Application for a Doctorate Fellowship-UiS.

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IPT

Insight into fluid/rock interaction and its influence on wettability alteration for heavy oil recovery by CO₂ from carbonate and sandstone reservoirs

Key words: Carbonate, sandstone, dolomitization intermediate product, contact angle, forces at surfaces, thermodynamics and kinetics of asphaltene colloids, miscible CO₂ flooding

Purpose
The main aim of this research project is to verify the recent proposed hypothesis from our research activities on fluid/rock interaction that lead to wettability alteration with key seawater ions in molecular level. This would expand our understanding and the kinetics of wettability alteration due to fluid rock interaction during miscible CO₂ flooding. This would enable to predict and may explain the success and failure in CO₂ flooding experienced/reported in literature.

Motivation
The role of magnesium and sulphate ions present in seawater and low saline water in rocks wettability alteration, fluid/rock interaction and enhanced oil recovery has led us to develop a hypothesis by which those ions interact with chalk in presence of oils. Adsorption isotherm of sulfate ions on chalk rocks has been addressed has been established that lead to hypothesis on the effect of fluid/rock interaction, that was later examined and confirmed at the molecular level using AFM (atomic force microscopy) and DLVO theory. Similarly, the current plan is to follow same path to study the developed hypothesis from the current work where key seawater ions are identified to interact differently when flooding with CO₂ is performed. The finding of this research work along with the current project, which is expected to start this month (May) would add another dimension to achieve our target of insight understanding of the fluid/rock interaction mechanism(s) during CO₂ flooding with possible modelling of the observed phenomenon.

Brief Background and literature
Buckley et al, 2002 (13) attempted to correlate the acid and base numbers from different crude oil with little success and indicated the necessity of both number for prediction of wetting alteration. Craig (14) and Mohammed et al, 1993 (15) demonstrated that crude oil/water interfaces, especially those from asphaltenic oils, exhibit substantial elastic mechanical strength. Our recent work (1-12) on wettability alteration including thermodynamic effect of pressure on rock wettability, isothermal adsorption work of some of oil components on the rock surface as well as the use of the nanotechnology to
assess at the molecular level the interaction have shown to be surface related process with a possible crystal modification.

References