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Hydrothermal oxidation of H₂S Spent & Unspent scavengers (SUS) – from laboratory to pilot scale

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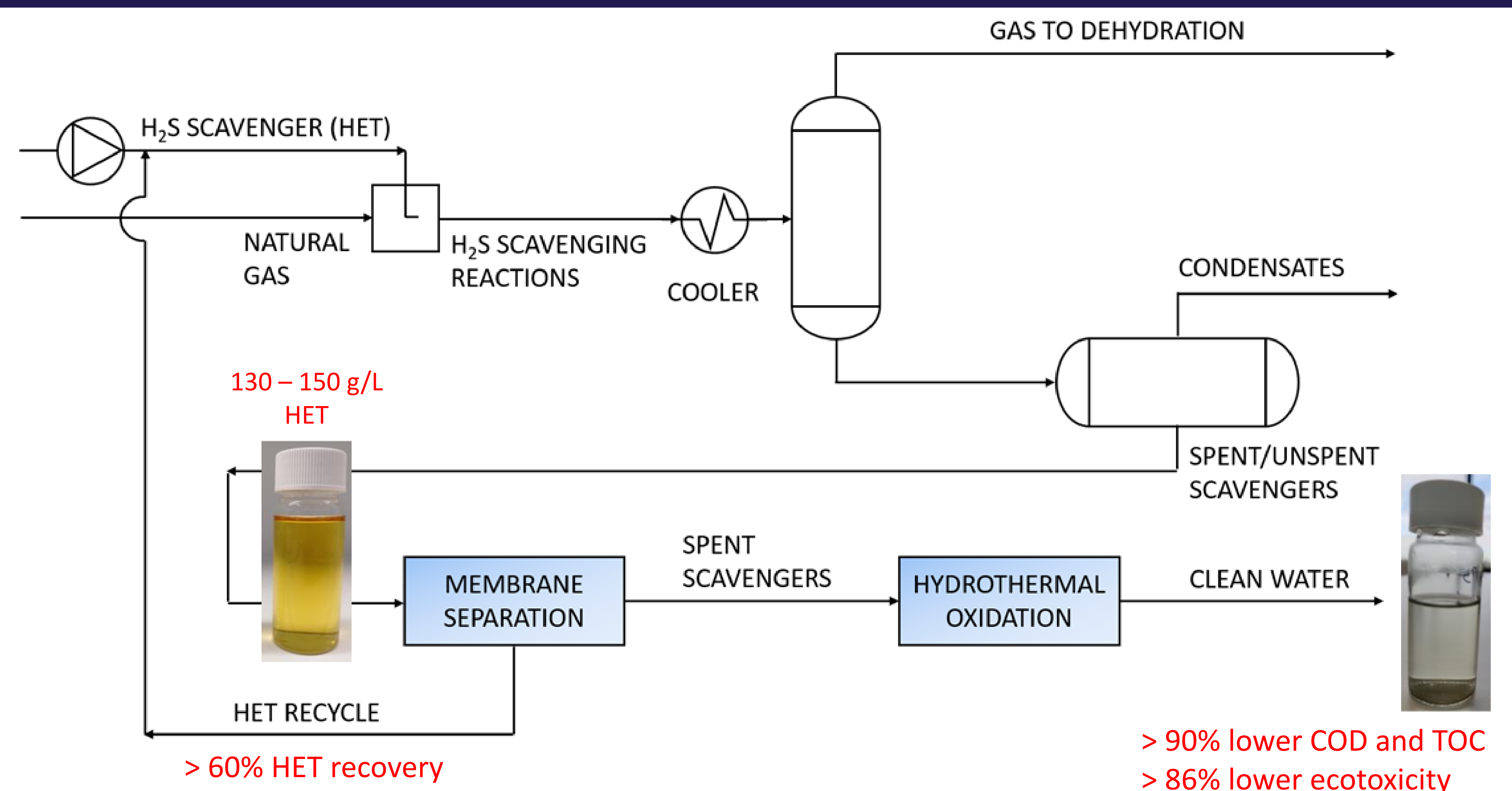
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Background

- Spent and Unspent H₂S Scavengers (SUS) are discharged into the sea: small quantity but high Environmental Impact Factor (up to 20% of the overall EIF of North Sea offshore platforms^[1]).
- SUS are highly concentrated of organics of moderate toxicity, therefore should be treated for a clean discharge.

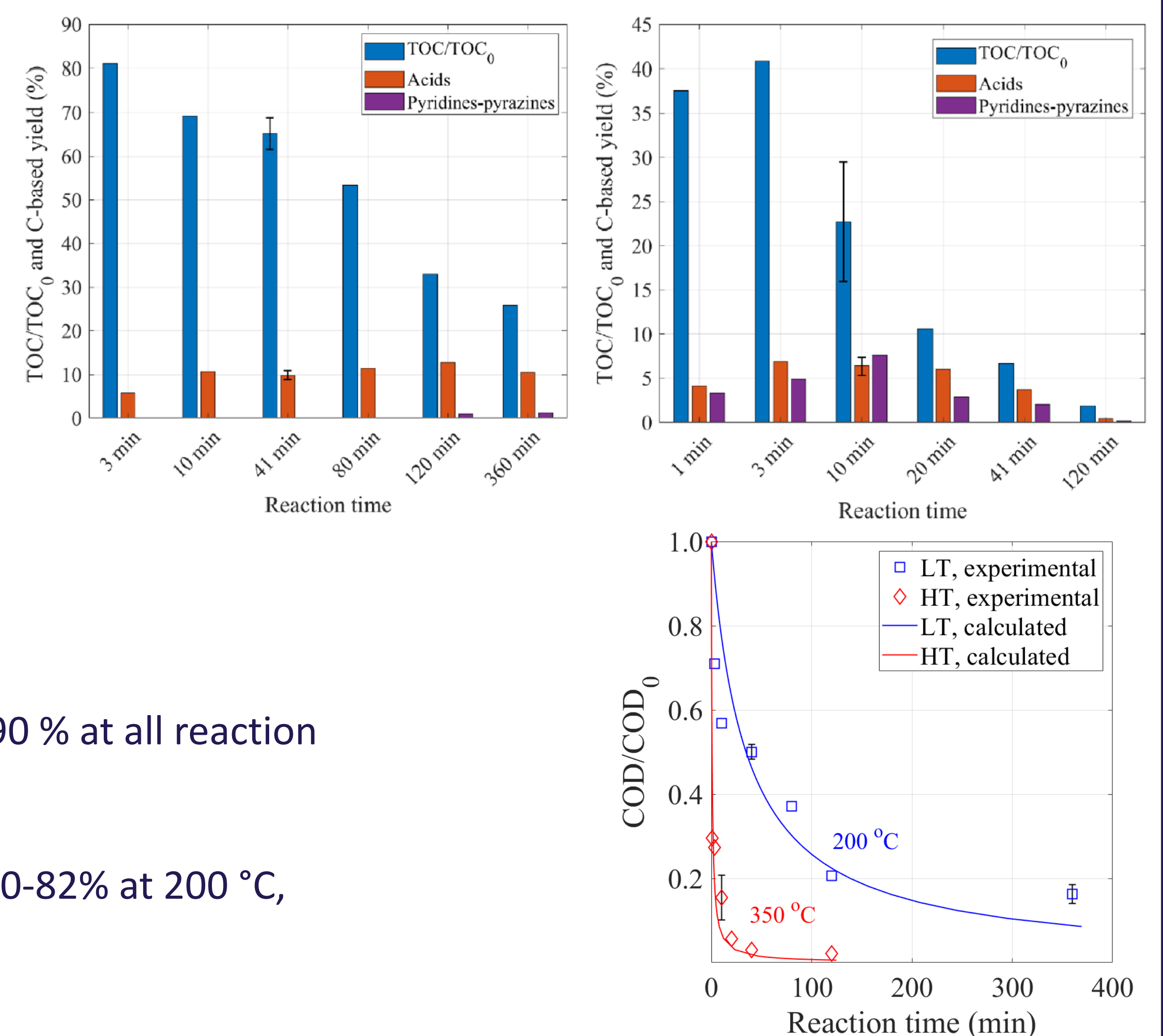
Proposed Novel Technology

- Recovery of unspent MEA-triazine (HET) by membrane nanofiltration.
- Recycle of HET to the injection point of the H₂S scavengers, reducing the operating expenses caused by the excessive use of MEA-triazine.
- Hydrothermal Oxidation (HTO) on spent scavengers, reducing the environmental impact of the water discharge of SUS H₂S scavengers.
- The novelty is the coupling of these two existing technologies in the offshore Oil&Gas environment.



Proof of concept at lab scale^[2-3]

- Chemical Oxygen Demand (COD) reduction up to 98%.
- Process at 350 °C is 70 times faster than at 200 °C.
- The hydrothermal oxidation reduces COD by 20-50% at 200 °C (LT) and 80-95% at 280-350 °C (HT).
- MEA-triazine (HET - unspent scavenger), monoethanolamine (MEA) and dithiazine (DTZ) are converted and do not appear in the HTO products.
- Almost all of sulfur and nitrogen end up to NH₄⁺, SO₄²⁻, while most of the carbon oxidized to CO₂.
- The toxicity of the spent H₂S scavengers to marine bacteria is reduced by more than 90 % at all reaction temperatures.
- The toxicity of the spent H₂S scavengers to algae is reduced by 48-66%, 59-86% and 60-82% at 200 °C, 280 °C and 350 °C, respectively.



Challenge and Objectives

My research project aims at:

- Demonstrate and validate the hydrothermal oxidation (HTO) in small continuous-flow laboratory unit (1 L/h) available in Aquarden Technologies (both on SUS and Spent scavengers after membrane recovery of MEA-triazine);
- Test HTO on a large-scale continuous-flow pilot unit also available in Aquarden Technologies (max flow ~200 L/h);
- Develop a model of the reactor based on the experimental results of the pilot scale;
- Develop an overall process simulation flowsheet to identify optimal configurations and operating conditions of the HTO.
- Develop the basic design of a prospective HTO unit to be installed in the offshore environment.

Acknowledgements

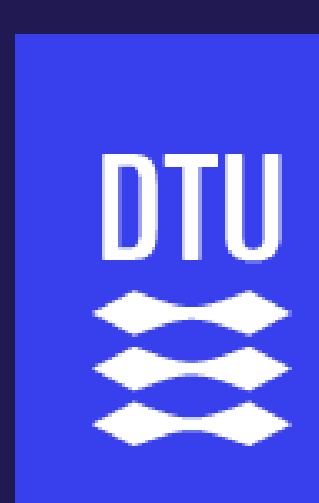
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- [2] Montesantos et al., <https://doi.org/10.1016/j.watres.2022.119507>
- [3] Montesantos et al., <https://doi.org/10.1016/j.cej.2021.131020>

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