



Drag Reducing Agents and applications



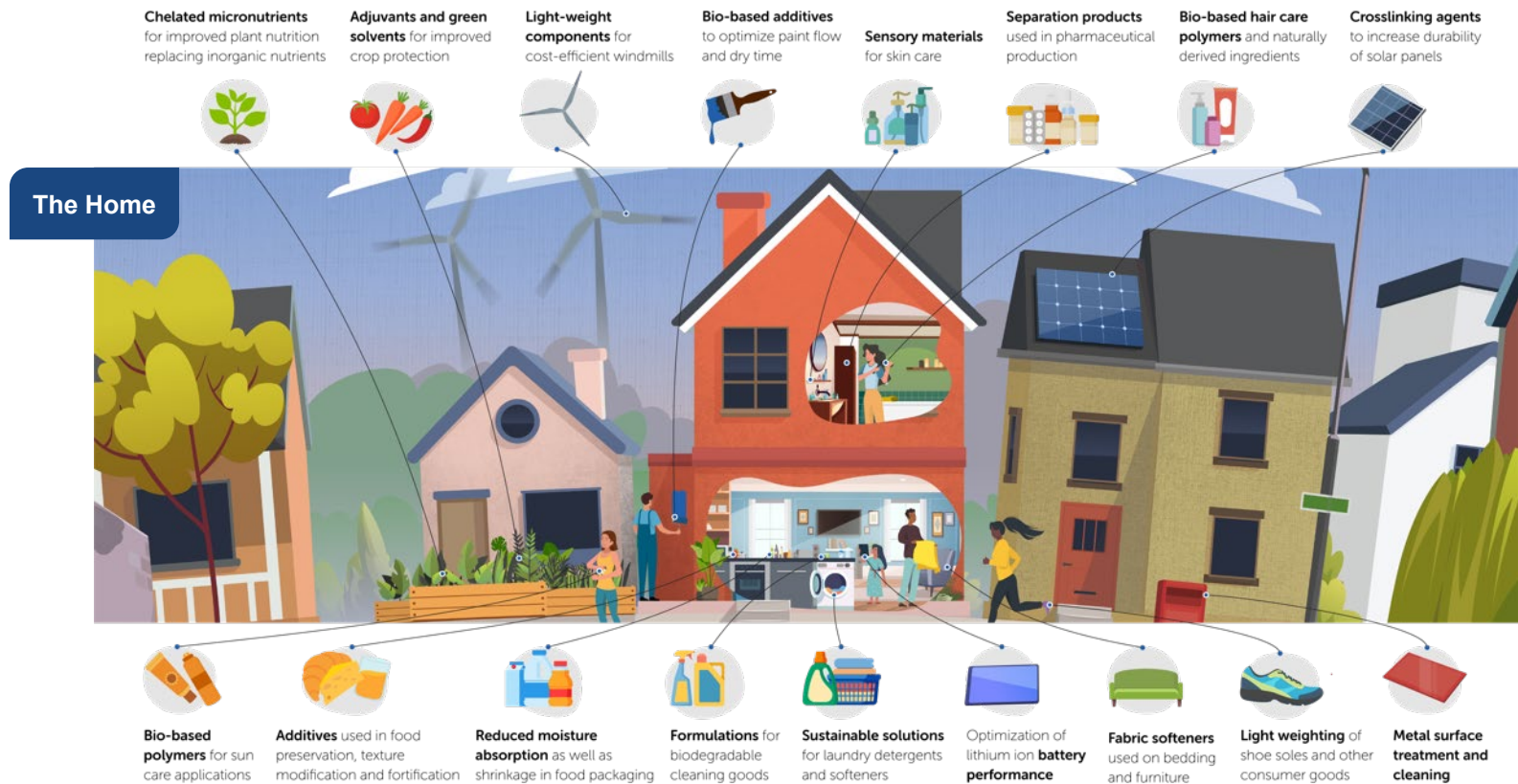
DRAGLOW Yearly Event
Den Haag, 14th of April 2022
Hans Oskarsson



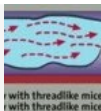
Nouryon



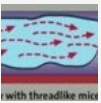
Nouryon Solutions are Essential to Many Everyday Products



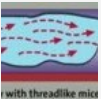
Agenda



Introduction to Drag Reducers



Applications of Drag Reducers, experience of surfactant DRA

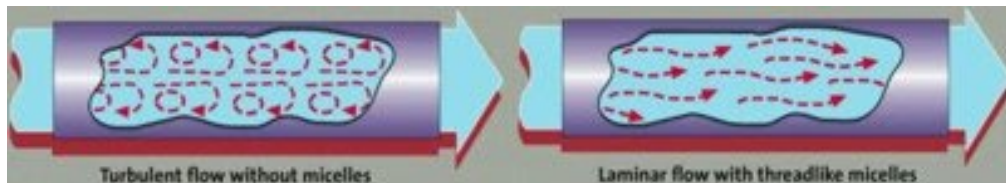


Outlook - Potential

Drag Reducing Agents (DRA)



DRA build up long structures which counteract turbulence:



Reducing friction which may be used for:

- Pump energy savings
- Increased capacity
- Reduced diameter in new designs - investments savings



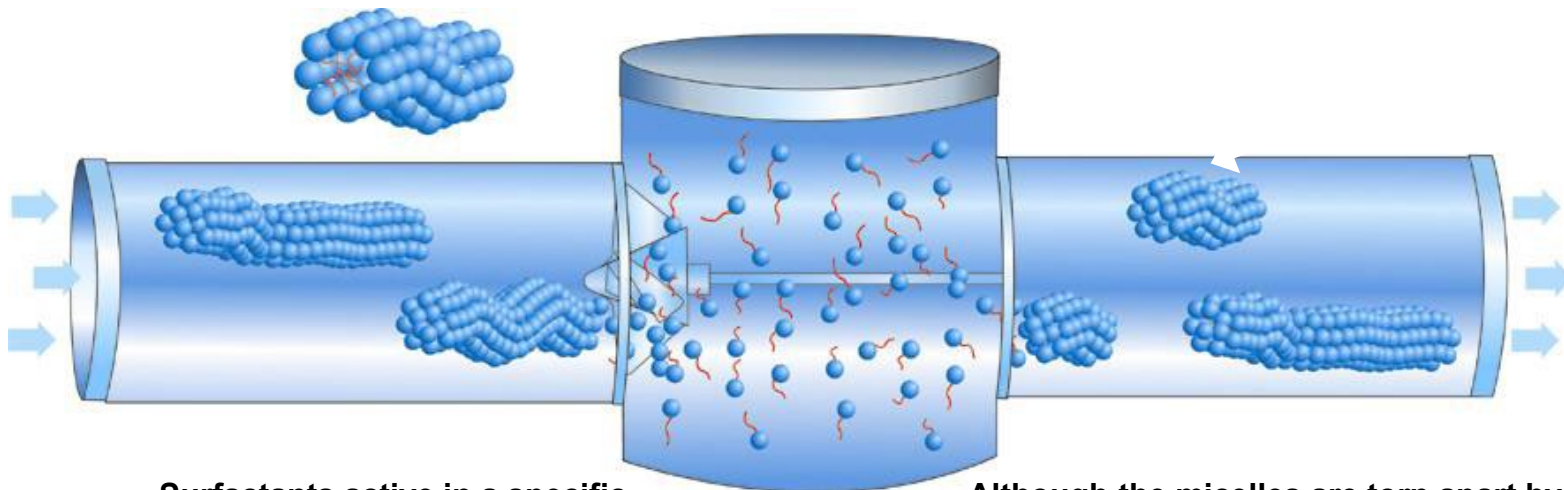
DRA can be achieved with:

- Fibers
- Polymers
- Surfactants

DRA surfactants function as “Living polymers” and can be re-circulated



Surfactants form threadlike cylindrical micelles



Surfactants active in a specific temperature window:

Nouryon commercial: 0 - 80 °C

Nouryon developing: 80 - 150 °C

Although the micelles are torn apart by shear forces within the pump, the fragments quickly rearrange

DRA applications and market



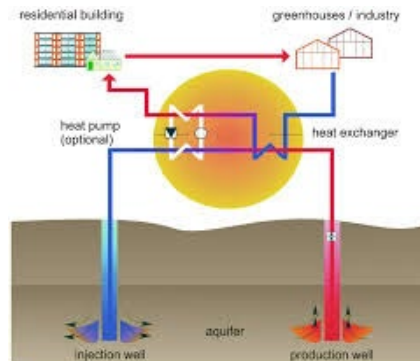
Oil industry

- Oil flow improvers
- Sea water injection (Friction reducers)
- Service bundles
- 410 M\$ global sales (manufacturer level) 2021¹⁾



District heating and cooling distribution

- Pump energy savings
- Capacity increase



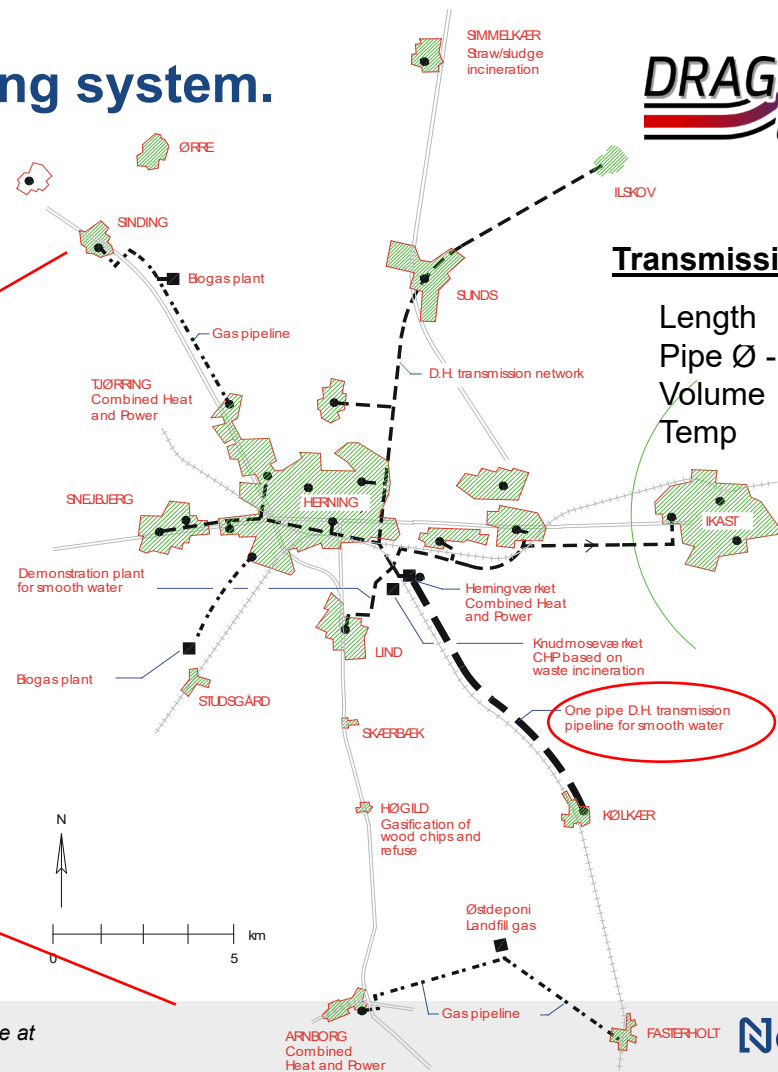
Opportunity – distribution of geothermal hot water

Surfactant DRA in district heating system. Trials in Herning, Denmark



Transmission pipeline

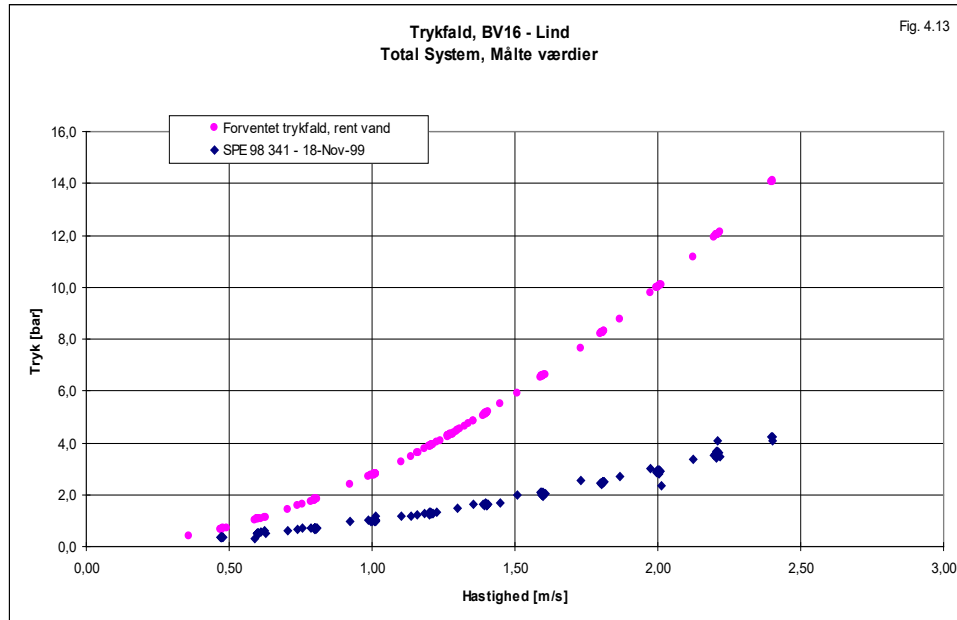
Length 2.880 m
Pipe Ø - 210 mm
Volume 200 m³
Temp 40 -80 C



Summary results Herning trials



- ✓ Operated successfully for 2 years
- ✓ Pressure loss decreased in heating transmission line by 70 %
- ✓ 500 ppm Surfactant DRA fully sufficient, no re-fill



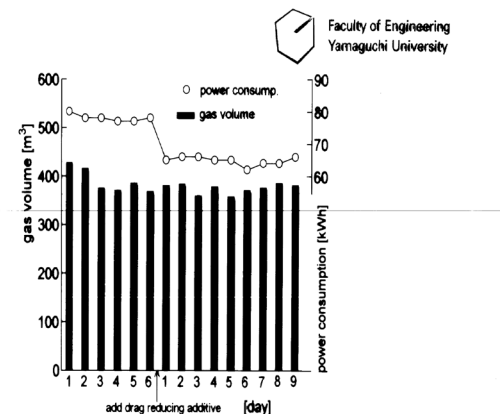
Conclusions:

- Surfactant DRA was found to be stable
- No damage to valves, sealing or pumps
- Cleaning effect was observed
- Reduced heat transfer in tube heat exch. (solutions are available)

District cooling – potential both in transmission and smaller air conditioning systems



- Transmission long distances of district cooling water can achieve up to 80 % drag reduction (50 % flow increase) ³⁾
- Surfactant drag reduction in small systems like air conditioning in buildings is achievable with a lower drag reduction ⁴⁾



Gas consumption of the refrigerating machine and power consumption of the pump before and after the addition of Ethoquad O/12

3) Marcus Lager, *TENSIDER I FJÄRRKYLENAT - FÖRSTUDIE* Marcus Lager Birka Teknik & Miljö AB ISSN

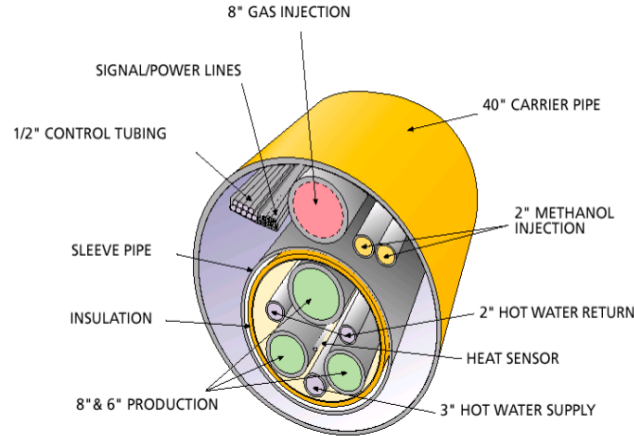
4) Takashi Saeki, *Application of Surfactant Drag Reduction for Practical Air Conditioning Systems*. May 2002, *Transactions of the Japan Society of Mechanical Engineers, Part B* 68(669), 1782-1488

Surfactant DRA in oil production service bundles (water heating tubes, 12 km), Gullfaks, Statoil



Needs:

- To increased capacity in hot water pipes (30 -120 °C) to prevent wax deposition in oil pipes, causing loss of oil production
- Polymer DRA tested, but not applicable (circulating system)



Results/Conclusions:

- Flow rate heating medium increased from 21 m³/h to 34 m³/h
- No operational problems and DRA effect continued for 11 years!

5) Presented by Statoil/AkzoNobel at "International drag reducer conference " in Herring 2001



Outlook for DRA – New applications



- DRA is expected to grow 10 % yearly and reach 2.04 Billion by 2026 ⁶⁾.
- Extensive research also investigate new applications, e.g. agriculture and Geothermal.

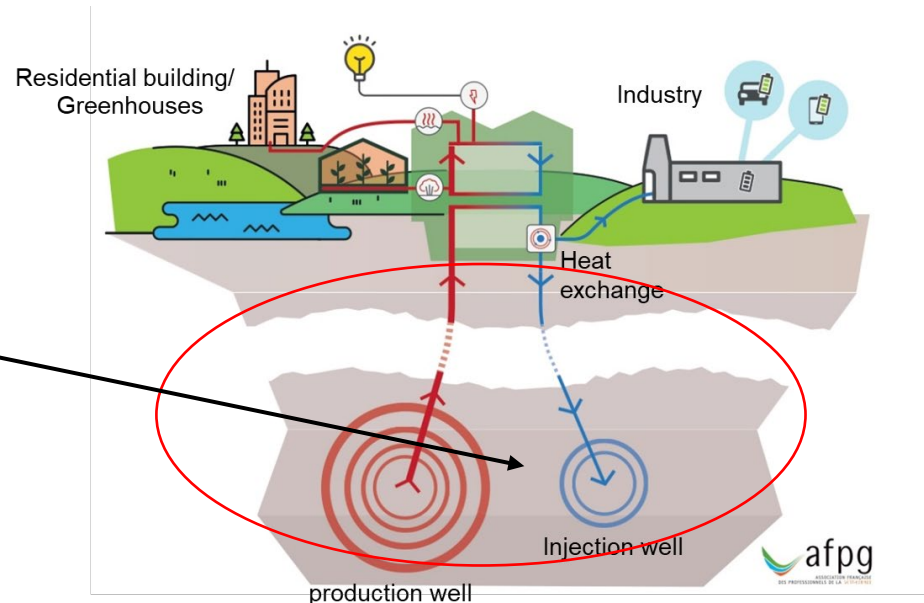


Challenge:

- High temperature
- Compatibility
- Heat transfer
- Reservoir permeability

Potential for DRA surfactants:

- Limited effect on reservoir
- Possibilities of re-circulation



⁶⁾ Drag Reduction Agent Market to Reach USD 2.04 Billion by 2026 | Reports and Data (prnewswire.com)

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