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MIC mitigation comparison of Halophyte-extract against THPS and Glutaraldehyde

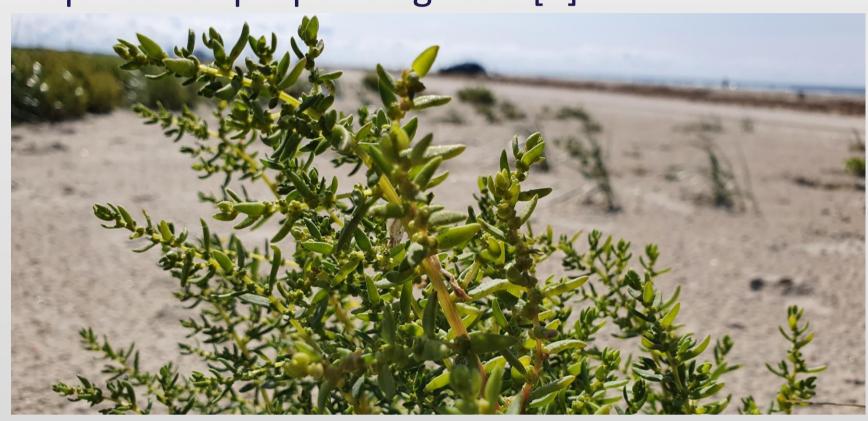
A Benchmarking Experiment

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Background

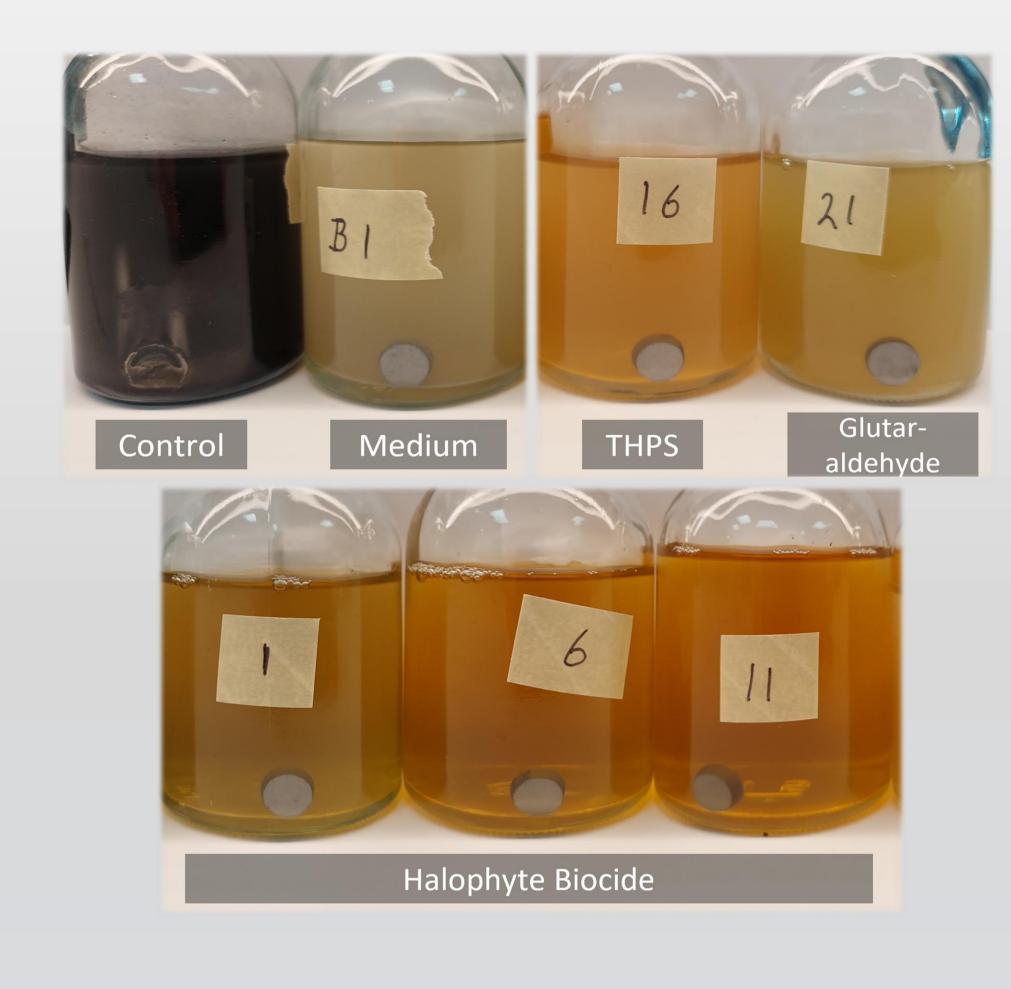
- ➤ Biocides are used to prevent biofouling and Microbiologically Influenced Corrosion (MIC).
- > Seawater injection introduces microorganisms from the seabed into reservoirs.
- Some Sulfate-reducing bacteria form biofilms and contribute to localized corrosion, oxidizing steel.
- A multiple lines of 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

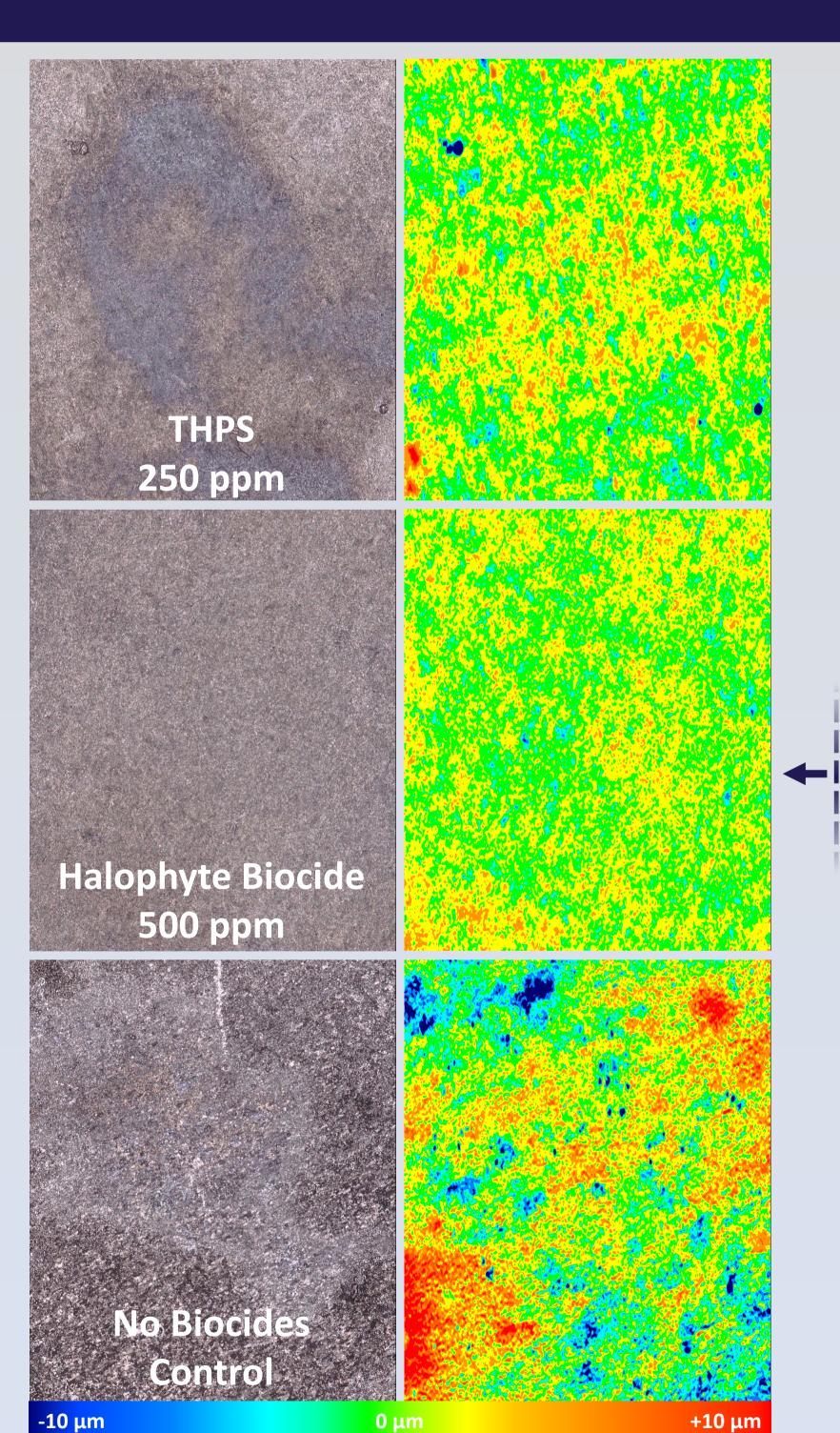
- 3 concentrations of Halophyte Biocide
- 500, 1000, 2000 ppm total dry matter
- 2 conventional biocides
 - THPS & Glutaraldehyde
 - 250 ppm active ingredient



Multiple Lines of Evidence

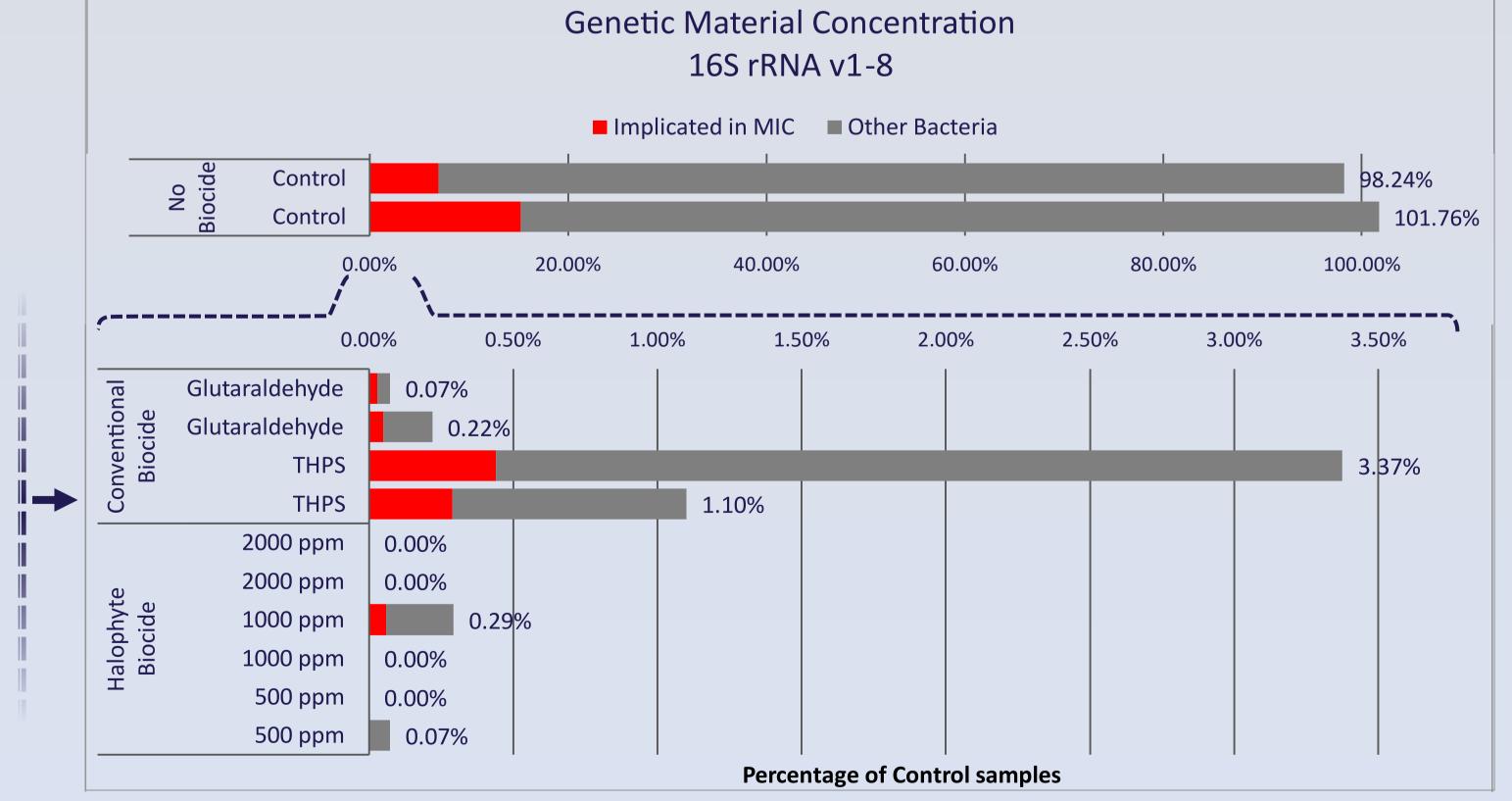
- H₂S concentration
- Coupon weight loss
- Coupon surface morphology (KEYENCE 3D optical profilometer)
- 16S rRNA Amplicon Sequencing

Results



- H₂S and Corrosion Rate 0.3 10 tion 0.25 0.2 0.1 0.1 0.01 0.05 0.001 250 ppm 500 ppm 1000 ppm 2000 ppm Abiotic Control 250 ppm Glutar. No Biocide Halophyte Biocide | Conventional Biocide |
- 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.

- Addition of biocides leads to a 2.5 orders of magnitude decrease in H₂S.
- Performance of Halophyte biocides and THPS are similar.
- ➢ Glutaraldehyde decreases the measured H₂S concentration below the abiotic control level.
- Microbiological corrosion is significantly decreased.
- ➤ Halophyte biocide reduces corrosion significantly but is less effective than conventional biocides.



Conclusion

- \triangleright All biocides significantly reduce H₂S production, by at least a magnitude of two. Halophyte biocides and THPS have similar performance, while Glutaraldehyde shows H₂S 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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References

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[2] Chaturvedi, T., Hulkko, L. S. S., Fredsgaard, M., & Thomsen, M. H. (2022). Extraction, Isolation, and Purification of Value-Added Chemicals from Lignocellulosic Biomass. Processes, 10(9), 1752. doi: 10.3390/pr10091752
[3] Stein, J. L, Chaturvedi, T, Skovhus, T. L., Thomsen, M. H., "Effect of Antimicrobial Halophilic Plant Extracts on

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