

# CLEAN BIOCIDES Project

## Corrosion Inhibitors from Halophilic Biomass

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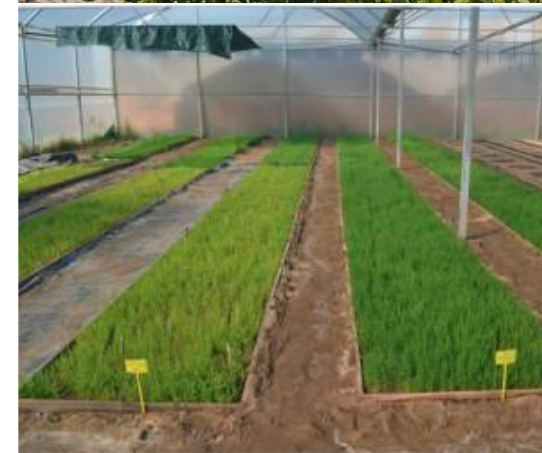
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# Why Halophytes?

## Hypothesis:

Halophilic plant extracts, produced and formulated in the right way, can be used as natural corrosion inhibitors and biocides for oil field application



- The natural Biocides can potentially replace more toxic, synthetic biocides
- Relatively cheap production cost when produced in a biorefinery setting
- Produced from waste part of the halophyte plant – after food production – and potentially after extraction of high value bio-compounds for food and cosmetics
- **Competitive cost and environmental safety (versus conventional biocides)**



Food



Waste

Ext. 1



Ext. 2



Aquacombe

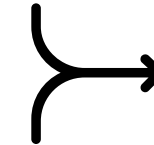
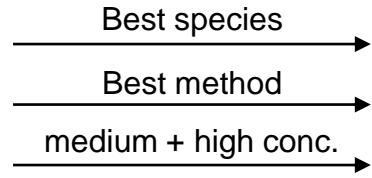


CLEAN BIOCIDES



# Optimizing for the best biocidal extract

- Screening of species and method
  - 4 Halophyte species
  - 3 extraction protocol
  - 4 extract concentrations
- Extraction severity optimization
  - 1 halophyte
  - 5 extraction severities
  - 2 concentrations in flasks

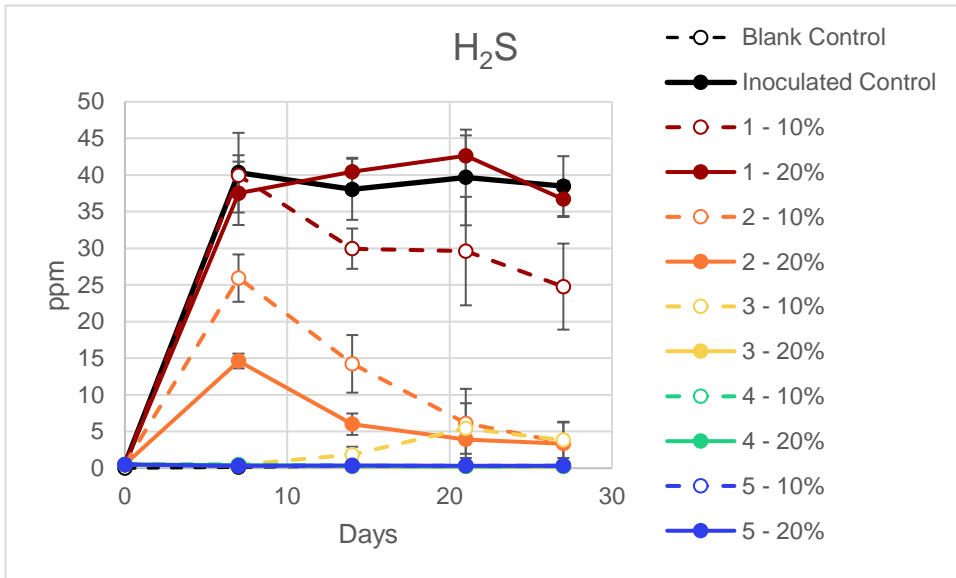
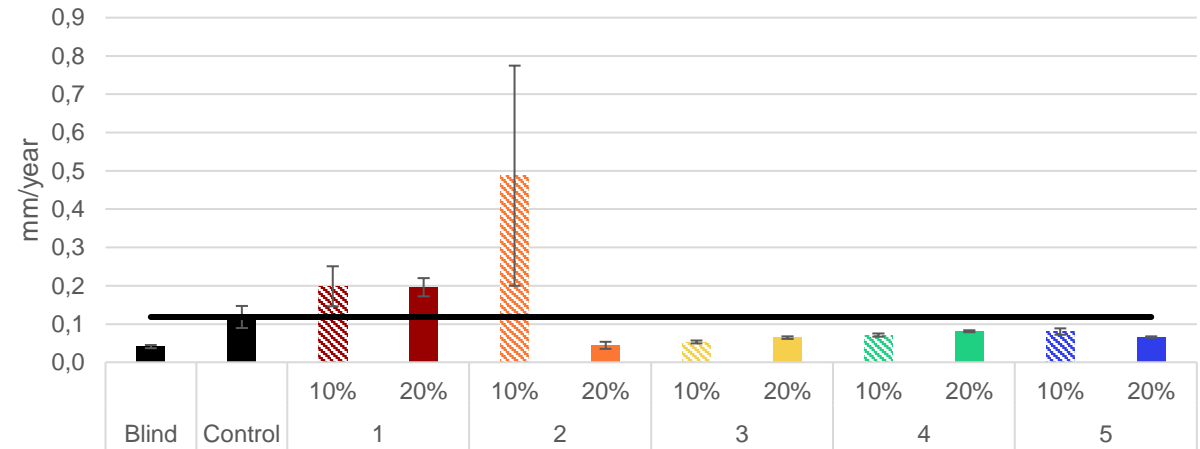


# Process severity optimisation



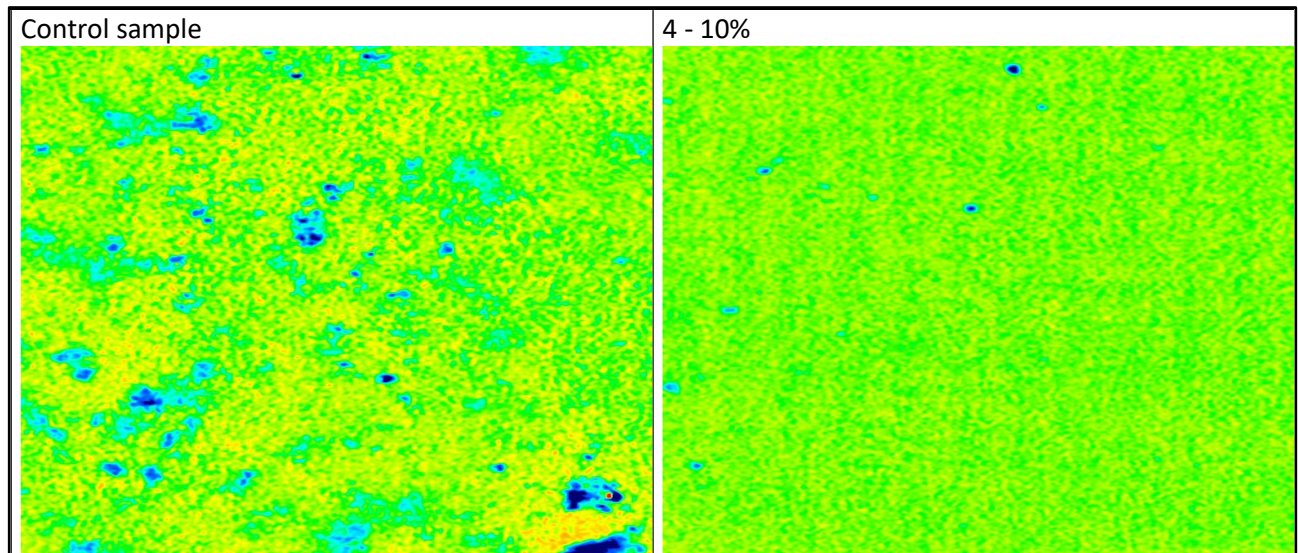
- Extraction severity optimization
  - 1 halophyte species
  - 5 extraction severities
  - 2 extract concentrations in flasks

Corrosion Rate



1-5 denotes increasingly severe treatments  
 10-20% denotes ratio of extract:medium in a flask

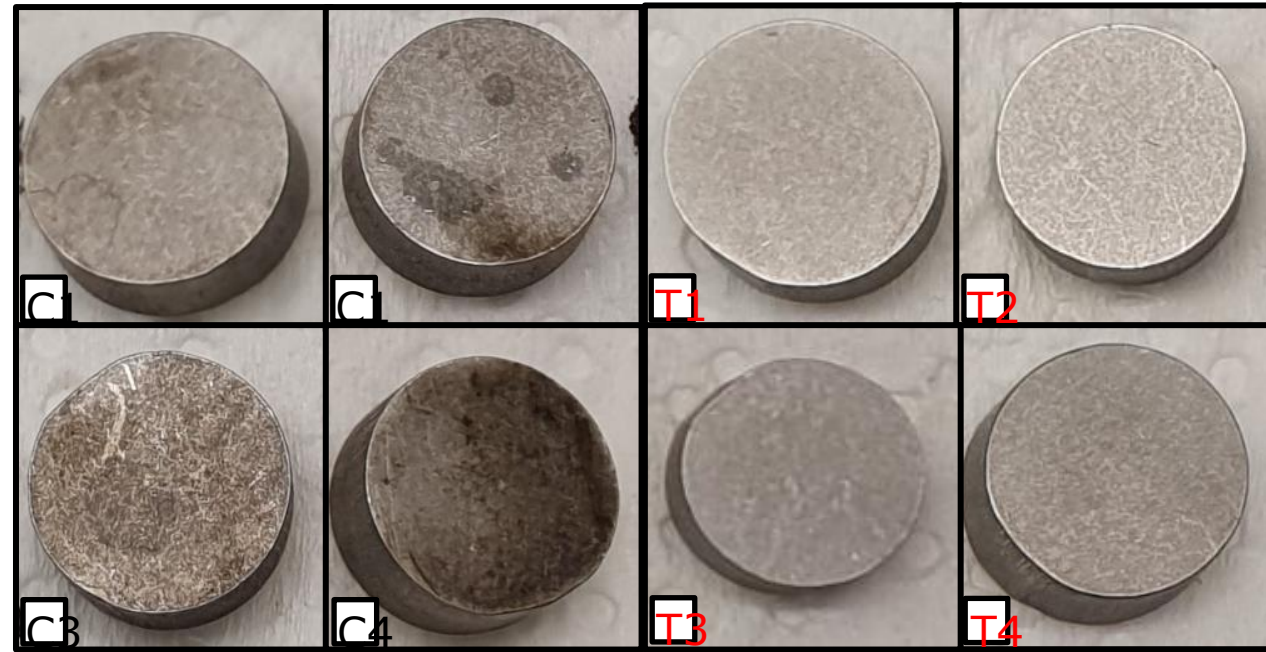
3D scanning of coupons







C = Control; T = Test samples



# I have a poster!

- Come have a chat at #30 during the Poster Session!

**Importance of the Multiple Lines of Evidence (MLOE) approach in Diagnosing Microbiologically Influenced Corrosion (MIC)**

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**Current Problems with Microbiologically Influenced Corrosion (MIC) diagnosis**

- Currently a standardized analysis for MIC does not exist
- Analyses are expensive – but cutting corners may lead to misdiagnosis
- Microbiologically influenced corrosion is often misdiagnosed

**Experiment**

An anaerobic biofilm reactor was inoculated with a mixed microbial culture mimicking that of produced water. Carbon steel coupons were added to rods inside the bioreactor. After 18 days a diluted lipolectin-based biocide was added to the medium.

**Results**

**Microbial community Analysis (16S rRNA Amplicon Sequencing)**

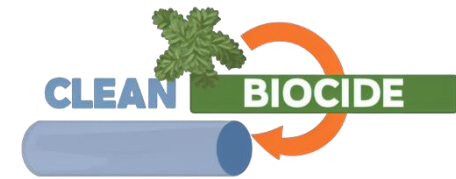
Cost of this analysis has decreased significantly in the past decades, making it a viable tool in MIC diagnosis.

- Microbial communities of the bulk liquid (planktonic), and inside the biofilm (sessile) can be very different.
- **Deinobacteretes**, highlighted in orange, are the microorganisms found associated with MIC. Their abundance varies greatly between samples.

**Control (No Biocide Exposure) After Overcoming biofilm**

**Control Coupon Removed before biocide addition** vs **Test Coupon (deepest pit 30 µm) Added with the biocide**

# CLEAN BIOCIDES: Ongoing and future work



- **Fine tuning of process conditions** for optimal extraction of target compounds giving maximum antimicrobial effect without environmental toxicity. This will also include standardization of the extraction and formulation processes to achieve a uniform product with standardized content of target compounds.
- **Formulation and test of optimal CLEAN BIOCIDES.** High level chemical characterization is ongoing. Formulation might include isolation Isolation/concentration of target compounds and/or removal of unwanted compounds
- **Scale up of the extraction process to 100 liter to pilot scale (The Halorefine process).** The extraction process will be scaled up using the Aquacombine extractor to examine the reproducibility of the biocide in large scale processing.
- **Detailed Process modelling and Techno-economic analysis** using Super Pro Designer or Aspen plus on production and use of halophyte biocides as MIC control in offshore oil production facilities and benchmarking against traditional biocides.