



OPTIMIZATION OF DISTRICT HEATING WITH FOCUS ON DRAG REDUCING ADDITIVES

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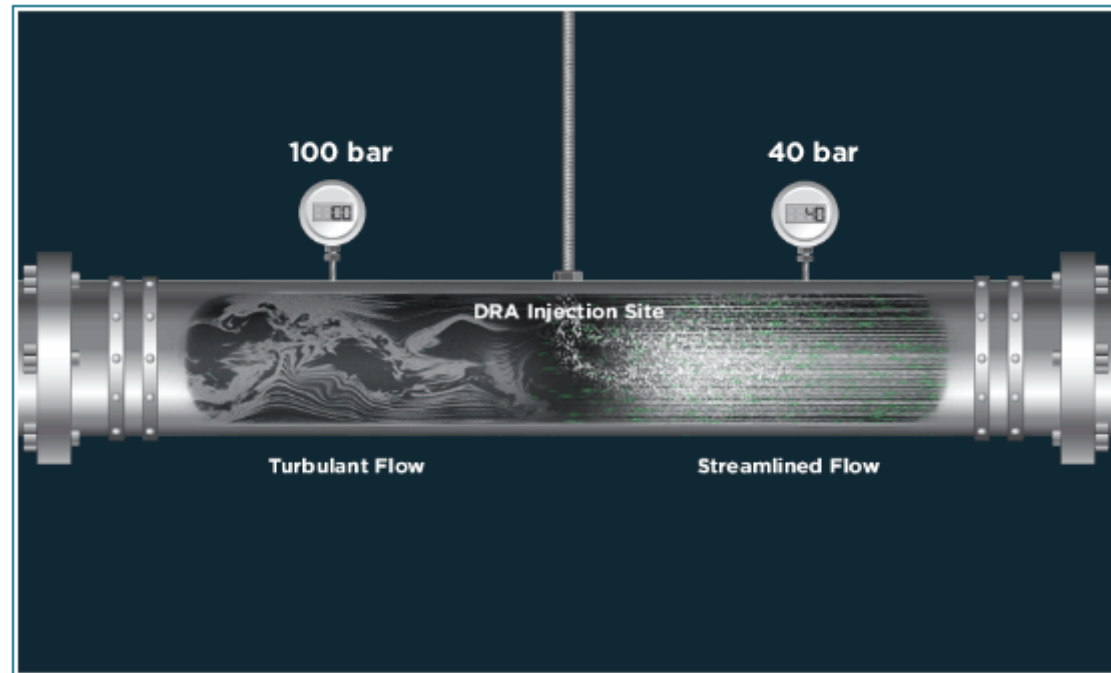


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Drag reducing additives



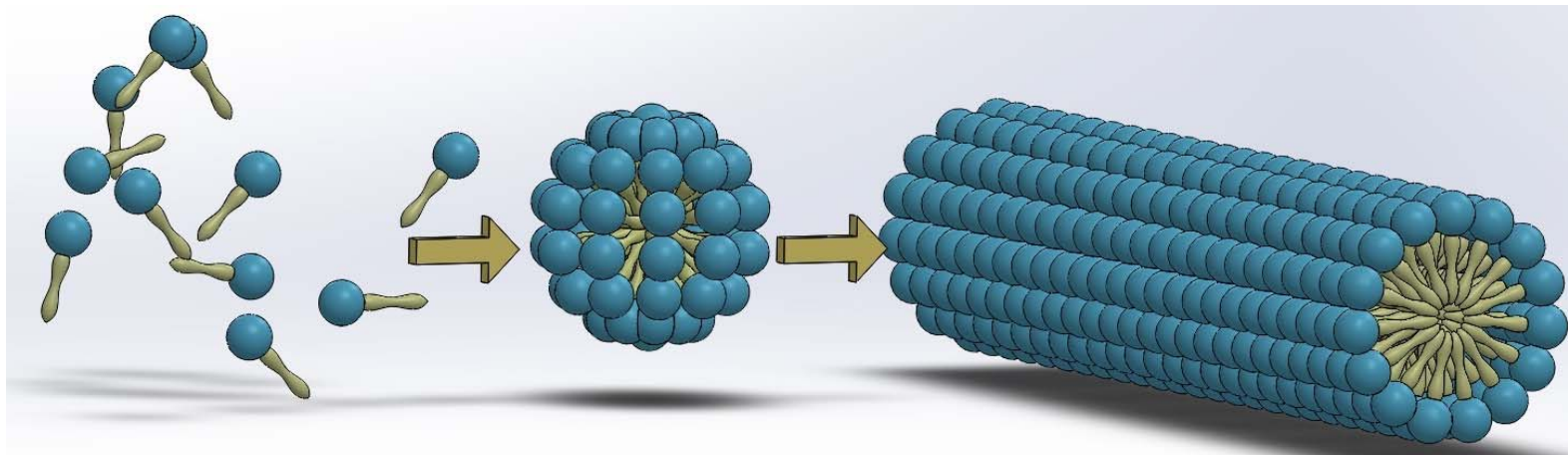
- **Polymers**
- **Fibers**
- **Surfactants**



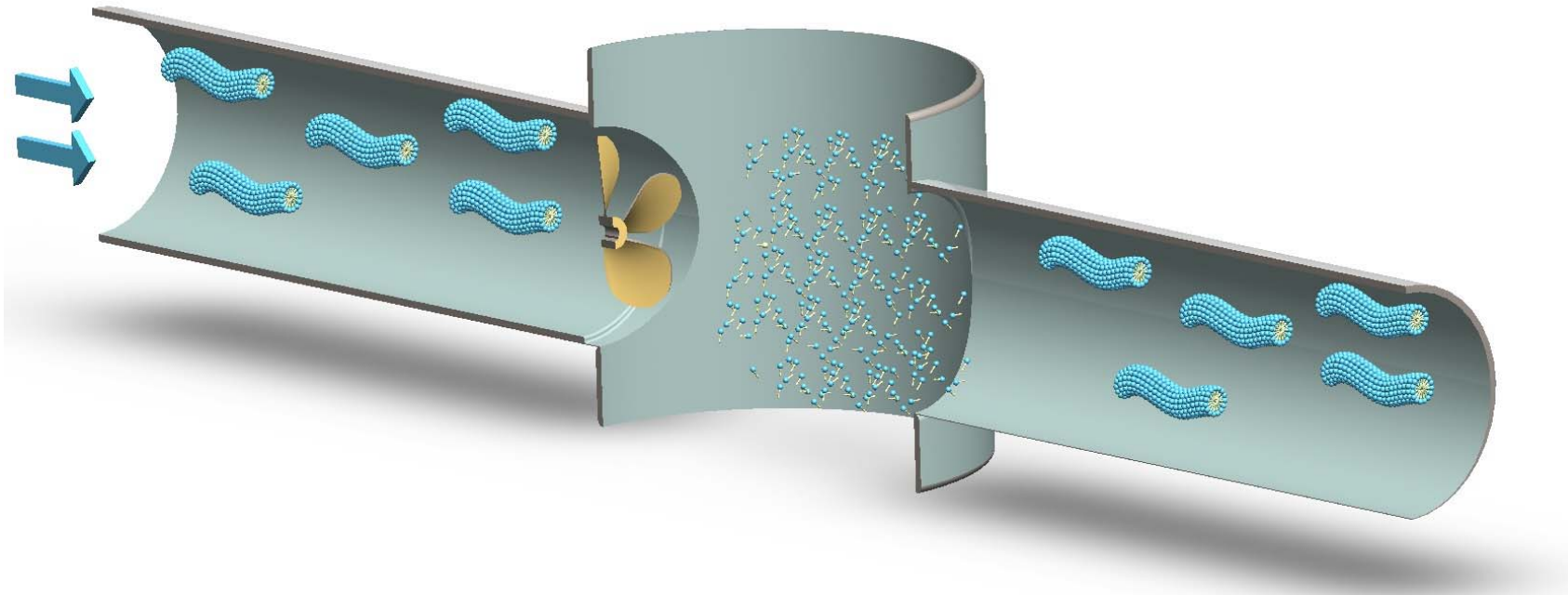
Drag Reducing Additives



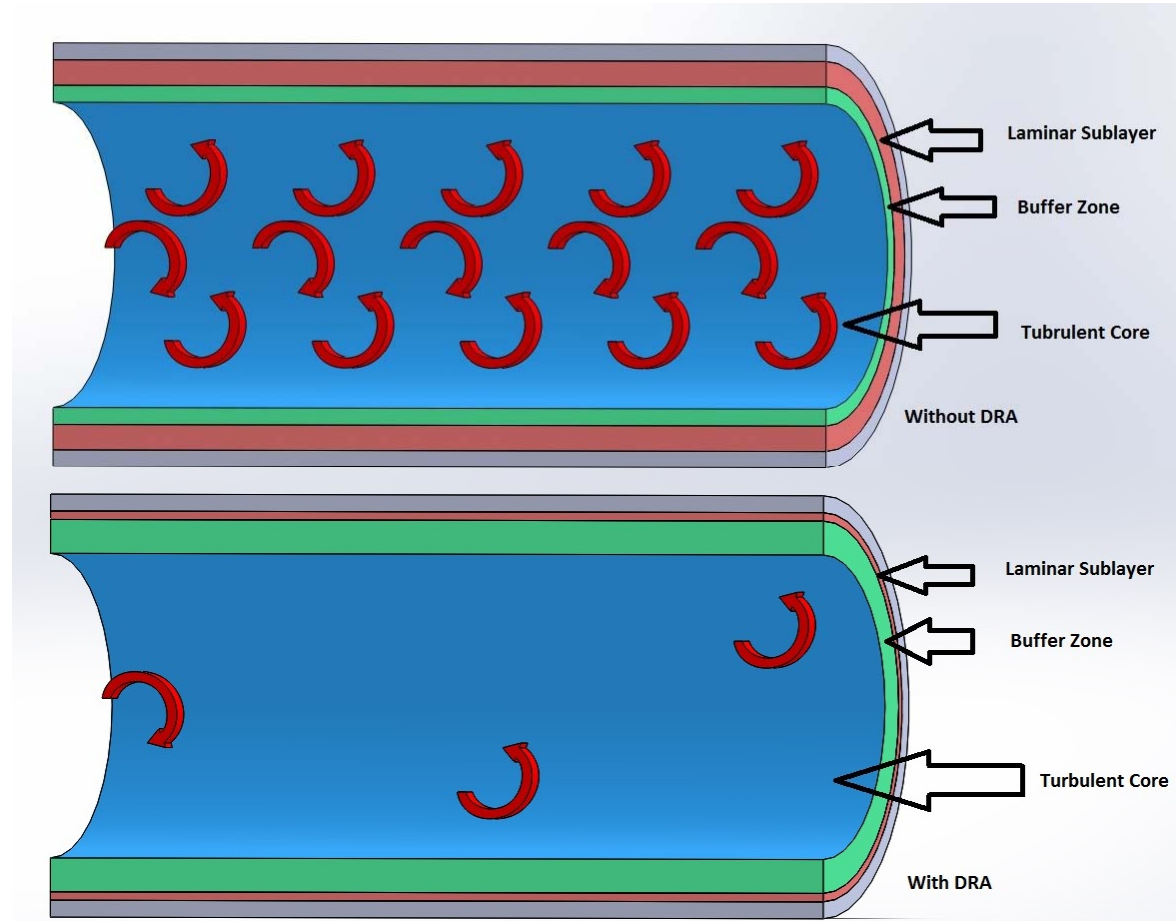
Formation of surfactant based DRAs



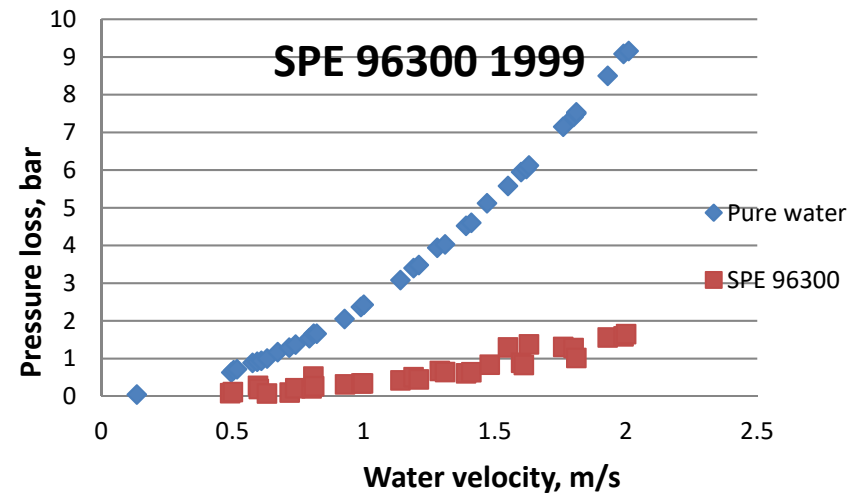
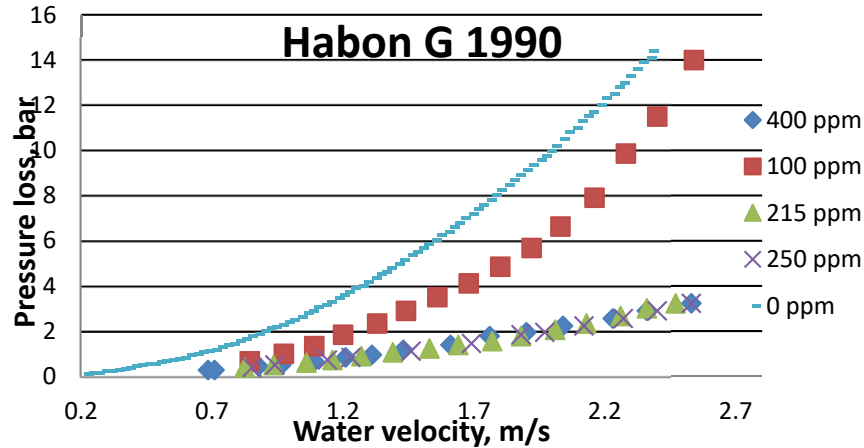
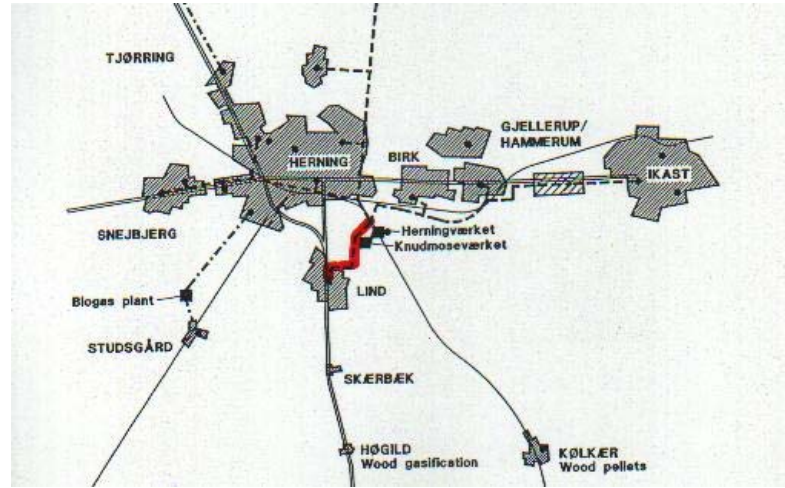
Reformation of surfactants after break



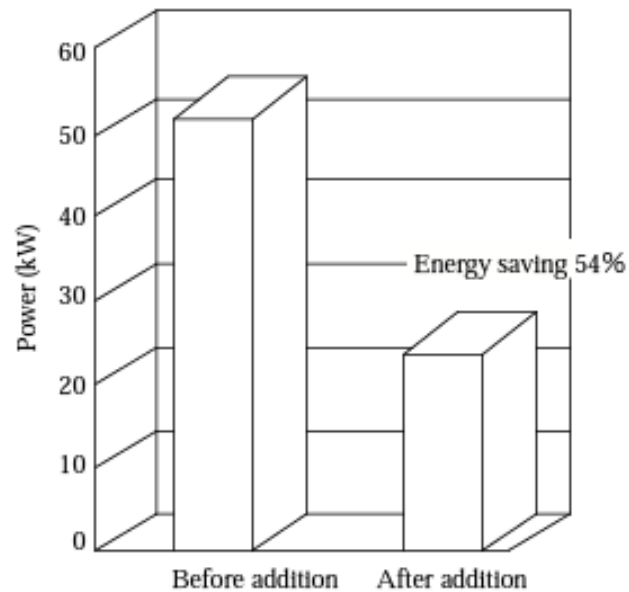
DRA working principle



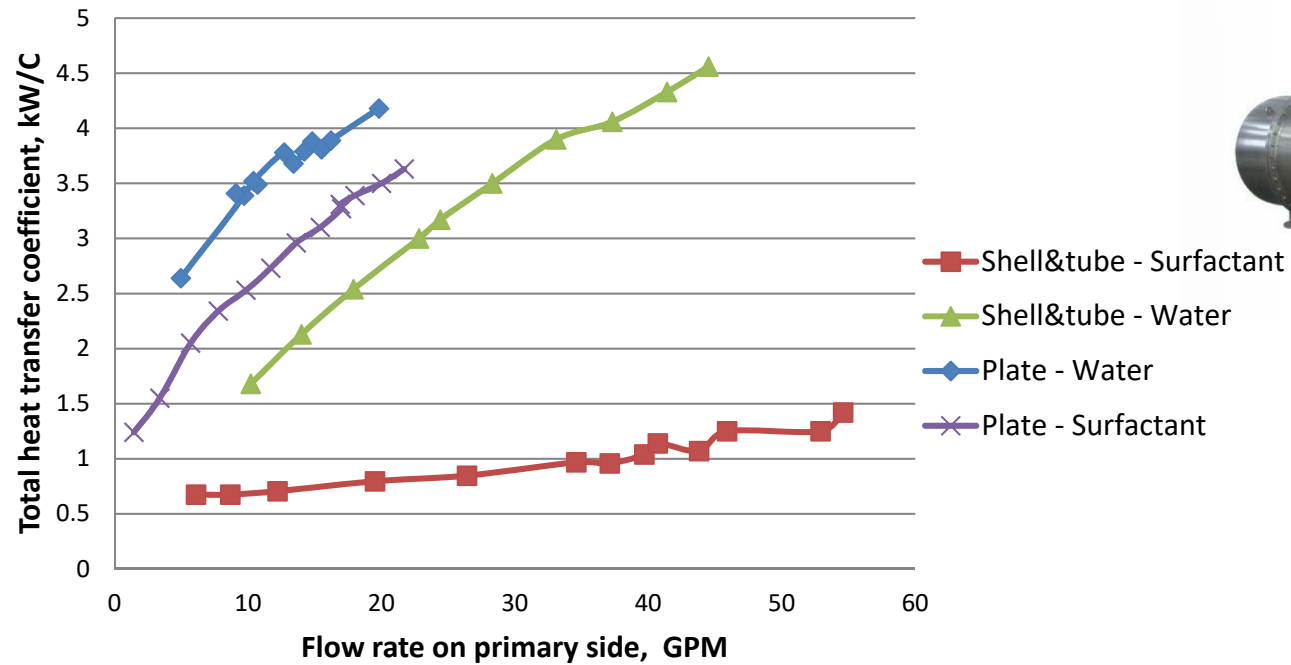
Large scale test in Herning



Large Scale test in Sapporo Japan



Heat transfer reduction



Methods of enhancing HTR



- **Modify inner surface of heat exchanger**
- **Temporal degradation of surfactant structures**
 - i. insertion of small destructive devices**
 - ii. ultrasonic energy to destroy surfactants**
 - iii. photorheological surfactants**

Intentional mechanical degradation of surfactants

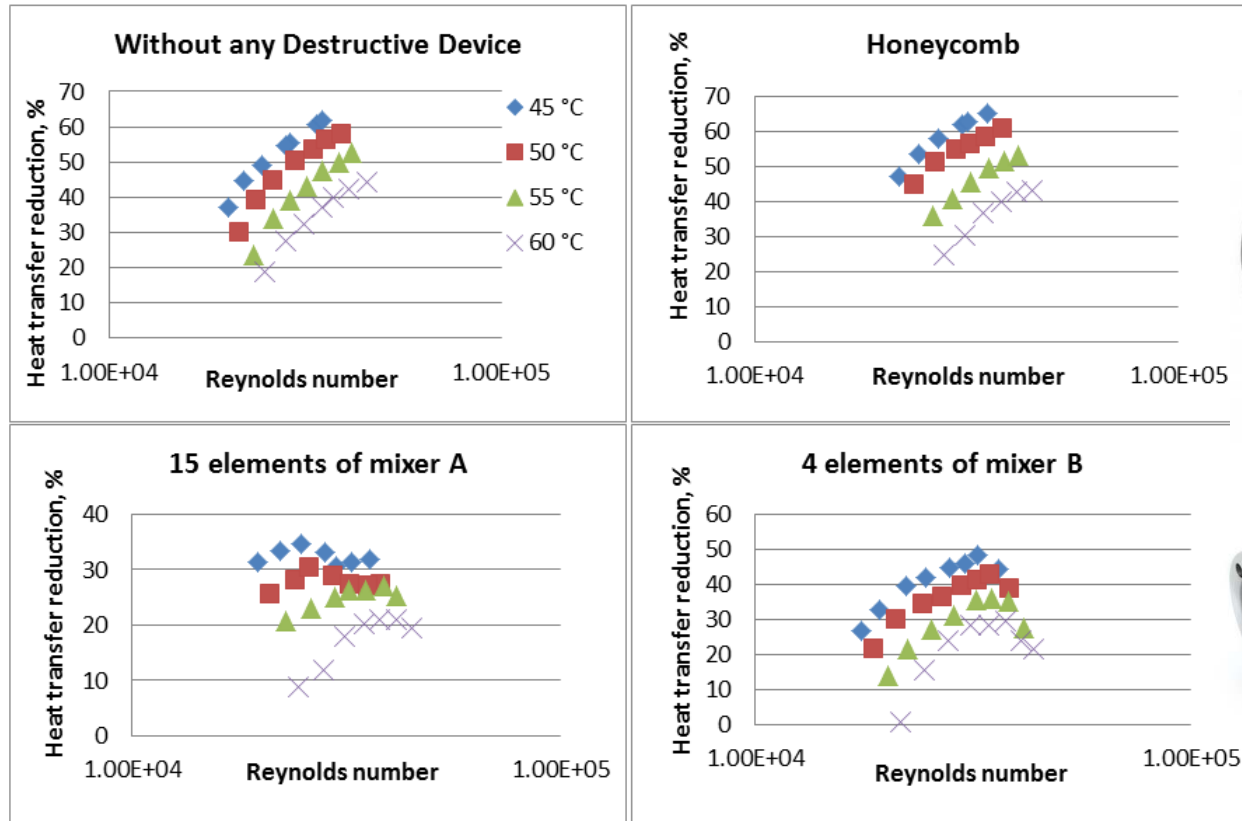
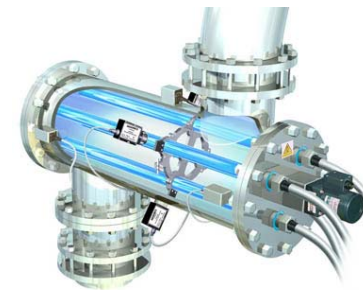
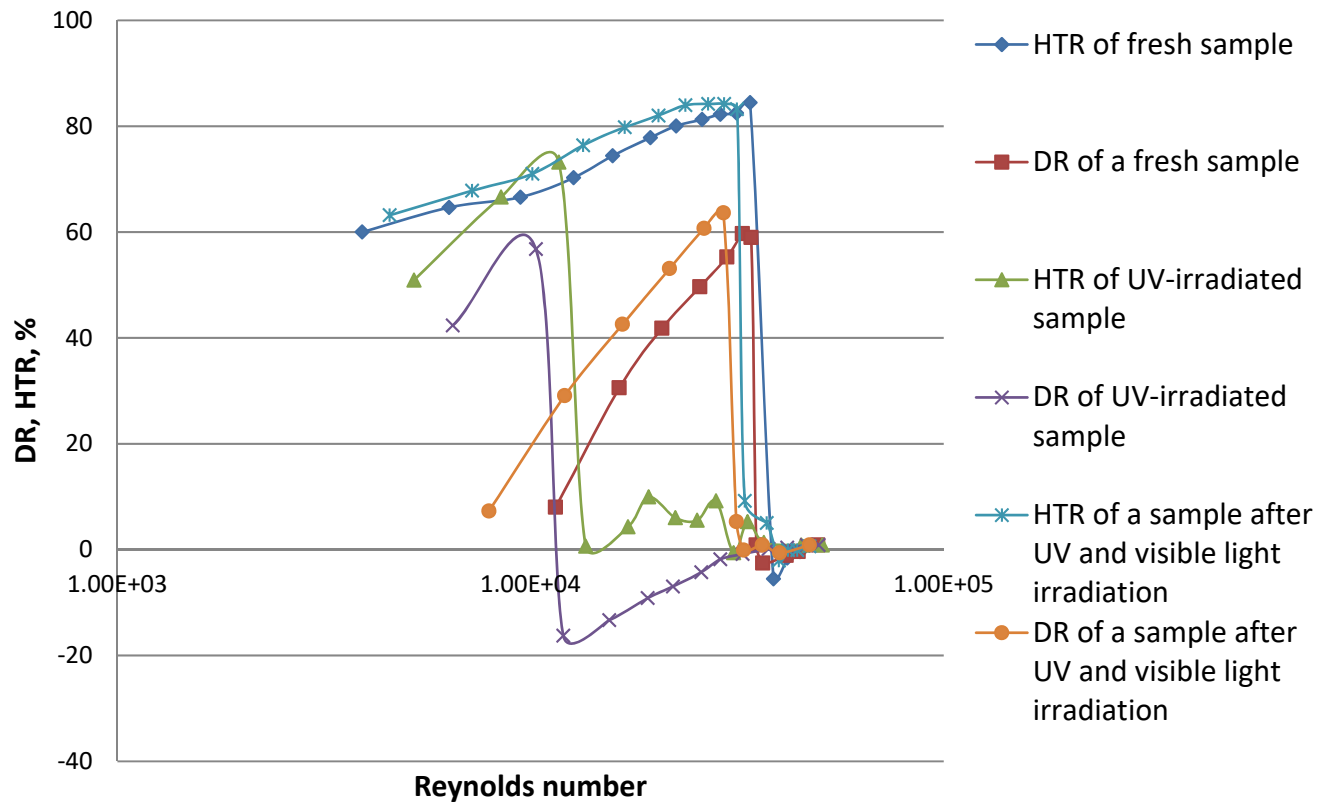
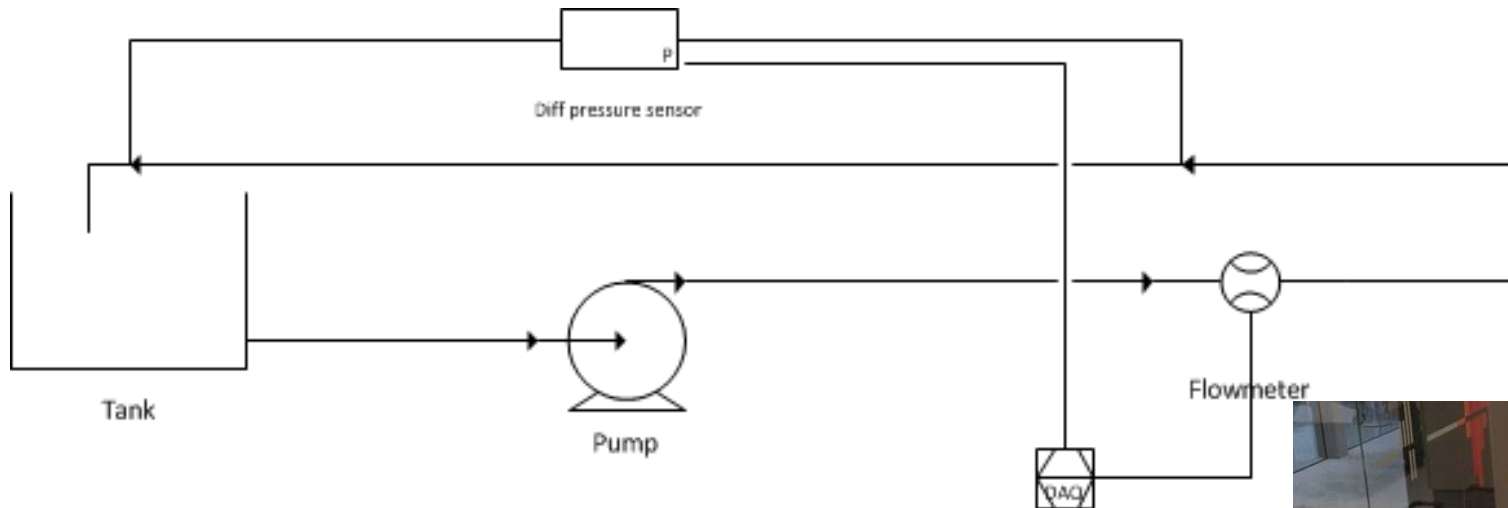


Photo reversible surfactant



Test rig in Aalborg University



Equipment List

Displayed Text	Description	Manufacturer	Model
Pump	Multistage,centrifugal	Grundfos	CR 10-9 A-A-A-E-HQQE
Tank	Open tank		
Flowmeter	Ultrasonic	Burkert	Type 8081
Differential pressure sensor	Piezoresistive	HF Jensen	PDS 0-0.3



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3rd international conference on
SMART ENERGY SYSTEMS AND 4TH GENERATION DISTRICT HEATING
Copenhagen, 12-13 September 2017

www.4dh.eu

www.reinvestproject.eu

www.heatroadmap.eu

Theoretical study



$$DR = \frac{f_w - f_s}{f_w} \cdot 100\%$$

$$HTR = \frac{Nu_w - Nu_s}{Nu_w} \cdot 100\%$$

Future scope of work



- **Carry out tests of new surfactant**
- **Complete theoretical investigation of heat transfer reduction of DRAs**



4DH

4th Generation District Heating
Technologies and Systems



Thank you for your attention

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