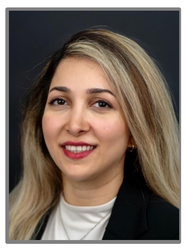

Evaluating Solubility and Retention of Phosphonate Inhibitors for Optimised Scale Control in Subsurface Applications

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energi SIMULATION

BACKGROUND

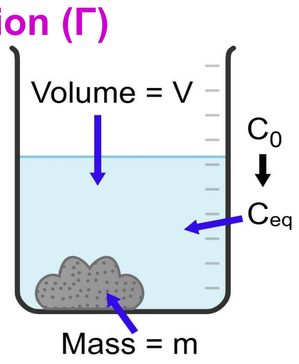
Mineral scales:

- ❑ Reduced production
- ❑ Increased costs
- ❑ Equipment damage

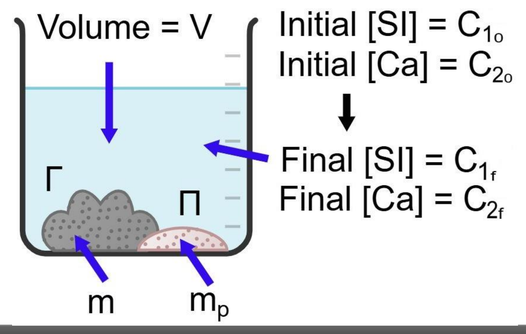
Scale inhibitors (SIs) are chemicals that prevent the scale formation. Controlled release of SI enhances the treatment's effectiveness (squeeze lifetime), and it is governed by 2 mechanisms:

1. **Pure adsorption (Γ)**

$$SI + n{\cdot}Ca \rightleftharpoons SI\_Ca_n$$



2. **Coupled Adsorption/ Precipitation (Γ/Π):**



WHY / PURPOSE

To present results to address gaps identified in previous research and to extend the current knowledge and understanding of

SI ↔ Carbonate ↔ Brine

interactions relating to SI squeeze treatments.

This research investigates the solubility of phosphonate SI/M^{2+} precipitates and evaluates the remaining supernatant effectiveness.

- ❑ Comparison of inhibition efficiency and complexation behaviour of supernatant solution with industrial products.
- ❑ Assess the effect of temperature on static solubility.
- ❑ Track solubility in different brines over time.

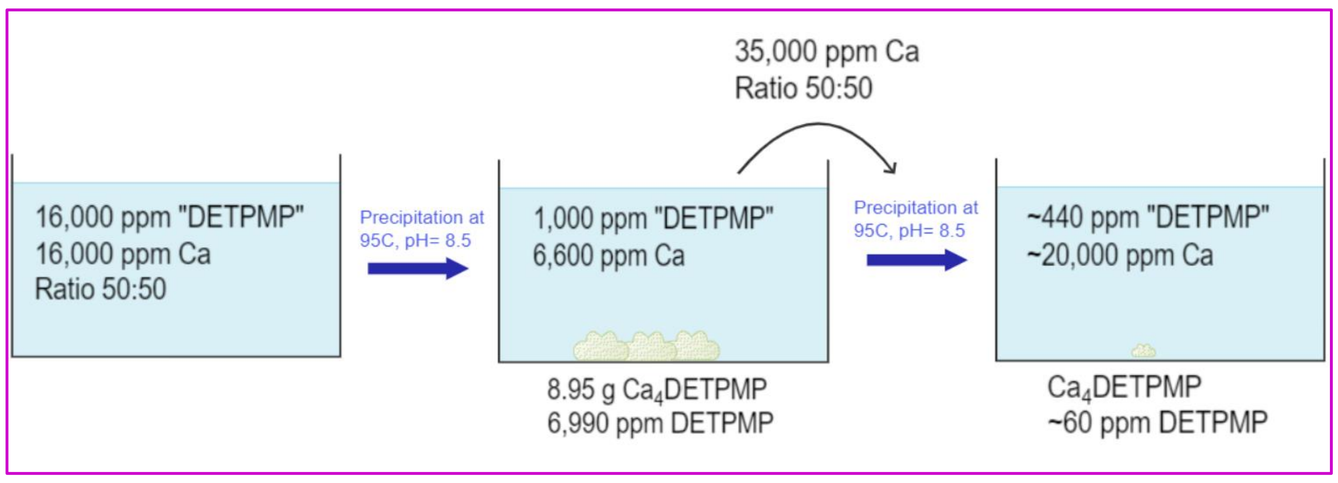
Future aims:

- ❑ Investigate the dynamic solubility of generated precipitates during chemical treatment
- ❑ To contribute data to support and improve SQUEEZE modelling

METHODOLOGY

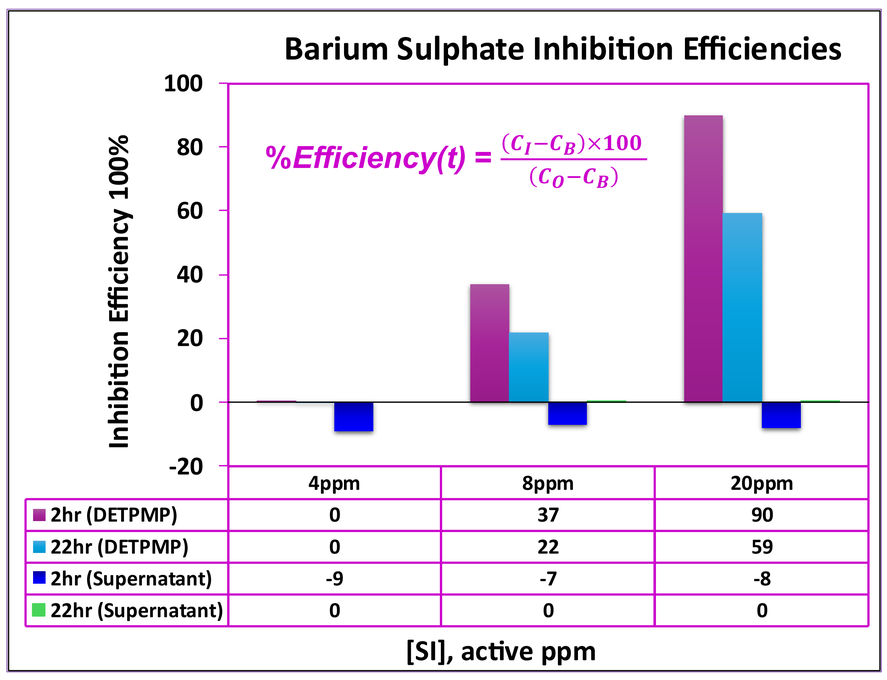
Building on our previous assessment comparing purified and commercial SI, investigated purified SI solubility, supernatant performance through the following experiments:

- Precipitation (Purification) at T = 95˚C
- Performance study of the supernatant solution → Inhibition Efficiency for $BaSO_4$
- Examining the solubility of purified SI → Precipitation with excess of Ca^{2+} at 95˚C



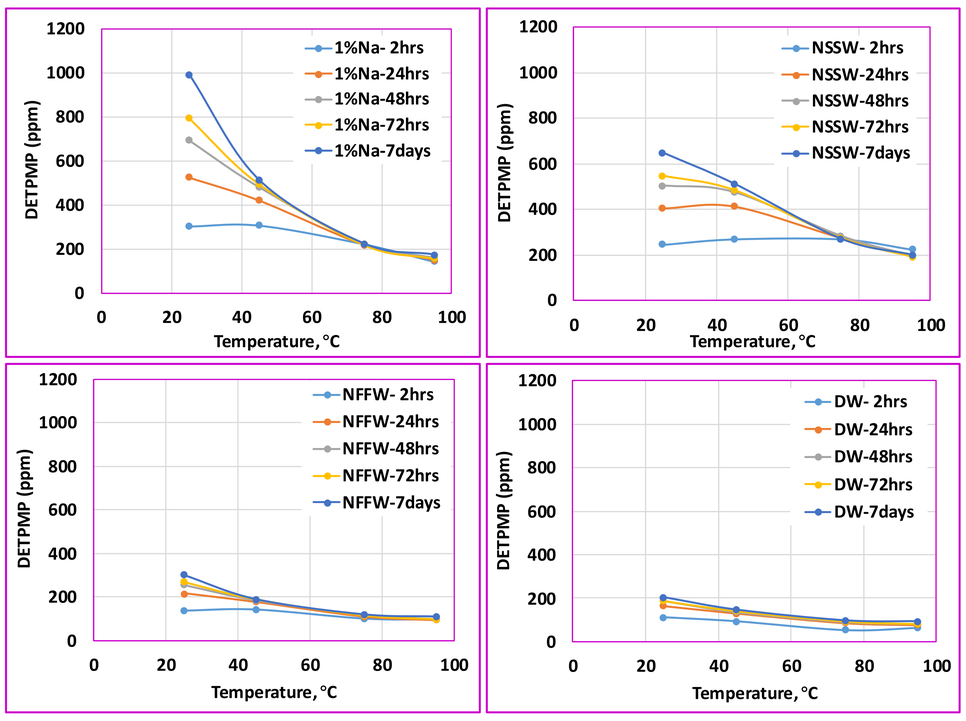
RESULTS

- Commercial and purified DETPMP comparison revealed the presence of ***~10% impurities (P-containing acids)*** in commercial DETPMP that do not influence this SIs adsorption and ***inhibition behaviour***.
- A detailed experimental investigation of the supernatant solution containing these impurities demonstrated only a minimal presence of DETPMP capable of forming complexes with cations or inhibiting the Barite precipitation.



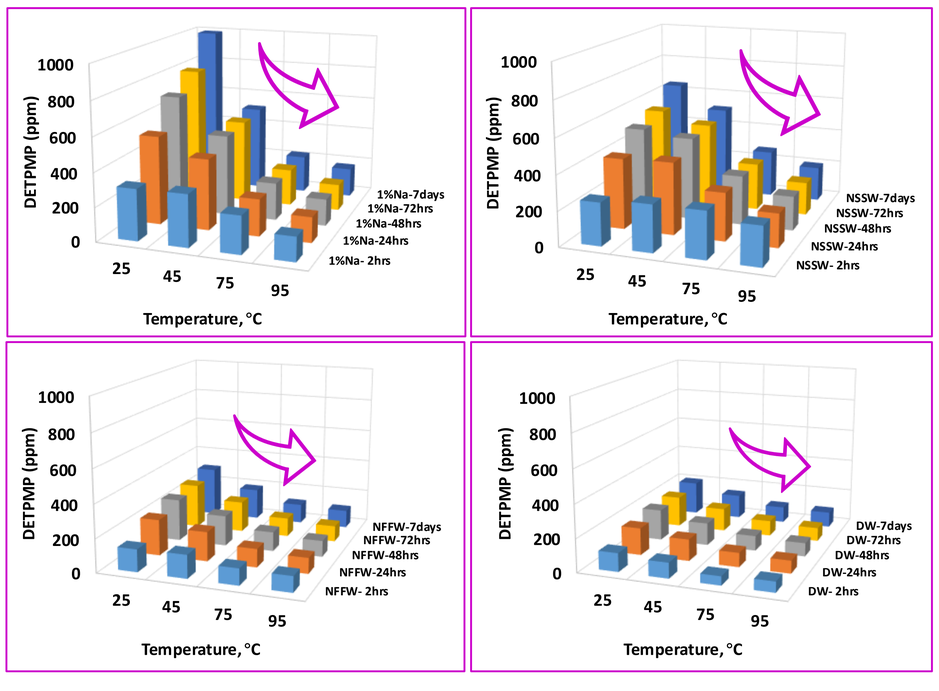
	4ppm	8ppm	20ppm
2hr (DETPMP)	0	37	90
22hr (DETPMP)	0	22	59
2hr (Supernatant)	-9	-7	-8
22hr (Supernatant)	0	0	0

[SI], active ppm



The solubility of the purified DETPMP was evaluated across ***various temperatures (RT, 45, 75, 95°C)*** and ***solvents (1% Na⁺, NSSW, NFFW, DW)*** to assess the retention capabilities of the resulting precipitates.

Precipitated complexes in all solutions become ***less soluble with increasing temperature***. The trends for NSSW (Mg/Ca= 5.3) and NFFW (Mg/Ca= 0.6) show that the inclusion of Mg greatly increases the solubility of the phosphonate/metal complexes.



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