Hydrothermal oxidation of H2S spent and unspent scavengers (SUS) – from laboratory to pilot scale

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Publication date:
2023

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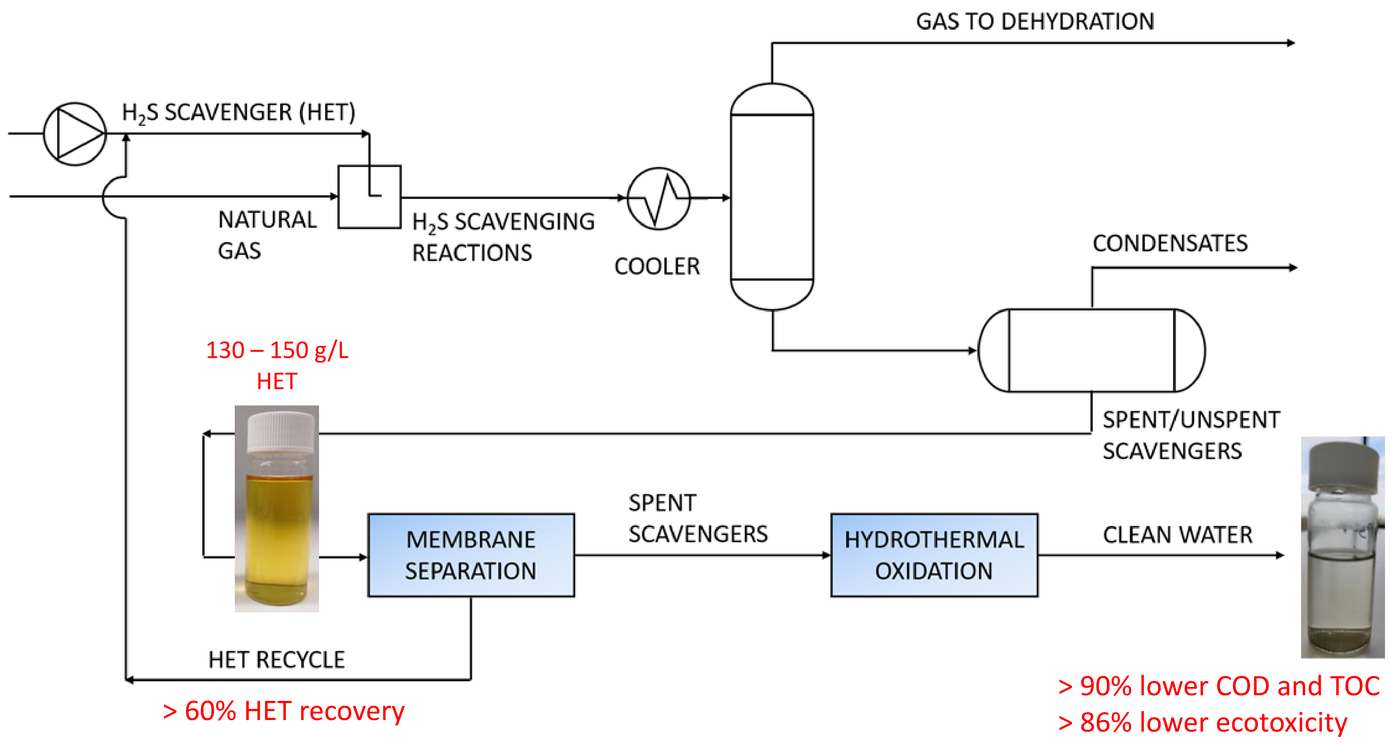
Background

- 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.

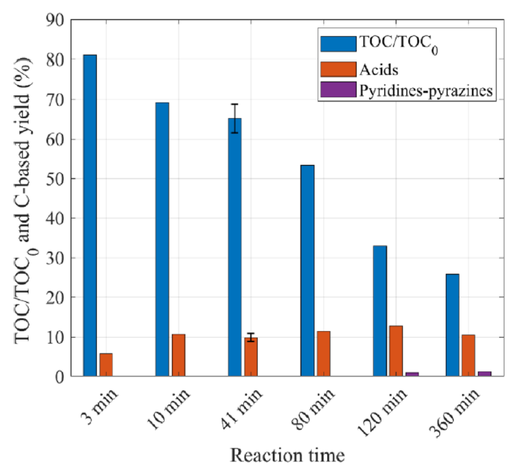
Proposed Novel Technology

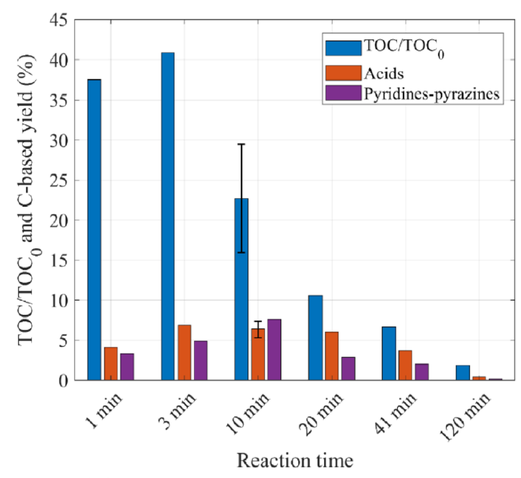
- Recovery of unspent MEA-triazine (HET) by membrane nanofiltration.
- Recycle of HET to the injection point of the H_2S scavengers, reducing the operating expenses caused by the excessive use of MEA-triazine.
- Hydrothermal Oxidation (HTO) on spent scavengers, reducing the environmental impact of the water discharge of SUS H_2S scavengers.
- The novelty is the coupling of these two existing technologies in the offshore Oil&Gas environment.

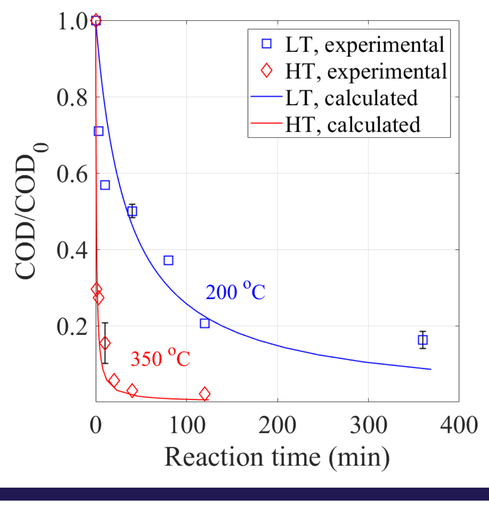


Proof of concept at lab scale[2-3]

- 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 NH_4^+, SO_4^{2-}, while most of the carbon oxidized to CO_2.
- The toxicity of the spent H_2S scavengers to marine bacteria is reduced by more than 90 % at all reaction temperatures.
- The toxicity of the spent H_2S 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

This project is financially supported by the Danish Offshore Technology Centre under the Produced Water Management Programme.

References

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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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