DRAGLOW Newsletter

October 2023

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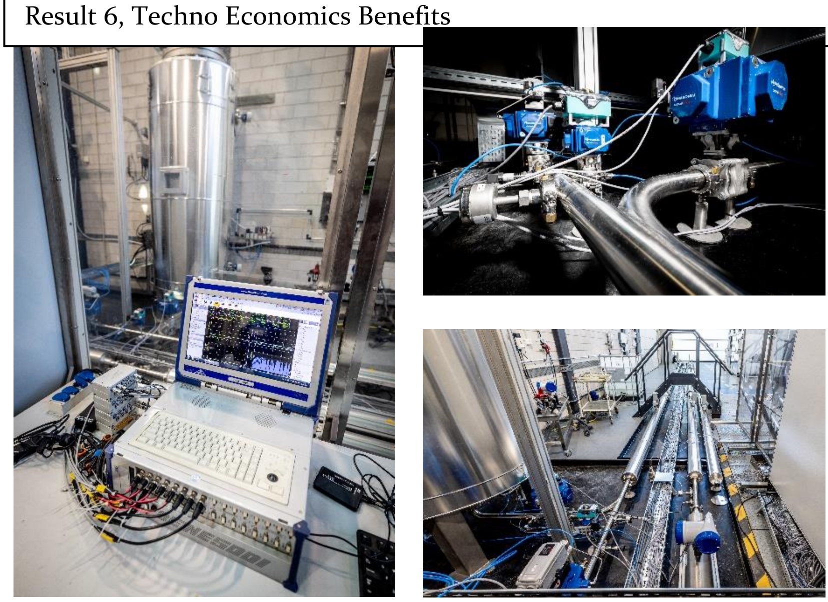
DRAG Reduction in Geothermal & District Heating Systems to LOWer Investment and Operational Costs

The DRAGLOW project is on full throttle. Different work packages are started and the first results and milestones are achieved already.

In this newsletter we will have a lookback at previous events and meetings, Forecast to future events and planning, Summary of project developments, Introduction of our Strategic Advisory Board and our upcoming events.

Project Results in execution:
Result 1, Fit for purpose material selection
Result 2, DRA performance
Result 3, Determine the suitability of the selected DRA’s
Result 4, Simulation models, DRA parameter implementation
Result 6, Techno Economics Benefits



High-Temperature High Salinity Flowloop, TNO (RCSG)
DRA Performance assessment in turbulent pipe flows

SUMMARY

A lot of progress within the different workpackages

Project progress

Event planning

Upcoming Events:

Draglow Webinar:

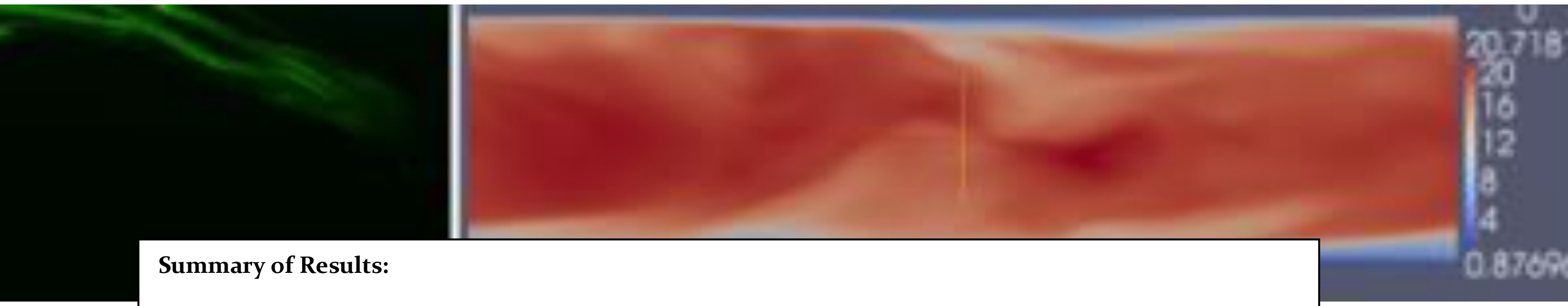
October 31th, 13.00 CET

Link to the webinar:

Microsoft Virtual Events Powered by Teams

Rijksdienst voor Ondernemend Nederland

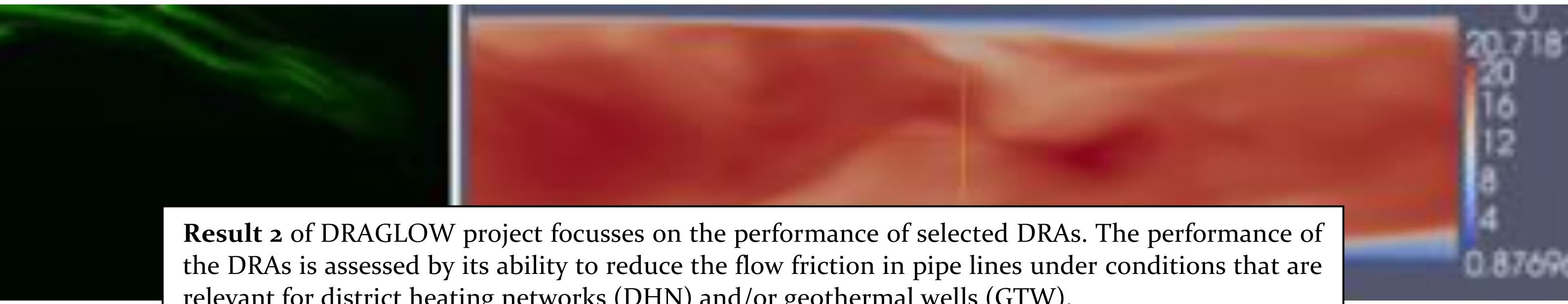
Het project is uitgevoerd met Topsector Energie subsidie van het Ministerie van Economische Zaken en Klimaat, uitgevoerd door Rijksdienst voor Ondernemend Nederland. De specifieke subsidie voor dit project betreft MOOI-subsidie ronde 2020.



Summary of Results:

Result 1 of DRAGLOW project focused on identifying environmentally friendly DRAs that can perform well in the specific conditions of geothermal and district heating systems. The study involved a comprehensive literature review to understand the mechanisms and applications of DRAs, as well as interviews with project members to gather insights on current and future geothermal and district heating systems. Based on the gathered information, a set of conditions was defined for the DRAs to function effectively in geothermal and district heating systems. A set of characterization tests were performed to measure the impact of DRA on the physico-chemical properties of the fluid and also to estimate the stability (thermal, solution and mechanical) of the DRA solutions. All the tests were performed on a total of 13 commercially available DRAs (polymers and surfactants) and 5 were selected for further research and evaluations. The outcome of Result 1 demonstrated the availability of commercial DRAs suitable for geothermal and district heating applications.

Example of thermally stable (top) and thermally unstable (bottom) DRA under geothermal and district heating conditions



Result 2 of DRAGLOW project focusses on the performance of selected DRAs. The performance of the DRAs is assessed by its ability to reduce the flow friction in pipe lines under conditions that are relevant for district heating networks (DHN) and/or geothermal wells (GTW).

HTS flow loop realized

To assess the performance of the DRAs, the HTS flow loop has been designed, constructed and commissioned in the last 1.5 years. This loop is capable of providing test conditions relevant to DHN and GTW: a flow velocity ranging from 0.5 to 3 m/s, fluid temperatures ranging from 25 to 115 °C, and fluid compositions ranging from tap water to saturated brines with a salinity up to 300 g/L. The fluid flow in the loop can either be realized by using a pump or by pushing the fluid between two tanks (the latter is used to avoid using the pump, which causes high shear rates that can damage polymer-type DRAs). Pressure, temperature and the pressure drop along the flow line is continuously monitored.

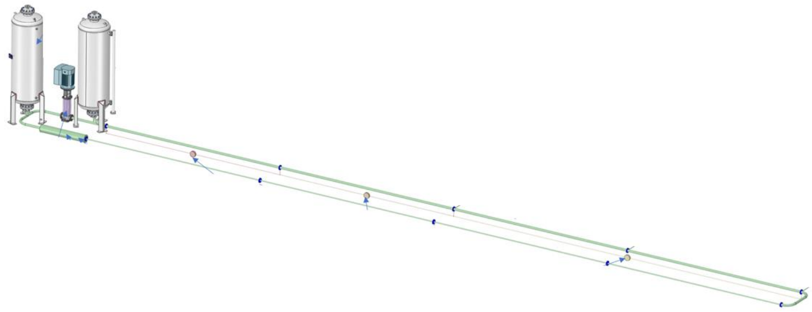


Figure: schematic of the flow loop used to assess the performance of the DRAs.

First drag reduction at field conditions measured

First fndings of the tests with surfactant-type DRAs show that significant drag reduction can be realized (up to about 80% drag reduction). The performance of the DRA depends amongst others on the temperature of the fluid, the turbulence intensity and fluid composition. Some DRAs seem to perform better at lower temperatures, while others perform better at higher temperatures (see figure below). By mixing a 'low-temperature' DRA with a 'high-temperature' DRA, the performance is to some extent tuneable.

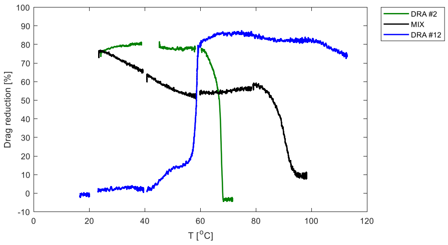
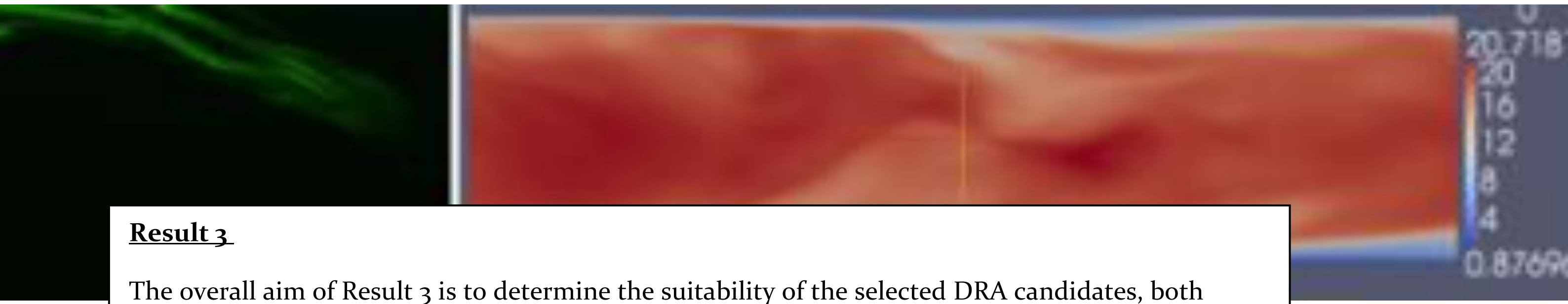


Figure: Drag reduction performance as a function of temperature for DRA#2, DRA#12 and a mixture hereof at a flow velocity of 1.6 m/s in a 2" pipe.

Upcoming experiments will focus on the performance of polymer-type DRAs. The impact of the presence of the DRAs on the heat exchange performance and the durabilitly of the DRAs is to be assessed as well.



Result 3

The overall aim of Result 3 is to determine the suitability of the selected DRA candidates, both polymers and surfactants, for geothermal applications. When considering the deployment of DRAs in geothermal wells, we need to fully understand and assess the impact of the DRA injection, both in the short-term and also on the long-term status of the geothermal system. In particular, we need to know that the DRAs will not adversely affect the sub-surface rock. Since DRAs are macromolecular materials, their injection into the geothermal reservoir has the potential to reduce the rock permeability and cause a decline in injectivity, and the degree to which this occurs needs to be assessed.

The initial screening tests in Results 1 and 2 assessed the thermal and chemical stability of the DRAs and also their drag reducing ability in pipeline systems. From these initial tests, the five most promising candidates were considered for Result 3. Corefloods have therefore been carried out with these candidate DRAs to determine their interaction with representative rock samples at geothermal reservoir conditions.

A schematic of the coreflood set-up is shown in Figure 1. The rock core used was Bentheimer sandstone, an outcrop rock which has similar physical properties to Dutch reservoir sandstones. All coreflood tests were carried out at 90°C, a temperature representative of Dutch reservoir conditions. The drag reducing agents were mixed with a 100,000ppm model reservoir brine. Large volumes, up to 1000 pore volumes (1000PV), of the DRA solution were injected into the core with stepped flow rates (0.1, 1 and 10 ml/min) to mimic both mid-reservoir and near-well-bore flow behaviour. The pressure response along the core (dP1, dP2, dP3 in Figure 1) was measured during each test and the resistance factor, $R_F = \Delta P_{DRA}/\Delta P_W$, calculated for each section of the core. The value of R_F could then be used to determine the impact of the DRA on the flow through the rock.

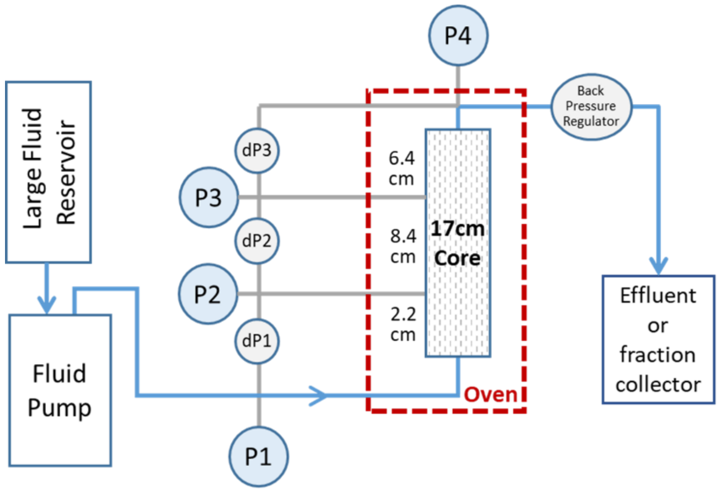
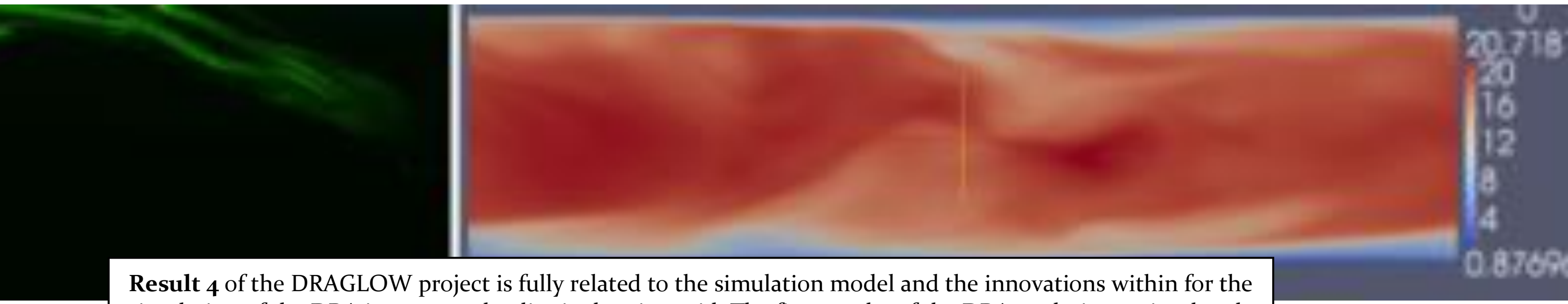
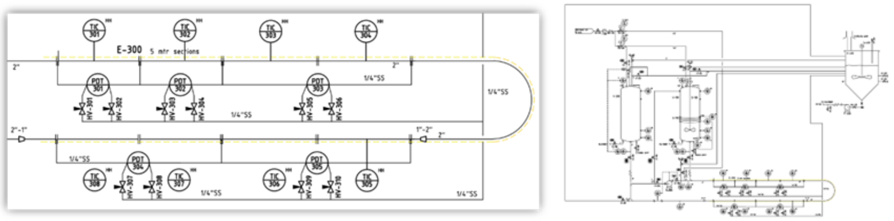


Figure 1: Schematic of the coreflood measurement setup. The pressure along the core was monitored at the four points indicated.



Result 4 of the DRAGLOW project is fully related to the simulation model and the innovations within for the simulation of the DRA impact on the district heating grid. The first results of the DRA analysis are simulated within the Ecostruxure Smart Water tool (Formerly Termis).

By adding the flowloop model into the system we were able to simulate and validate the physical flowloop testing results. Next step was to create the possibility to implement and adjust the DRA specifications and influencing parameters into the full grid model.



Schematic overview of the flowloop installation

The modeling software is now capable of adjusting several parameters like viscosity and friction factors to be adjusted in the model. Therefore the model is capable to determine the DRA effects on the grid (piping and energy). As the testing of different DRA's are still in progress we are still working on validating the tooling on there use and result.

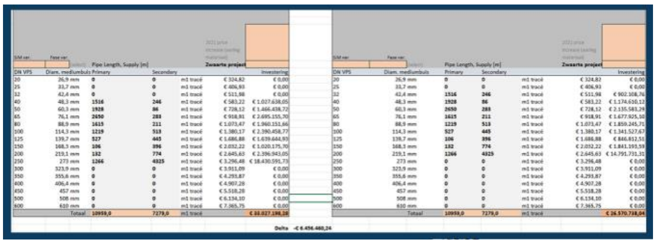
The next step is to asses the DRA impact on the geothermal well via simulations. The team is realizing progress on this part the last period.

Both results will provide input for the techno-economic impact which is assessed in Result 6

Result 6 is focusing on the techno-economics benefits of the DRA's in both the geothermal wells as the District Heating grid. It's our goal to have a integrated project approach where we are able to asses both the production and the grid part of the project.

During the project the team has gathered and assessed 7 different Grid financial models and 3 different financial models on geothermal wells. Each model varies from each other in the general approach. The final results where within reasonable variations from each other. The user friendliness was the biggest difference between the models.

At this moment the team is assessing the necessity to create an integrated source and grid model as defined within our project approach and goals. This is still part of the development. In the mean time the team is developing a simple webtool for public use. This webtool will make it possible for external users to asses the benefits of the different DRA's within their ow system as a simulation tool. The results are expected to provide indications on the increase of capacity within existing district heating systems or the size reduction in new to be developed projects.



SIM var:	Fase var:	Pipe Length, Supply [m]			Zwaarte project	
DN VPS	Diam. mediumbuis	Primary	Secondary			Investering
20	26,9 mm	0	0	m1 tracé	€ 324,82	€ 0,00
25	33,7 mm	0	0	m1 tracé	€ 406,93	€ 0,00
32	42,4 mm	0	0	m1 tracé	€ 511,98	€ 0,00
40	48,3 mm	1516	246	m1 tracé	€ 583,22	€ 1.027.638,05
50	60,3 mm	1928	86	m1 tracé	€ 728,12	€ 1.466.438,72
65	76,1 mm	2650	283	m1 tracé	€ 918,91	€ 2.695.155,70
80	88,9 mm	1615	211	m1 tracé	€ 1.073,47	€ 1.960.151,66
100	114,3 mm	1219	513	m1 tracé	€ 1.380,17	€ 2.390.458,77
125	139,7 mm	527	445	m1 tracé	€ 1.686,88	€ 1.639.644,93
150	168,3 mm	106	396	m1 tracé	€ 2.032,22	€ 1.020.175,70
200	219,1 mm	132	774	m1 tracé	€ 2.645,63	€ 2.396.943,05
250	273 mm	1266	4325	m1 tracé	€ 3.296,48	€ 18.430.591,73
300	323,9 mm	0	0	m1 tracé	€ 3.911,09	€ 0,00
350	355,6 mm	0	0	m1 tracé	€ 4.293,87	€ 0,00
400	406,4 mm	0	0	m1 tracé	€ 4.907,28	€ 0,00
450	457 mm	0	0	m1 tracé	€ 5.518,28	€ 0,00
500	508 mm	0	0	m1 tracé	€ 6.134,10	€ 0,00
600	610 mm	0	0	m1 tracé	€ 7.365,75	€ 0,00
	Totaal	10959,0	7279,0	m1 tracé		€ 33.027.198,28

SIM var:	Fase var:	Pipe Length, Supply [m]			Zwaarte project	
DN VPS	Diam. mediumbuis	Primary	Secondary			Investering
20	26,9 mm	0	0	m1 tracé	€ 324,82	€ 0,00
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40	48,3 mm	1928	86	m1 tracé	€ 583,22	€ 1.174.610,12
50	60,3 mm	2650	283	m1 tracé	€ 728,12	€ 2.135.583,29
65	76,1 mm	1615	211	m1 tracé	€ 918,91	€ 1.677.925,50
80	88,9 mm	1219	513	m1 tracé	€ 1.073,47	€ 1.850.245,71
100	114,3 mm	527	445	m1 tracé	€ 1.380,17	€ 1.341.527,67
125	139,7 mm	106	396	m1 tracé	€ 1.686,88	€ 846.812,51
150	168,3 mm	132	774	m1 tracé	€ 2.032,22	€ 1.841.193,59
200	219,1 mm	1266	4325	m1 tracé	€ 2.645,63	€ 14.791.731,31
250	273 mm	0	0	m1 tracé	€ 3.296,48	€ 0,00
300	323,9 mm	0	0	m1 tracé	€ 3.911,09	€ 0,00
350	355,6 mm	0	0	m1 tracé	€ 4.293,87	€ 0,00
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450	457 mm	0	0	m1 tracé	€ 5.518,28	€ 0,00
500	508 mm	0	0	m1 tracé	€ 6.134,10	€ 0,00
600	610 mm	0	0	m1 tracé	€ 7.365,75	€ 0,00
	Totaal	10959,0	7279,0	m1 tracé		€ 26.570.738,04

Delta -€ 6.456.460,24