Evaluation of the impact of modified injection water on topside oil/water separation
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Introduction
The implementation of water-based EOR techniques (e.g. SMART water injection) in substitution to standard waterflooding causes physico-chemical changes in produced water that may affect the oil/water separation and have implications in the design of the topside separation units. In fact, the compositional changes obtained by altering the water composition even to a small extent “may cause unintended phase separation difficulties downstream” [1]. These compositional effects are mainly related to the size of oil droplets and, even most importantly, to their surface electrical charge that can alter to large extent the coagulation kinetics and, therefore, the overall separation kinetics.

Technological gap AWF.1:
Treatment of Produced Water with EOR/IOR additives.

Materials and methods
1. Water with different ionic composition [Table 1].
2. Oil in water dispersion (IKA Ultra Turrax @ 10000 RPM)
3. Gravimetric separation with settling time span of 5 to 60 minutes using 100 ml separating funnels.
4. Extraction with n-pentane, inspired by the OSPAR reference method.
5. Quantification by GC-FID. External standard calibration with the same oil used for the experiments.

<table>
<thead>
<tr>
<th>Water Type</th>
<th>NaCl (g/L)</th>
<th>Na₂SO₄ (g/L)</th>
<th>Ionic Strength (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distilled</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>PW1</td>
<td>6.0</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>PW2</td>
<td>1.5</td>
<td>3.6</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Table 1: Compositions used for the experiments

Results and discussion
- Results are within the range of expected values (1000-2000 ppm) for industrial oil and water gravimetric separation process [3].
- Large differences of oil in water concentration were observed, depending on the ionic composition.
- The differences are larger at 5 minutes settling time, which corresponds to typical residence time in offshore 3-phase separators. The amount of dispersed oil was 83 % lower in PW1 and 70 % lower in PW2, compared to the base case (distilled water).
- With increased settling time, the effect of ionic composition is less pronounced.
- Besides ionic strength, the presence of specific ions influence the oil and water separation as well.

Perspective
- Analyze the results in terms of physical properties (e.g. zeta potential, particle size, interfacial tension).
- Study the effect of the pH under the current investigation parameters.
- Reinforce the knowledge on the role of asphaltenes and resins to the stability of the oil/water emulsions.
- Evaluate the effect of the ionic composition on the performance of production chemicals like flocculants, aiming at cost reduction.

References
1. Perry’s Chemical Engineers Handbook, 8th ed., p. 1776

Acknowledgements
The project is financially supported by the Danish Hydrocarbon Research and Technology Centre.