Join testing for fast-track antifouling innovation into Hull efficiency

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19th ICMCF
Over 200 shipping lines

504 operated vessels of which 186 under shipmanagement

All seas, all seasons!

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Our Commitment towards Climate Change

- Between 2005 and 2015, CMA CGM Carbon efficiency has been improved by 50 % per teu-Km.
- Between 2015 and 2025, CMA CGM targets an additional - 30 % CO2 per teu transported.
- In 2017, CO2 efficiency improved by 10 % per teu carried.

Main Key Drivers

Ethics
Regulations
Pressure
Business

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Energy Efficiency Measures

- Since 2009, slow or super slow steaming have been adopted.
- From 2020, 9 ships of 22,000 TEUs will be delivered with liquefied natural gas propulsion. CMA CGM is the first shipping company in the world to equip giant containerships with this motorisation.

- In 2017, the average age of the owned fleet was less than 8 years.
- Every year, CMA CGM introduces new buildings equipped with state-of-the-art environmental innovations.
- Ships currently in the fleet are sent in dry dock to be upgraded.

LNG Benefits:
- CO₂: -25%
- NOₓ: -85%
- EEDI: -20%
- SO₂: -99%

In 2017, Bulbous bow retrofit program has been achieved.

Propeller retrofit program is ongoing.

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Finally - Frictional Resistance!

- A large portion of the total resistance comes from frictional resistance;
- Friction Part was considered invariable for a long time;
- With decreasing ship speed the relative contribution of the frictional resistance becomes more and more important;

Since 2016, in addition to Hull form optimization, we have implemented measures to reduce frictional resistance.
Reduction of frictional Resistance - Hull maintenance changes

- New policies implemented for owned fleet (2018)
- All Underwater operations are now organized by a dedicated team (2018);
- We collect more data on fouling development;
- Impact of each technologies on Antifouling system?
- Only limited offer of cleaning solutions.

- Done during Newbuilding and Dry Docking (each 5 years)
- Possibilities to repair paint degradation by Touch up or Full Sandblasting;
- After 10 years of operation: Sandblasting is crucial;
- After 5 years of operation: Economical study established for each vessel;

- Is no longer considered only as aesthetic;
- Antifouling System applied during NB and each DD;
- System will remain for 5 years (strategic decision);

Propeller Polishing & Hull cleaning Program

Surface Preparation

Antifouling Selection

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Antifouling Selection – A real challenge

- Specifications for antifouling selection required:
  - Vessel’s speed
  - Commercial trade
  - Time at sea
  - Interval between Dry Docking;

- Final schedule for dry docking is driven by operational constraints and not paint applications requirements.

- Paint supplier selection is subject to a yearly fleet tender.

- Vessels can change commercial line at any time. It’s means changes of:
  - speed’s profile
  - average sea water temperature
  ➢ Fouling challenge will be different

Our challenge: find the best antifouling for our business model
Antifouling Selection – A real challenge

18000 TEUS
Vessels delivered in July 2015
No changement in commercial line

Performance Lost (per vessel):

<table>
<thead>
<tr>
<th>1st year</th>
<th>2nd year</th>
<th>3rd year</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASELINE</td>
<td>1,70%</td>
<td>4,20%</td>
</tr>
<tr>
<td>1,70%</td>
<td>187</td>
<td>361</td>
</tr>
<tr>
<td>582</td>
<td>361</td>
<td>1124</td>
</tr>
</tbody>
</table>

Fouling Condition after 2,5 years of services:

Additional Power (%)
Additinal Fuel Consumption (T/year)
Additional Emission CO2 (T/year)
1st year 2nd year 3rd year
1,70% 187 582 3rd year 4,20% 361 1124

Long time to know performance of Antifouling
Fouling Control Technologies in HEMPEL

Different approaches for the same goal:

✓ **Fouling release** (Biocide free-Passive protection)

✓ **Antifouling** (Active protection)

✓ **Fouling Defence** (HEMPEGUARD)
Development of Fouling Control products is costly and time consuming

- **Technology**
  - Idea
  - Proof of concept
  - Product development
    - Product idea
    - Lab formulation
    - Field testing
  - Real life testing starts in the last stage of development
  - Test areas
  - Real life
  - Launch

5 to 7 years of development including real life testing
Our proposal: Fast-track antifouling testing in real life

Dual benefit:
CMA get early access to new technologies
HEMPEL shorten the development time

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Case studies: 16020 DSME

Vessels operated on French Asia Line (FAL)

Vessels remain operated for at least 5 years on this line

Largest liners are deployed on this line

Trade: French Asia Line

Round trip North China – North Europe

All seasons / all climates

CMA CGM Alexander Von Humboldt

Container carrier 16020 TEUs (LOA: 396m; Breadth: 53,6m)
Delivered in 2012

Operational profile of 16020TEUS on FAL
Fast-track antifouling test to adjust antifouling performance drivers to the specific pattern requirements in a short time

- Binder technology
- Biocide package
- Polishing rate/leached layer
  - Low
  - Medium
  - High

Determining the most cost – efficient solution in a reduced time
HEMPEL proposed different prototypes to be applied on VB

**Application**
June 16 @ COSCO shipyard
Zhoushan-China

**Diving Inspection**
May 17 - Malta

**Different polishing rates and biocide combinations**
Test areas analysis: Visual inspection, biocide combination and samples analysis by microscopy

Visual inspection

Possible biocide combinations, not all is in one paint

- Cuprous oxide
- Selektepo
- Econea

Polishing and leached layer determination

- CuPt
- Zineb
- Sea Nine

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Test areas conclusion
Antifouling performance, polishing rate, biocide relationships

<table>
<thead>
<tr>
<th>Test</th>
<th>Fouling type</th>
<th>Affected area</th>
<th>Technology</th>
<th>Biocide combination</th>
<th>Sample analysis</th>
<th>Polishing rate</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Slime</td>
<td>5-10%</td>
<td>SPC/Premium</td>
<td>Medium Smart</td>
<td></td>
<td>2-3 µm/month</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Slime</td>
<td>&lt;1%</td>
<td>SPC/Premium</td>
<td>High Smart</td>
<td></td>
<td>2-3 µm/month</td>
<td>1</td>
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<tr>
<td>3</td>
<td>Thick slime</td>
<td>25-50%</td>
<td>SPC/Premium</td>
<td>High Conventional</td>
<td></td>
<td>2-3 µm/month</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Slime</td>
<td>&lt;1%</td>
<td>SCP/Premium</td>
<td>High conventional</td>
<td></td>
<td>3-4 µm/month</td>
<td>1</td>
</tr>
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</table>

SPC: Self-Polishing Copolymer
Conclusion

- Test areas 2 and 4 show the best antifouling performance to this specific pattern requirements. The systems applied on test area 2 and 4 are Self Polishing Copolymers paints having different technologies, polishing rates and biocide package.

- The fast-track join testing allowed HEMPEL to determine the most cost – efficient solution (binder technology, polishing rate and biocide package) to this specific sailing pattern.

- This study helped CMA ships in the choice of our selection Antifouling system for our future 22000TEUS. We have chosen product of patch number 4.
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SHIPPING THE FUTURE

CMA CGM