Current projects within the DPI programme Polymers for Oil & Gas

Project #807: Smart Brines for minimal Surface Adsorption in Polymer EOR (ADBLOCK)
University of Twente (NL)
March 2018 – February 2022

Project leader: Prof. Frieder Mugele
Researcher: Amrutha Mohan (PhD)

We will study the adsorption of polymer to mineral surfaces on three different scales. Single molecule force pulling experiments using Atomic Force Microscopy (AFM) in ambient brine will be carried out to characterize the binding energy and kinetics for the functional groups of the polymer on different parts of the surfaces (e.g., silica, clay(s), natural rock). Additional collective effects emerging upon adsorption of ensembles of polymer molecules on the mesoscale will be studied using Quartz Crystal Microbalance (QCM, ellipsometry). On all two scales the composition of the brine (pH, salt content, low molecular weight additives) will be varied to identify conditions that minimize the adsorption of model polymer systems (e.g. polyacrylamide (PAAm) derivatives). The project is expected to result in a comprehensive picture of the physical and chemical factors governing polymer adsorption onto mineral surfaces from molecular to macroscopic scales. Specifically, recommendations will be delivered for optimized brine composition and additives for selected standard polymers used in enhanced oil recovery (EOR).
This project will be in collaboration with Project #808.

Project #808: Adsorption/Retention of Polymer in Porous Media (ARP02M)
University of Bordeaux (FR)
December 2017 – December 2020

Project leaders: Henri Bertin, Aziz Omari
Researcher: Bauyrzhan Satken (PhD)

The objective of the experimental study is to deeply investigate the adsorption of polymer and copolymer in porous media for EOR applications. Polymers of different chemistries will be considered both in Powder form and in emulsions as used in the field. The influence of salinity and temperature will be considered. Porous media will be well mineralogy characterized natural sandstones. Adsorption/retention will be investigated during core flood experiments in presence/absence of residual oil with a complete characterization of incoming and effluent polymer. Expected results are experimental data that will help to optimize injected polymer with respect of the considered formulation.
This project will be in collaboration with Project #807.

Project #818: Experimental and Numerical Evaluation of Polymer Visco-Elasticity Effects during EOR Applications (PROVE)
University of Clausthal (DE)
February 2019 – January 2022

Project leaders: Rafael Hincapi
Researcher: Niels Langanke (PhD)

This research project aims to investigate the efficiency of viscoelastic effects of polymer solutions to enhance oil recovery. The evaluation is driven by a detailed investigation of polymer viscoelastic phenomenon. To define mechanistic and quantitative explanations for the viscoelasticity effects, the project focuses on three complementary aspects:
1. Laboratory investigation of polymer viscoelasticity in porous media

2. Interpretation of experimental results and derivation of mathematical descriptions
3. Validation of laboratory performance and oil recovery predictions
With the experience obtained at ITE in previous polymer projects, experimental evidence will help to provide further understanding to the debated phenomenon.

Project #821: New Polymeric Surfactants for Enhanced Oil Recovery (NewPS4EOR)
University of Groningen (NL)
March 2019 – April 2023

Project leaders: Prof. Francesco Picchioni
Researcher: Aleksander Guzik (PhD)

The use of polymeric surfactants is a promising, yet not much explored, approach for chemical enhanced oil recovery, because of their interesting rheological and interfacial properties. Most of the polymers proposed for EOR in literature are based on ill-defined structures, which does not allow a clear structure-properties relationship study in this context. Here we propose the synthesis of well-defined polymeric surfactants, by means of controlled radical polymerization techniques. The effect of variations in their structure (e.g. block lengths) on the solution properties, and in turn on the recovery of oil in lab-scale experiments, will be studied.

Project: #833: Polymers for EOR in Low Permeability Carbonate Reservoirs (TBD)
Heriot Watt University (UK)
April 2020 – March 2023

Project leaders: Alan Beteta, Mike Singleton
Researcher: vacancy

This PhD study is designed to address the challenges of Polymer EOR in carbonate reservoirs, where the high salinities (and sometimes, high temperatures), along with the reactive nature of carbonate formations, can be problematic for traditional EOR polymers.
The initial stage of the study will be to perform an extensive literature review to highlight potential candidate monomers/polymers, which have the potential to overcome these issues. It is anticipated that the experimental work will focus on the rheology, adsorption, injectivity and thermal stability of identified chemistries. Other areas of study may be identified in collaboration with the DPI and industry partners. These will be included in the scope of work to further context the results. An example of which may be reservoir simulation studies.
Should suitable polymers not be identified in the literature or deemed un-economical, it is suggested that the study move focus to polymers with varying anionic: cationic functionality.
