Testing and Analysis of Anti-Biofouling Coatings

NSRP Surface Preparation & Coatings Meeting
Hampton, VA
September 9, 2025

Presented by:
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Hepburn and Sons

Problem Overview

- Natural waterways contain microorganisms that attach, grow, and spread across surfaces
- This biofouling process can result in micro and macro issues including:
  - Clogged intakes and filters
  - Increased hull drag and corresponding performance decreases
  - Corrosion
- Mechanical removal is effective but can be time and labor intensive
- Legacy anti-fouling treatments often cause environmental damage

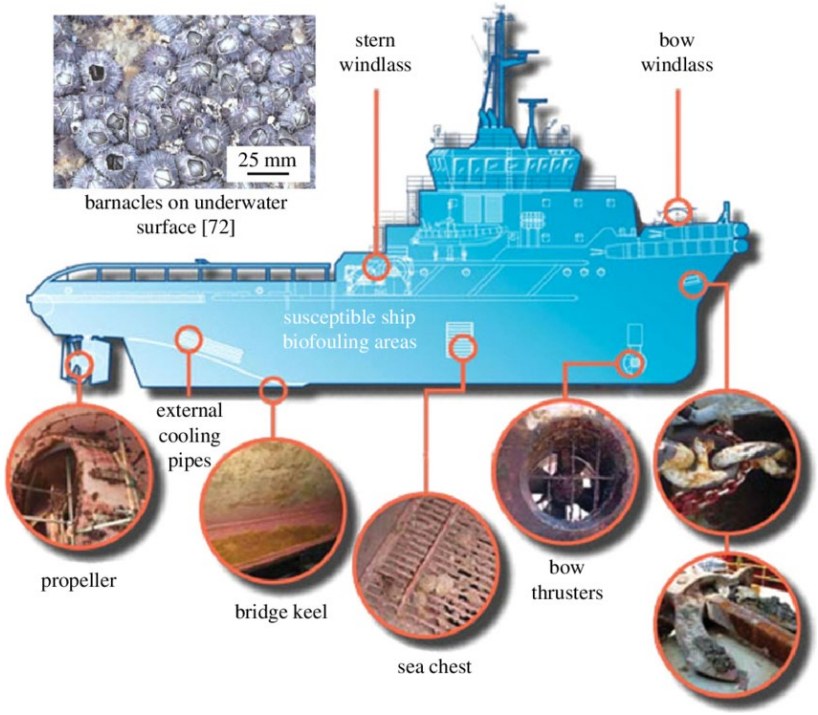


Image per Bixler “Biofouling: lessons from nature”, 2015

Proposed Solution

- Novel nano coating technologies have been developed with mission-specific optimization capabilities including:
  - Drag reduction
  - Corrosion prevention
  - Biofouling
- Thin coating layers are typically less than 0.001” and exhibit strong bonding strengths
- Incorporating nano coatings into ship maintenance can reduce cost and schedule while increasing efficiency

Images per Buitendijk “Tackling biofouling: Hull must be clean for shipping to be green”, 2022

Expected Benefits

- Shipyards and Navy have additional options for mitigating biofouling supported by NRL produced data

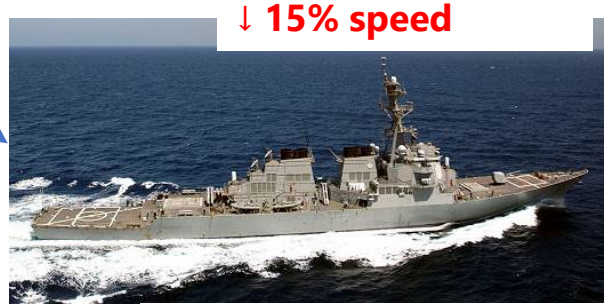
- Extend maintenance intervals for subsea components and water operating equipment

- ROI evaluations for methods and applications of coatings established

↑ 1 mm biofouling

↑ 80% frictional drag

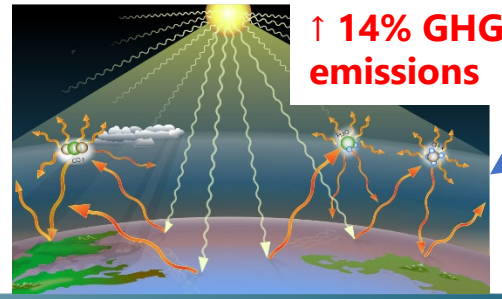
↓ 15% speed



*Gordon, Atlas of marine-fouling… 1992

↑ 5% biofouling

↑ 14% GHG emissions



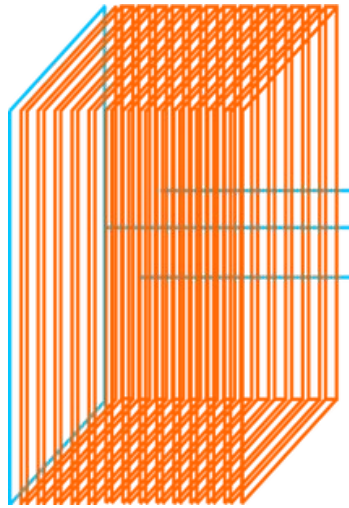
↑ 17% fuel consumption

*Dobretsov, Expected effect of climate change on fouling … 2009

Participants

BIO INTERPHASE
The BIOINTERFACING Company™
Restoring and Reinforcing Biological Needs

COVAL
Next Generation Nano Coatings

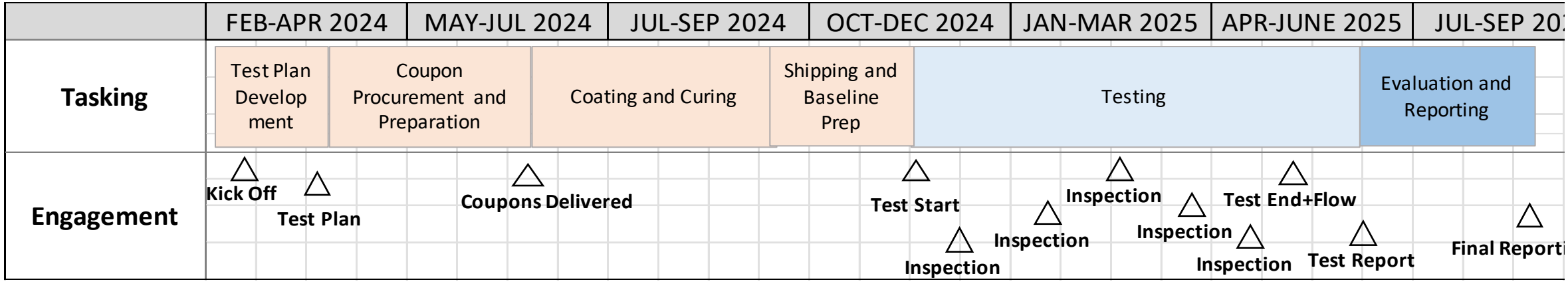

Scale Materials Inc.


Hepburn and Sons LLC


Newport News Shipbuilding
A Division of HII

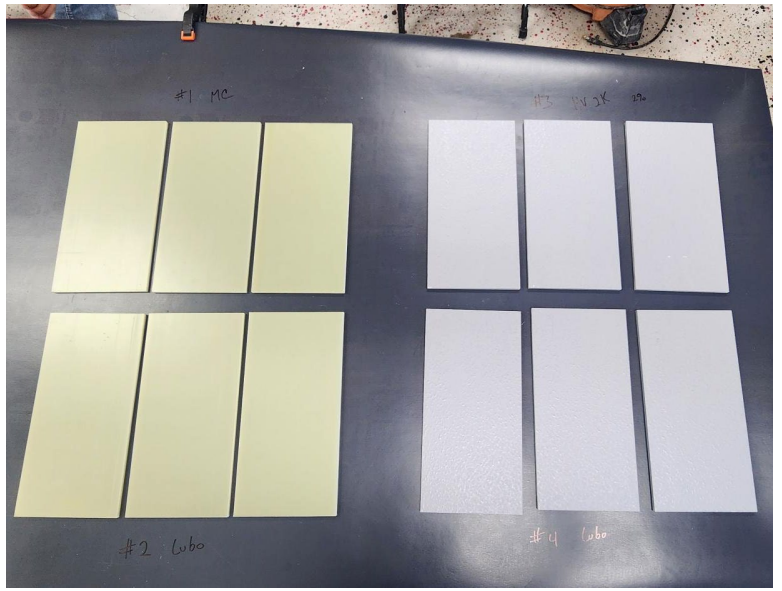
Evaluation Methods, Milestones and Schedule

- Develop test plan in combination with vendors and NRL
- Enable coating formulation optimization
- Evaluate performance using variation on MIL-PRF-24647E paragraph 4.4.1
- Expose panels for 6 months in horizontal orientation
- Flow-test to evaluate final fouling state



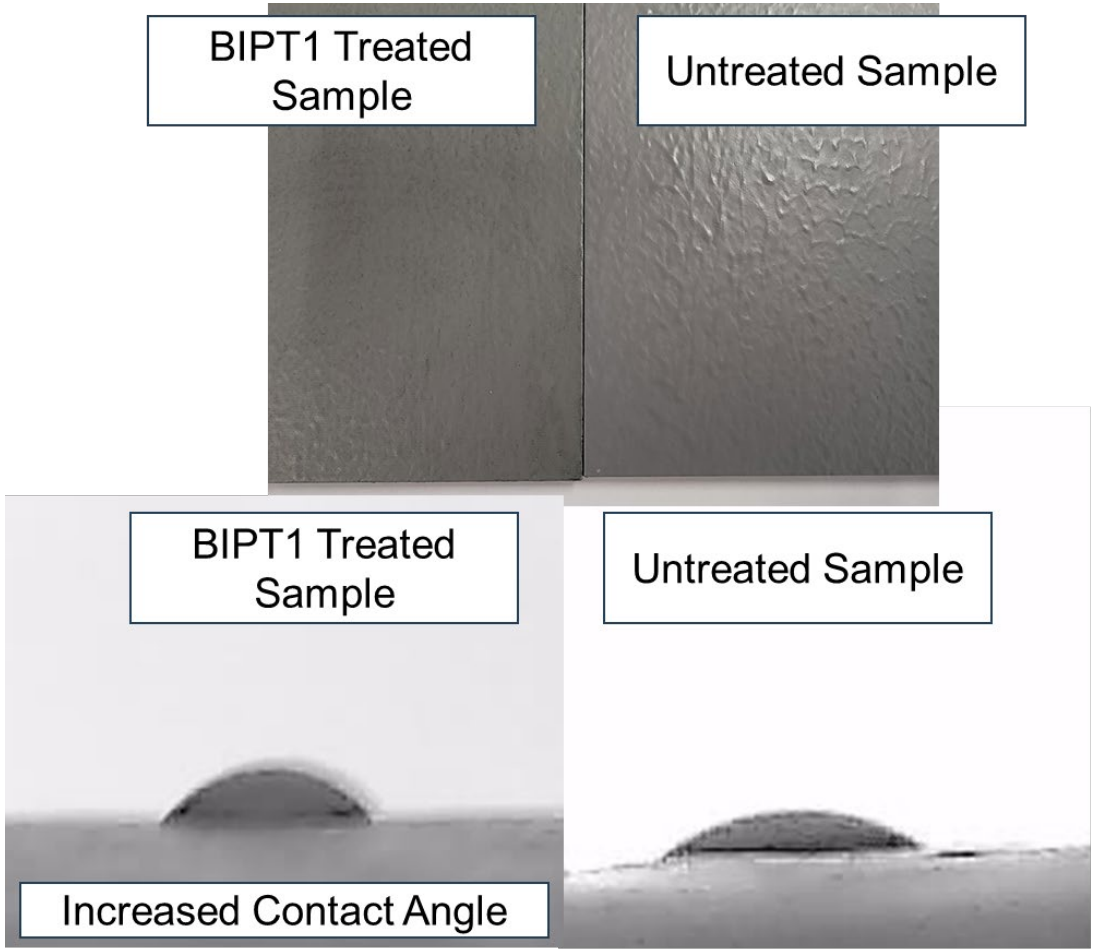
Test Overview

- Fiberglass panels for exposure (12”x6”x0.25”)
- 12 panels per vendor
  - 3 panels per rack
  - Allowed up to 4 variations of coating
- Evaluated simultaneously against conventional MIL-PRF-24647 variants: Interspeed 640, Intersleek 1100SR
- Caged, horizontal submersion in Biscayne Bay
- Monthly inspections of status
- Flow testing at NRL Key West facility at conclusion



Approach

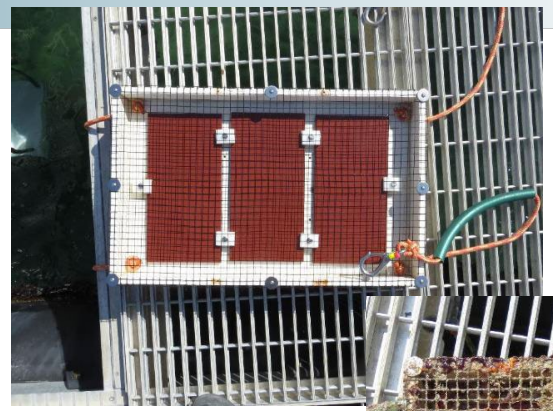
- Coval Technologies
  - Covalent bonding of polysiloxane
  - Hardness and durability of urethane
- BIOINTERPHASE
  - Bio-based polymer
  - Surface tension and biocatalysts
- Scale Materials
  - Zwitterions for AF
  - Customizable for targeted application

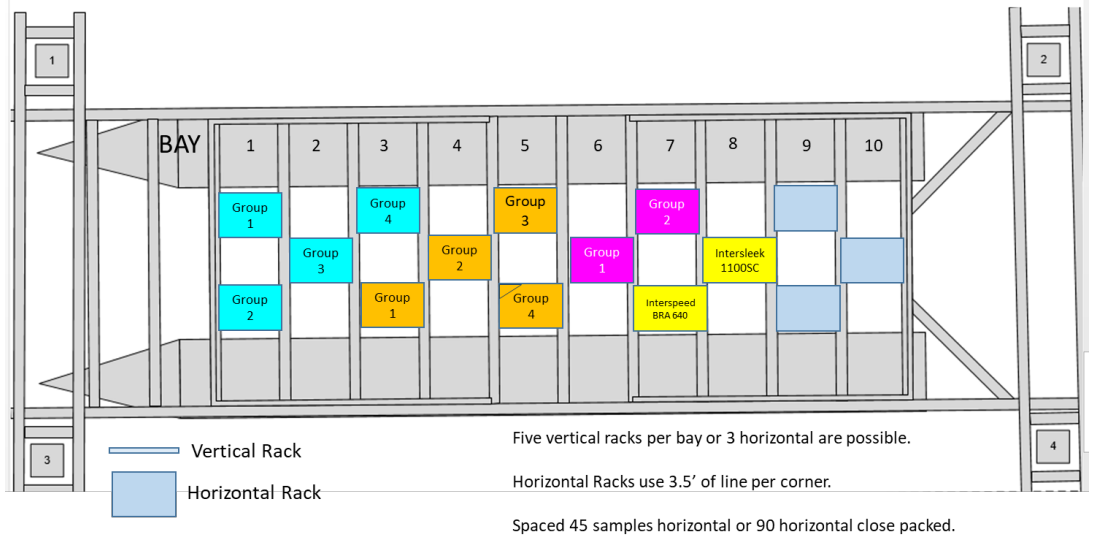


Evaluation of wetting contact surface angle alteration on panels by BIOINTERPHASE

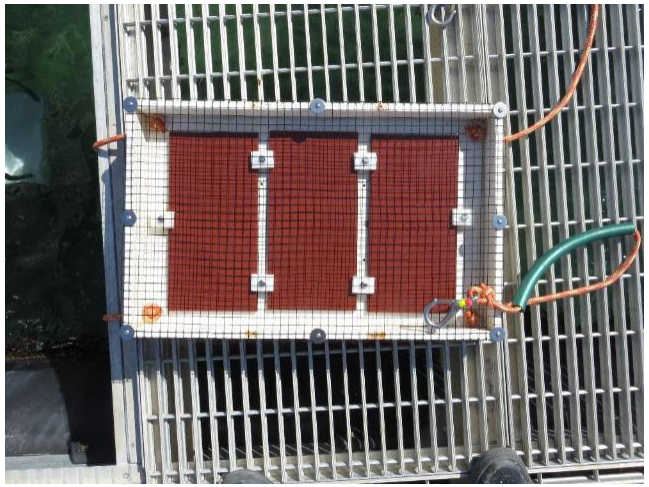
Status

- Panels were installed in raft during week of 18 November 2024
- Inspections completed monthly by NRL from November 21, 2024 through May 1, 2025 (Pictures to follow)
- Flow testing delayed due the equipment issues at NRL. Flow testing now set for week of September 8th. (NCE Approved)
- The samples have been in water in Miami since the last inspection to prevent die-off.



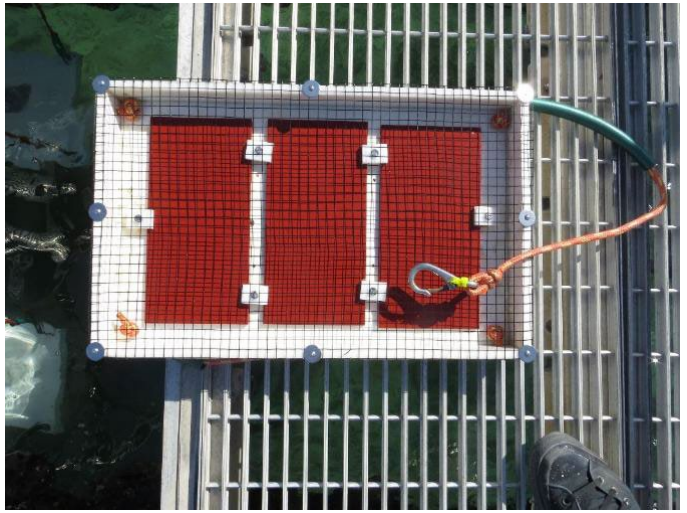


Status - Control Panels

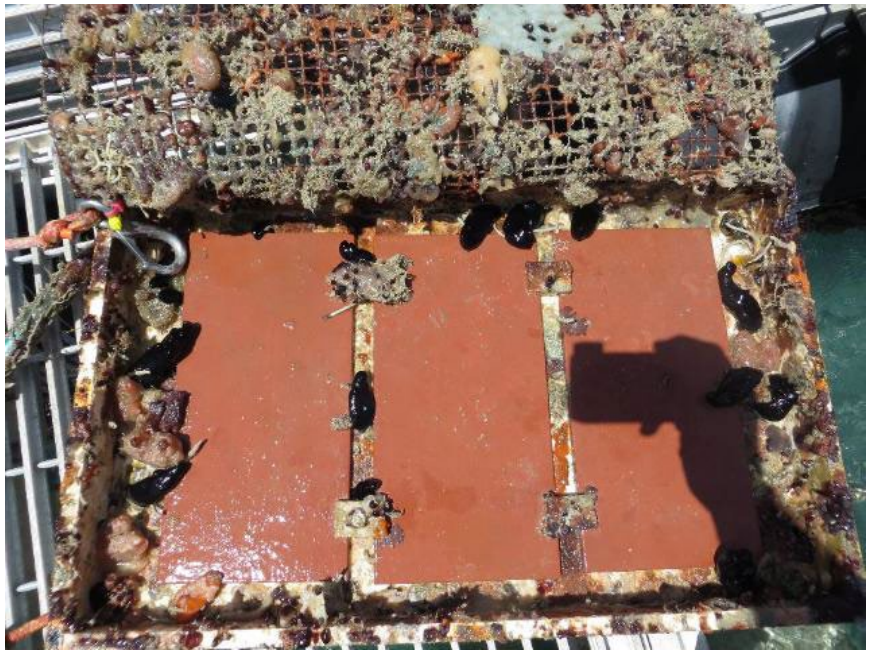


Interspeed
BRA 640

Intersleek
1100SC



November 21, 2024



Intersleek 1100 – 10-15% fouled most likely overgrowth anchored off test sample.

BRA 640 – 0%, fouled ablative coating.

May 1, 2025

Status - BioInterphase

BIPB1

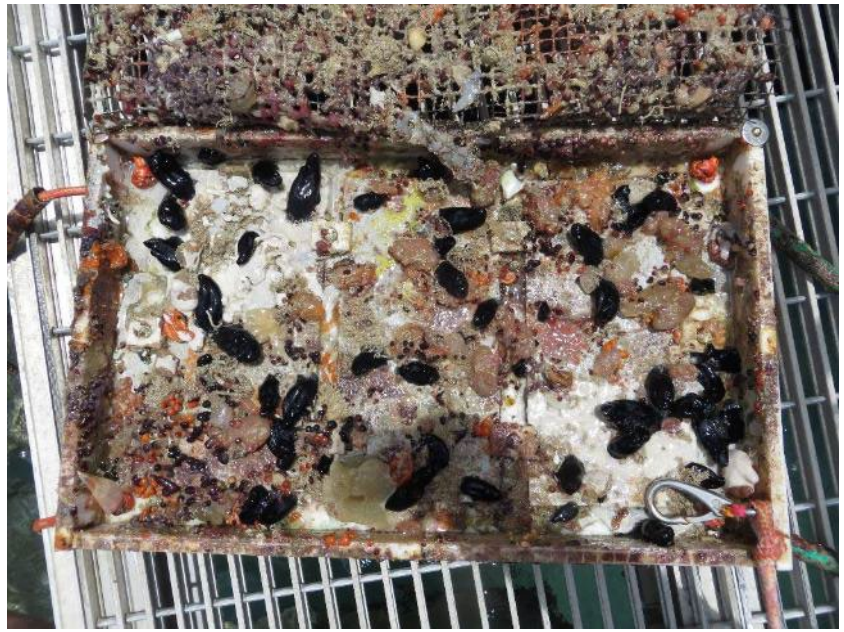
BIPQ1

90% or more fouled with soft fouling, (black solitary tunicates, orange & brown colonial tunicates, white mat tunicates, dark brown encrusting bryozoans, light brown branching arborescent bryozoan), and possibly some hard fouling (mangrove oysters), under the others.

Status - BioInterphase

BIPT1

BIPX1

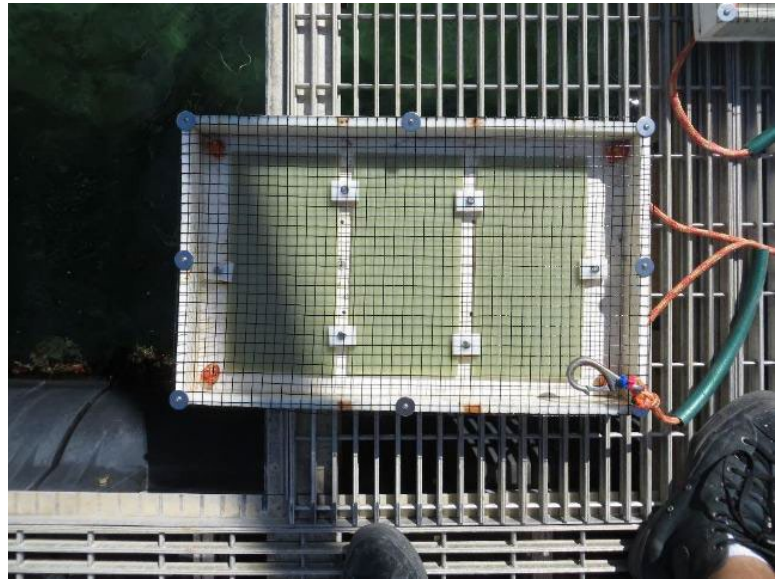


90% or more fouled with soft fouling, (black solitary tunicates, orange & brown colonial tunicates, white mat tunicates, dark brown encrusting bryozoans, light brown branching arborescent bryozoan), and possibly some hard fouling (mangrove oysters), under the others.

Status - Coval

Group 1

Group 2



95% or more fouled with soft fouling, (black solitary tunicates, dark brown encrusting bryozoans), and slight possibly of some hard fouling (mangrove oysters).

Status - Coval

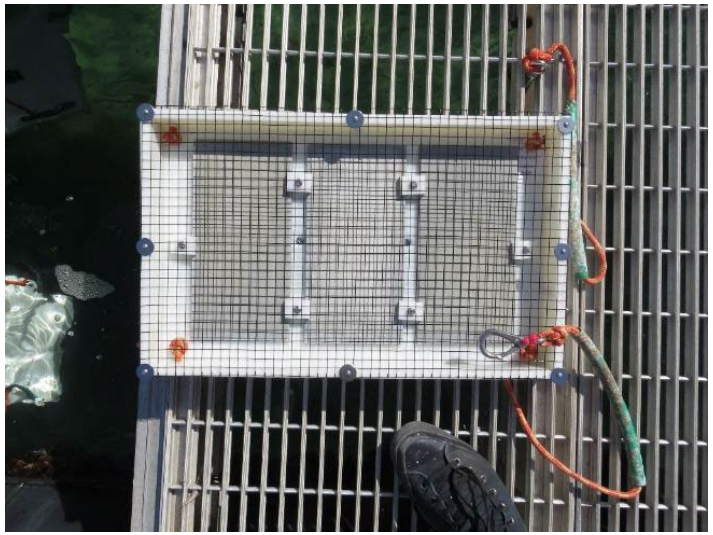
Group 3

Group 4

Group 3 - 90% or more fouled with soft fouling, (black solitary tunicates, pink tunicates, white mat tunicates, orange colonial tunicates), and some hard fouling (mangrove oysters).

Group 4 - 70% or more fouled with soft fouling, (black solitary tunicates, pink tunicates, and white mat tunicates, orange colonial tunicates), and some hard fouling (mangrove oysters).

Status – Scale Materials



Group 1

Group 1 - 95% or more fouled with soft fouling, (black solitary tunicates, pink tunicates, white mat tunicates, orange & brown colonial tunicates, light brown branching arborescent bryozoan), and slight possibly of some hard fouling (mangrove oysters).

Group 2 - 95% or more fouled with soft fouling, (black solitary tunicates, pink tunicates, white mat tunicates, orange & brown colonial tunicates, light brown branching arborescent bryozoan, brown encrusting bryozoans), and some hard fouling (mangrove oysters).

Group 2

Findings and Path Forward

- Most samples appear not to have ablative properties like the Interspeed BRA 640 (control) as they are exhibiting heavy fouling. Biofouling consists of mostly soft organisms, with the possibility of some hard fouling.
- Panels will be removed from test rig and transported in seawater to Key West for flow testing during the week of September 8th.
- By having the samples immersed for 9 months continually, larger colonization has happened, showing which formulations are susceptible to specific types of soft and hard fouling. Additionally, the longer duration will aid in the flow channel exposure with determination of which systems show promise as "easy-release" because the larger growth generates more drag in flow.
- Report from NRL compiling the test results and interpretations will be developed and submitted to Hepburn.
- Final Report will be developed by Hepburn including any recommended follow-on activities regarding coatings.

Questions?

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