Use of Nanoparticles and Surfactants to Generate Foam for Mobility Control

One of the major challenges in petroleum industry is producing residual oil from underground. One of the major techniques for enhancing oil recovery (EOR) is using gas injection. However, gas has poor volumetric sweep efficiency, this is attributed to its high mobility which considers to be higher compared with oil and water mobility. Several techniques are proposed and applied for reducing gas mobility; using surfactant to generate foam is one of these techniques.

The goal of this work is to solve the challenges facing the surfactant foams. These challenges include the low stability of surfactant foam at harsh reservoir conditions (high pressure and temperature) and stability in presence of crude oil. The use of nanoparticles to stabilize surfactant foams may offer a novel technique of generating stronger foams for gas mobility control. This might result in improving gas sweep efficiency and increasing oil recovery.

Research Activities:

- Investigating the effect of nanoparticles in improving the stability and strength of the surfactant foams by conducting static foam height test with and without crude oil.
- Studying the chemical interactions between nanoparticles and surfactants.
- Analyzing the stability of nanoparticles and surfactants by measuring their zeta potential.
- Conducting foam bubble size measurements using microscopic devices to evaluate the potential of nanoparticles to strengthen the surfactant foam by reducing the foam bubble size.
- Running mobility and viscosity tests of generated foam to assess the ability of nanoparticles to stabilize foams.
- Running coreflood experiments to test the ability of generated foam to reduce gas mobility and therefore enhancing the oil recovery.
- Analyzing the foam propagation in core samples using Computed Tomography (CT).

Generating viscous foam that can withstand reservoir conditions might be achieved by adding nanoparticles to surfactant. Below figure shows the effect of nanoparticles in reducing the foam bubble size which results in a stronger and more stable foam. This foam has been tested in presence of crude oil and promising results have been found. A lot of work has been done to evaluate the effect of this foam to minimize the gas mobility which might lead to Enhancing Oil recovery.

![Comparison of foam bubble size of surfactants with and without Nanoparticle](image-url)