INDUCED FORMATION DAMAGE FOR ENHANCED WELL ABANDONMENT

SPE Aberdeen Well Decommissioning 2022

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OILFIELD SCALING

Pipeline contaminated with inorganic scale (Mady and Kelland, 2020).

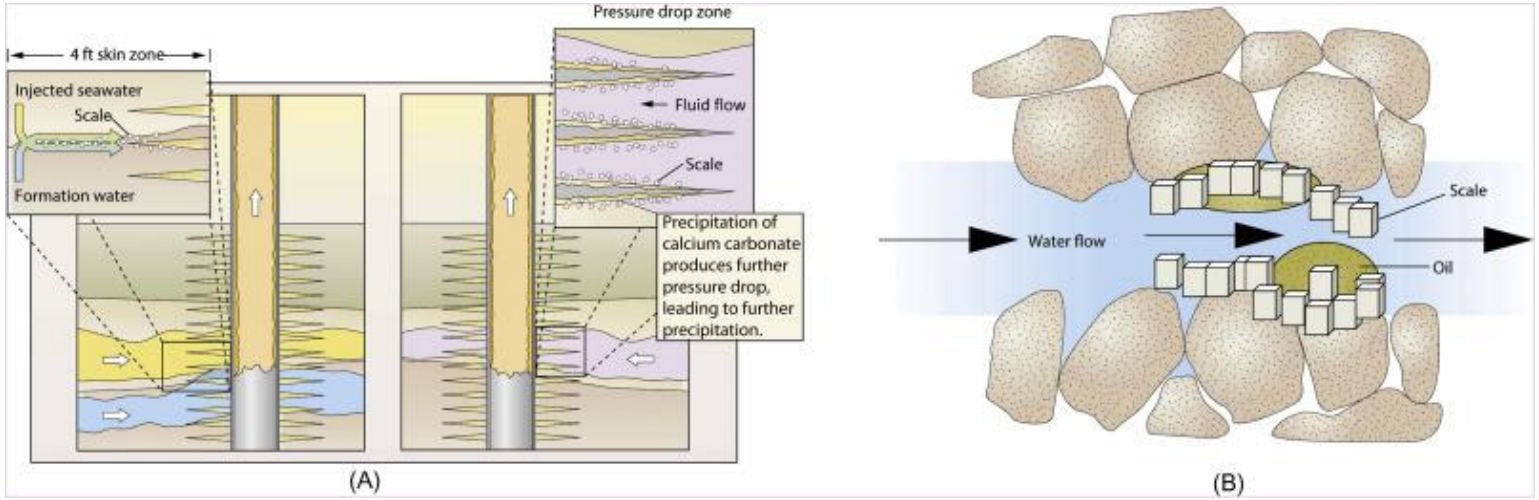


Diagram of formation damage caused by scale deposition in near wellbore formation (Wu, 2018).

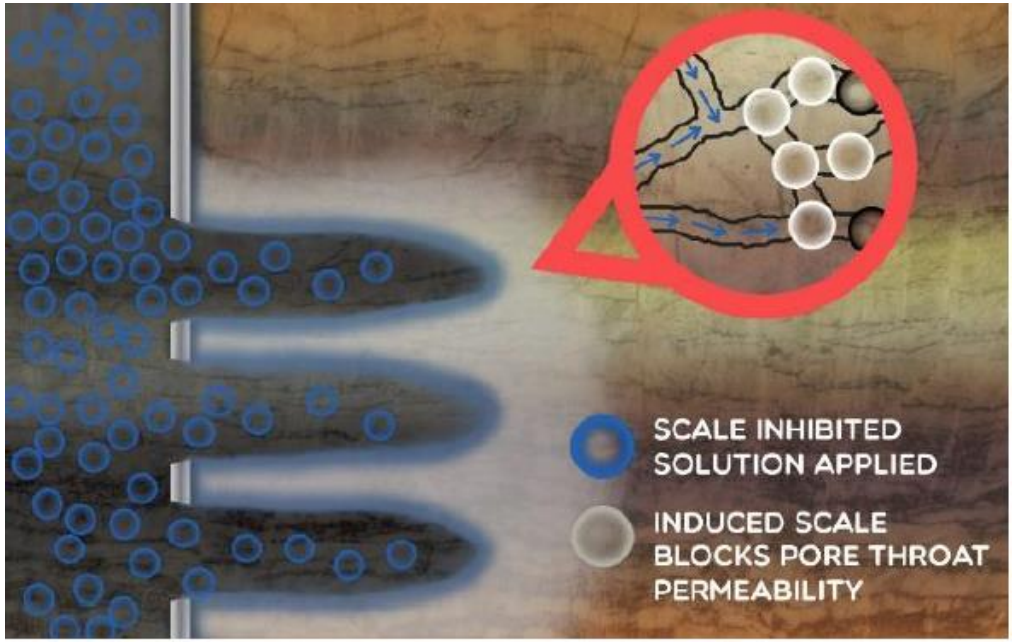
"Calcium sulfate has been one of the major scales which cause many significant and serious operating problems in producing oil/gas wells and in water injectors. ***Impermeable hard scale deposits of calcium sulfate can severely impair the formation permeability…***" (Al-Khaldi, 2011).

As we look to permanently decommission our wells, could we use oilfield scaling to our advantage?

Mady, M. F. and Kelland, M. A. (2020). 'Review of Nanotechnology Impacts on Oilfield Scale Management', *ACS Applied Nano Materials,* 2020, 3, pp. 7343 – 7364.
Wu, X. (2018). Formation Damage by Inorganic Deposition. In Yuan, D. and Wood, D. (editors) *Formation Damage During Improved Oil Recovery, Fundamentals and Applications.* Gulf Professional Publishing (Elsevier.
Al-Khaldi, M.H. (2011). 'New Insights into the Removal of Calcium Sulfate Scale', *SPE European Formation Damage Conference, Noordwijk, Netherlands, 7 June*. SPE-144158-MS.

XCLUDE - INDUCED FORMATION DAMAGE

- Solids-free, low viscosity fluid is pumped into the zone to be isolated
- In formation, calcium sulfate scale precipitates, blocking pore throats and reducing permeability
- Reaction is controlled until fluid enters formation
- Reaction is not reversible



PERFORMANCE TESTING

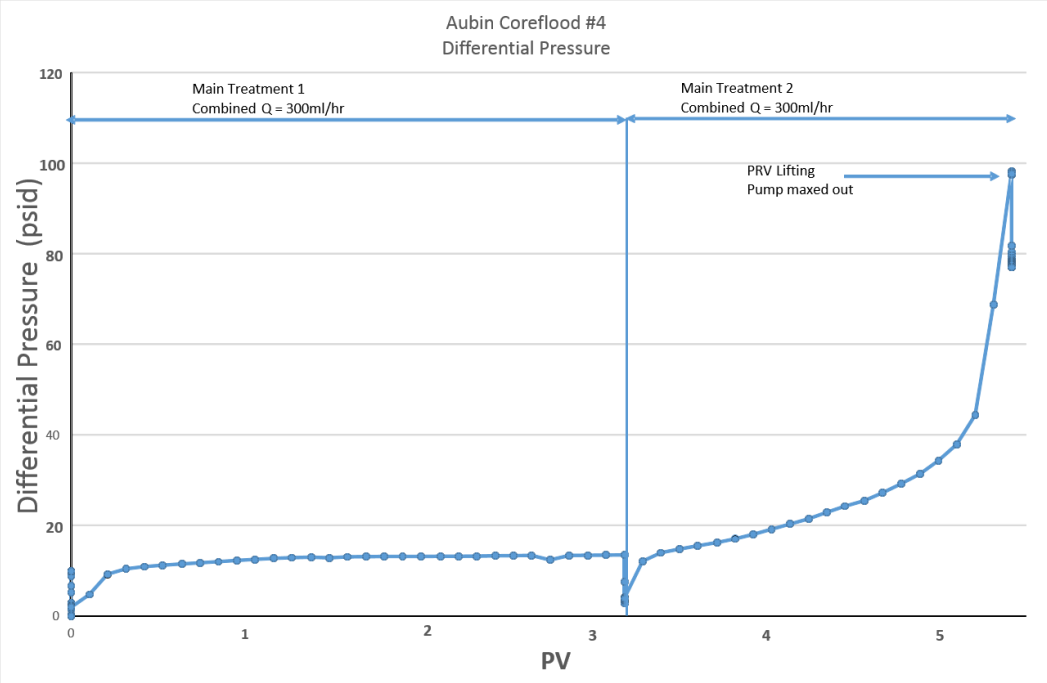
INDEPENDENT CORE FLOOD TESTING

Temperature: 20 ˚C

Sandstone cores, 400 – 650 mD

Flow rate: 20 - 300 mL/hour

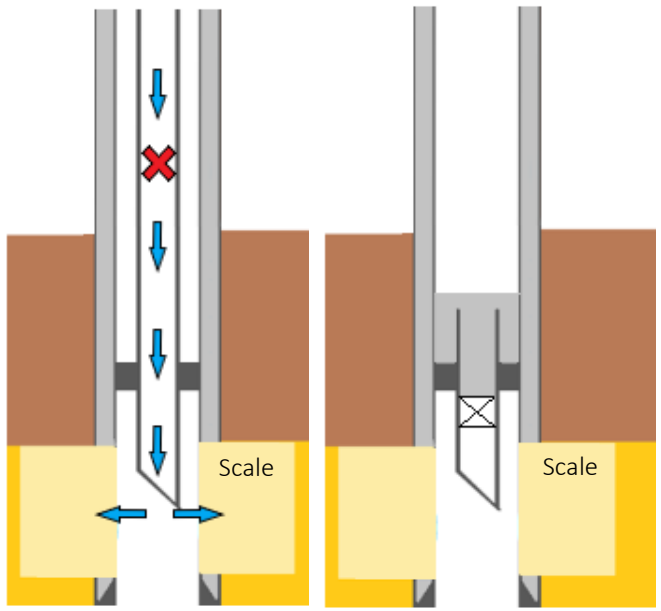
Results: Permeability reduction of 90 – 99.7 %



SAND PACK TESTING

APPLICATIONS

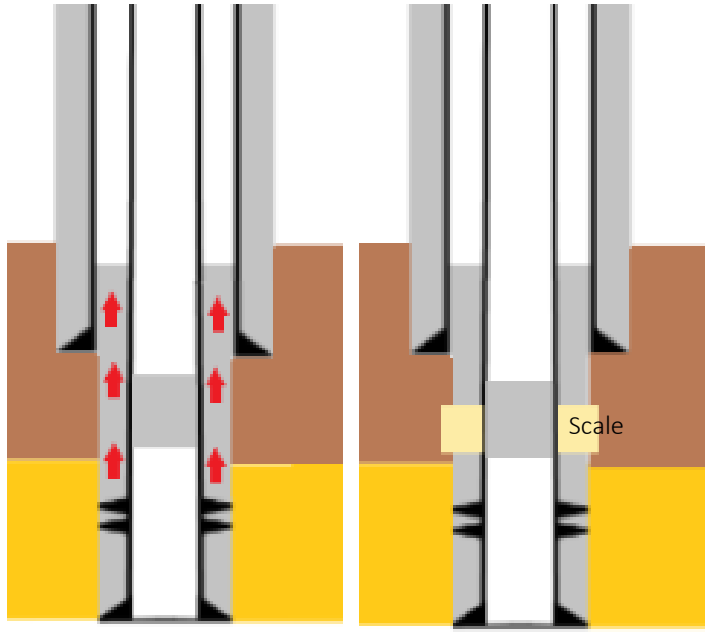
Well decommissioning



Make the well safe prior to P&A without requirement for workstring or rig

- High pressure wells
- Wells with access issues (e.g. fish stuck in hole, deteriorated wellheads)

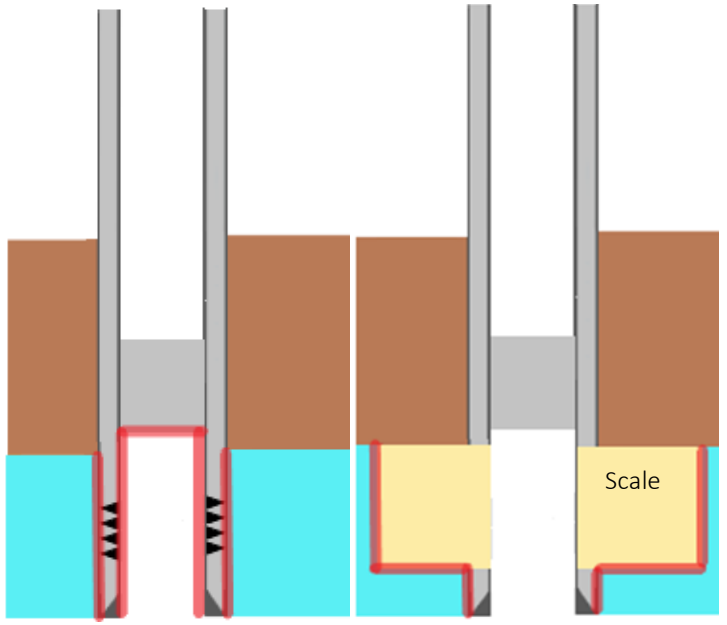
Annular cement remediation



Alternative to perf, wash and cement or section milling

- Reduced equipment and rig requirement (e.g. guns run on wireline).

Wells in CO_2 stores

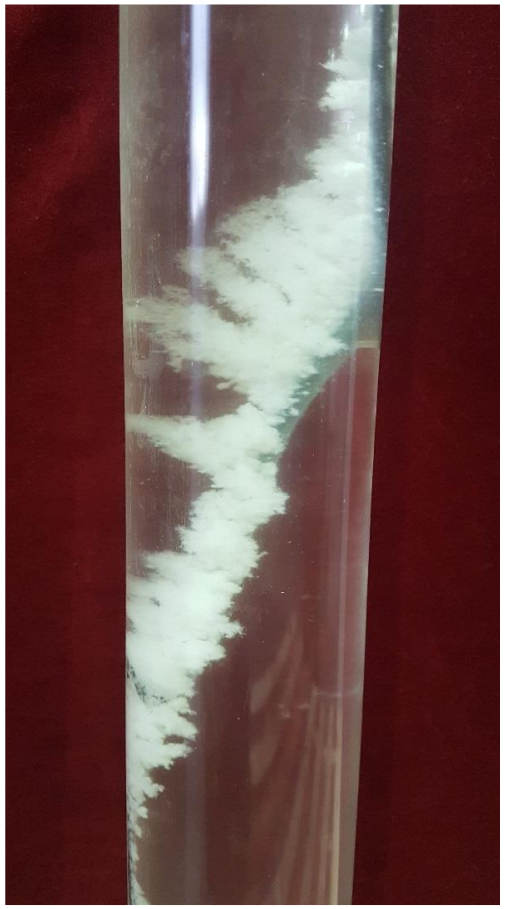


Displace corrosive fluids away from wellbore prior to decommissioning

- Additional security for wells with potential degradation issues (e.g. legacy oil and gas wells)

COULD XCLUDE BLOCK THE WELLBORE?

Extent of scaling after 24 hours.



Extent of scaling after 72 hours.

- Limited scale is built up due to the presence of retarder in system
- Scale forms slowly in the well
- Scale that does form is easily removed
- When Xclude enters the reservoir, retarder is adsorbed and scale precipitation accelerates.
- Increasing temperature in formation also accelerates scaling reaction

FIELD TRIALS

- First field trials planned for summer 2022.
- Supported by Net Zero Technology Centre.
- Multi-well field trial in onshore UK wells.
- Xclude will be bullheaded into the perforations.
- Downhole monitoring will be conducted using DAS/DAS (fibre optic acoustic and temperature sensing)
  - Pre-treatment: Confirm injectivity and flow path of fluids into formation
  - During treatment: Monitor flow of Xclude chemical
  - Post-treatment: Confirm no injectivity into formation

SUMMARY

- Calcium sulfate scale creates a barrier in formation rather than wellbore
  - ✓ Does not require good annular cement - barrier extends beyond this
  - ✓ Maintains wellbore internal diameter - maintains access for future well work (e.g. geothermal operations, additional plugs)

- Cost effective
  - ✓ Can be bullheaded into formation for well decommissioning (rigless, through tubing)
  - ✓ Can de deployed using coil tubing for selective zonal isolation (e.g. geothermal well systems)

- Low risk
  - ✓ Low hazard chemical components (OCNS registered, low hazard or PLONOR)
  - ✓ Xclude will not “set” in the well – precipitate is granular in form so can be circulated if left in well for prolonged periods

aubin

QUESTIONS