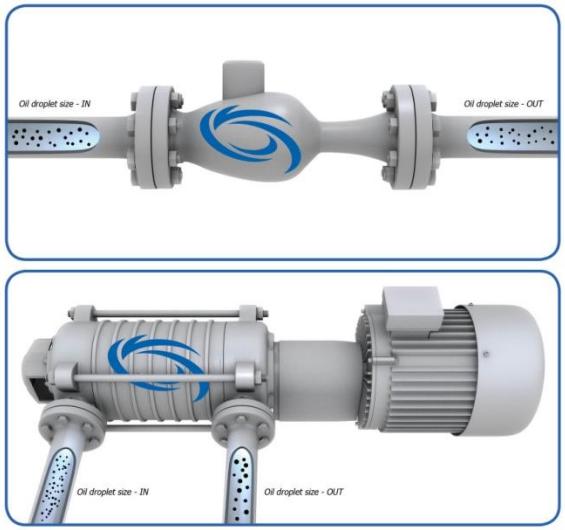
TYPHONIX AS

Next generation process flow control solutions

Development of a New Separation Friendly Centrifugal Pump



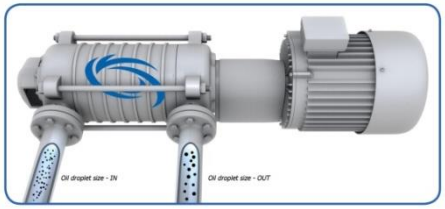
Niels van Teeffelen (niels.teeffelen@typhonix.com)
TEKNA Produced Water Management 2015

Presentation Overview

- Company
- Technology Background
- Pump Development
- Prototype Testing
- Test Results
- Overall Conclusion
- Benefits

Company

Low Shear control & choke valves



Low shear pumping solutions

Multiphase sampler

3-Phase Lab testing facilities

Sponsors:

eni norge

Statoil

mokveld

ConocoPhillips

Shell

Total

GDF SUEZ

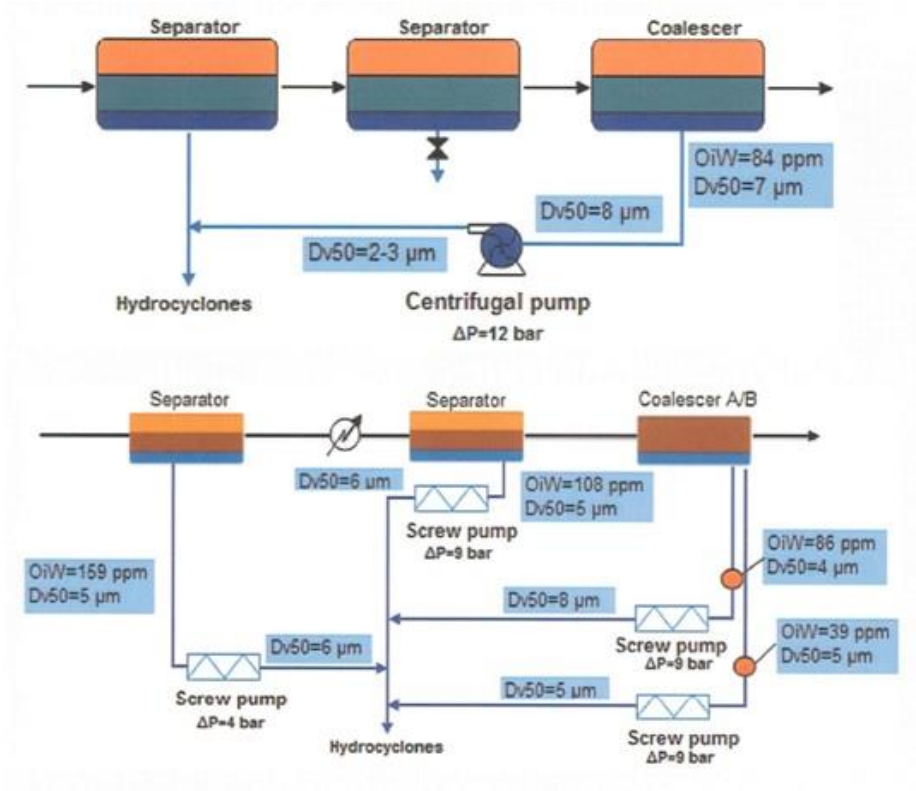
Petrobras

Forskningsrådet

Innovation Norway

Technology Background

Field experience with produced water pumping



Ref. Mator, Tekna Conf. PW 2010

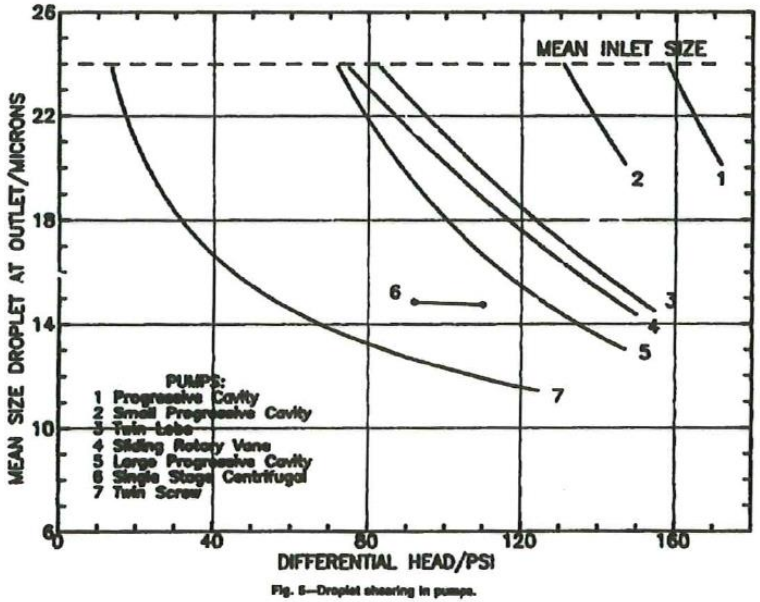


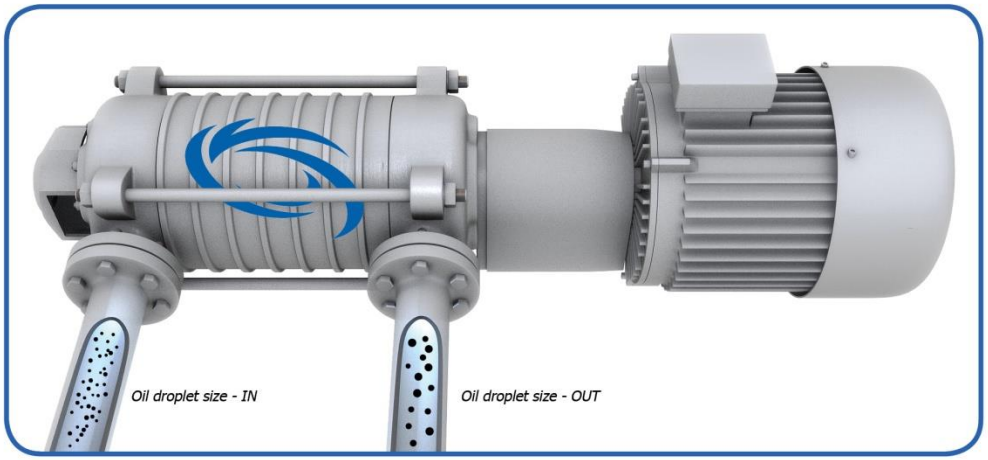
Fig. 5—Droplet shearing in pumps.

Flanigan et al. 1988

Development project

Project goal:

Develop a separation friendly multi-stage centrifugal pump for produced water applications



Statoil

GDF SUEZ

Forskningsrådet

ConocoPhillips

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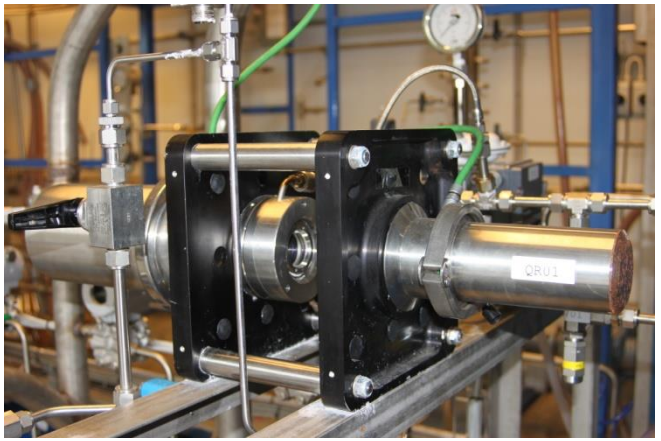
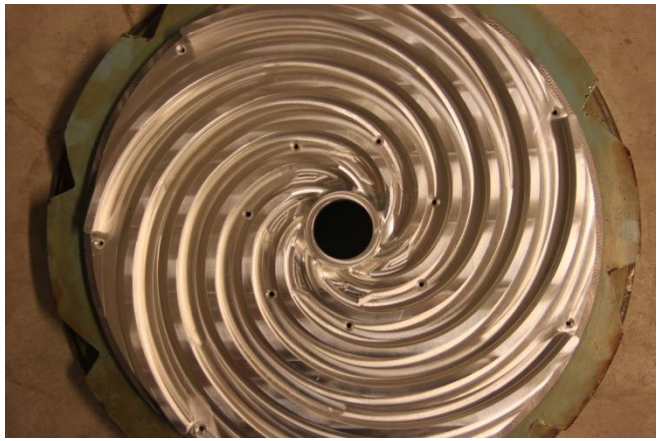
Test rig





Testing Parameters

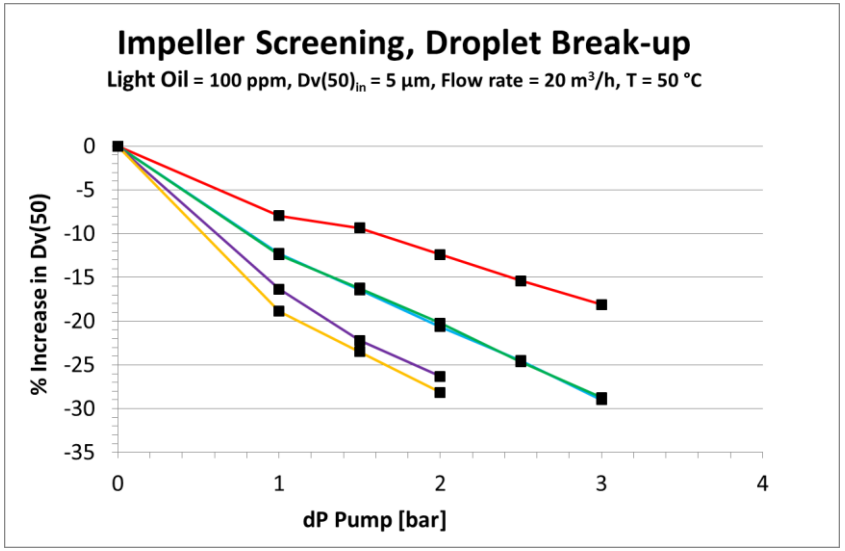
Determine the influence of pump geometry, operating and process conditions on oil droplet break-up.

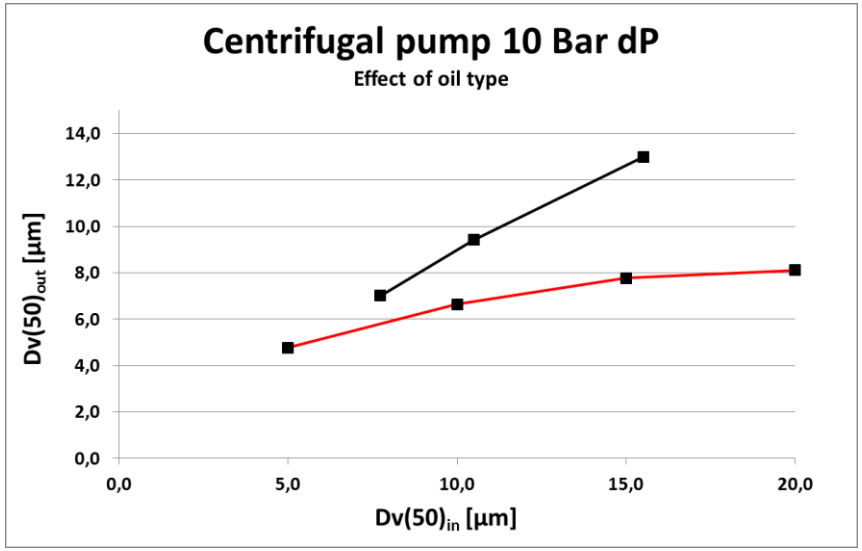
- Impeller geometry
- Diffusor geometry
- Pump differential pressure
- Inlet OiW concentration
- Inlet droplet size
- Crude type
- Water Salinity
- Etc.

Some Results

Pump development project:

- 17 different test set-ups.
- More than 4000 test-points.



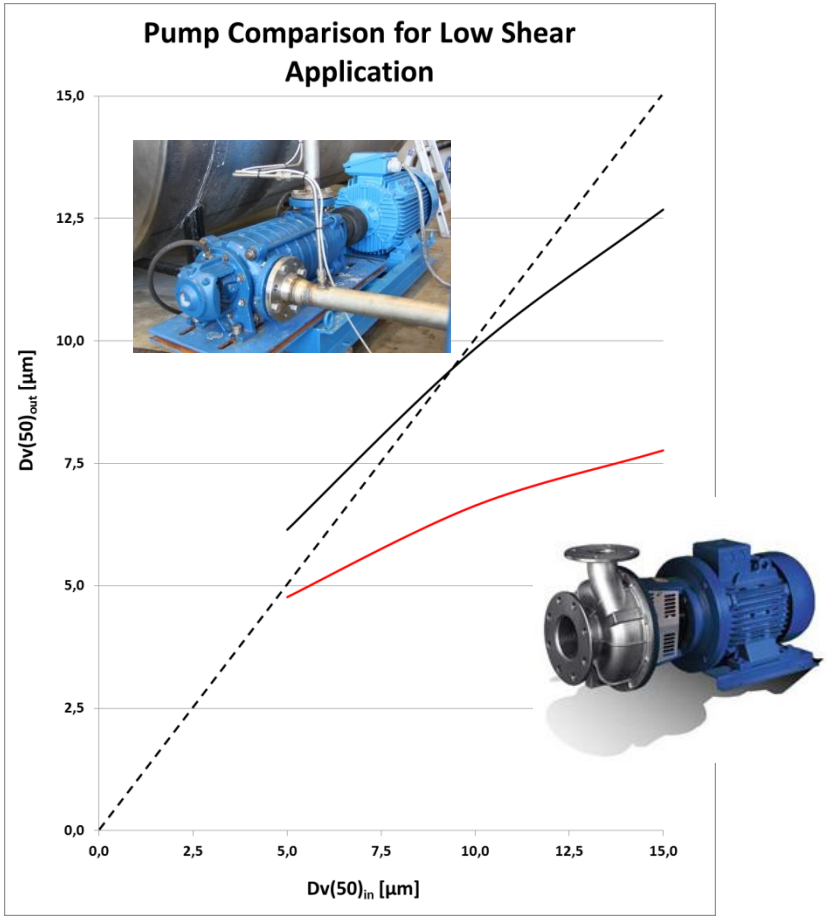


Design established

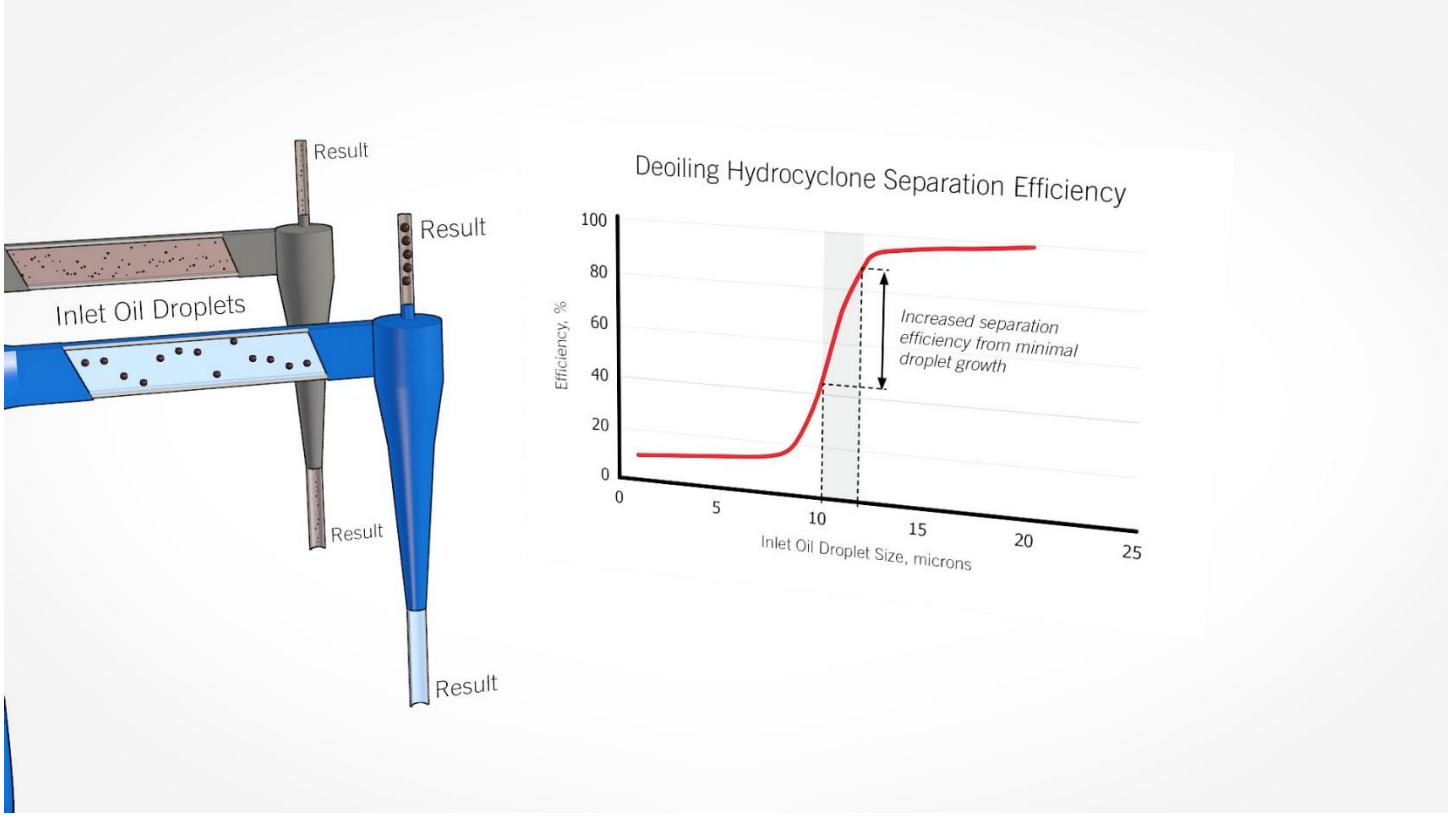
Low shear multi-stage centrifugal pump design established

Input:

- Pump head
- Capacity
- Inlet droplet size (Dv50)
- API crude
- Allowed droplet size reduction



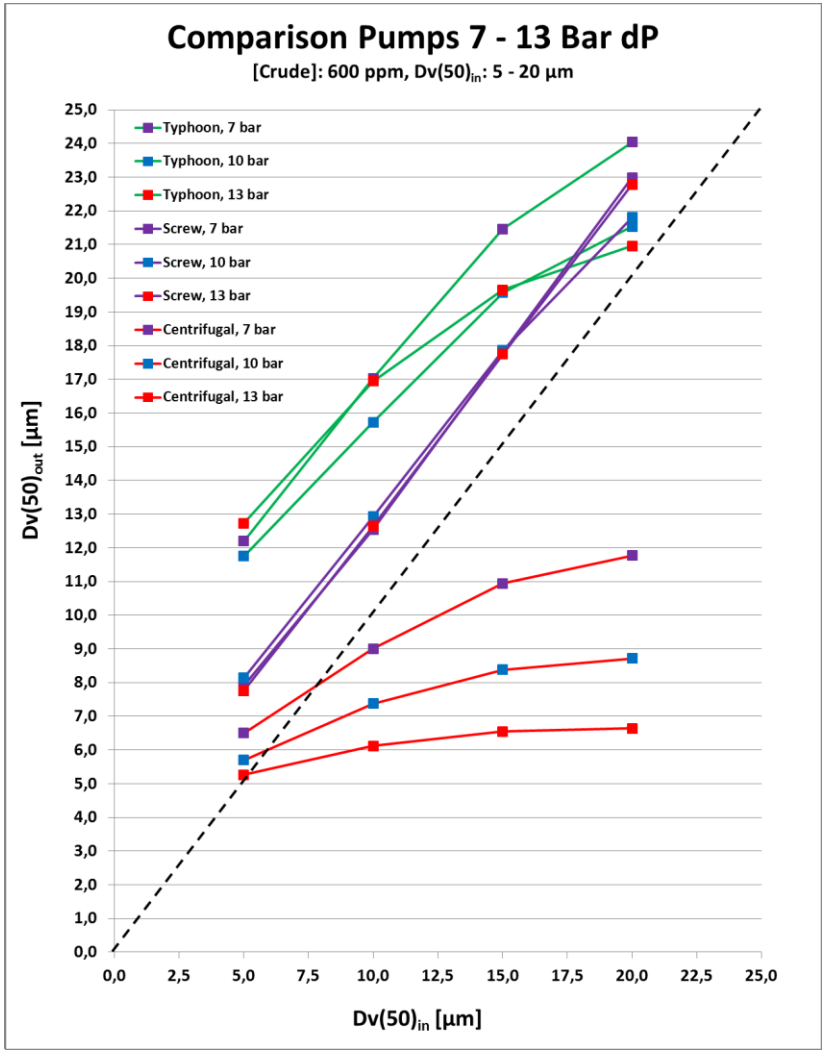
Process Benefits



From Low Shear to Coalescing

- Control shear level to obtain coalescence
- Collision based coalescence dependent on:
  - OiW concentration
  - Inlet droplet size
  - Turbulence intensity
  - Fluid viscosities

Early results



Prototype

Specifications:

- Capacity: 60 m³/h
- Differential Head: 150 m

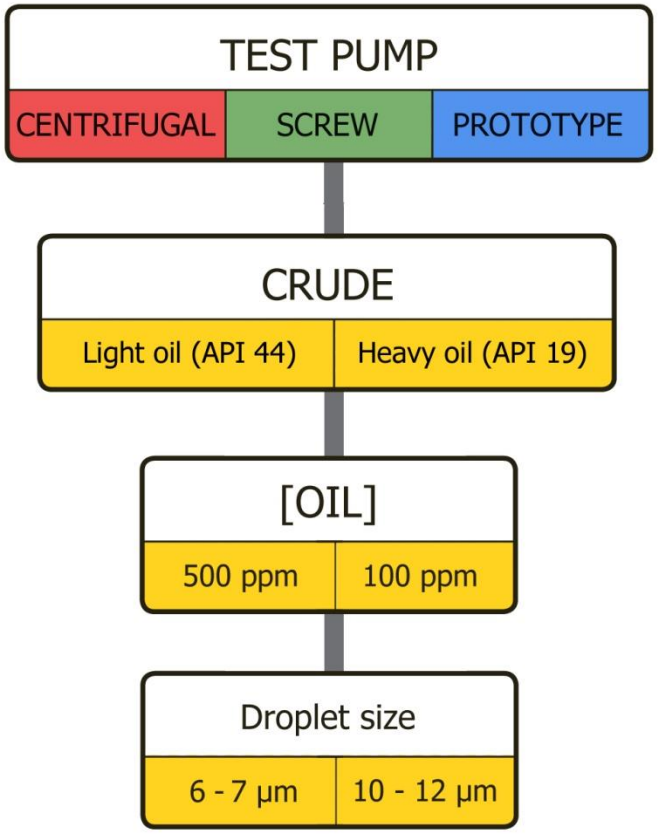
Performance parameters:

- Outlet droplet size
- Hydrocyclone efficiency
- Hydraulic efficiency

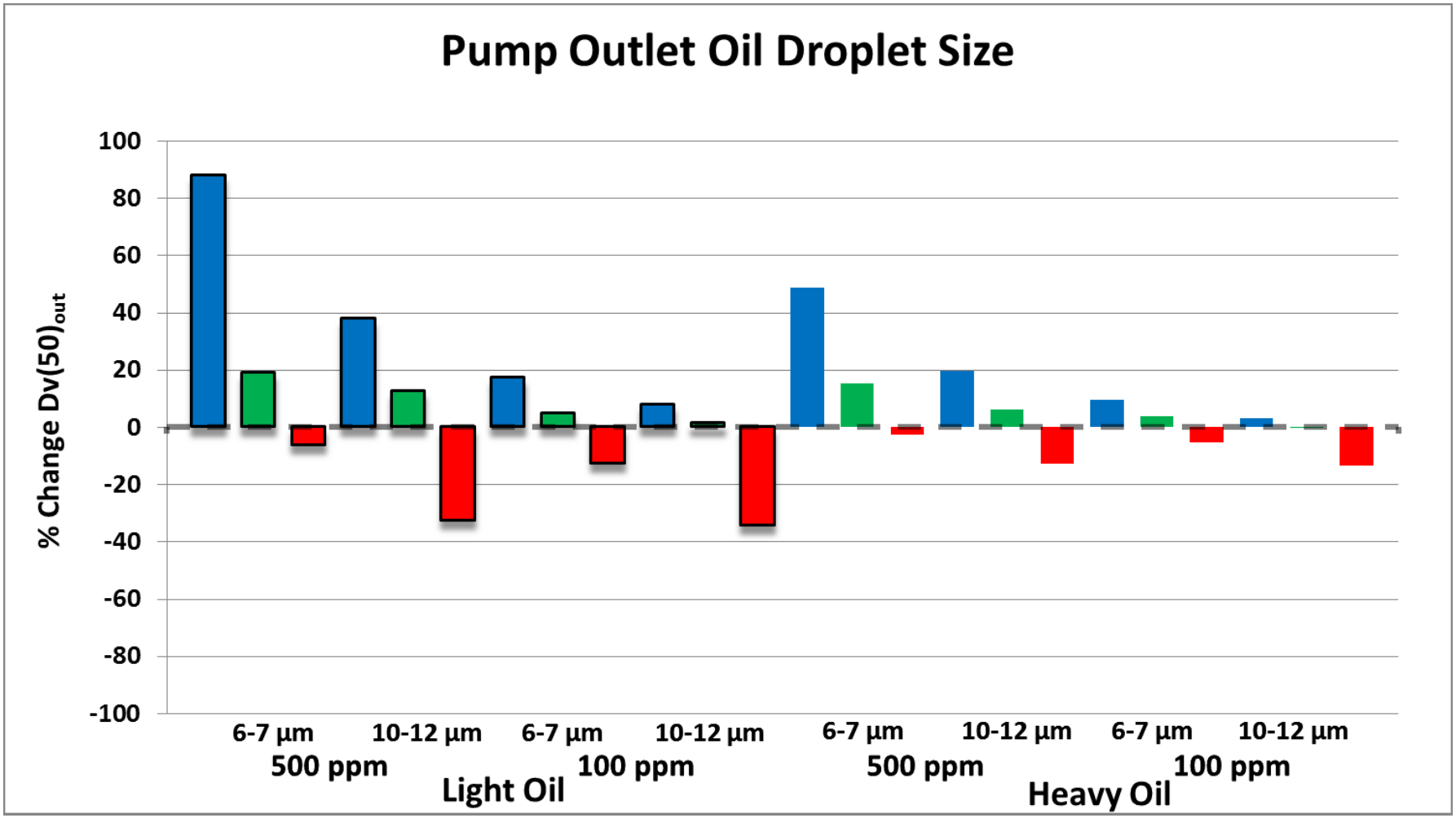
Comparison:

- Progressive cavity pump
- Single stage centrifugal pump

Prototype Testing



Test results – Outlet droplet size



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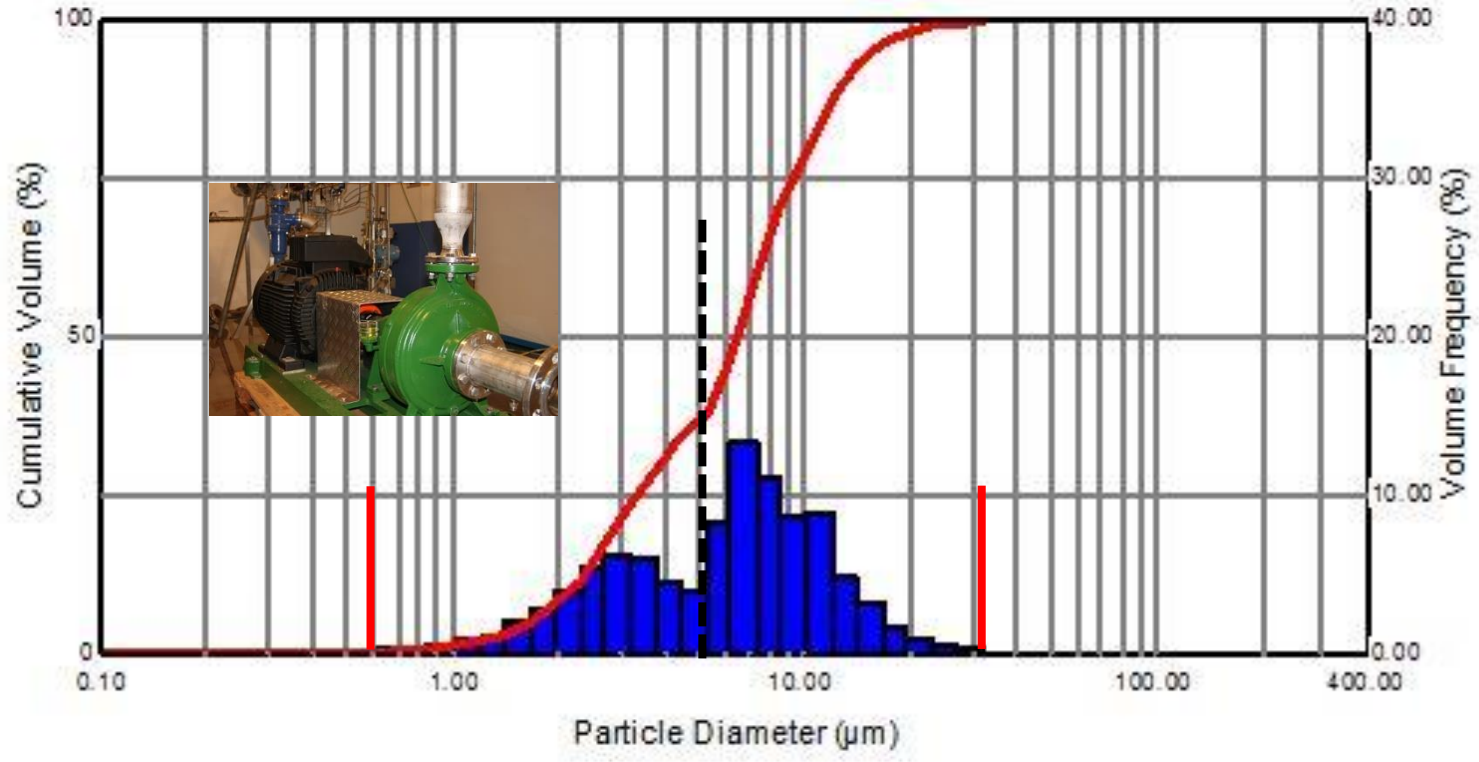

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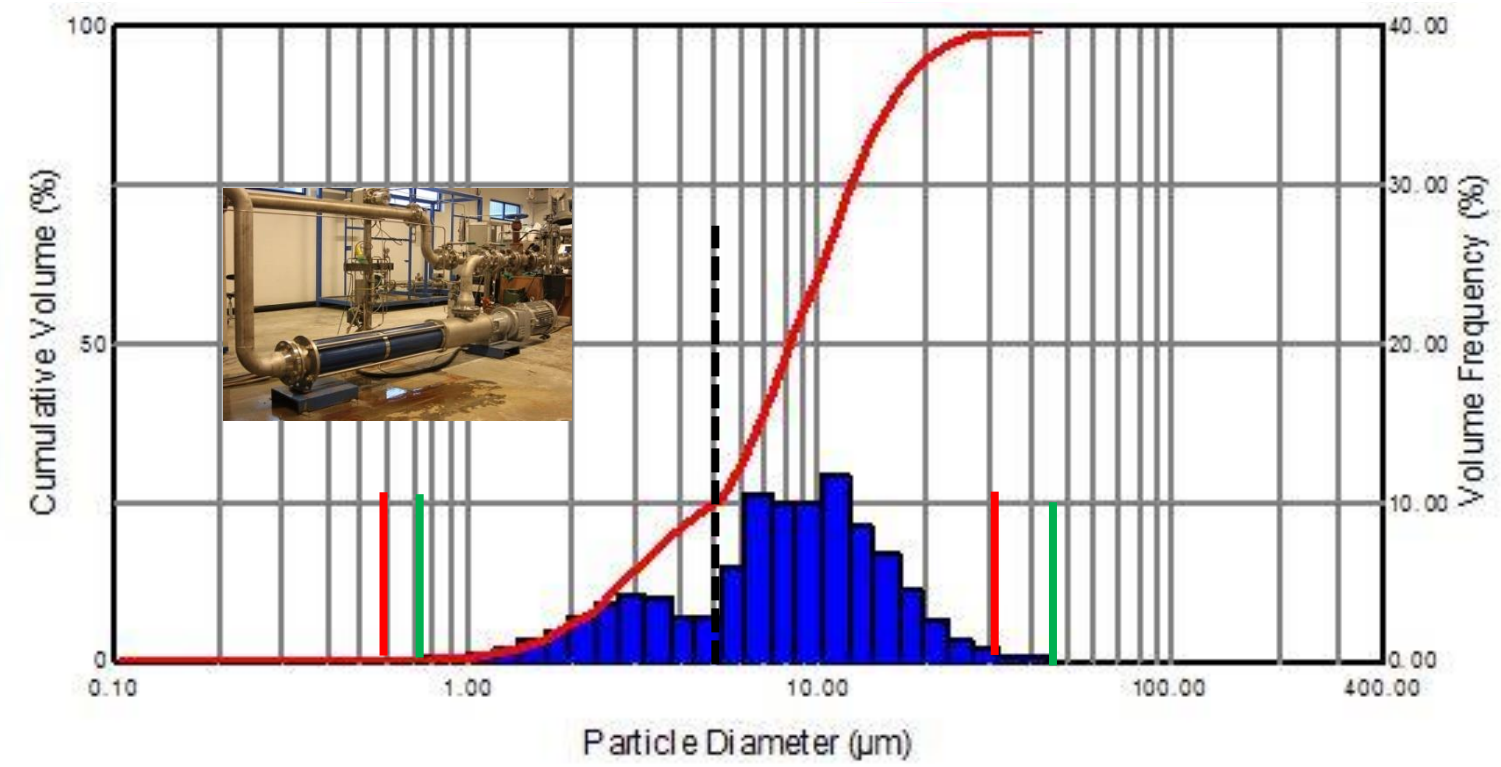
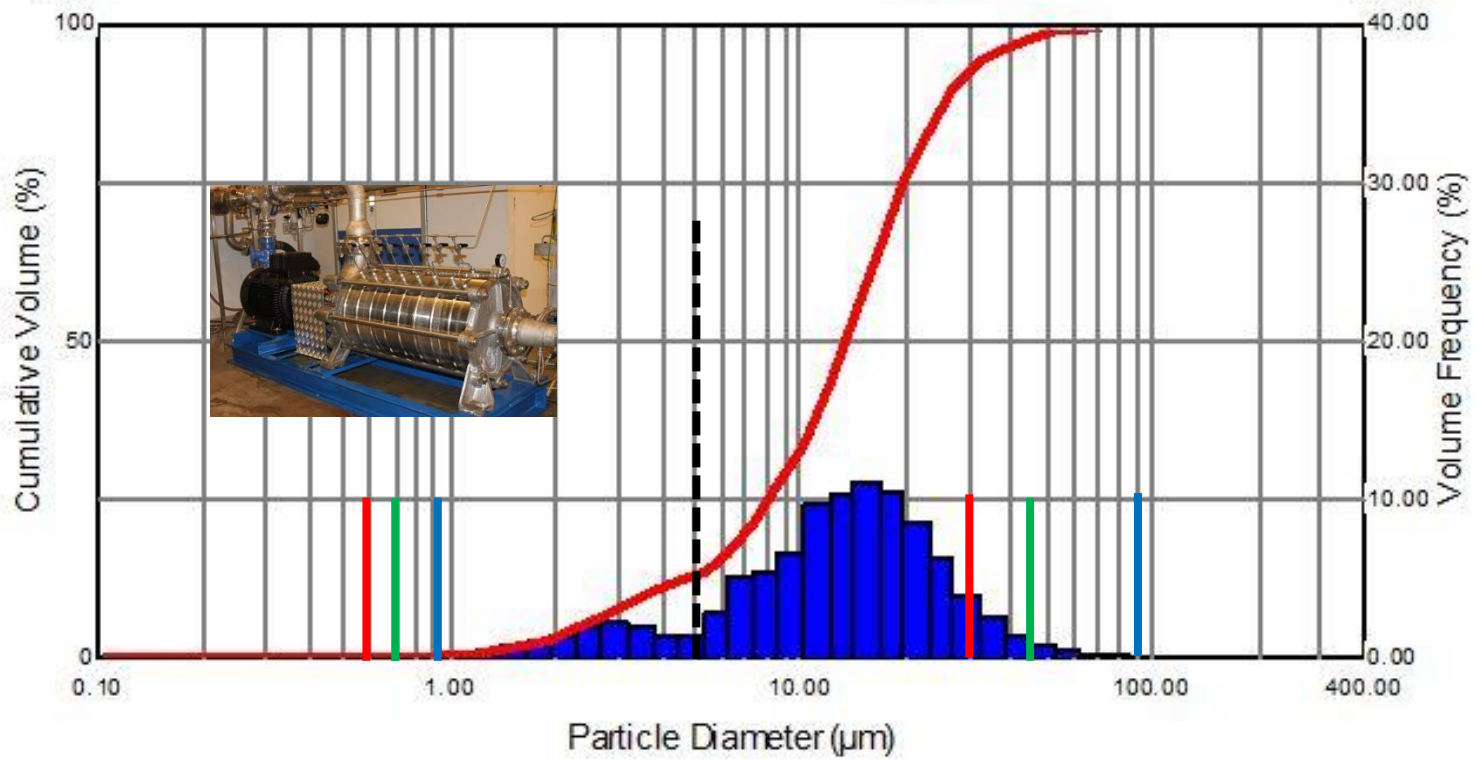
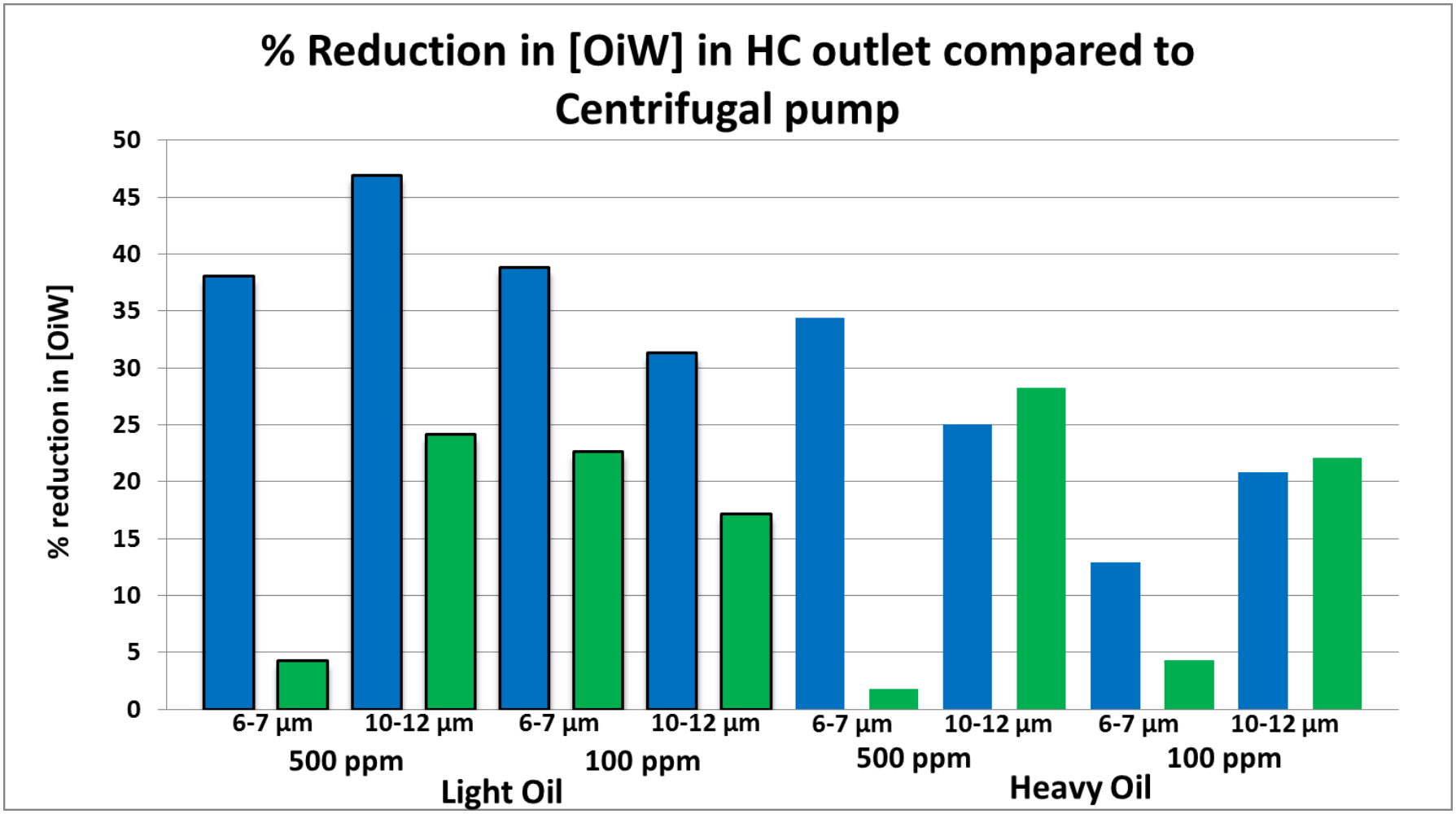


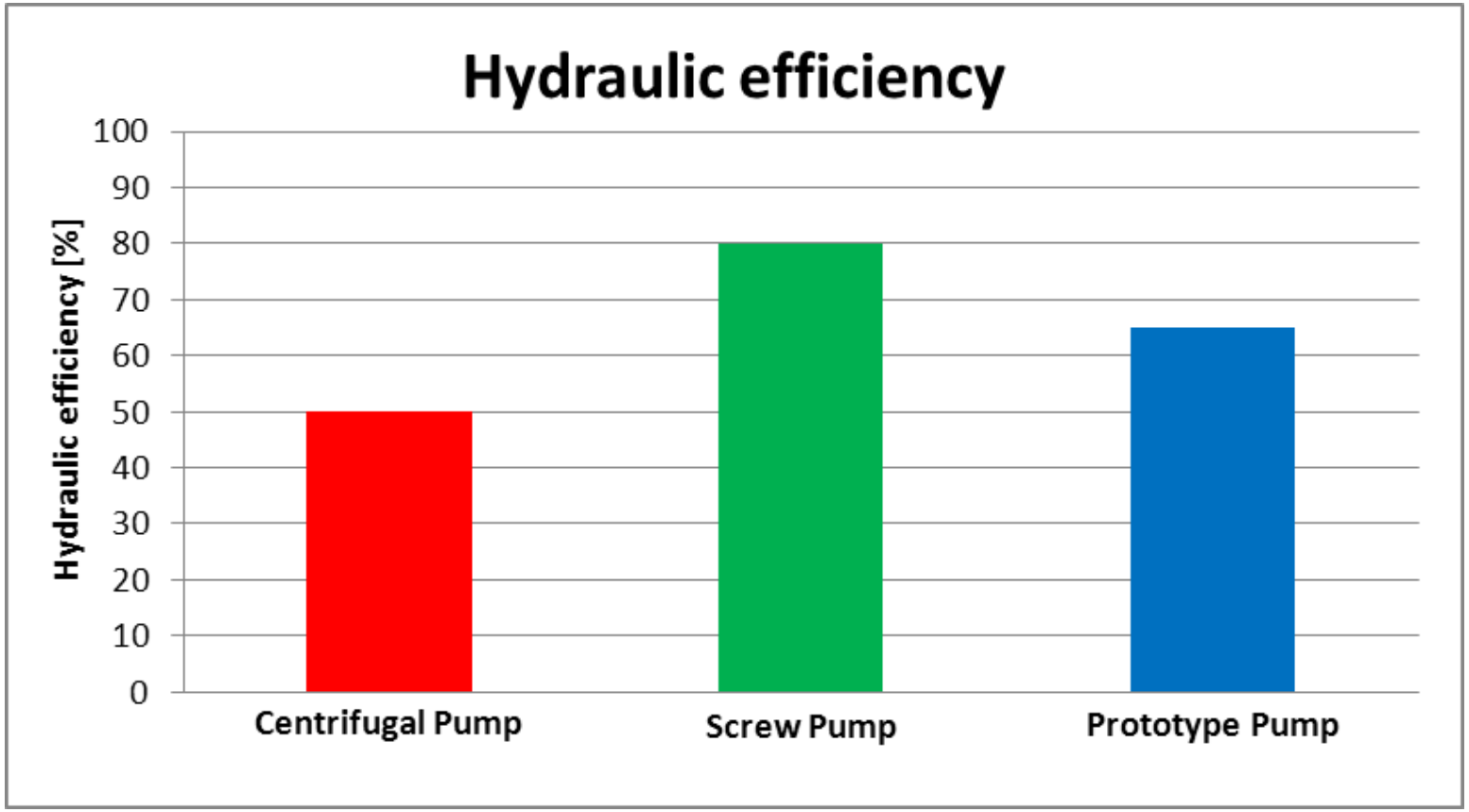
Test results – Outlet droplet size



Test results – Effect on HC efficiency



Test results – Hydraulic efficiency



Conclusions

- The coalescing pump significantly increases oil droplet size
  - Coalescence is increased with increasing oil concentration
  - Coalescence is increased with reducing inlet droplet size
- The coalescing pump significantly increases hydrocyclone efficiency
- The coalescing pump has significantly higher hydraulic efficiency than a single-stage centrifugal pump

- Coalescing low shear multi-stage centrifugal pump – ready for first use

Benefits

- Increase performance of d/s produced water treatment equipment.
- Less oil in produced water.
- Both Low Shear and Coalescing
- Better suited to handle upsets.
- Robust and Reliable pump type, High Mean Time Between Failure.
- Low maintenance load.
- Less need for chemicals.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cleaner production