Accelerating decarbonization via hull efficiency improvement

Scaling up the adoption of advanced hull coatings

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Global BDM – Dry Bulk
Marine Biofouling: Fouled Underwater Hull
Invasive Species: Black-striped Mussel

- High-risk threat to Northern Territory waters.
- Invaded Darwin Harbour marinas in 1999 but was successfully eradicated.
- Spreads on hulls and internal seawater plumbing of commercial & recreational vessels.
- Multiplies rapidly and forms dense groups that can substantially reduce local biodiversity.
- Can cause massive fouling on wharves, marinas & seawater systems, and can damage marine farms.
Vessel biofouling as a vector for invasive species
Water temperature and fouling pressure
The effect of fouling: Fuel Penalty

- **Slime fouling**: ~1-5% fuel penalty
- **Weed fouling**: ~10-15% fuel penalty
- **Animal fouling**: ~40% fuel penalty

- Increase in fouling
- Increase in frictional resistance
- Increase in fuel consumption
Conventional Antifouling coatings
Work by delivering biocides from a polymer system that deters the settlement of fouling organisms.

Fouling Release coatings
Work through physical means involving modifying the surfaces of the coatings making it difficult for fouling organisms to remain attached.

Fouling Defence coatings
Utilises both methods as mentioned above.
Biocide types & combinations: Designed for maximum antifouling performance

- Not all the biocides have the same effectiveness against the organisms.
- A smart biocide combination lowers the minimum concentration required at the surface to keep it clean.
Conventional Antifouling: *Working mechanism*

- **Sealer**
- **Active AF**
- **Leach layer**
Silicone has higher smoothness

Silyl acrylate before (left) and after 7 weeks of immersion in 30°C artificial seawater at 20 knots (right). The microroughness increases clearly.

Hempaguard X7 before (left) and after 7 weeks of immersion in 30°C artificial seawater at 20 knots (right). Virtually no effect of immersion on the microroughness.
Hempel’s journey in silicone solutions: Fouling Release and Fouling Defense
Silicone coatings is being verified as one of the best investments.

Applying Hempaguard is one way for ship owners to improve the Ship CII.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Claimed Savings</th>
<th>Cost – Estimated CAPEX</th>
<th>ROI</th>
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</thead>
<tbody>
<tr>
<td>Rudder Surf Bulb</td>
<td>5%</td>
<td>Moderate</td>
<td>&lt; 36 month</td>
</tr>
<tr>
<td>Rudder Surf Fins</td>
<td>1%</td>
<td>Moderate</td>
<td>&lt; 132 month</td>
</tr>
<tr>
<td>PBCF</td>
<td>1%</td>
<td>Moderate</td>
<td>&lt; 14 month</td>
</tr>
<tr>
<td>Contra Rotating Propeller (CRP)</td>
<td>3%</td>
<td>Moderate</td>
<td>&lt; 132 month</td>
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<tr>
<td>Mewis Duct</td>
<td>3-7%</td>
<td>Moderate</td>
<td>&lt; 14 month</td>
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<tr>
<td>Propeller Duct</td>
<td>3%</td>
<td>Moderate</td>
<td>&lt; 24 month</td>
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<tr>
<td>Wake Equalizing Ducts</td>
<td>2%</td>
<td>Moderate</td>
<td>&lt; 18 month</td>
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<tr>
<td>Pres-Swirl Fins</td>
<td>2%</td>
<td>Moderate</td>
<td>&lt; 30 month</td>
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<tr>
<td>Silicon Anti-fouling Paints</td>
<td>6%</td>
<td>High</td>
<td>&lt; 9 month</td>
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<td>Air Lubrication</td>
<td>4%</td>
<td>High</td>
<td>&lt; 60 month</td>
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<tr>
<td>De-rated ME</td>
<td>&lt; 6%</td>
<td>Low</td>
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<tr>
<td>Part Load Optimization</td>
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<td>Moderate</td>
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<tr>
<td>Turbocharger Cut-Out</td>
<td>3%</td>
<td>No</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Comparing commercially available technologies:
Antifouling / Fouling Release / Fouling Defense

- Ideal hull performance
- Fouling Defence (Biocide containing Silicone)
- Premium Antifouling (Silyl acrylate SPC)
- Silicone Fouling Release (Biocide free Silicone)
- Market average Antifouling (Rosin based)

Equivalent to 6% less fuel consumption (2% - 3% speed)
Impact of hull coating upgrade on CII & EEXI

CII impact
Reduce emissions per nautical mile by reducing fuel consumption

EEXI impact
Increase Vref after EPL through out-of-dock power gain

Hempaguard X7

Top-tier SPC antifouling

Market average SPC antifouling

Out-of-dock performance

Out-of-dock
Performance over time
Service time

Out-of-dock power gain

Speed loss over time

EEXI improvement
one-time

CII improvement
5-yr avg

- 6%*
- 1.4%**
- 2% speed increase Vs any NB antifouling
- 20% Vs mrk avg
- 7-10% Vs top tier

- 0%
- 1.5-2.5%
- No impact
- 10-13%
- Vs mrk avg

- 0%
- 5.9%
- No impact
- 

* Proved based on frictional studies, towing tank tests and model large scale tests run by independent partners. Confirmed by actual data from ships in service using performance monitoring equipment.

** Full hull application. 1% speed loss requires 3% power increase to maintain speed
HEMPAGUARD X7 & X8 Silicone Fouling Defence

- **120 days Idle guarantee**
- **2-3% Out of dock speed increase**
- **Up to 20% Total fuel savings in 5 years**
- **1.2% - 1.4% guaranteed speed loss over 5 years**
- **3,000+ vessels applied**
- **Full operational flexibility**
Thank you!
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