DRAG Reduction in Geothermal & District Heating Systems to LOWer Investment and Operational Costs

RESULT 3 – Impact of DRAs on Geothermal Reservoirs

Introduction

Drag reducing agents (DRAs) are an important tool in reducing operational expenses in Geothermal and district heating systems. They can aid in the reduction of pumping costs, by reducing turbulence in the pipe flow and thus reducing the amount of drag.
However, if these DRAs are used in a Geothermal well, we need to know that they will not adversely affect the sub-surface rock and cause any reduction in permeability.
The aim of Result 3 is therefore to determine how the different DRAs interact with rock samples at reservoir conditions.

Experimental Set-Up

A schematic and photo of the core-flood set-up are shown in Figures 1 and 2 respectively.

The rock core used was Bentheimer sandstone, which has similar properties to Dutch reservoir sandstones. All tests were carried out with the oven set at 90°C, a temperature representative of reservoir conditions.

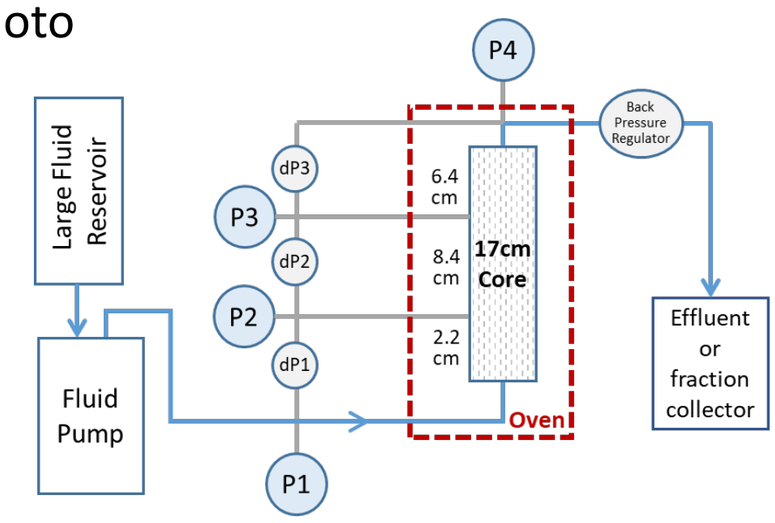


Figure 1: Schematic diagram of the core-flood set-up

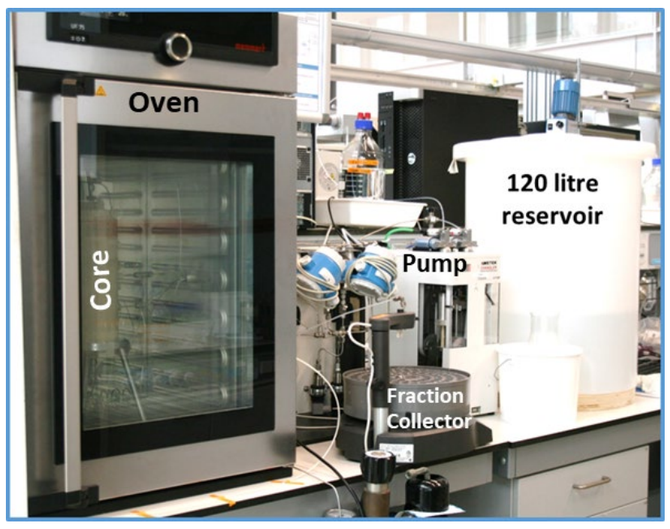


Figure 2: The core-flood set-up in the laboratory

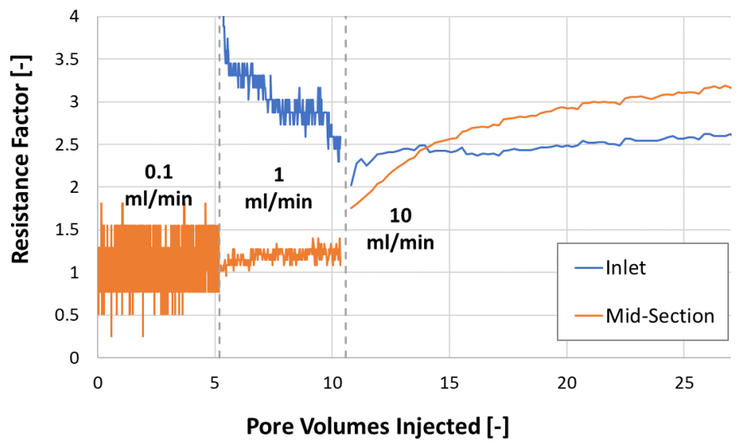
Large volumes of low concentrations of the drag reducing agents in NaCl brine were injected into the core at a range of flow rates, mimicking both near-well-bore and mid-reservoir behaviour.

The pressure response along the core was measured during the flow and the "Resistance Factor", $RF = \Delta P_{DRA} / \Delta P_{brine}$ was used to determine how much impact the DRA has on the rock.

Core-Flood Results

Polymer Injection

A solution containing 10mg/litre (*10ppm*) of a candidate polymer DRA was injected, with stepped flow-rates, giving the resistance factors shown below.

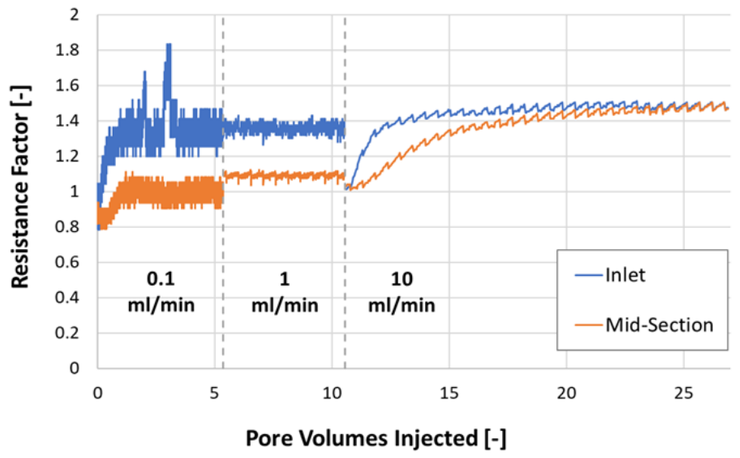


The noisy signal at 0.1 ml/min is due to the small size of the measured pressure drops.

Low values of RF were measured, particularly at the lowest flowrates that are characteristic of the middle of the reservoir. Any increase in the RF can be partly attributed to the extra viscosity of the DRA solution

Surfactant Injection (Wormlike Micelles)

The candidate surfactant DRA (*5000ppm*) was mixed with sodium salicylate (*1000ppm*) to trigger the formation of worm-like micelles. The values of RF are, again, very small and mainly linked to the solution viscosity.



Conclusions and Future Work

Conclusions

- The core-flood tests indicate that, under the correct conditions, good injectivity can be achieved.
- Both polymers and surfactants can show good injection behaviour.

Future Work

- The optimal concentration for each DRA, to both maximise drag reduction and minimise injectivity decline, will be determined.
- Longer tests will be carried out, injecting at least 1000PV of the DRA solutions, to determine if there is any cumulative injectivity problems over long timescales.

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