, the candidate should extend existing Python codes for pore scale network modeling already developed by other students. For the grid model, the candidate should extend a prototype. The first step is to conduct primary drainage on an altered version of the which simplifies the thermodynamic based drainage process. One research question for the project is to reveal how energy dissipation during primary drainage is dependent on sample size. Supervisor: Carl Fredrik Berg



Characterization of wetting through electrokinetics: The aim of this project is to develop an experimental procedure for measuring all three interfacial tensions in the Young contact angle equation through electrokinetics. The candidate will extend the existing contact angle measurement equipment to obtain an electrical potential difference (voltage difference) between the fluid and the substrate (the solid). According to electrokinetic theory the contact angle is related to the potential difference, and this relationship can be used to estimate all three interfacial tensions; fluid-gas, solid-fluid and solid gas. Supervisor: Carl Fredrik Berg and Per Arne Slotte

Microfluidic investigation of osmosis mechanism in low-salinity enhanced oil recovery: This specialization project and consecutive master project will be the literature review and experimental investigation of osmosis mechanism during low-salinity water injections as an enhanced oil recovery method. The specialization project will focus on the literature review and preparing the experimental set-up for conducting 1D and 2D microfluidic experiments. In the master project, the student will focus on conducting the experiments in different water salinities and oil properties for characterizing the water-oil interaction in low-salinity water injection. The main purpose of the project is to conduct benchmark experiments and consider the membrane behavior of oil separating low-salinity and high-salinity water. Supervisor: Mohammad Hossein Golestan