

### Result 1 | Fit for purpose material selection

#### Goals

1. Defining and validating system requirements:
  - Determine conditions for which DRA should reduce the drag in geothermal and district heating systems
  - Create requirements and test matrices for experiments in Results 2 and 3
2. Select DRAs for further investigation in DRAGLOW.
3. Inputs to the implementation and piloting Result 5.

#### System requirements

Requirements were determined (surveys, workshop):

- Temperature stability: up to 120°C for district heating, up to 90°C for geothermal wells
- Brine compatibility:
  - Demi water (with pH modification)
  - Geothermal synthetic brine (100 and 300 kppm)
  - Geothermal field brine
- DRAs should lead to low viscosity at high shear

#### Tests for DRA selection

Three different tests are performed:

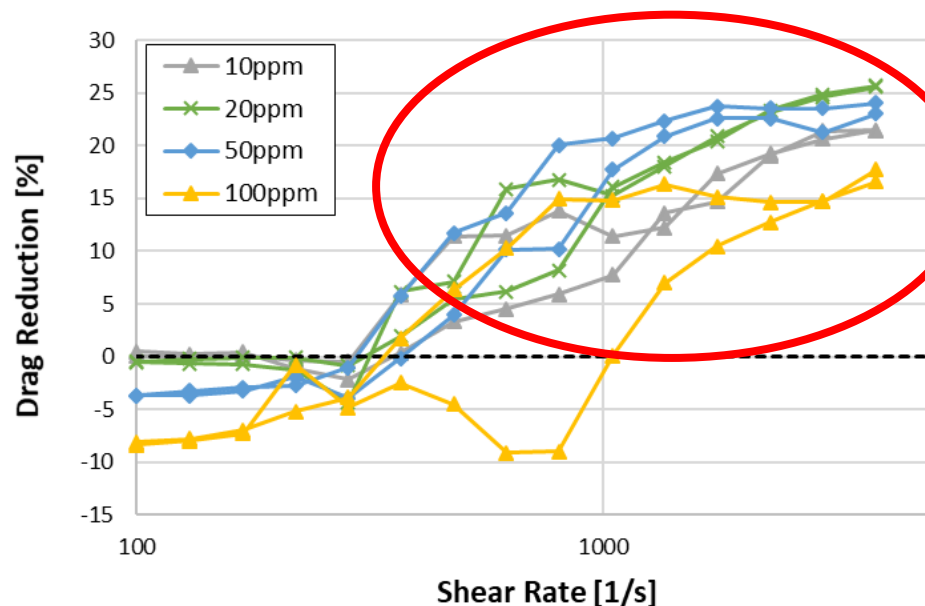
- Vortex tests (to check whether DRA occurs at all)
- Temperature and brine compatibility tests
- Rheometer tests (to check viscosity at varying shear rate)

Scope of the tests:

- 6 surfactants from different groups and type
- 8 polymers, of which 2 are biopolymers
- Tests with and without corrosion inhibitors

#### Rheometer tests

Rheological measurements are performed in a Couette geometry. To determine the drag reduction, the measured torque is compared to the torque with only brine.

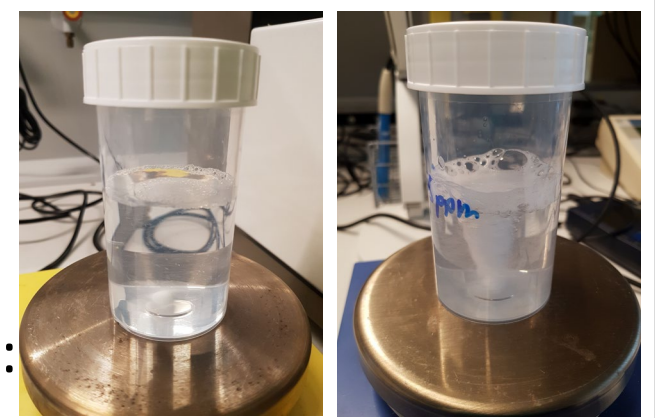


Drag reduction

At low shear (laminar), behaviour dominated by viscosity. At high shear (turbulent) drag reduction is observed.

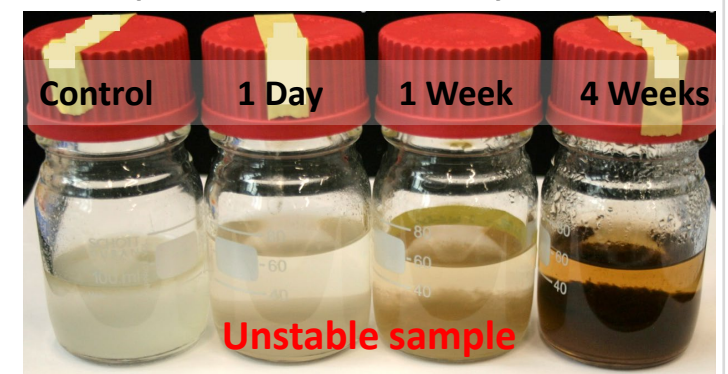
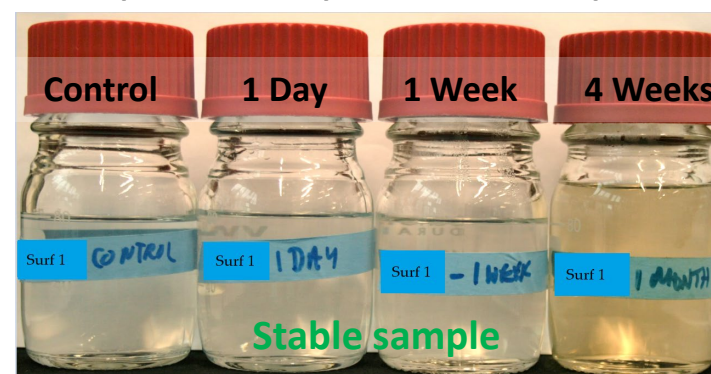
#### Vortex tests

If the DRA is compatible with the brine, and the dosage is correct, no vortex is formed when stirring (left picture). If not, a vortex is formed (right): this sample is not suitable.

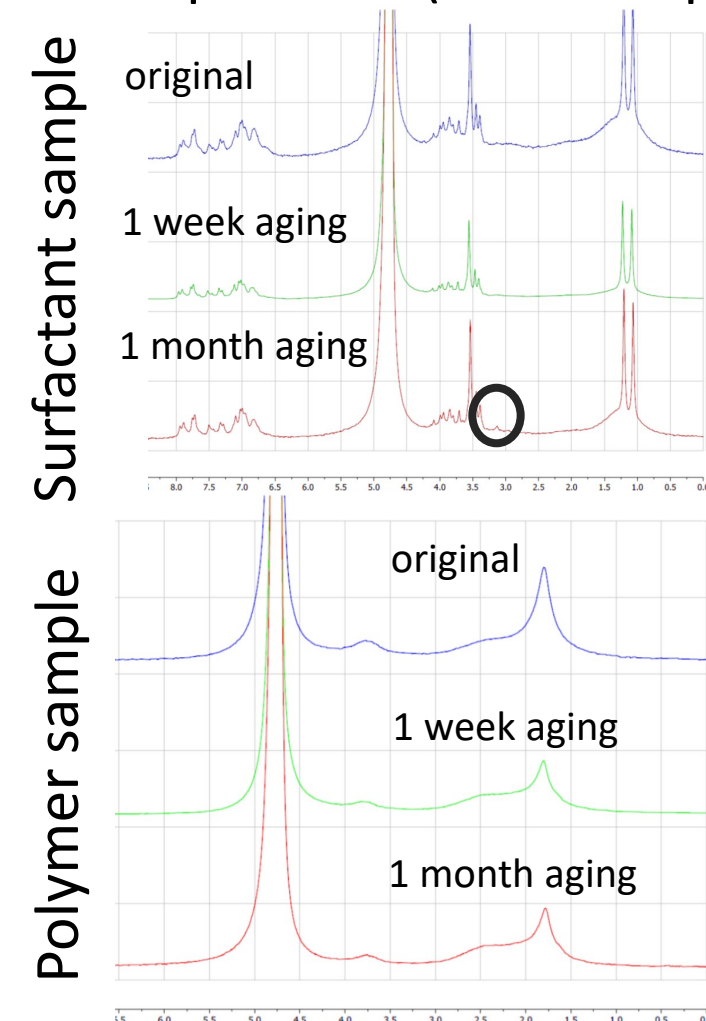


#### Temperature and brine compatibility

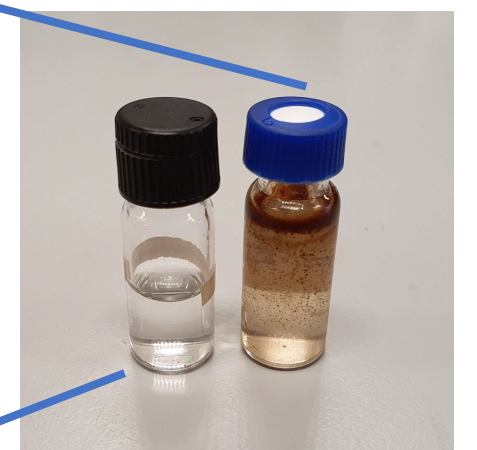
Samples are stored in an oven at high temperature for 1 day/1 week/1 month to show temperature and brine compatibility. The samples are inspected visually:



Chemical stability can be quantified by measuring the NMR spectrum (see example below).



Chemical degradation leads to changes in NMR spectrum



No new peaks in NMR spectrum: no degradation

An example of one thermally stable DRA (NMR spectrum is unaltered) and one thermally unstable DRA (changes in NMR spectrum) is shown above.

#### Summary

These three test methods are currently being performed to determine the suitability of drag reducing agents for use in the other Results.

In the project, 14 drag reducing agents are included in the tests. The applicability of 14 DRAs for geothermal and district heating systems is going to be evaluated.