Non-Wetting Phase Trapping in Hysteresis Cycle for Gas-Liquid Phase Systems

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Purpose of the Research

- To understand the nature of the displacement of gases in a gas-liquid system under different temperature and pressure conditions inside the pore spaces of geological formations.

- The amount of trapped gas can be studied by designing drainage and imbibition laboratory experiments.

The Principle Behind the Experiment

- Whenever we try to displace one fluid with the other in a pore system, there is a force that holds the two fluids. This force is called capillary force.

- The measurement of the force required to displace one fluid with another is the principle behind capillary pressure measurements.

Measuring Equipment Used

- For this research we used reliable equipment called CPCS-355Z Capillary Pressure CO2 System.

- CPCS-355Z Capillary Pressure CO2 System enables us to measure very small forces while at high pressures and temperatures similar to those conditions encountered in a petroleum reservoir.

How the CPCS-355Z system works

- The CPCS-355Z offers a method to measure incremental desaturation data versus pore capillary pressure at reservoir conditions of temperature and pressure.

- The incremental pressure method enables a set of differential pressures to be selected prior to the test that should best define a characteristic capillary pressure curve.

How the CPCS-355Z system works

- During the incremental pressure test process, each pressure differential will cause all pores that possess capillary retention forces lower than the force created by the imposed differential pressure to be drained of their water content.

- Starting with the lowest differential pressure, all pores of similar capillary retention characteristics are drained at each preprogrammed differential pressure condition.

- The differential pressure between fluids on either side of the capillary barriers is the capillary pressure and is measured by way of differential pressure transducers.

Conditions for the Experiment

- Temperature: 30℃ for drainage process and 50℃ for imbibition process
- Pore Pressure: 1524 psi
- Confining Pressure:2025psi
- Fluids: N2, brine
- Parameters under Test: capillary pressure, water resistance

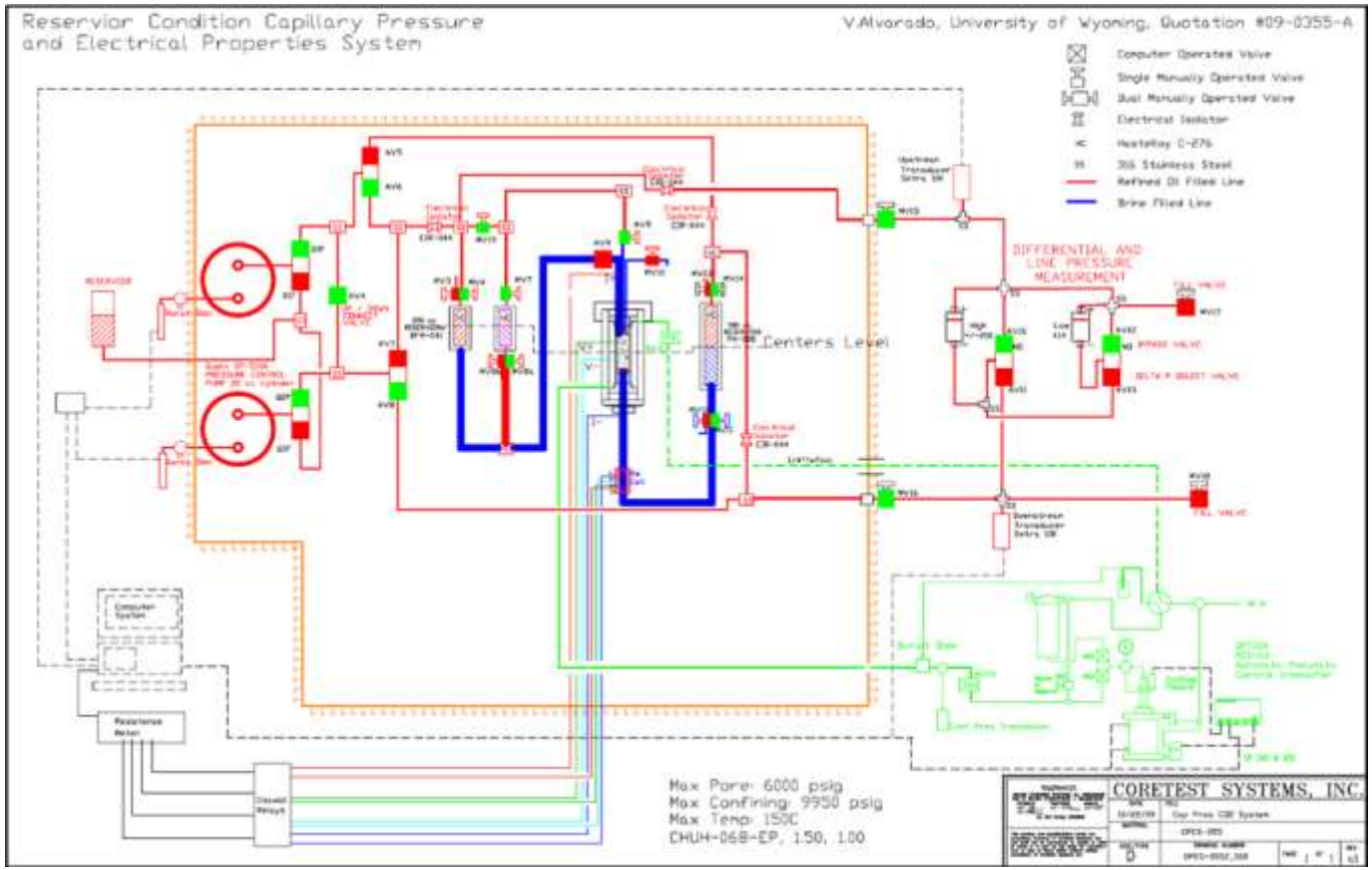
Core Sample

D=3.773 cm
L=2.605cm

Brine Property

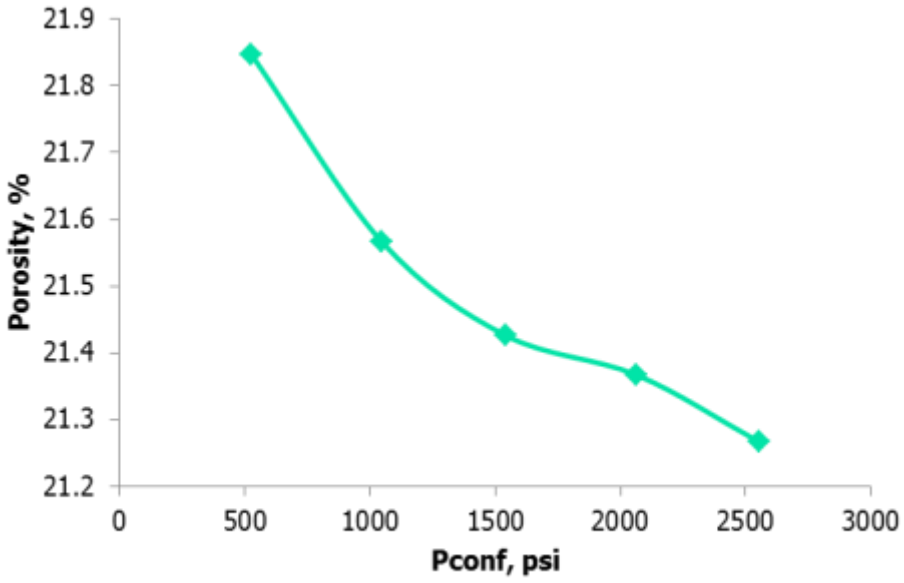
Salt	Concentration
NaCl	28.000 g/L
KCl	0.935 g/L
$CaCl_2.\ 2H_2O$	1.559 g/L
$MgCl_2.\ 6H_2O$	11.561 g/L
TDS	35,526.33 ppm

CPCS-355Z Capillary Pressure CO2 System

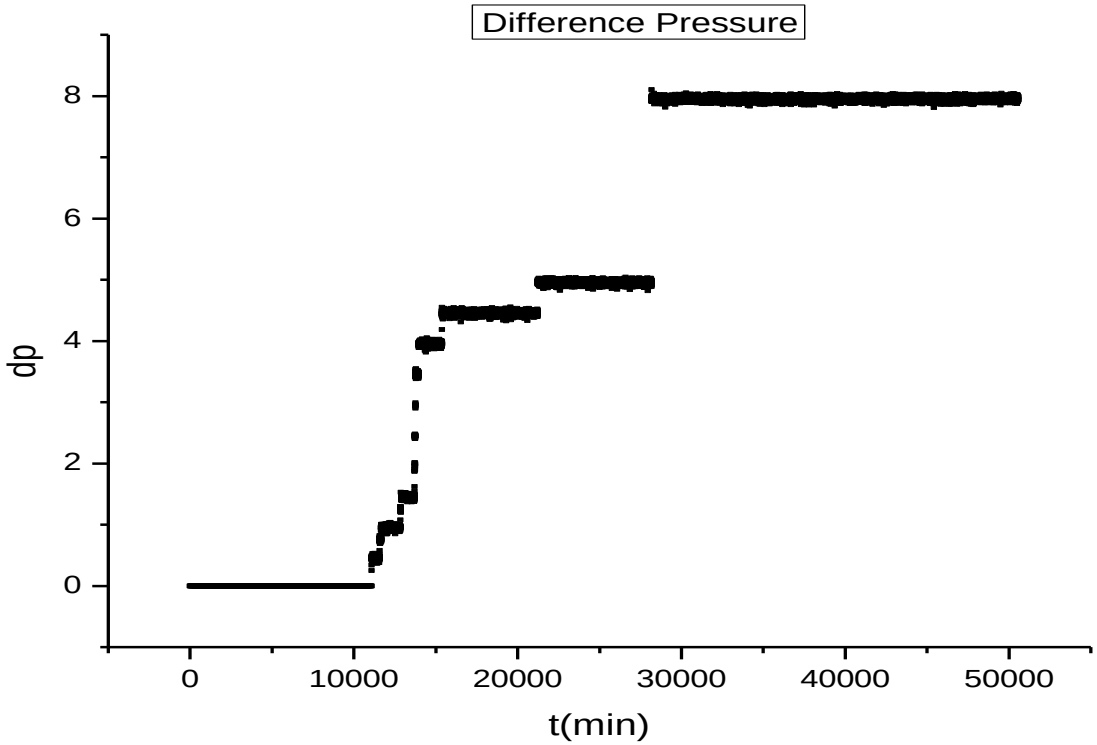


CPCS-355Z Capillary Pressure CO2 System cont.

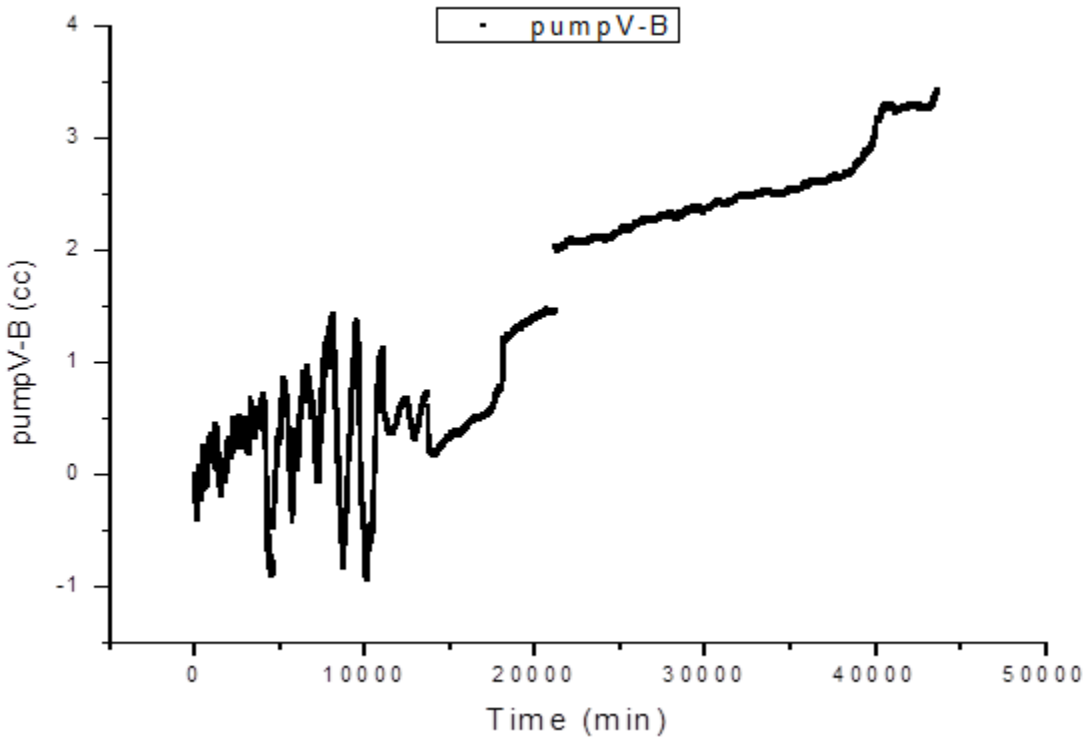
Core Property



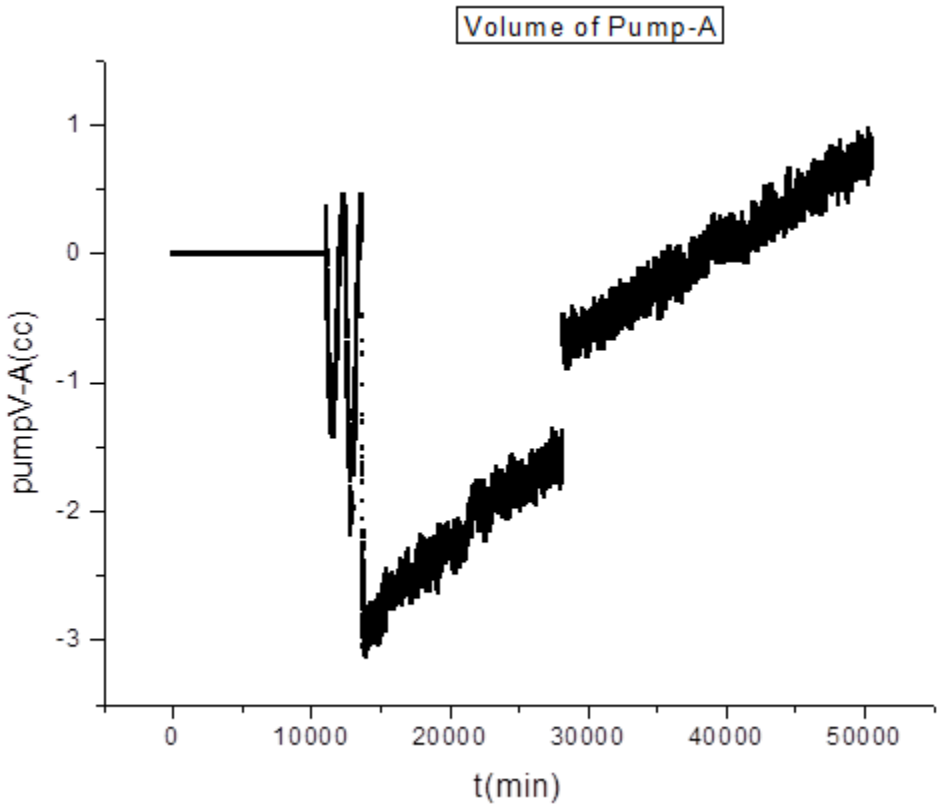
Experiment Results - Drainage



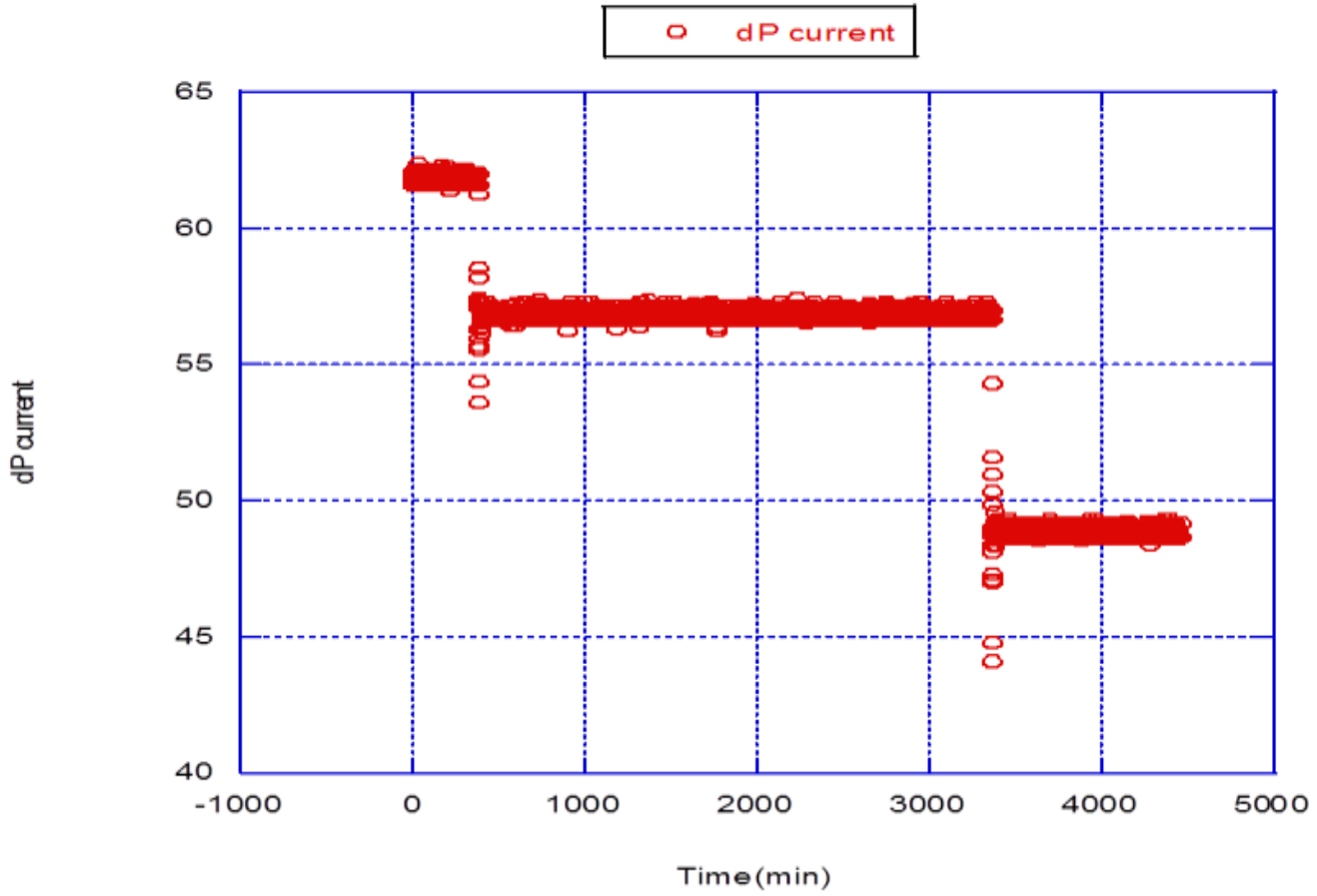
Experiment Results - Drainage



Experiment Results - Drainage



Experimental Results- Imbibition



Summary

- The objective of this research is to investigate the amount of N2/CO2 trapped in a porous media and the nature of its mobility, in a context of CO2 geo-sequestration in laboratory experiments under realistic pressure and temperature conditions.
- Due to reactive nature of CO2 in the pours media, it makes the study of amount of CO2 gas trapped in gas-liquid system very complicated. As a result, we started our study by using inactive gas(N2) in a brine reservoir.
- N2 gas is suitable for this study as it fulfills our need for inactive gas in a brine solution. Therefore, we can use the N2-Brine system as a base for study of a complicated CO2 – Brine system.

References

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Thank You !