Supplementary file

Addressing mobility control challenges in high-pressure high-temperature oil reservoirs via water-saturated CO_2 injection

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Yin, H., Ge, J., Hussain, F. Addressing mobility control challenges in high-pressure high-temperature oil reservoirs via water-saturated **CO_2** ***injection. Advances in Geo-Energy Research, 2025, 16(3): 276-287.***

The link to this file is: https://doi.org/10.46690/ager.2025.06.07

Table S1. Summary of the literature on using foam agent or thickener to increase foam stability.

Citation	Foam agent/Thickener	Concentration	Temperature (°C)	Half-life/Stability	Observations/Key findings
Wang et al. (2017)	Nonylphenol polyethoxylate (nonionic)	1.5%	40-100	5-40 min at 40°C, drops to 0-10 min at 100°C	Foam stability significantly reduced as temperature increases.
	Anionic surfactants	1.5%	60-120	10-100 min at 60°C, falls to 5-70 min at 120°C	Decreased foam stability with temperature increase.
Emrani and Nasr-El-Din (2017a, 2017b)	Alpha olefin sulfonate (AOS) + Silica nanoparticles	0.1-0.3 wt% nanoparticles	24-60	Decreasing half-life with increasing temperature	Nanoparticles enhance foam at low temp, but stability decreases with rising temp.
Li et al. (2019)	Lauryl alcohol polyoxyethylene ether + Silica nanoparticles	1 wt% nanoparticles	50	Improved foam stability at 50°C; higher temp untested	Stability improvement at moderate temp, but untested at high temp.
Li et al. (2020)	Oil-based CO_2 foam	Not specified	20-70	The foam height increases with temperature up to 50°C, beyond which the half-life decreases.	Temperature affects oil-based foam stability by reducing crude oil viscosity, promoting foam formation, and accelerating liquid-film drainage, decreasing foam stability.
Bello et al. (2022)	Surfactant + nanoparticles	0.01-0.5 wt% nanoparticles	25, 70	Same half-life at 25°C and 70°C	Foamability is significantly higher at 25°C than 70°C.
Zhang et al. (2019)	Ethylene oxide surfactant	1 wt%	50-90	Decreasing half-life as temperature increases	Foam stability strongly temperature-dependent.

Zhang et al. (2020)	Amine surfactants	1 wt%	60-130	Decreasing half-life as temperature increases	Foam stability strongly temperature-dependent.
Al Hinai et al. (2018)	26 commercial polymers	0.8-5 wt%	56-104	The solubility/stability of 25 polymers decreased with increasing temperature.	Viscosity capacity generally reduced with higher temperature; pressure slightly improves effectiveness.
Gandomkar et al. (2023)	Poly (fluoroacrylate)	2-3%	40-100	Solubility decreases with increasing temperature	Requires higher reservoir pressure at higher temperatures to maintain effectiveness.

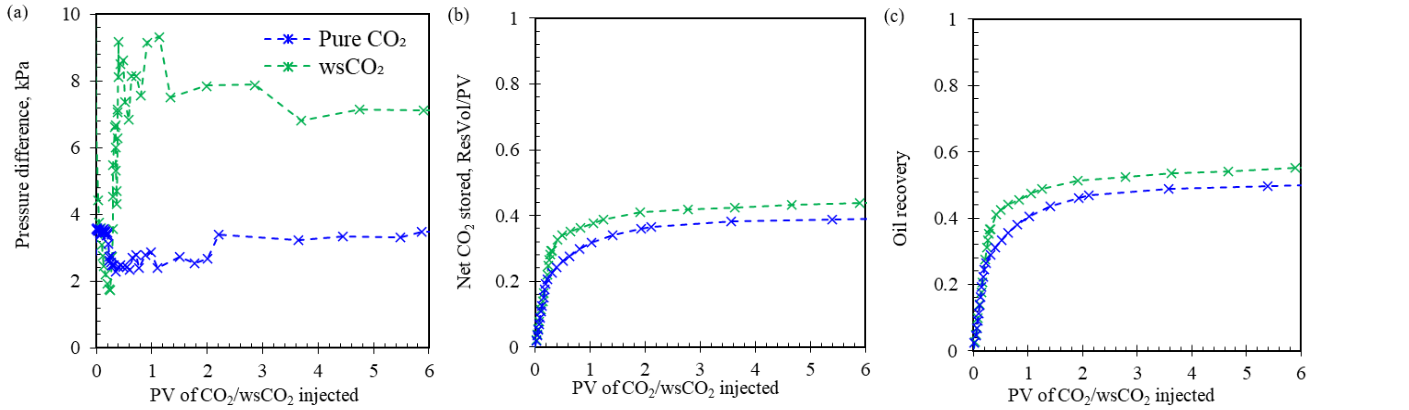

Fig. S1. Comparison of experimental observations on pure CO_2 injection and $wsCO_2$ injection at 70 °C and 10.3 MPa.

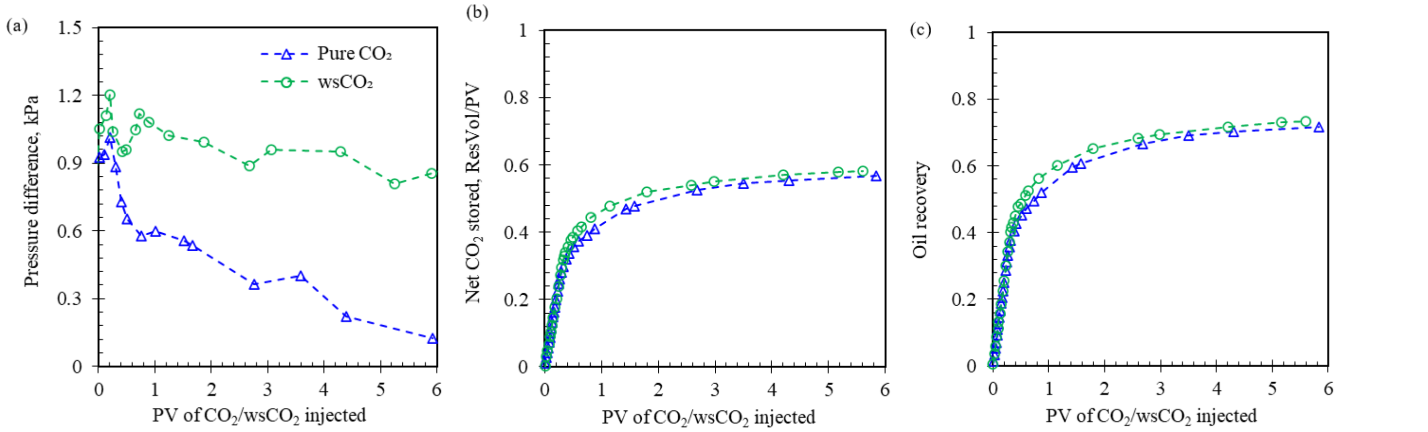

Fig. S2. Comparison of experimental observations on pure CO_2 injection and $wsCO_2$ injection at 70°C and 12 MPa.

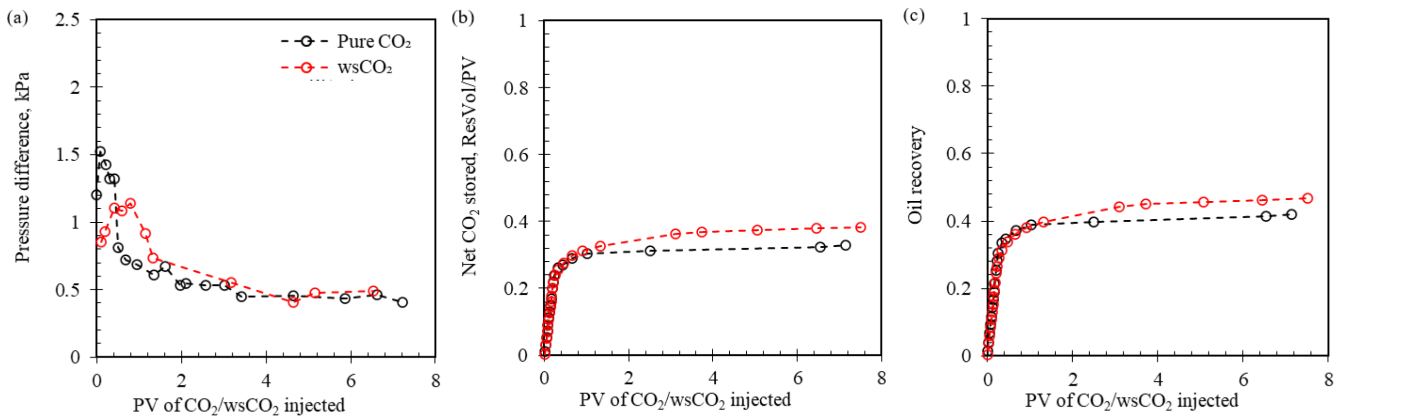

Fig. S3. Comparison of experimental observations on pure CO_2 injection and $wsCO_2$ injection at 116°C and 10.3 MPa.

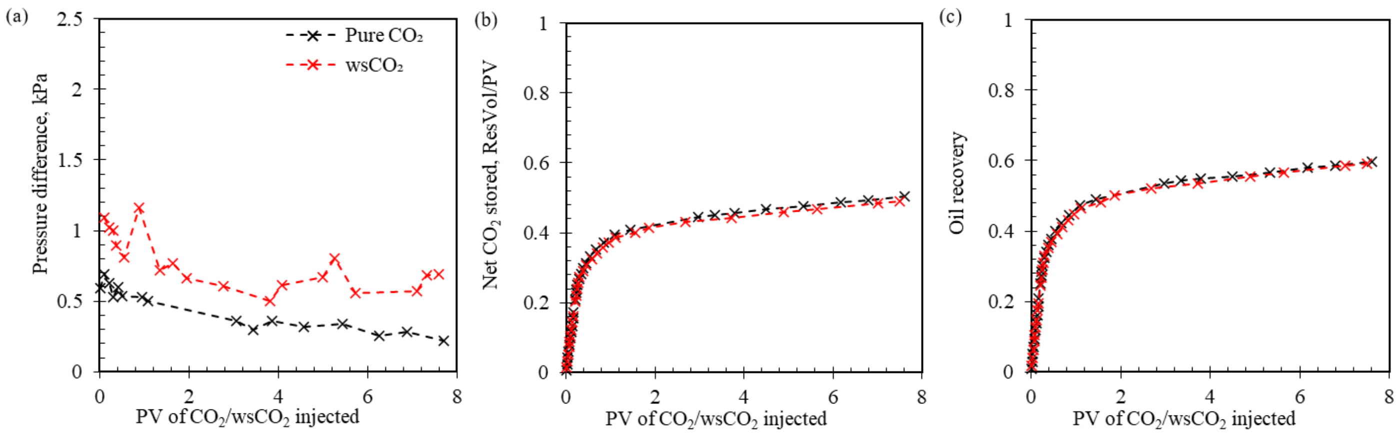

Fig. S4. Comparison of experimental observations on pure CO_2 injection and $wsCO_2$ injection at 116 °C and 14.6 MPa.

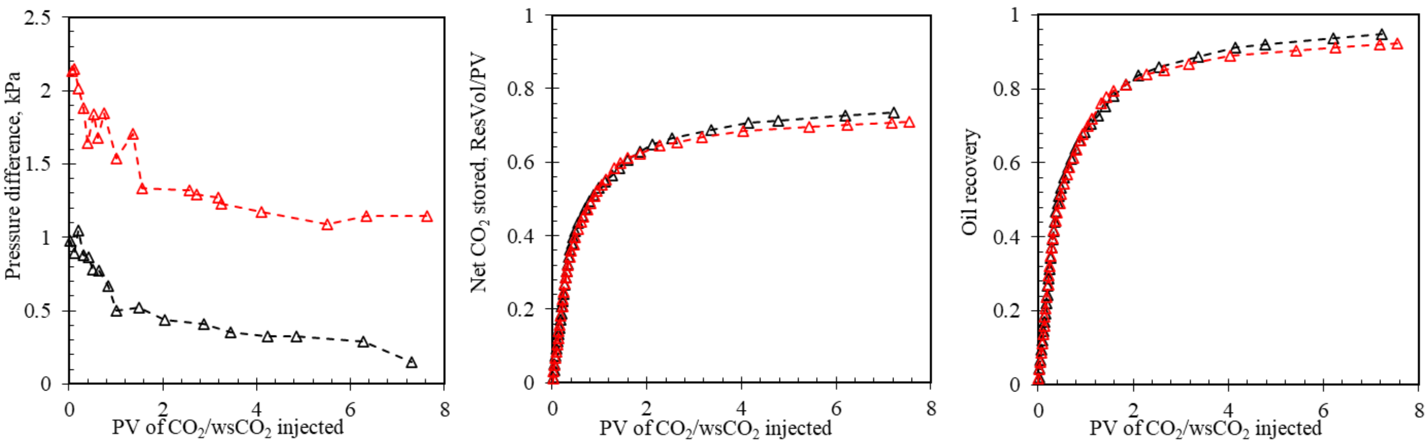

Fig. S5. Comparison of experimental observations on pure CO_2 injection and $wsCO_2$ injection at 116 °C and 18.6 MPa.

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