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SMI Forum 2016

**Advanced Materials
Technology Centre**
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Biocide Free Antifouling Coatings for Maritime and Harbor Applications

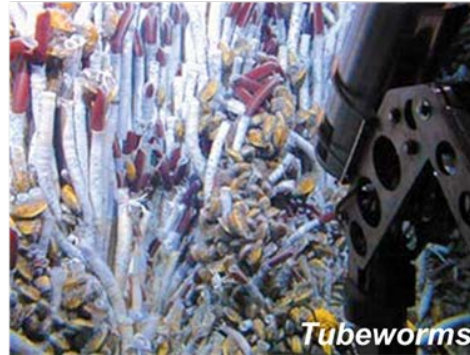
Project ID: SMI-2013-MA-13

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Fouling Challenges for Maritime Industry

- ✓ Increase drag resistance
The speed reduces more than 10%.
- ✓ Increase fuel consumption
Increase CO₂ emission
- ✓ Increase corrosion damage, Shorten the dry docking interval and increase the maintenance cost



Antifouling coatings are conventionally the most economical method for control of fouling.



Problem Statement

- Environmental impact by biocide:
 - Rate of biocide degradation
 - Toxicity to non-target organisms
 - Potential for bio-accumulation
- Toxic Biocide: Cuprous oxide (restricted by some countries)
- Replacement needed

Alternative solutions

- ❖ Fouling releasing antifouling system
- ❖ Micro & Nano structured surfaces –Super-hydrophobicity or hydrodynamics
- ❖ **Natural active ingredients as anti-foulants**

High Cost!
Difficulty in applications!

Objective of the Project

This project aims to develop a new generation of biocide-free coatings and a scalable production process to make antifouling coating for marine antifouling applications.

Formulation of CDP and SPC Antifouling Paints

- Polymer (Binder):
 - Soluble: hydrophilic
 - Non-soluble: hydrophobic
- Pigment and extenders:
- Plasticizer:
- Biocide:
- **Functional fillers**
- Additives: anti-settling agent
dispersing agent etc
- Solvent: xylene, butanol

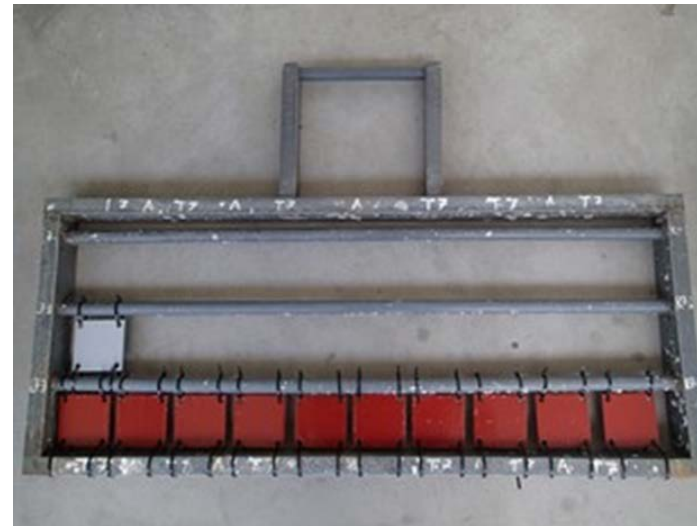
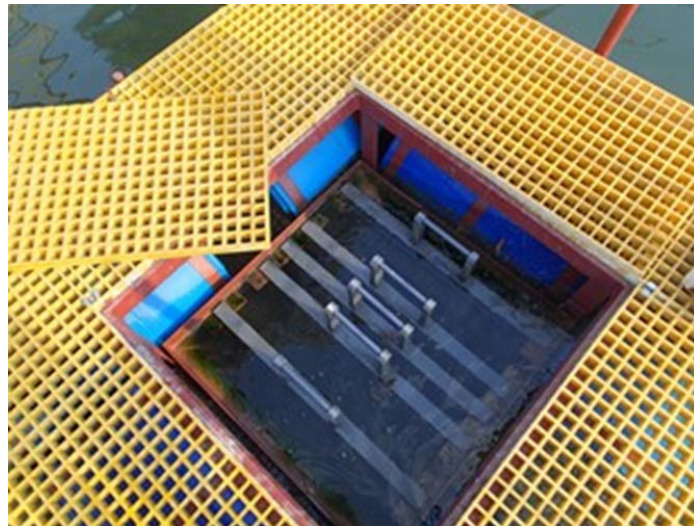


Study of low-toxic or non-toxic materials/chemicals as anti-foulants

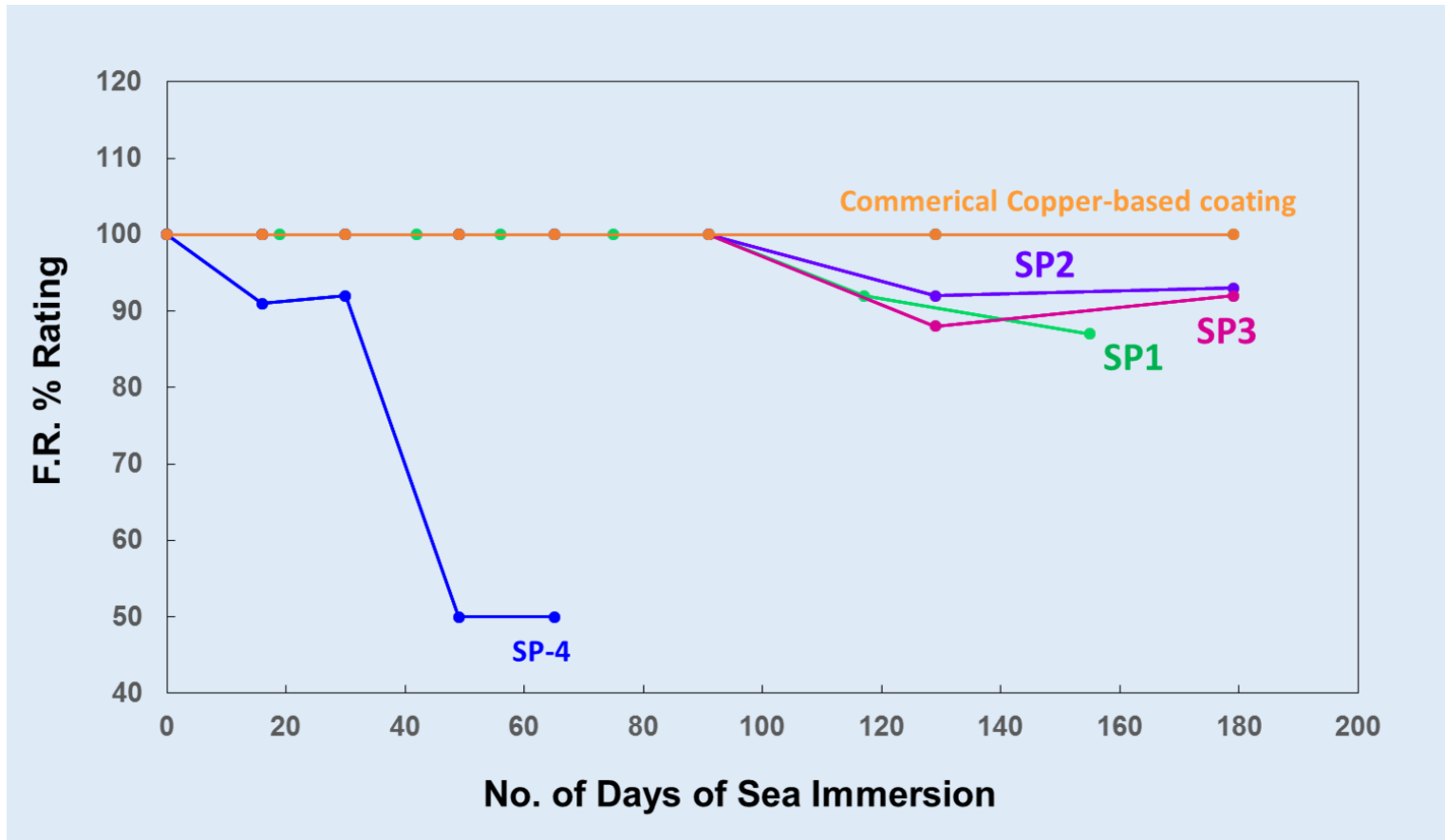
- 1) Nano materials.
- 2) Natural materials
- 3) Essential oils
- 4) Food preservatives
- 5) Extraction compounds from the natural materials
- 6) Chemicals

Evaluated over 200 formulations and 600 samples!

Anti-fouling Effectiveness Characterization-Raft test (ASTM D3623- 78a (2012))



Antifouling Effectiveness and Reliability Testing



Using non-toxic chemical and/or natural product as anti-foulants!!

- ❖ Environmental friendly copper-free antifouling paints were successfully developed in this project and showed promising fouling resistance.
- ❖ The developed coating formulations showed good antifouling effectiveness for 6 months immersion in sea.

Raft-Testing Result



Sample SP2 before testing



After testing for 31 days



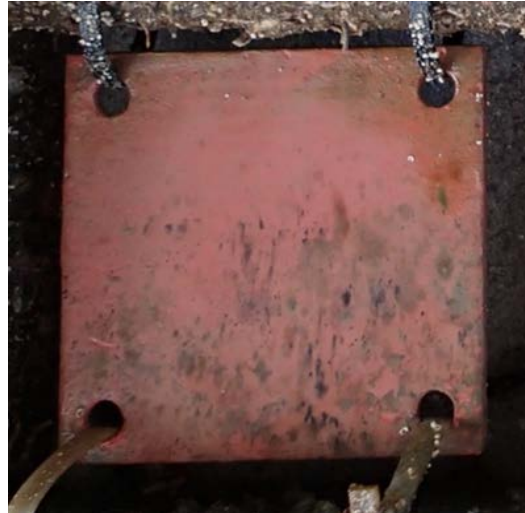
After testing for 66 days



After testing for 92 days



After testing for 130 days



After testing for 176 days



After testing for 236 days



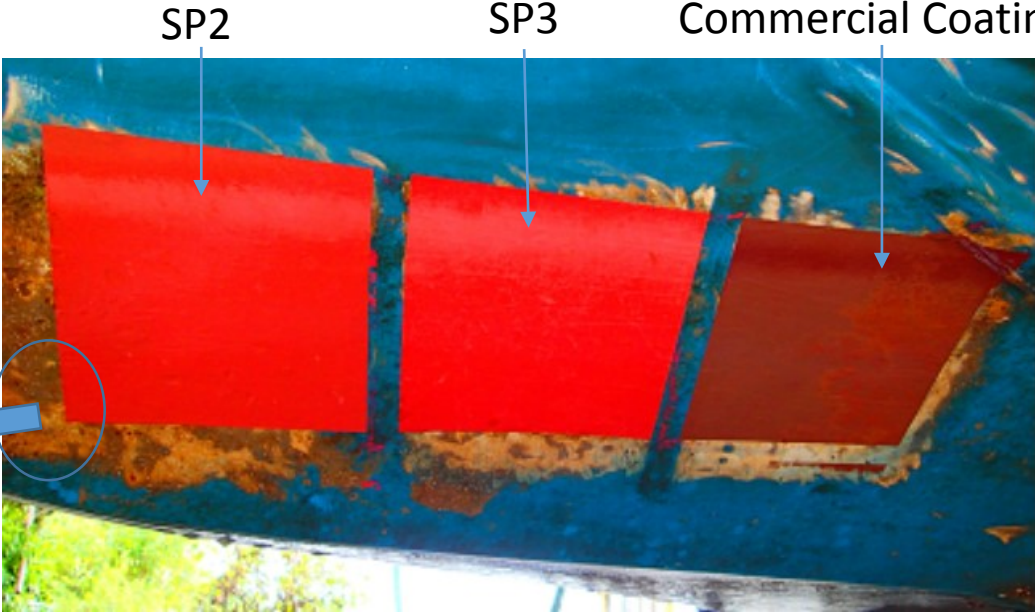
Uncoated sample

Patch Testing on Sea-Going Boat

- ❖ Prototype samples were coated onto Dynaglass boat.
- ❖ Test location at Poly Marina West Coast Ferry Road, Singapore



Fouling formed on the boat surface without protection



Front of boat (after 3 months of patch testing in the sea)



Patch testing in progress

Summary

1. Relevance to Maritime Industry

- New copper-free environmentally-friendly antifouling coating systems

2. Innovation

- Materials- Non-toxic chemicals and natural products as anti-foulants
- Processes- Customized high speed dispersion and two-step extraction to prepare coatings

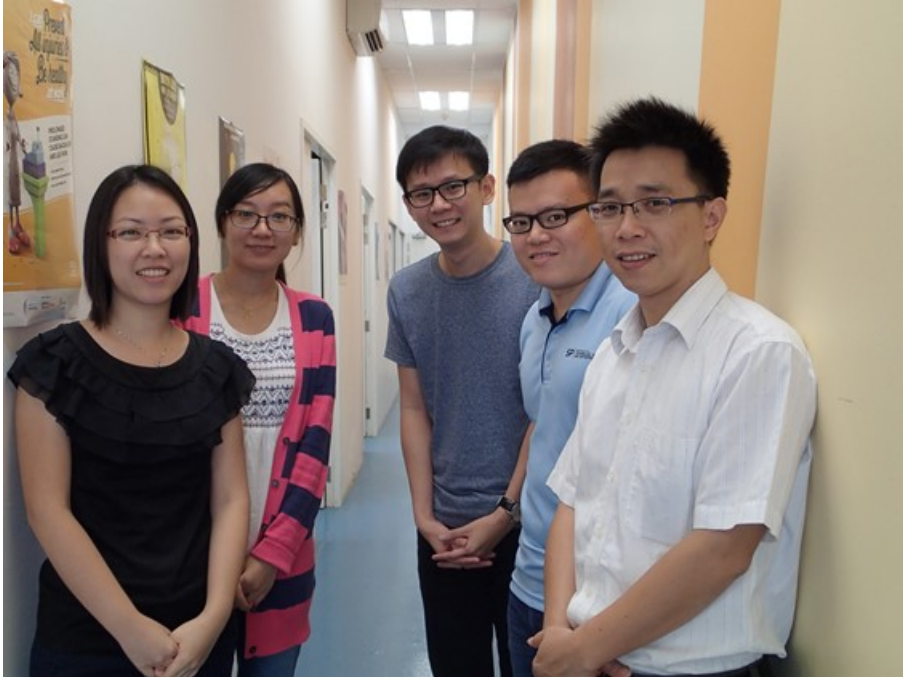
3. Impact

- Comparable cost (S\$15-20/L)
- Provide alternative option for the current anti-fouling coatings technology
- Potential commercialisation to paint-makers

4. Next Step...

- Patent filing (TD submitted)...
- Engaging industry for technology transfer...
- Further improvement of coating performance...

Acknowledgment



Research Team & Collaborators

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- **Low Aik Seng**
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