MIC mitigation comparison of Halophyte-extract against THPS and Glutaraldehyde

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A Benchmarking Experiment

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BREAKING NEW GROUND
AALBORG UNIVERSITY
BIOENERGY & BIOPRODUCTS

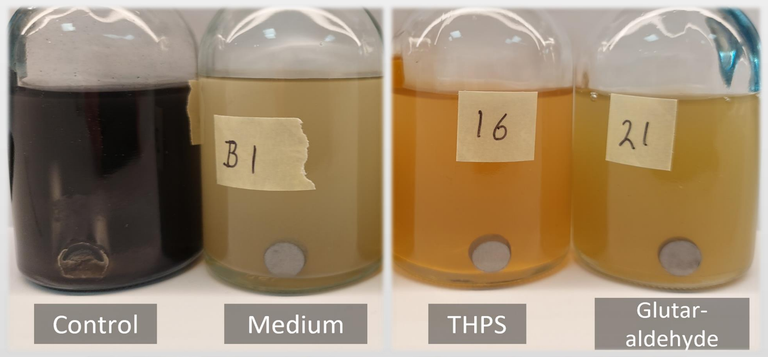
Background

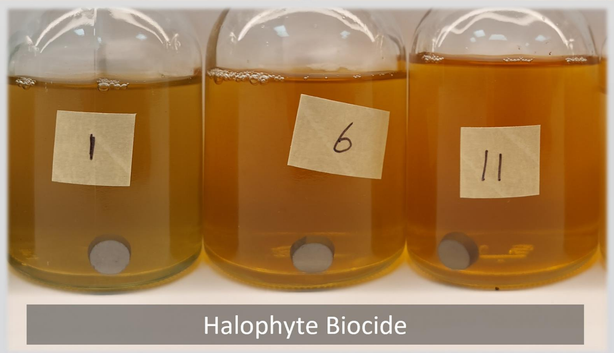
- **Biocides** are used to prevent biofouling and **Microbiologically Influenced Corrosion (MIC).**
- Seawater injection introduces **microorganisms from the seabed** into reservoirs.
- Some **Sulfate-reducing bacteria** form biofilms and contribute to localized corrosion, oxidizing steel.
- A **multiple lines of evidence (MLOE) approach** is required for proper diagnosis.[1]

- **Halophytes**: Plants that can grow in saline environments.
- Halophytes are super-producers of bioactive chemicals, some with **biocidal properties**. [2]
- A **biocidal fraction** can be obtained from certain halophytic biomass using proprietary biomass processing methods. [3]

Experiment Setup

- An experiment was conducted using a series of flasks to test the effectiveness of a **halophyte-derived biocide** compared to two commonly used conventional biocides in the industry, THPS and Glutaraldehyde.





Preparation

- Flasks with Postgate Medium
- Low allow (LA-C 0.41) carbon steel coupon
- Inoculation with mixed microbial culture from sea sediment

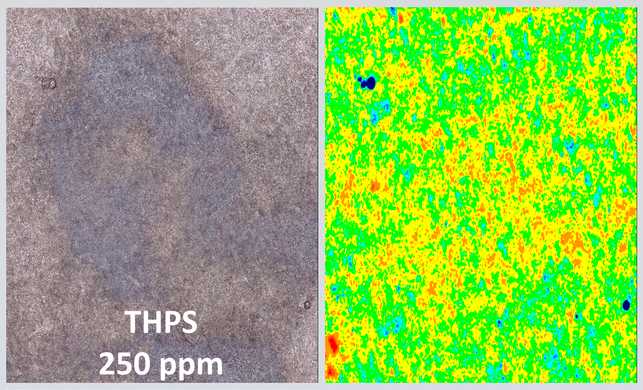
Test of biocide: 25 days

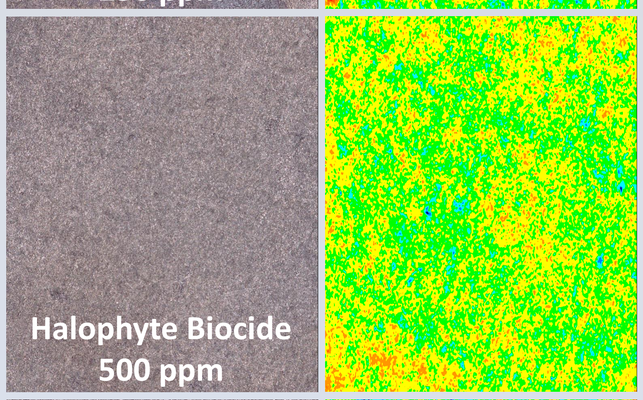
- 3 concentrations of Halophyte Biocide
  - 500, 1000, 2000 ppm total dry matter
- 2 conventional biocides
  - THPS & Glutaraldehyde
    - 250 ppm active ingredient

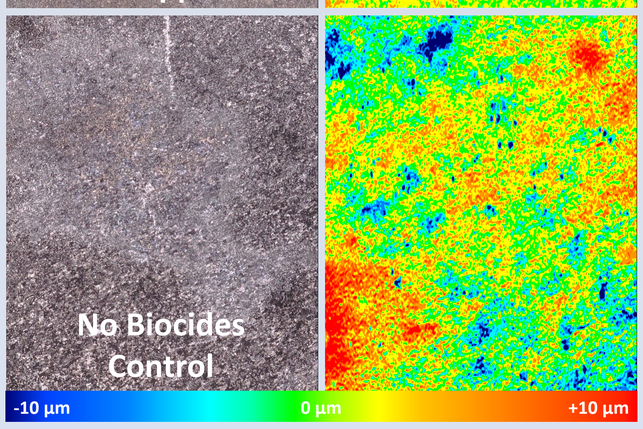
Multiple Lines of Evidence

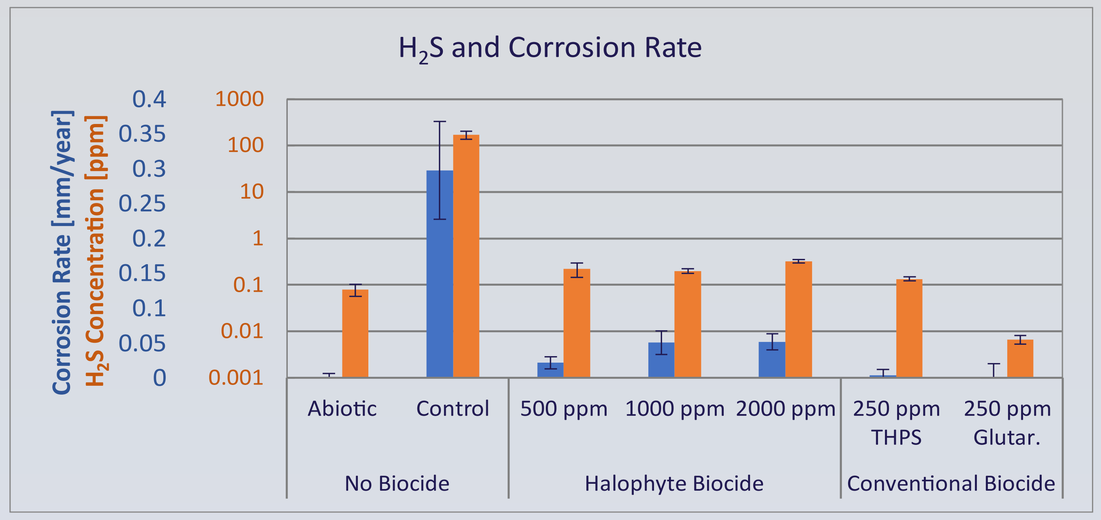
- H_2S concentration
- Coupon weight loss
- Coupon surface morphology (KEYENCE 3D optical profilometer)
- 16S rRNA Amplicon Sequencing

Results





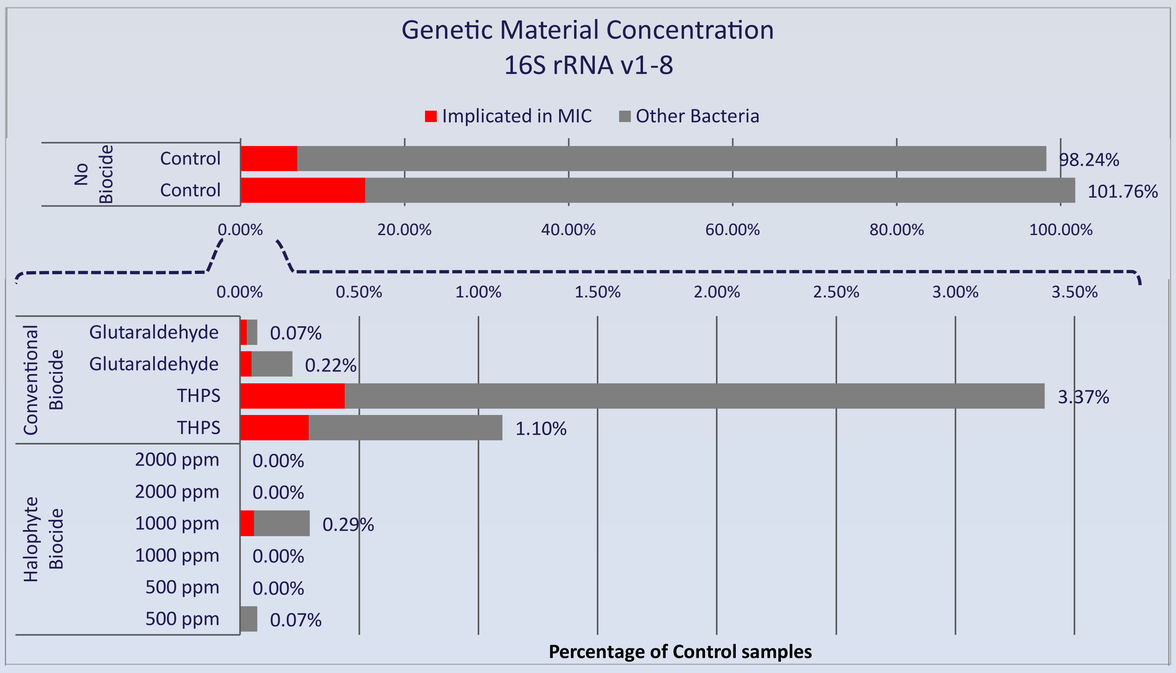




- Addition of biocides leads to a **2.5 orders of magnitude decrease** in H_2S.
- **Performance** of Halophyte biocides and THPS are **similar**.
- **Glutaraldehyde decreases** the measured H_2S concentration **below the abiotic control** level.
- **Microbiological corrosion** is **significantly** decreased.
- Halophyte biocide reduces corrosion significantly but is less effective than conventional biocides.

- **All Biocide** addition visibly **reduces corrosion**.
- **Halophyte** biocides excel at **preventing pitting**.

- Biocides significantly **reduce total genetic material** according to microbial community analysis.
- In **4 out of 6** samples treated with **halophyte** biocide, the **concentration** was **too low for detection** in amplicon sequencing.
- **Values** are presented as a **percentage of the control's** average genetic material concentration.



Conclusion

- **All biocides** significantly **reduce H_2S production**, by at least a magnitude of two. **Halophyte biocides and THPS have similar performance**, while Glutaraldehyde shows H_2S measurements below the abiotic baseline.
- **All biocides lower corrosion rates.** The difference between THPS and halophyte biocides is statistically insignificant. However, **halophyte biocides prevent pitting** better.
- All biocides significantly reduced the concentration of bacteria and genetic material. 4 of the 6 **halophyte-treated samples** had **too little genetic material for analysis**, proving that the halophyte extracts effeciently eliminates corrosion inducing microbes.

Acknowledgments

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