MINIMIZATION OF LOSSES IN LOW TEMPERATURE DISTRICT HEATING

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4DH
4th Generation District Heati
Technologies and System

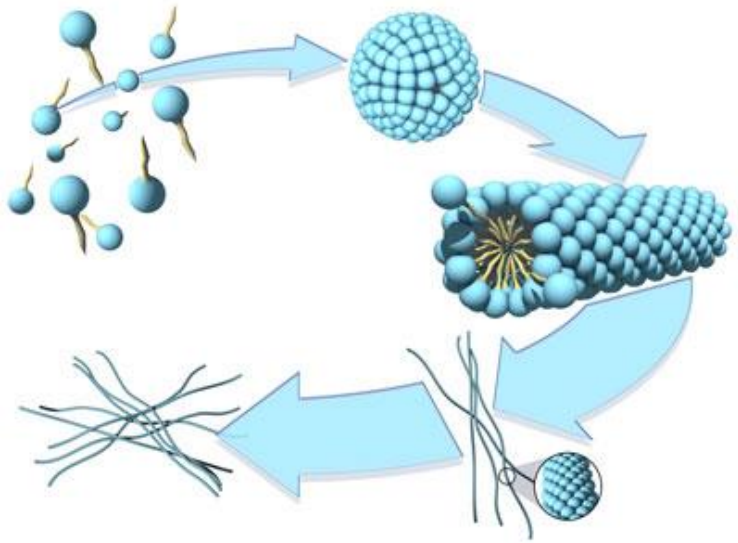
Objectives

- Development of measures for optimization of the heating system. E.g. drag reducing additives, pulse operation, local temp. boosting by heat pump, new materials of pipes and insulation.
- The creation of a mathematical model based on real case. Investigation of the actual thermal and hydraulic regimes of the heating system.
- Simulation and investigation of the system performance including suggested measures on the basis of created model
- Determination of the energy and economic benefits after the introduction of measures aimed to optimize heat supply system.

Sub objectives

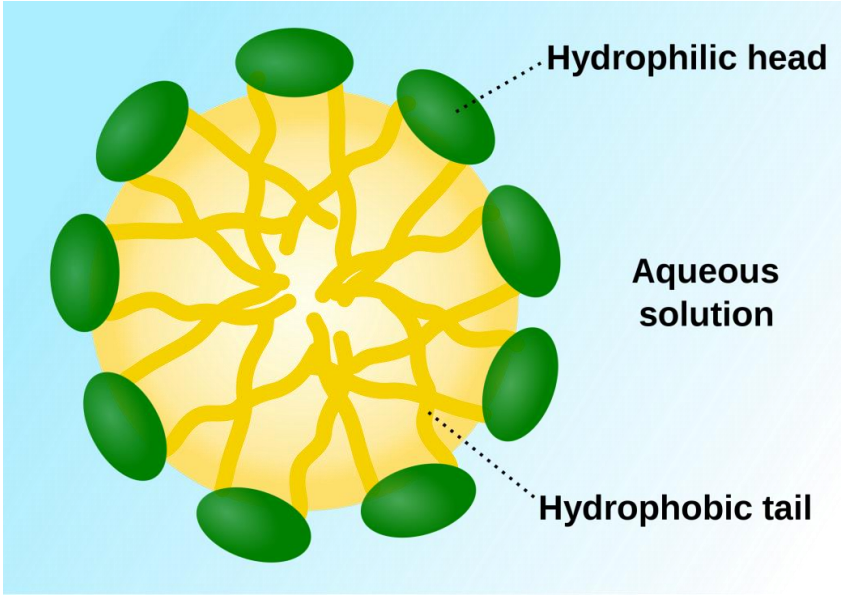
- Optimization of the operation of the DH supply;
- New materials with lower surface roughness, better insulation and flexibility;
- Local temperature boosting by heat pumps or electric boilers;
- Drag reducing additives which can reduce the pressure losses in the distribution system or alternatively used for increasing the flowrate in systems with low supply temperature for maintaining the same amount of heat.

Drag Reducing Additives



Surfactant molecules dispersed in a liquid are called micelles.

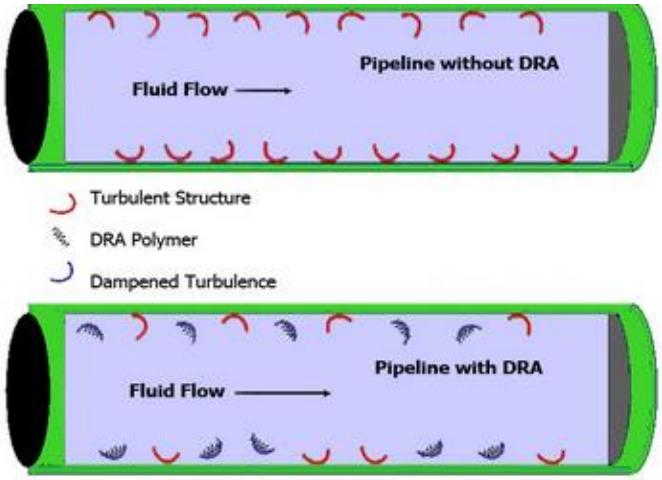
- Wormlike micelles
- Spherical micelles



After break can reform in comparison with usual polymers

How does DRA work?

This interaction is complex; the long chain molecules dampen turbulent bursts near the pipe wall and inside the flow



Hence due to different obstacles, long chains can be destroyed and DRA will stop work until it reforms

Reference cases

Object	Operating hours per year	Benefit
Home for the aged (5.5 kW , 2*1.5 kW)	8760	39%
Hotel1 (15 kW)	8000	49%
Hotel2 (11 kW, 7,5 kW)	2000	48%

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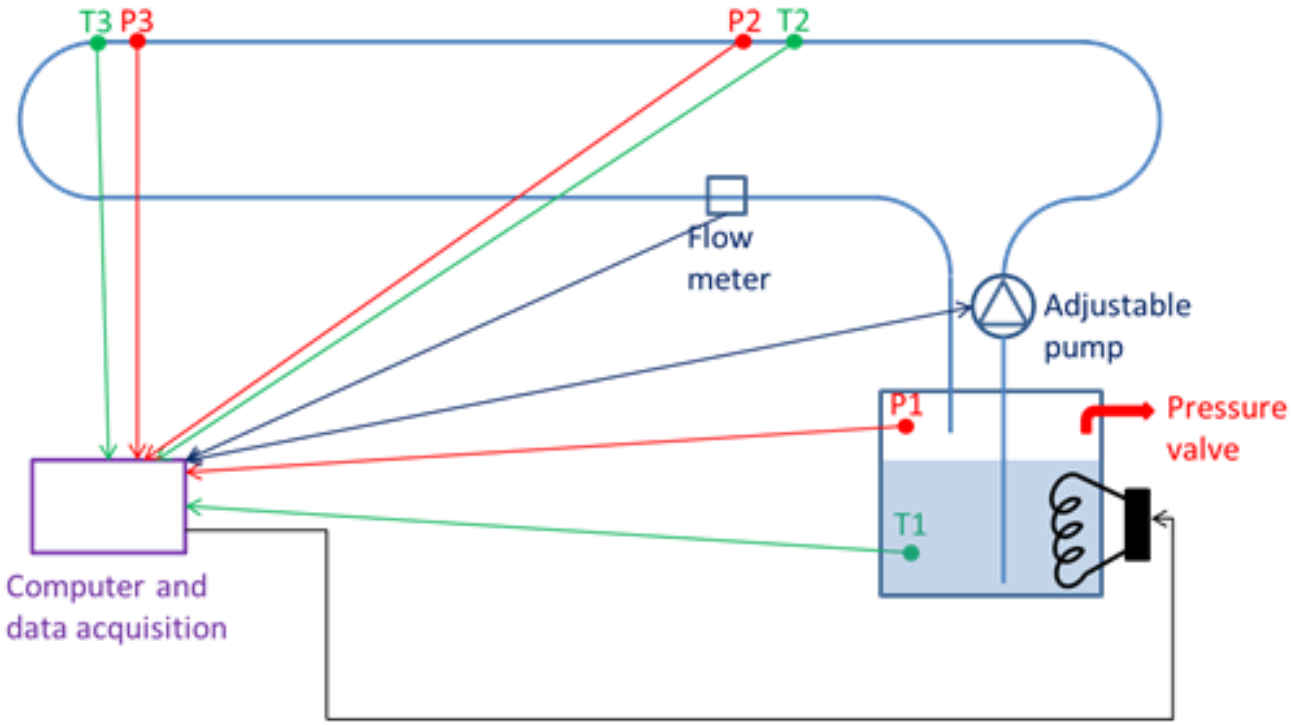
Test rig

Schematic illustration of the test facility at Aarhus University



Partners and schedule of DRA testing

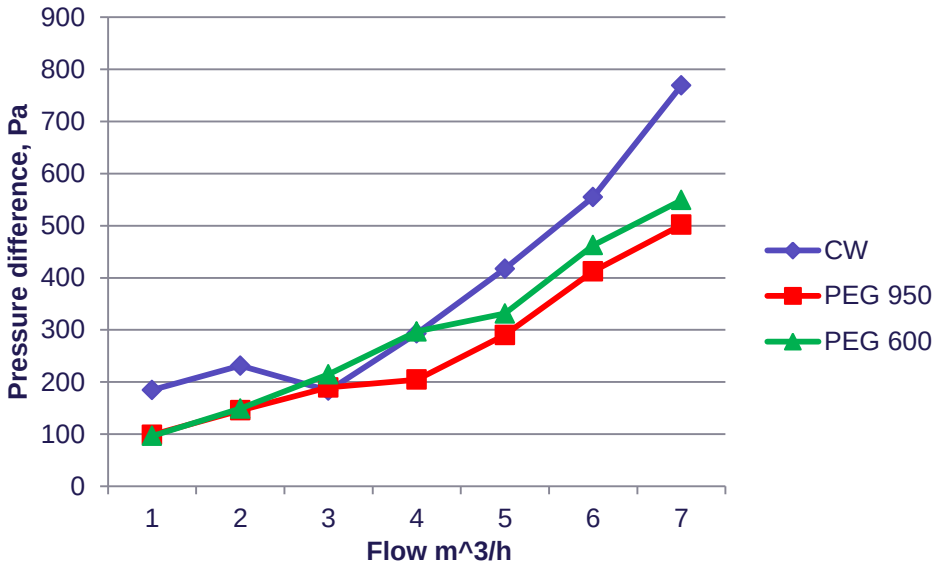
Person	Company
Mogens Hinge	Aarhus University
Kate Wick-Hansen	Dansk Fjernvarme
Flemming Hammer	COWI
Jesper Breuning	Provectas

Duration	Tasks
1st-2nd week	Tests with clean water
3rd-5th week	First tests of clean water with diff. temperature and flowrates
5th-7th week	Equipment calibration possible change of press. sensors
9th-12th week	Test of known polymer PEG4000
12th week-..	Tests of new made DRA

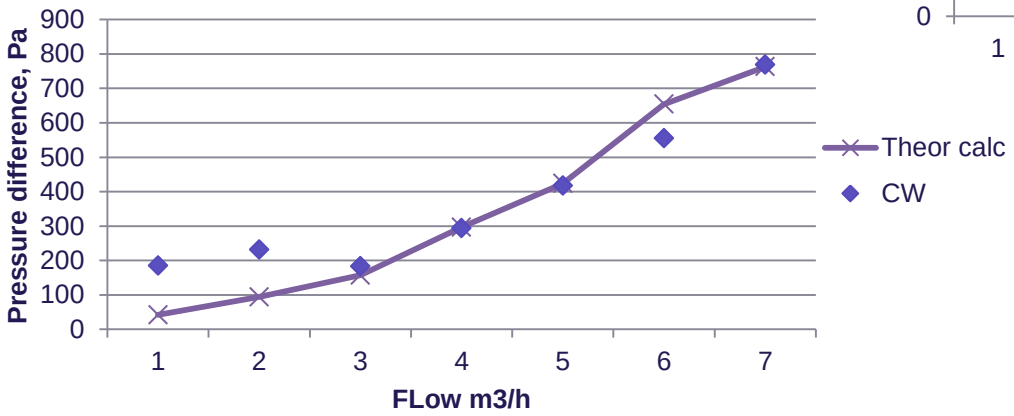
Results of preliminary test

- Gauge pressure 1bar
- Clear friction reduction average of 30%
- Good correspondence between exp. and num. data

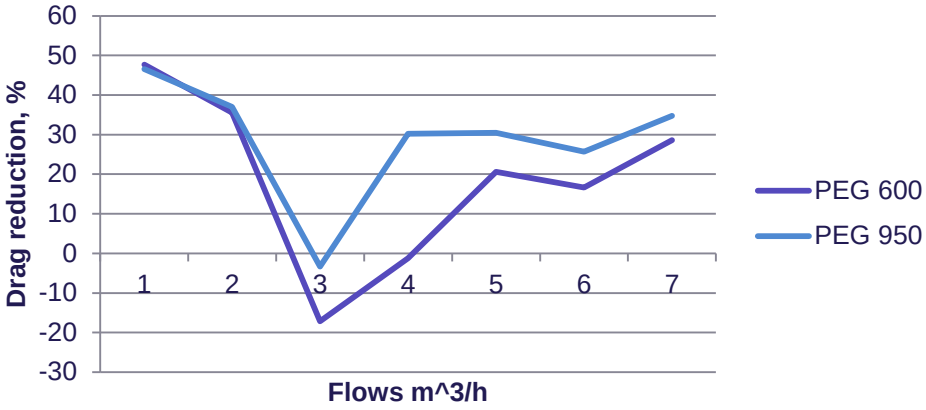
Clean water vs PEG

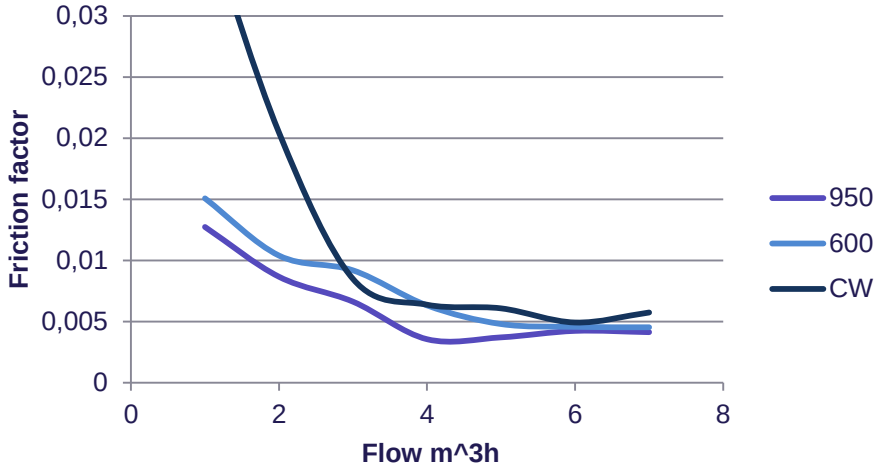


Experimental vs numerical data



Drag reduction results





Disadvantages of current installation

- Significant noise in measurement during low flows
- Low possible max velocity (0,8 m/s)
- Low possible max pressure loss (1kPa)

Desirable outcomes and plans of DRA testing

- Test 5 existing DRA candidates
- Expectations: 80% pressure loss reduction in the straight pipe
- Make test of possible DRA efficiency reduction in heat exchanger and develop measures to avoid it
- Study decrease in heat loss due to decreased turbulence
- Bring the substance to existing DHN

Conclusions

- Make 4th gen district heating more easily accessible and financially attractive
- Decrease energy consumption and reduce heat losses of distribution systems from approximately 20% to 10% of the produced heat
- Development of algorithm and procedure for evaluation of energy saving measures.

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