Enhanced Oil Recovery and CO2 Storage by Carbonated Water Injection

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Presentation Outline

- Objective
- Experimental Setup
- Rock and Fluid Properties
- Coreflood Results and Discussion
- Compositional Analysis of Produced Fluids
- Conclusions
Outline:

- Introduction
- Objective and Research Approach
- Experimental Results
  - Rock and fluid properties
  - Coreflood Experiments
- Conclusions
CO2 Injection

- Many years of experience in CO2 injection but in very limited locations.
CO2 Injection

- Renewed interest globally in CO2 injection in oil reservoirs for both EOR and CO2 storage.
- Large quantities of CO2 can be potentially captured from Power plants.
- Cost of CO2 capture from power plants is currently exorbitant.
- Alternative injection strategies are needed to use lower quantities of CO2 at lower cost.
Carbonated Water Injection

- In CWI, CO2 is used efficiently.

- CO2 can be obtained from smaller and low-cost sources.

- Usually at higher CO2 concentration and pressure.
Broad Objectives – CWI JIP @ HWU

- To investigate the performance of carbonated (CO2-enriched) water injection (CWI) as an injection strategy for increasing oil recovery as well as safe CO2 storage.

Research Approach

• High pressure flow visualisation (micromodel) tests.
• Core flood experiments at reservoir conditions.
• Mechanistic modeling and numerical simulation.
Variable of the experiments

- Sandstone & Carbonate Cores
- Light, medium and heavy crude oil
- Various injection strategies; secondary & tertiary CWI
- Wide range of P, T and brine salinity
Pore-scale Visual Experiments
CO2 Dissolution & Oil Swelling

Infinite CO2 dissolution and oil swelling for light oil

After WI

110% swelling During CWI
Flow Diversion

*Improved sweep by flow diversion*

*waterflood*  
*Carbonated waterflood*
Wettability Alteration
Core Flood Oil Recovery

Oil recovery, PV

PV injected

WI

CWI

14 %IOIP
Core Flood Oil Recovery

Oil Recovery (%OIIP)

PV Injected

23.54% OIIP

1.5 PV

T1-WI

T1-CWI

2nd June 2011
Differential Pressure During WI & CWI

Differential Pressure (psi) vs CW Injected (PV)

- CWI
- WI
Oil Recovery (%OIIP)
Tests Comparison

17.23% OIIP

Oil Recovery (%OIIP)

PV Injected

T2-CWI
T3-WI
Oil Recovery (%OIIP) Tests Comparison

- T2-CWI: 0.15 PV CO₂, 0.06 PV CO₂ Prod.
- T2-CO2I: 0.70 PV CO₂, 0.36 PV CO₂ Prod.
- T3-WI: 17.23% OIIP
- T3-CO2I: 0.70 PV CO₂, 0.36 PV CO₂ Prod.
CONCLUSIONS

1. Both secondary and tertiary CWI tests recovered significantly higher oil recovery compared to conventional waterflooding.

2. The additional oil recovery happens in a shorter time scale in secondary CWI compared to tertiary CWI.

3. In addition to CO2 transfer from CW to oil, there are indication of favorable wettability alteration and also flow diversion contributing to oil recovery.
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