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IRHPOC: New Instrumentation and Method For CO2-driven EOR Study

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HPOC： Powerful Innovative system

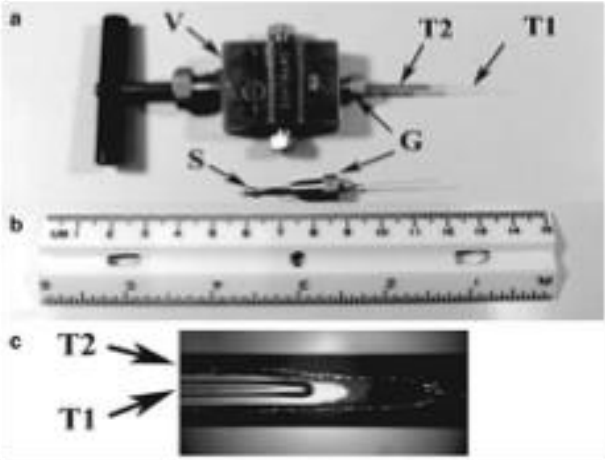

Fig. 1. Photograph of a high-pressure optical cell (HPOC).

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Optical cells with fused silica windows for the study of geological fluids

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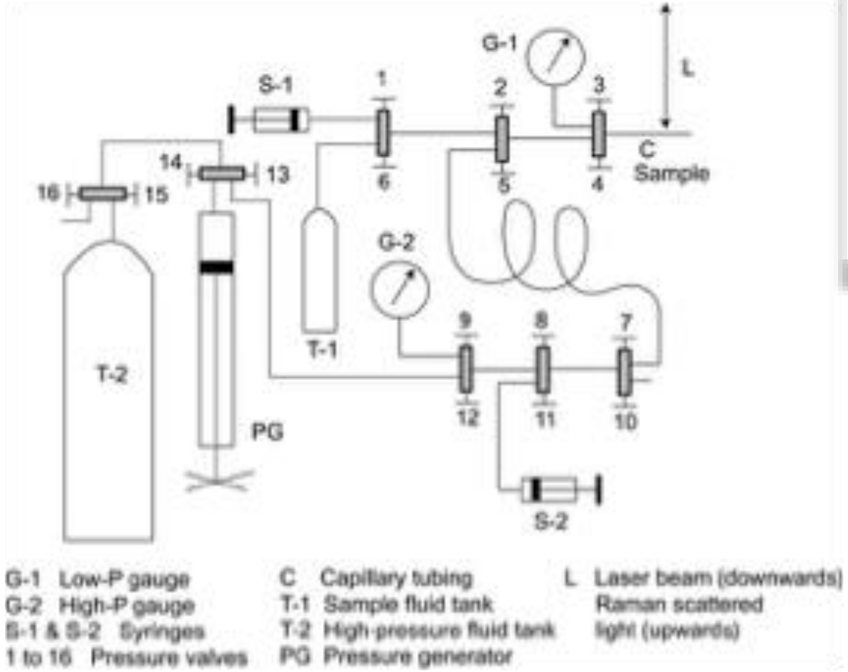
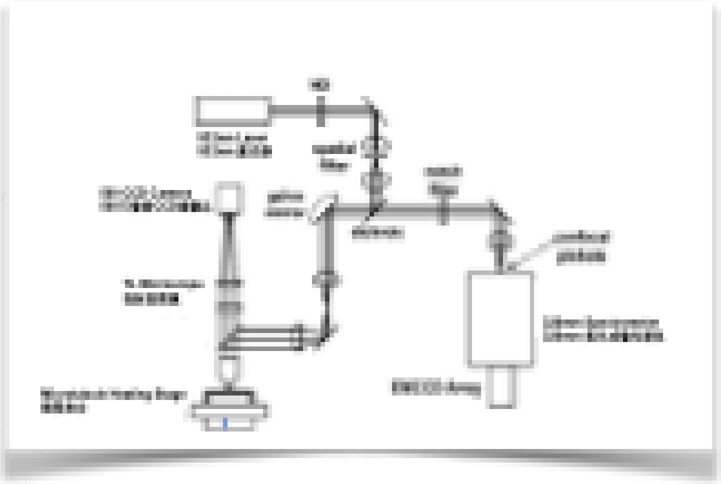


Fig. 2. Schematic diagram showing the sample loading and pressurization system for Raman spectroscopic analysis of fluid samples.



Schematic diagram of GeoRaman Microprobe.

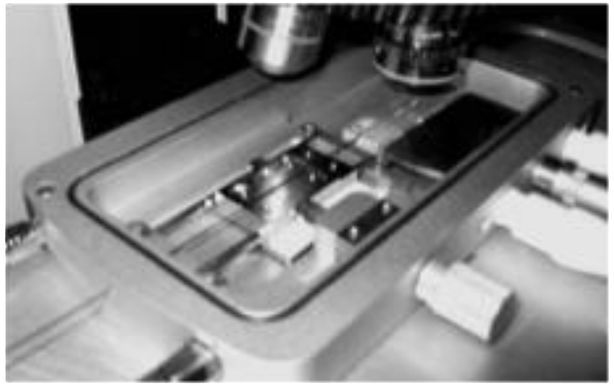
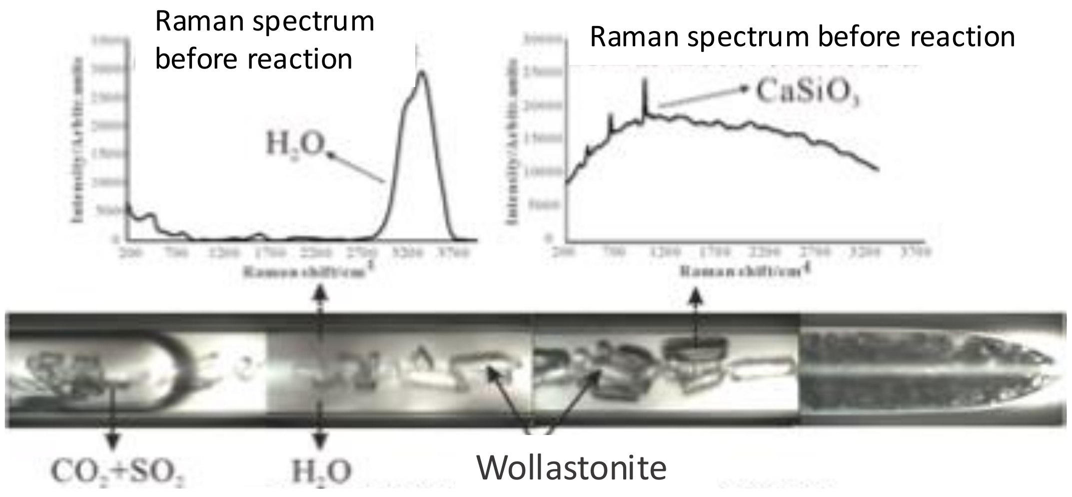
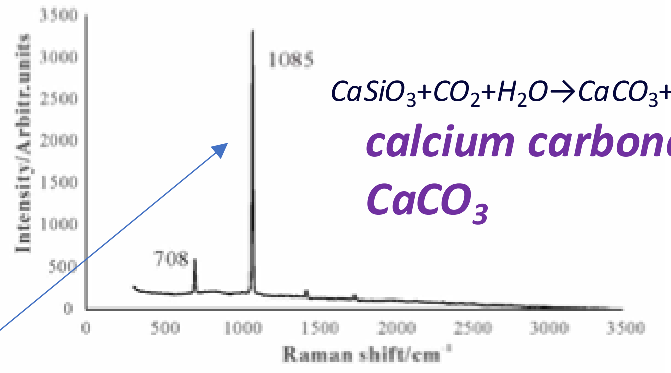


Fig. 3. Photograph of the sample chamber of the heating-cooling stage.

Application on CO_2 Storage Study



Cell image and Raman spectrum before reaction

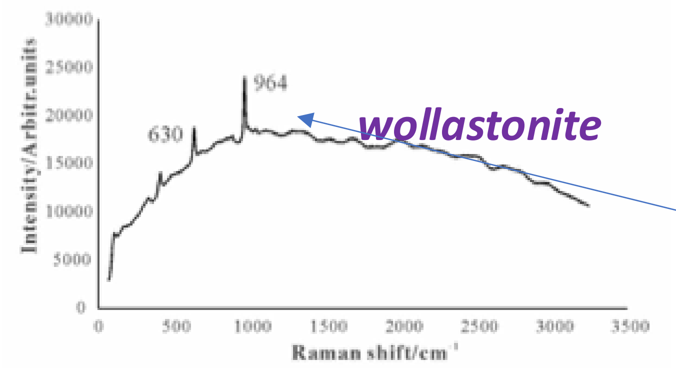


$CaSiO_3+CO_2+H_2O \rightarrow CaCO_3+H_2SiO_3$

calcium carbonate

$CaCO_3$

Raman shifts are 1085 cm^{-1} for calcium carbonate

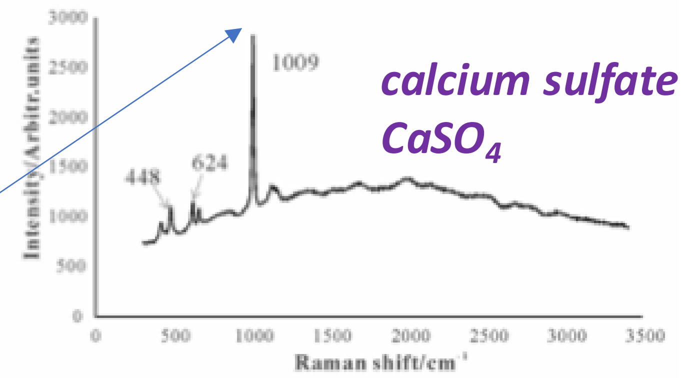


wollastonite

Raman shifts are 964 cm^{-1} for wollastonite

Comparing of Raman shifts on wollastonite and deposit before and after reaction with CO_2 and SO_2

2021, by Ms. Qing Zhou



calcium sulfate

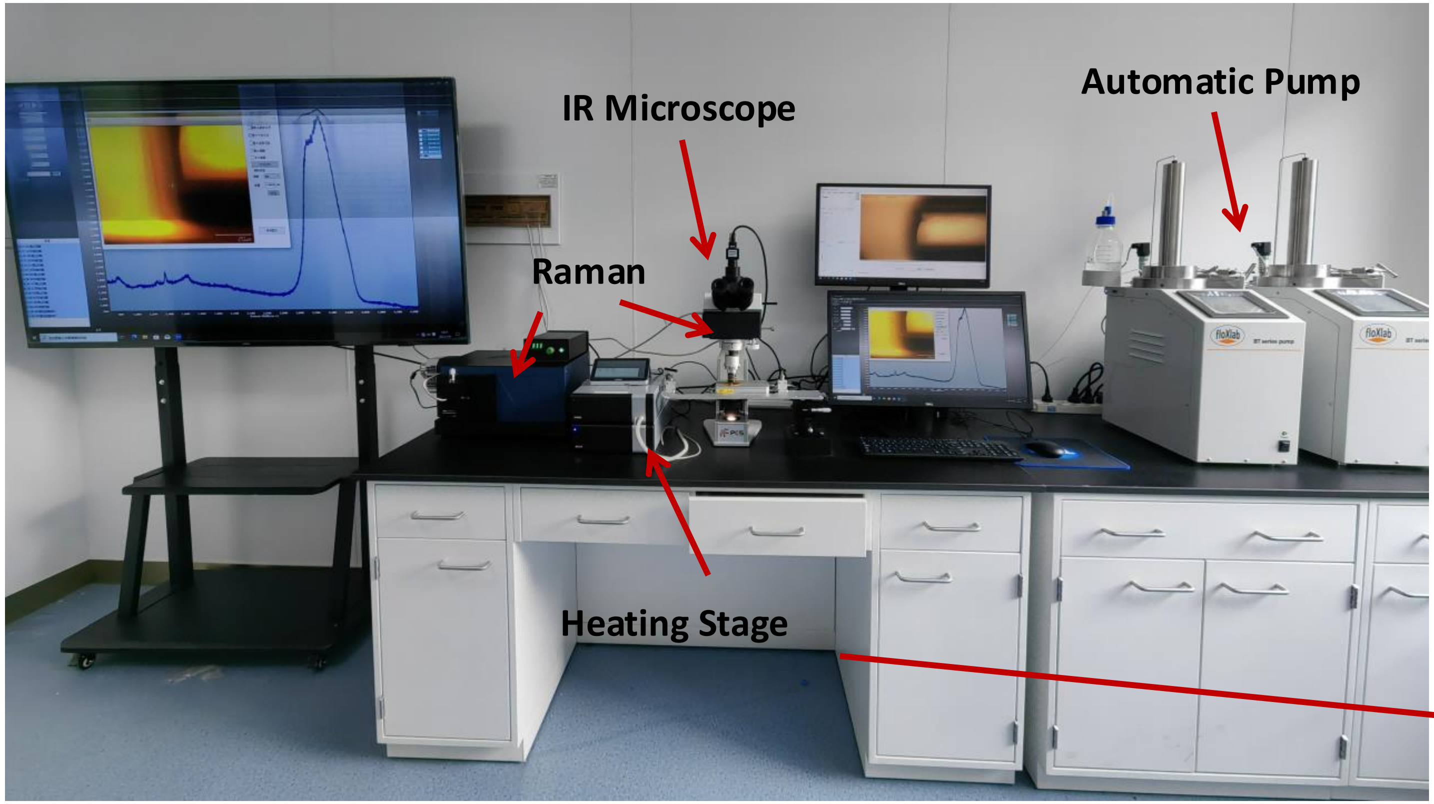
$CaSO_4$

Raman shifts are 1009 cm^{-1} for calcium sulfate.

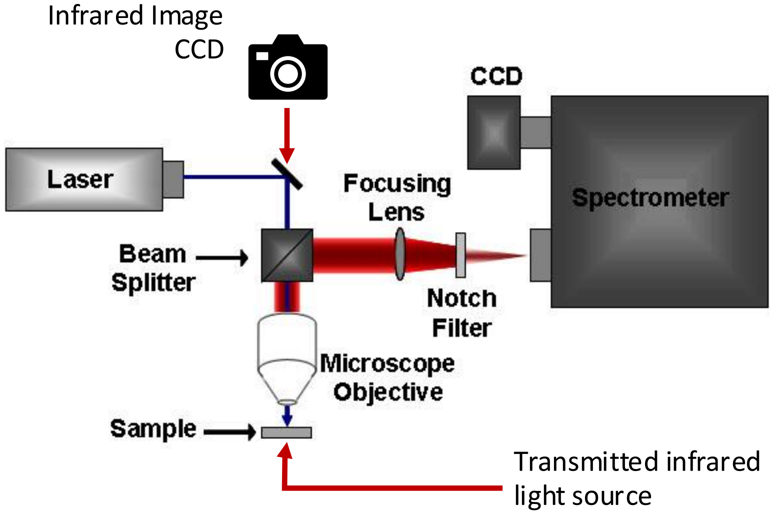
Not for CO2-driven EOR study because of color and fluorescence of black oil

IRHPOC : Infrared High Pressure Optical Cell Instrumentation

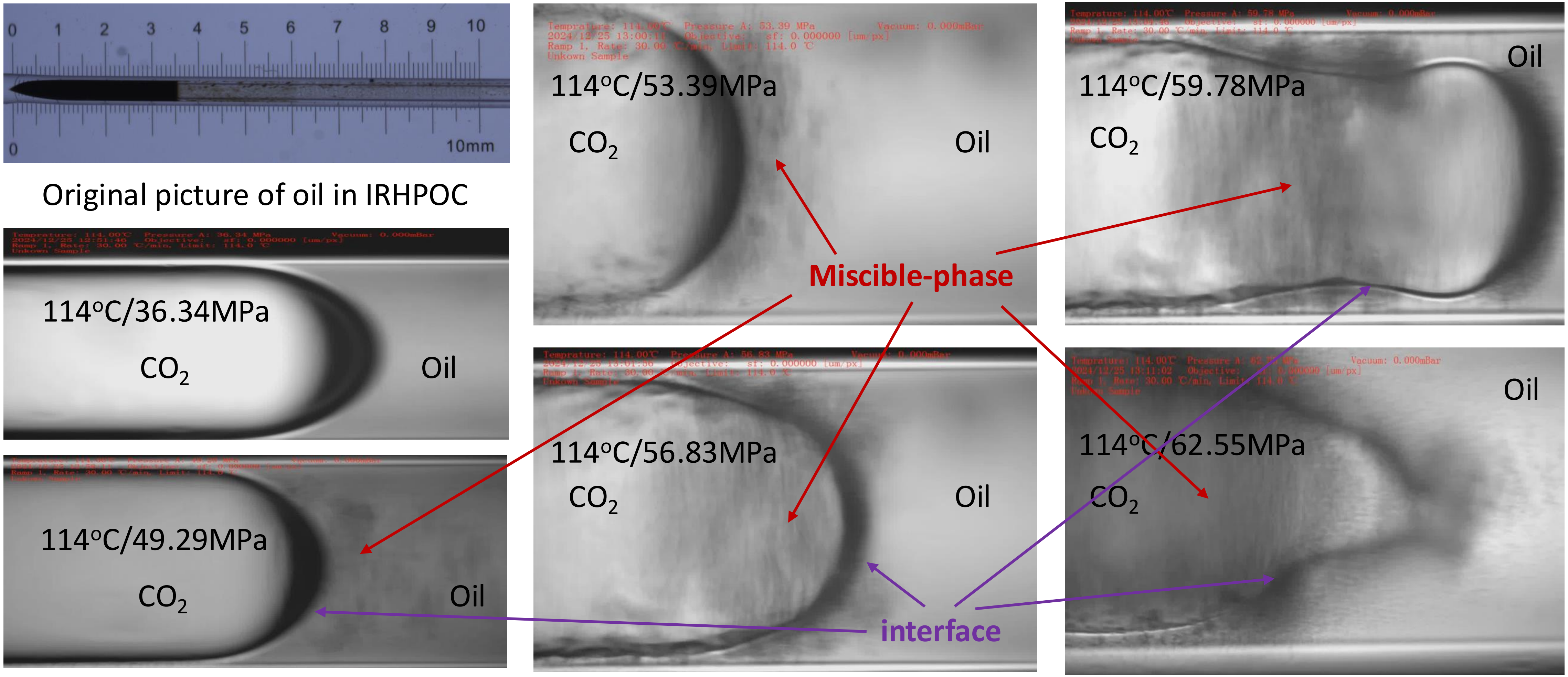
– the new innovation system on CO_2-driven study



System configuration

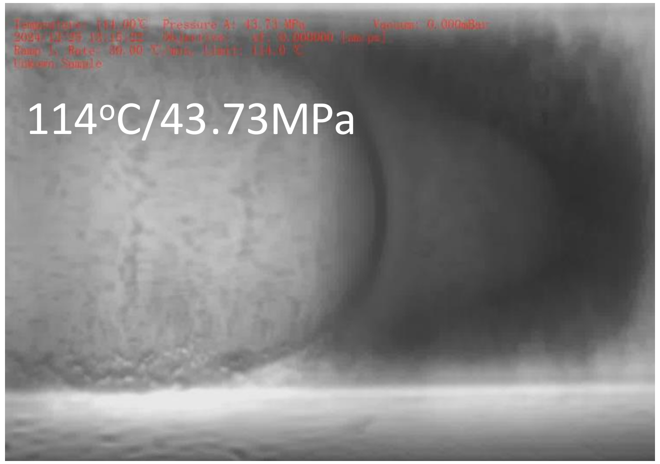


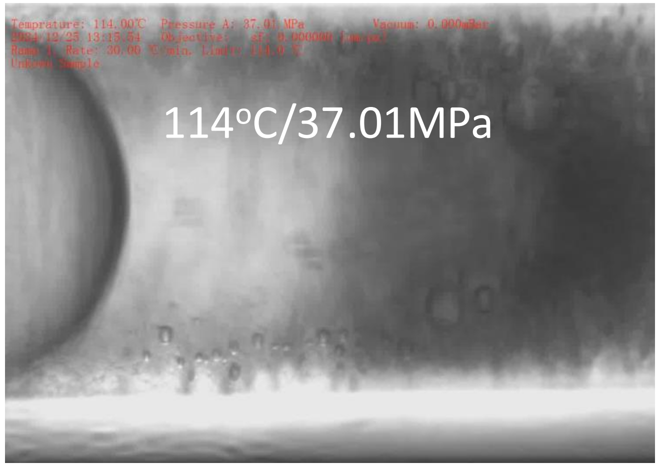
Application of IRHPOC on Oil A /CO_2 Interaction

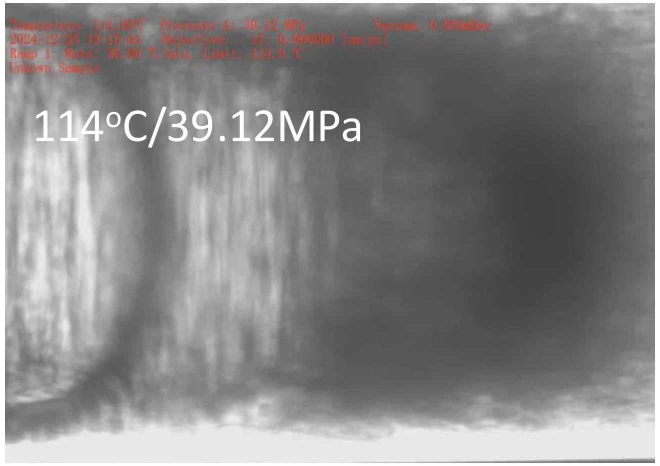


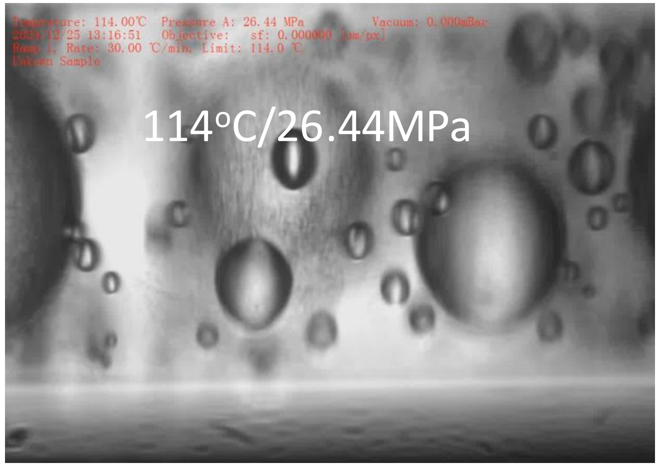
Pressure increase →

Application of IRHPOC on Oil A/CO_2 Interaction





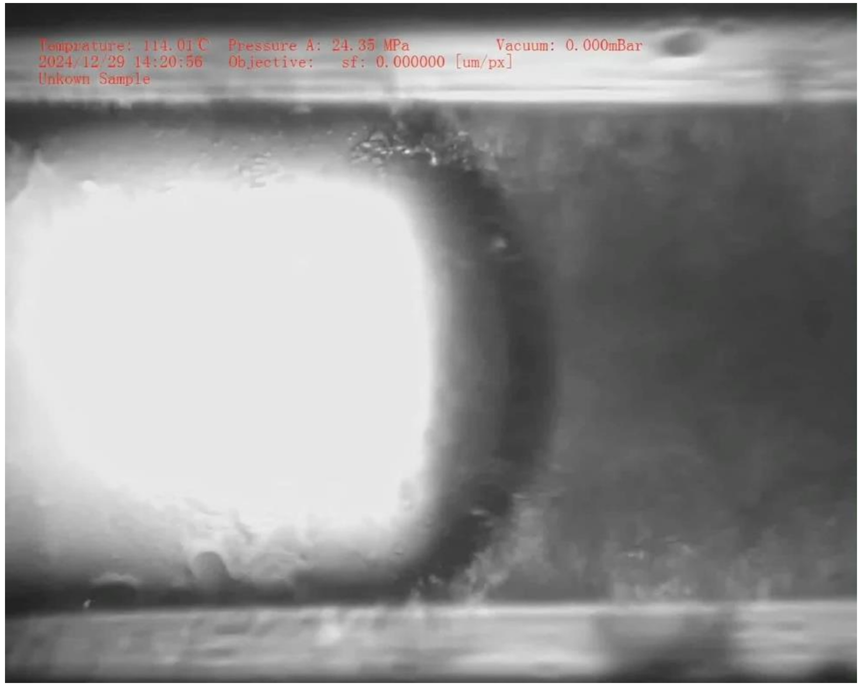




Pressure decrease →

0.5% Chemical Treated Oil A / CO_2 Interaction

Original picture of oil in IRHPOC



Increase

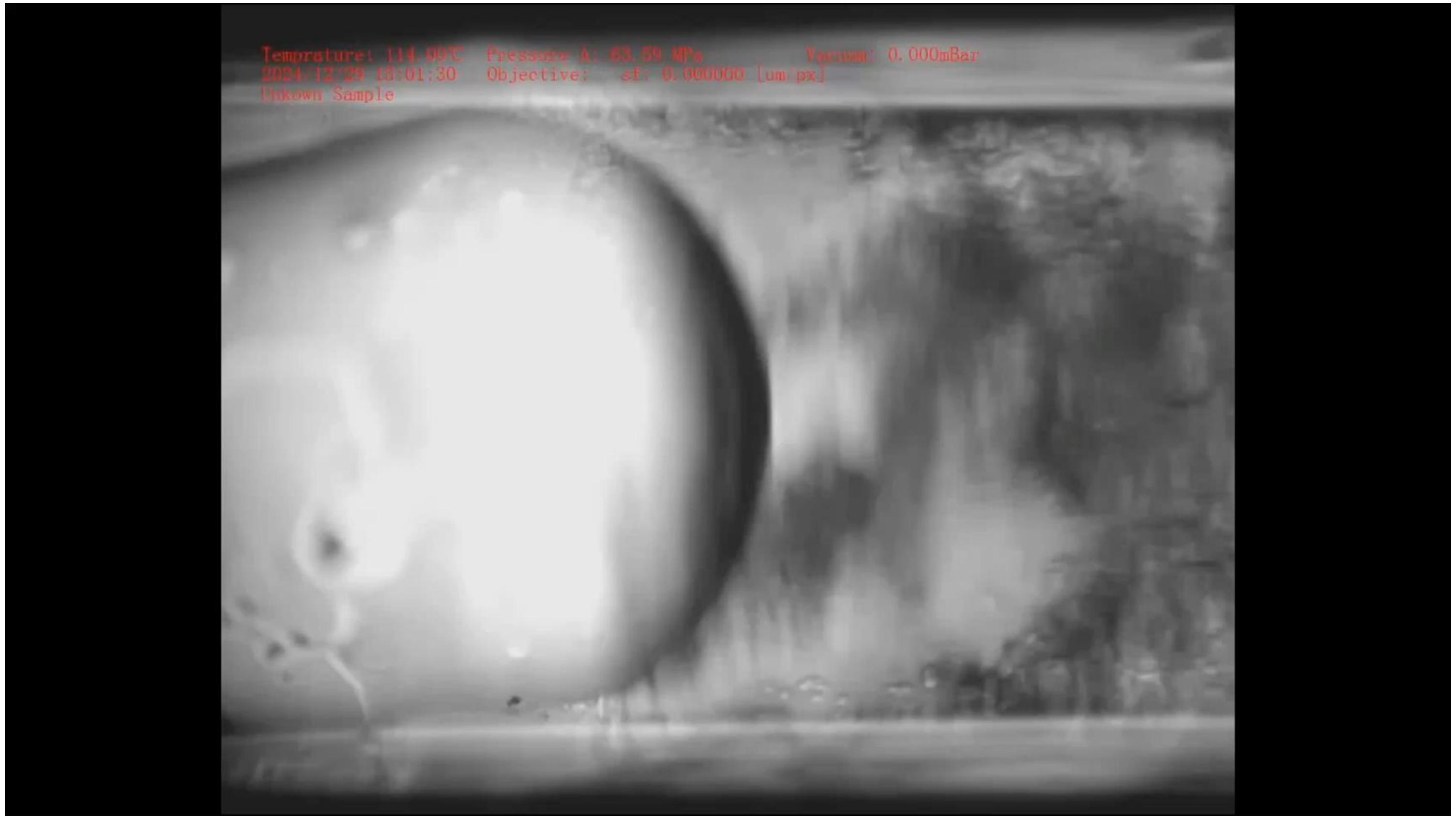
Pressure

Stable

0.5% Chemical Treated Oil A / CO_2 Interaction

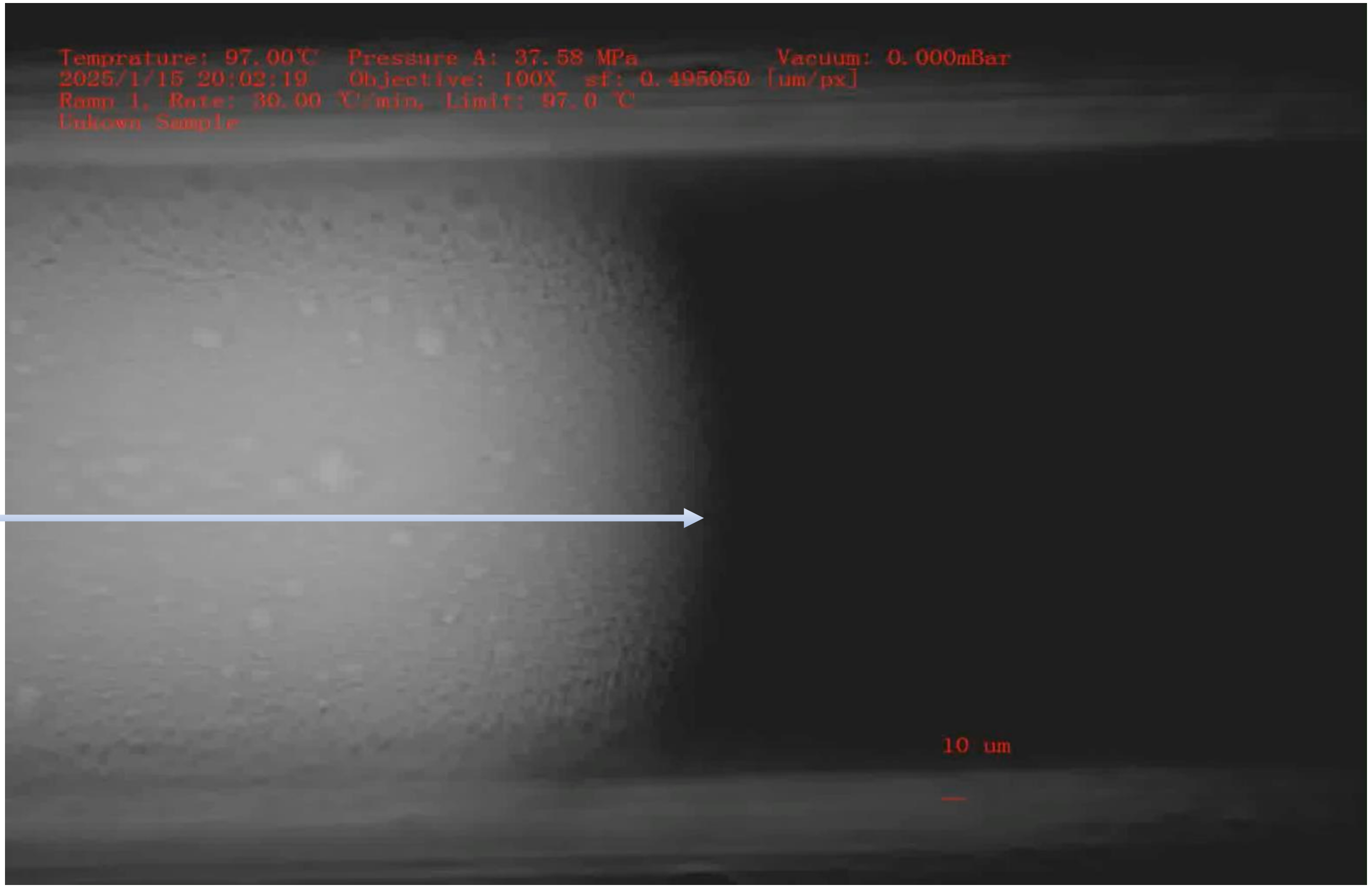
Pressure

Decrease



Oil B with 30% water / CO_2 Interaction

Reservoir Condition:
97°C / 50.12MPa

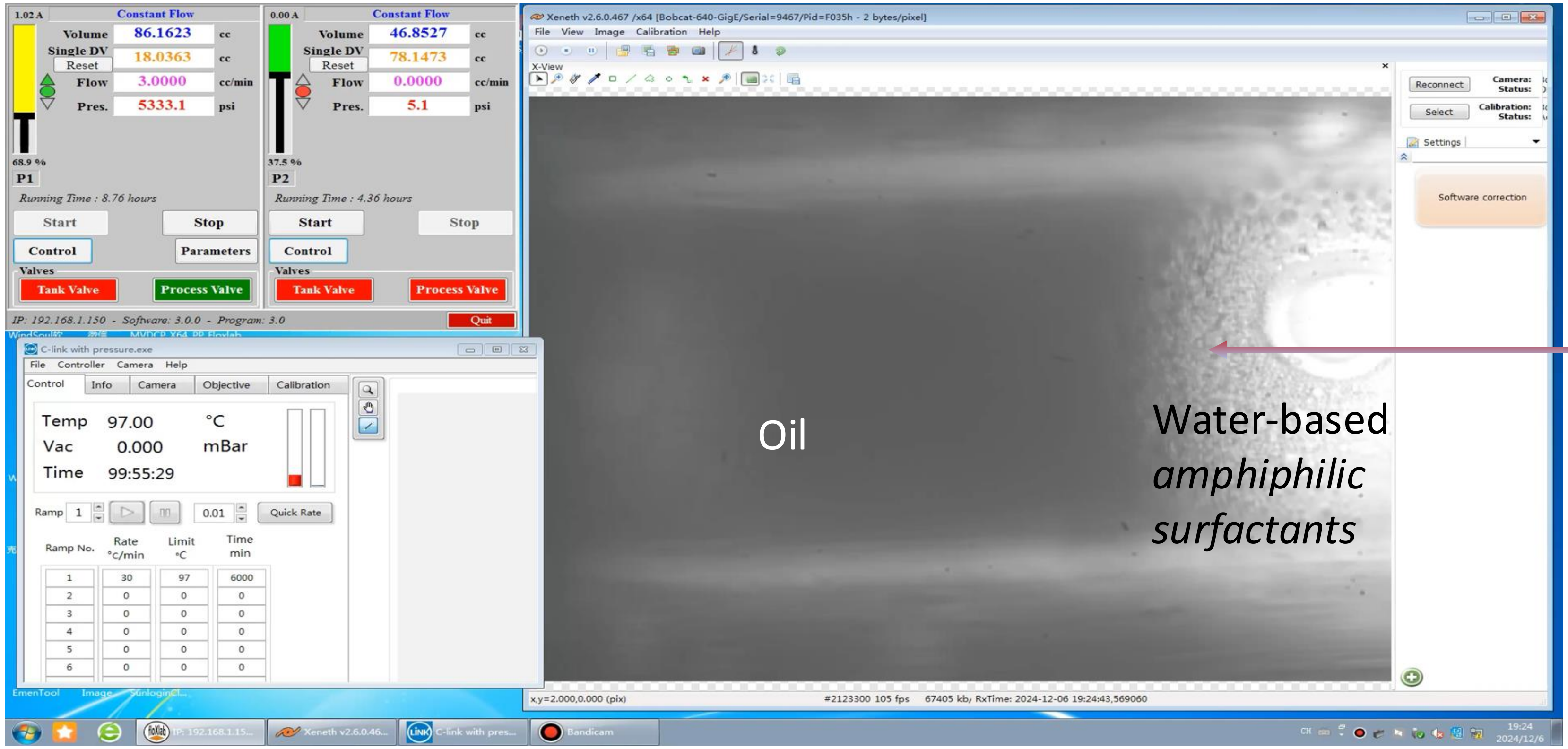


Interface

Oil diffusion into the CO_2 / water system

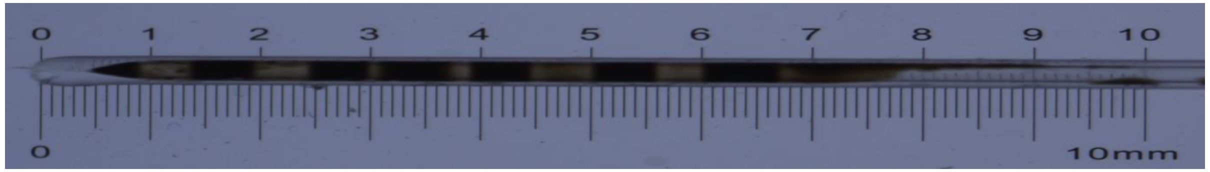
Pressure increase →

Oil B with 30% water-based amphiphilic surfactants / CO_2 Interaction



Reservoir Condition:
97°C / 50.12MPa

Interface



Pressure increase

Original picture of oil in IRHPOC

Oil B with 5% oil-based amphiphilic surfactants / CO_2 Interaction

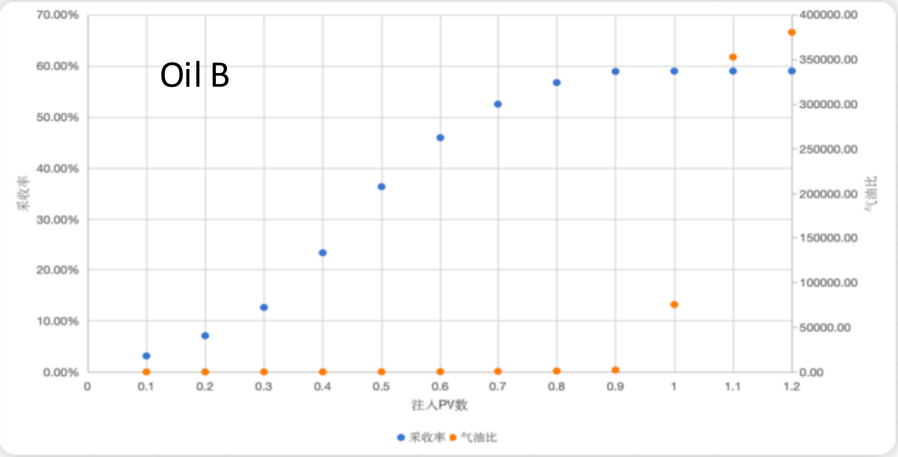
Reservoir Condition:
97°C / 50.12MPa

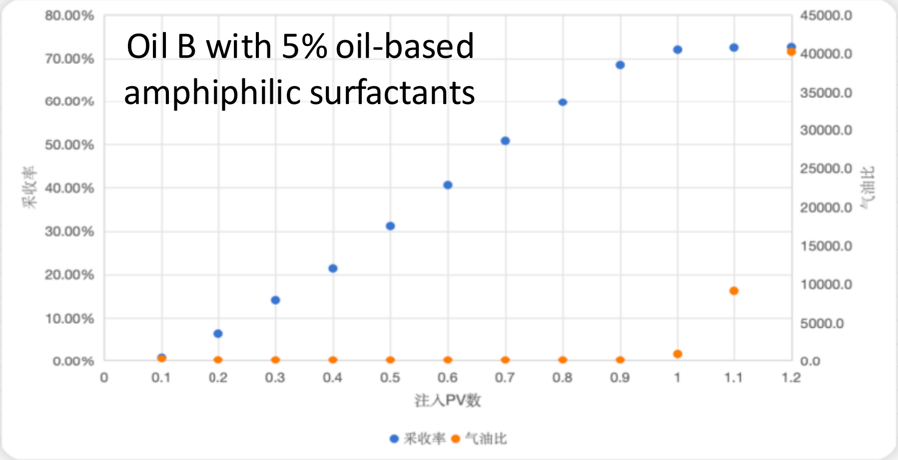
Interface

Pressure increase →

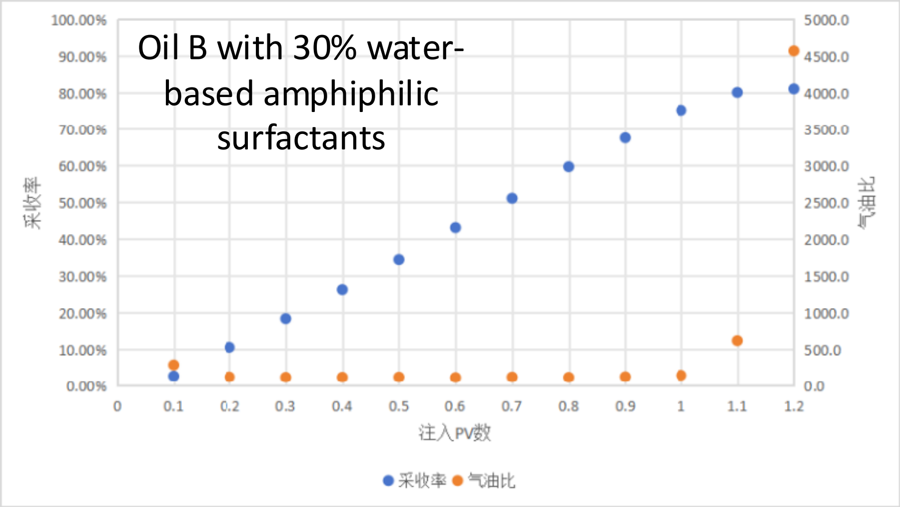
Comparison of EOR Between Oil B and Oil B with Chemical Additive

EOR





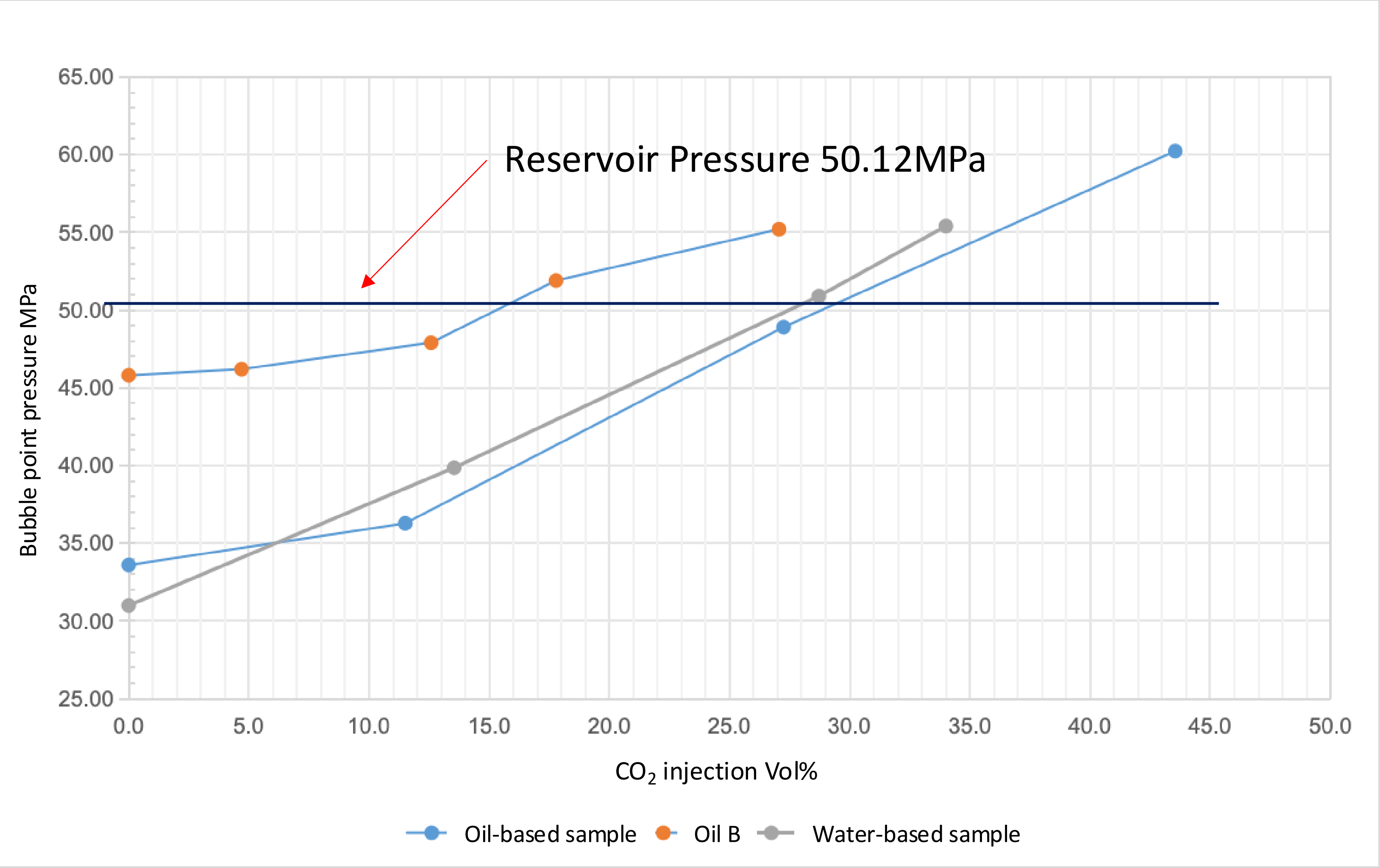
MMP decrease when adding chemical additives



Enhanced Oil Recovery (EOR) using CO_2-Driven Techniques:
Slim-Tube Analysis Under Reservoir Conditions 97°C / 50.12MPa

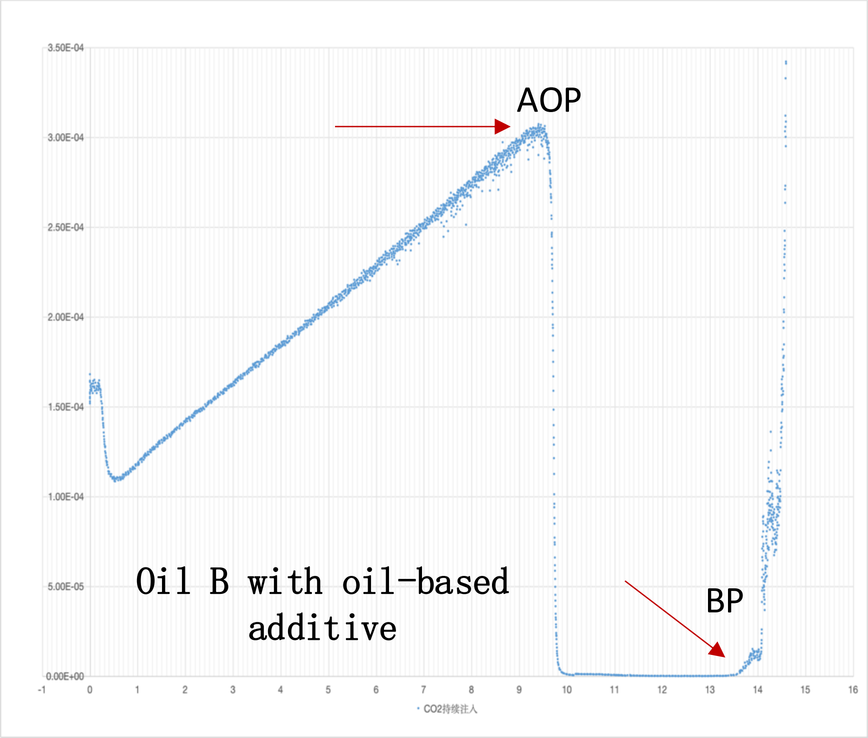
Injecting PV of CO_2

Comparison of EOR Between Oil B and Oil B with Chemical Additive



Comparison of EOR Between Oil B and Oil B with Chemical Additive

Infrared signal strength



CO_2 Injection Amount

Oil B						
Date	Reservoir P	Oil vol	CO2 injection	Injection Vol %	Max Injection	Max Vol %
2024.12.20	7267 psi	30.40 cc	3.80 cc	11.11	6.80 cc	18.28
Oil B with oil-based additive						
Date	Reservoir P	Oil vol	CO2 injection	Injection Vol %	Max Injection	Max Vol %
2024.12.5	7267 psi	30.09 cc	9.50 cc	24.00	13.50 cc	30.97
Oil B with water-based additive						
Date	Reservoir P	Oil vol	CO2 injection	Injection Vol %	Max Injection	Max Vol %
2024.12.20	7267 psi	30.24 cc	8.60 cc	22.14	10.10 cc	25.04

Preliminary Summary

① IRHPOC constitutes potent instruments in the study of CO_2-driven Enhanced Oil Recovery (EOR).

② Chemical additives have the potential to boost CO_2 solubility and reduce both bubble point (BP) and minimum miscibility pressure (MMP).

Thanks for your attention

PES Australia