



Separation of MEG and its impact on produced water handling

Produced Water Workshop 2021
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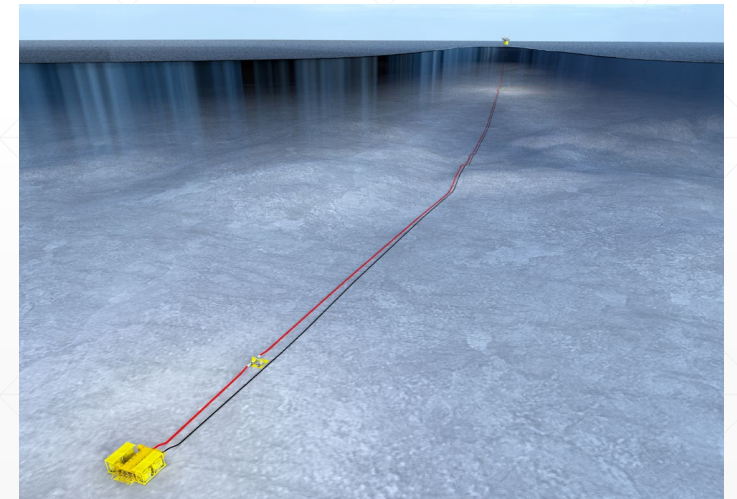
Outline

- Use of MEG in production
 - Technology assessment & qualification - Influence of MEG on water quality
 - Technology screening
 - Test results from batch separation testing
 - Test results from produced water handling
 - Recommended measures to meet treated water discharge specification
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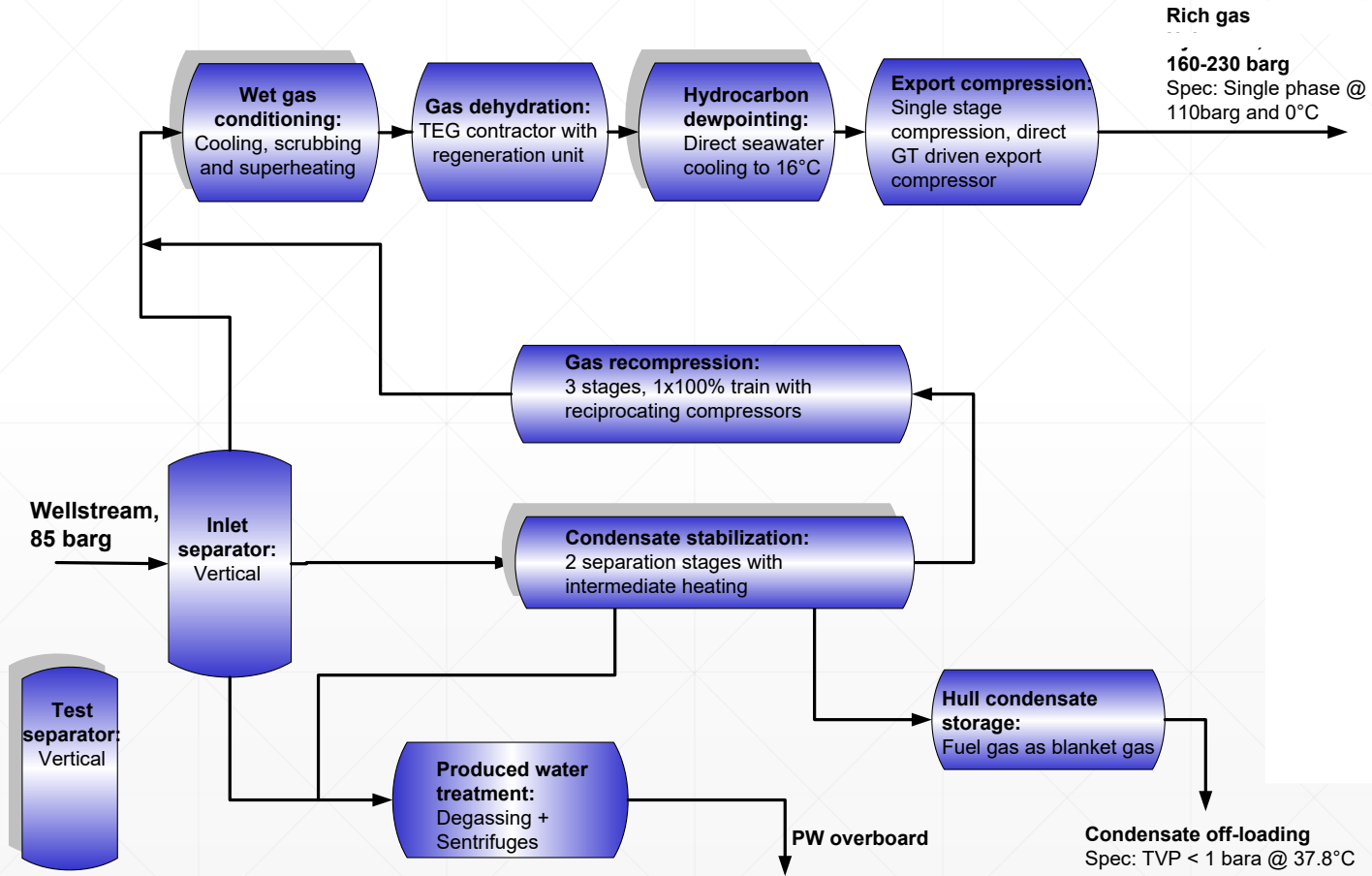
Tie-back of gas field to existing installation

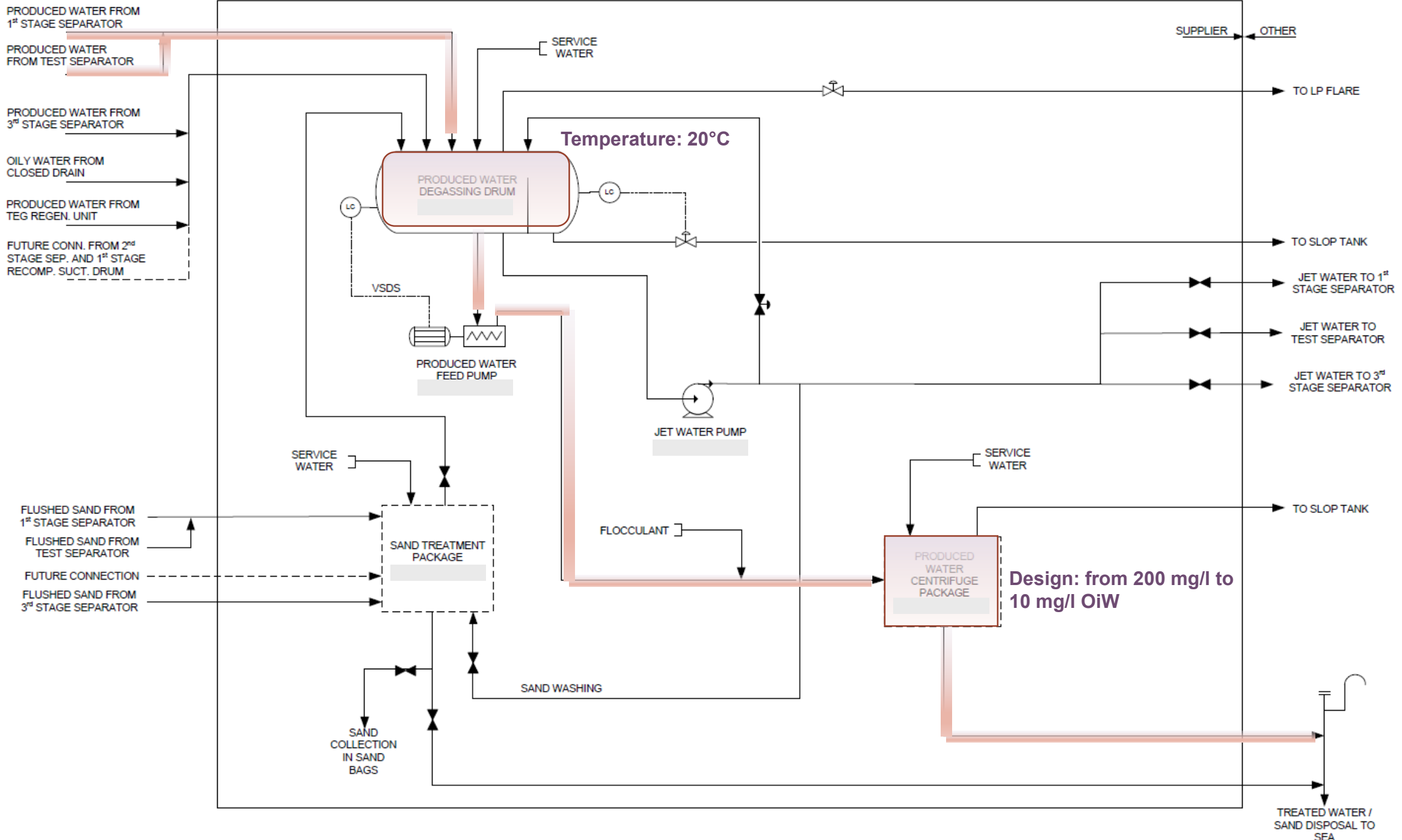
Development concept –tie-back of new field

- Gas field with associated condensate and condensed water
- Well stream from the new field will be mixed with well streams at the operating installation
- Continuous injection of MEG at the well-head
 - Design case: 30wt% MEG
 - Expected normal operation: ~10-15wt% MEG



Topside separation process





Produced water system operation – today

- Design target: <10 ppm OiW
 - Discharge permit: <30 ppm OiW

 - No continuous MEG injection today, but expected to be required at tail-end production

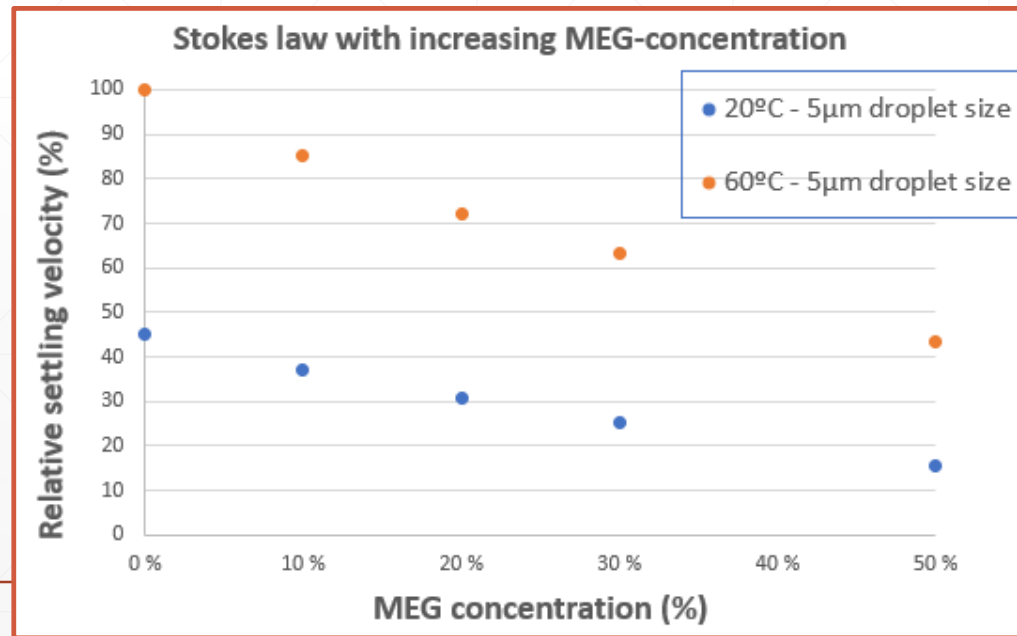
 - Start-up situations with ~50wt% MEG
 - Reduced separation efficiency when MEG > 18wt% (heating via 3rd stage separator)
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PW system operation – expected after tie-back of new field

- Continuous injection of MEG
 - Increased viscosity of the water phase
 - Increased density of the water phase



Less efficient separation



Technology Qualification activities

- **Theoretical Study:** Screening and evaluation of technologies and solutions suitable for treatment of produced water containing MEG on a continuous basis
 - **Batch separation tests** were performed at Equinor's Research Centre Trondheim to verify the effect of MEG on oil-water separation
 - **Water treatment tests** were performed in the water test rig in Equinor's Research Centre Porsgrunn to gain more data of predicted challenges from MEG and possible mitigating measures
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Screening - suitable solutions / separation principles

Enhanced gravity

Crossflow filtration

Adsorption

Flotation

Coalescence

Absorption

Enhanced gravity
(centrifuge) ✓

Dilution of water phase

Chemicals ✓

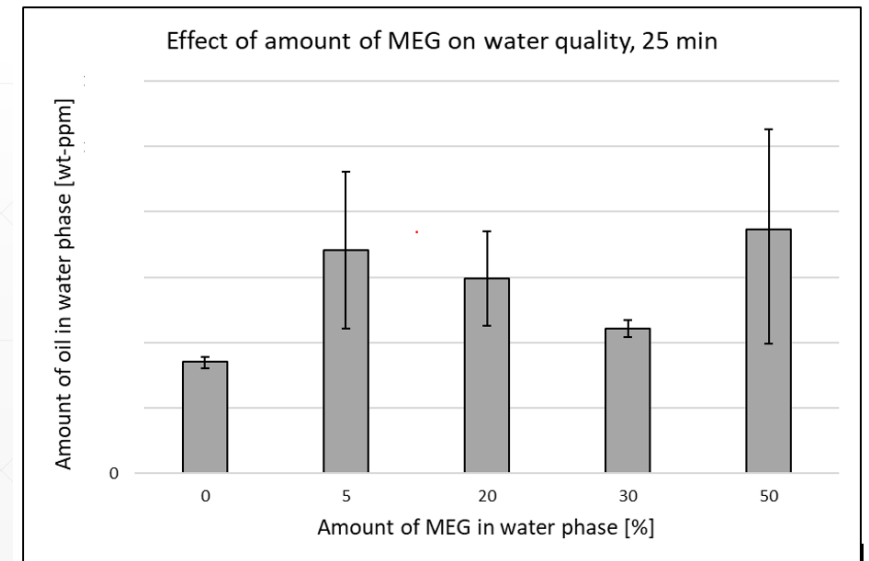
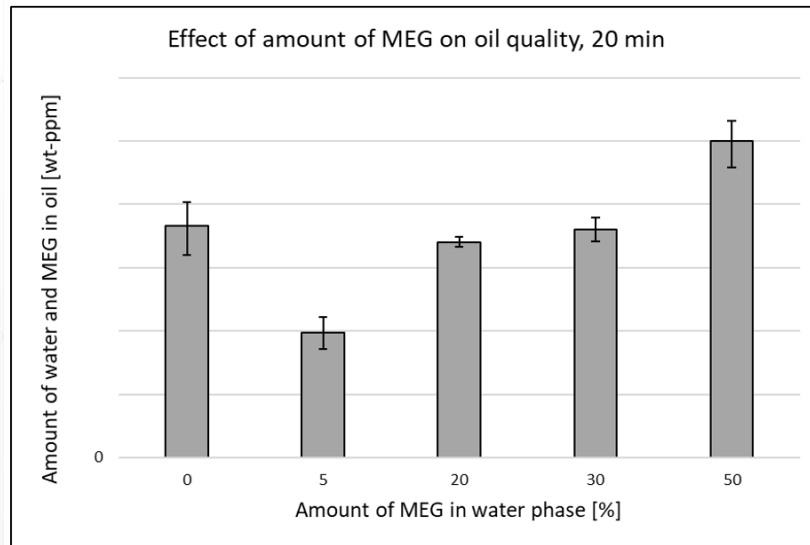
Electro flocculation/
coagulation

Increased temperature ✓

Results – Batch separation tests

THE EFFECT OF MEG (5-50wt%) ON OIL-WATER SEPARATION

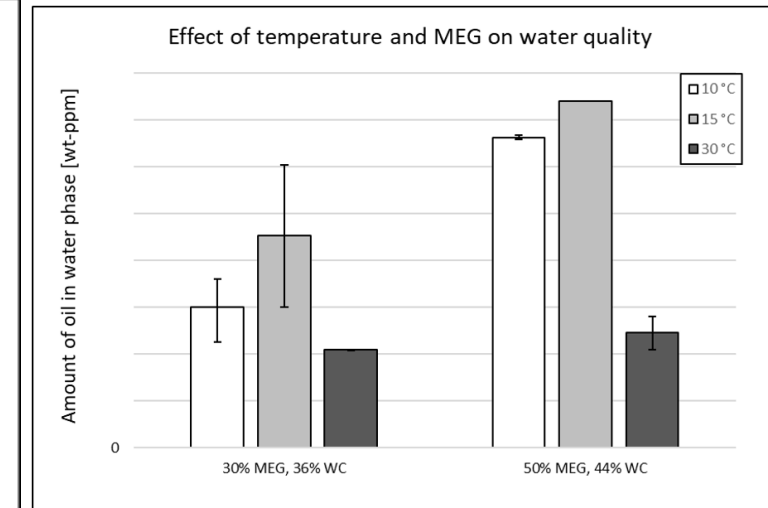
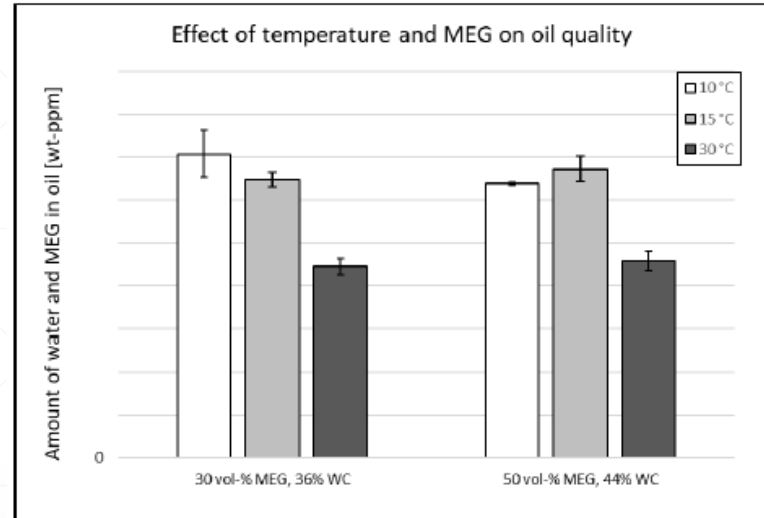
- For MEG concentrations up to 30 wt% no clear negative effect was observed for oil quality at 30°C.
- For MEG concentrations up to 30 wt% no clear negative effect was observed for water quality at 30°C.



Results – Batch separation tests

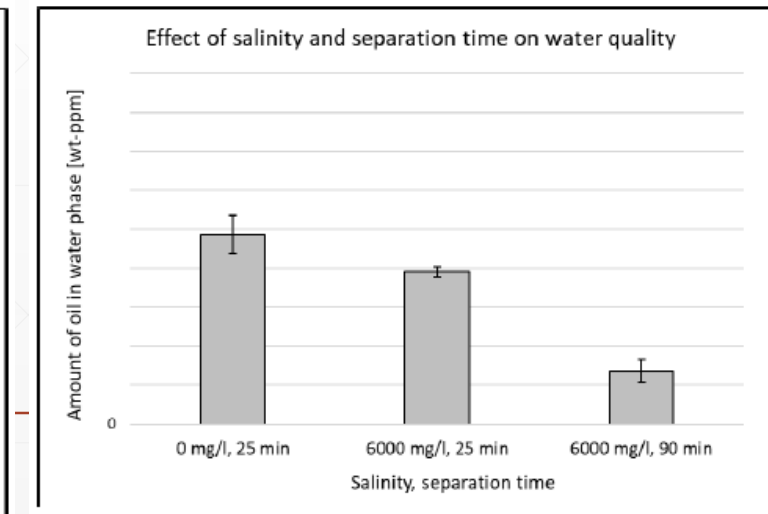
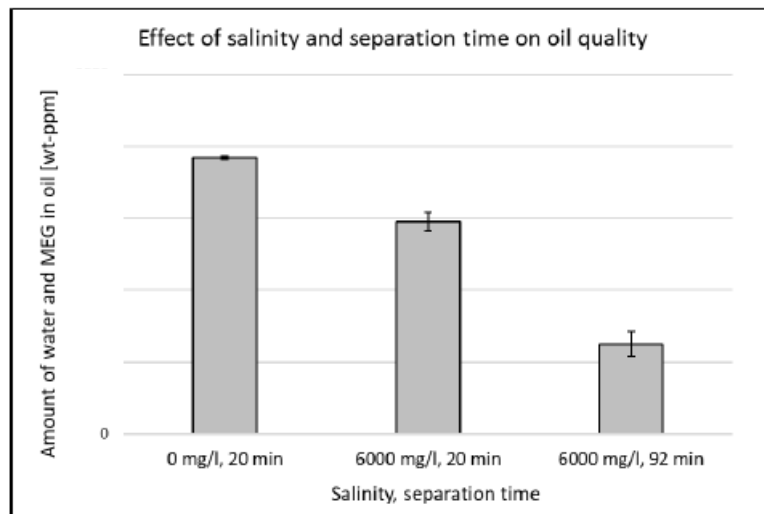
THE EFFECT OF TEMPERATURE ON OIL AND WATER QUALITY

Lower temperature (10-15 °C) has a **negative effect** on both oil and water quality compared to 30°C.



THE EFFECT OF SALINITY AND RESIDENCE TIME ON OIL AND WATER QUALITY

Salt in the water has a **small positive effect** on both oil and water quality

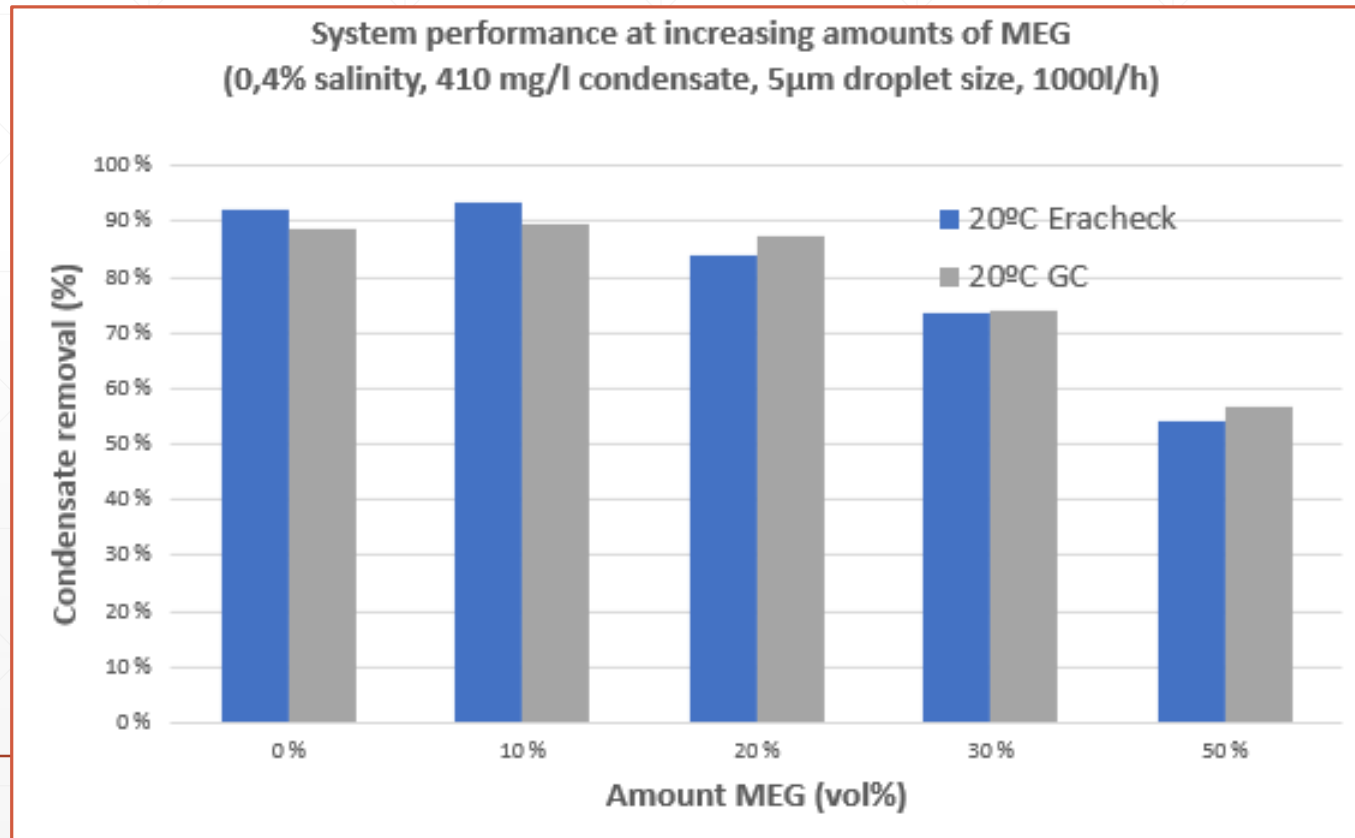


PW tests in water rig – main test parameters

Parameter	Min	Mid	Max
Temperature (°C)	20	-	60
Condensate in water (mg/l)	81	410	820
MEG in water (vol%)	10	30	50
Flowrate (l/h)	500	1000	1500
Salinity (% / mg/l)	0 / 0	0.4 / 5620	1.3 / 16091
dP over choke valve (bar)	3	5	10
Flocculant dosage (ppm _{vol})	0	5	15

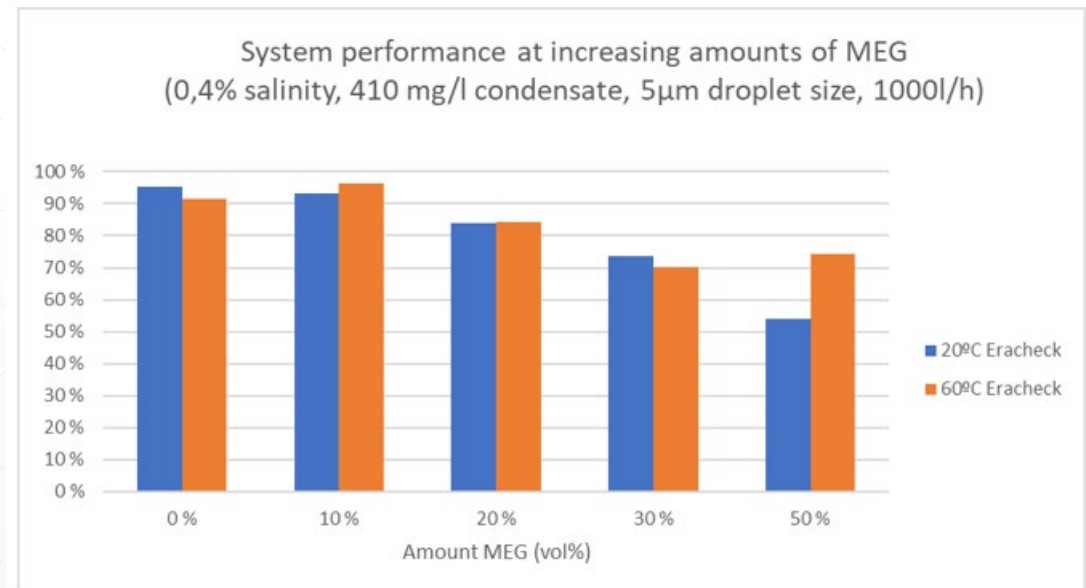
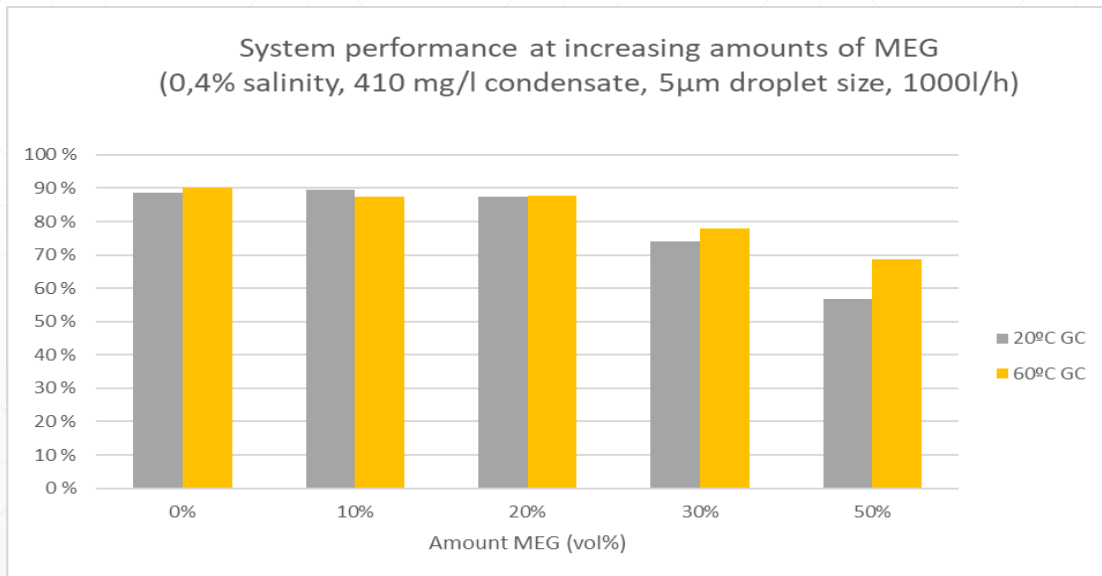
Results - PW tests in water rig

The effect of MEG - **negative impact** on the performance of the system at >20wt% MEG



Results - PW tests in water rig

The effect of **increased temperature** - **Positive effect** on performance at MEG concentrations $\geq 30\text{wt}\%$



Results - PW tests in water rig

- The effect of **increased residence time** in centrifuge:
 - **Positive effect**
 - From around 60% condensate removal @3 sec residence time to 80% @ 7 sec residence time (30wt % MEG)
 - The effect of adding **chemicals**:
 - **Minor effect**
 - If pH is increased from 5 to 8, positive effect 10-15 %-points increased performance
 - The effect of **reduced shear /larger droplet size**:
 - **Positive effect**, but less than expected
 - 10%-points improved performance of centrifuge with 11 μ m droplets vs 5 μ m (30wt % MEG)
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Summary and recommended measures to meet treated water discharge specification

- Existing installation operation today:
 - No MEG → Water quality discharge specifications are generally met (< 30 mg/l OIW)
 - Periodically use of MEG in relation to start-ups → Negative impact on PW treatment system
 - To meet the OIW specification on discharge to sea for this specific field:
 - **5-10 wt%** MEG case - No modifications required
 - **20wt%** MEG case - Heating upstream degassing drum and increased residence time in centrifuge
 - **30wt%** MEG case – Heating upstream the degassing drum, increased residence time in centrifuge and low shear valves
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Thank you!

Separation of MEG and its impact on produced water treatment

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