Investigating Asphaltene Stability in Crude Oil During Carbon Dioxide Injection

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Motivation

Hydrocarbons are usually thought of as being a fluid (gas or liquid).

Asphaltene is a solid component of the crude oil that is stabilized via resins or as a nano-colloid.

It can cause severe production problems and safety hazards in wellbores, equipment, and pipelines.

Objective

- Investigate the factors that may impact asphaltene stability in the crude oil and quantify the effect of these factors.
- Determine how to reduce asphaltene precipitation and deposition and how to mitigate or alleviate asphaltene buildups.

Experimental Materials

- Specially designed filtration setup
- Crude Oil from Kirk Lease, Kansas
- Stainless Steel tubings and connections
- High pressure CO₂ cylinder
- Filter membranes with pore sizes of 0.2, 10, and 100 nm, and 2.7 μm
- High precision camera
- Chemical agents (water, heptane, kerosene, naphtha, and xylene)
- Transparent 1000 ml glass beaker
- Pipettes (plastic and glass)
- Asphaltene Saturated Filter membranes

Experimental Setups

Asphaltene Stability Setup

Asphaltene Mitigation Setup

Conclusions

- The reservoir thermodynamic conditions were found to have a strong impact on the stability of the asphaltene in the crude oil.
- Increasing the carbon dioxide injection pressure resulted in a decrease in the asphaltene filter cake thickness and an increase in the areaal filtrate displacement.
- Heptane could not be used as an effective chemical agent for asphaltene mitigation since the asphaltene is insoluble in heptane.
- Although asphaltene was soluble in naphtha, the chemical agent could not mitigate the asphaltene plugging well.
- The two most effective chemical agents used in this research for asphaltene mitigation were kerosene and xylene. Overall, xylene was the best agent.

Selected Publications


Acknowledgment

I would like to thank MST for providing me with the Chancellor’s Distinguished Fellowship.