Proposal for Efficient Prevention of Bio-fouling and Preservation of Marine Environment

PERRIER KIM
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   • Amendments to MEPC 207(62)

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0. Relevant issue

DAELIM Marigold
0. Relevant issue

DAELIM Marigold

- A recent example of a ship not strictly observing the guideline
- The Korean ship (unclean hull) got refused to enter the port by New Zealand MPI due to severe extent of Biofouling

Hereby we need to reconsider:

**Actual effectiveness of IMO Rules on Biofouling control**
1. What is bio-fouling

**Bio-fouling**: The gradual accumulation of organisms such as algae, bacteria, barnacles, and protozoa on underwater equipment, pipes, and surfaces, corroding and impairing structures and systems.

*Bio-fouling is continuing to increase as the seaborne trade keeps going along high demand.*
1. What is bio-fouling

Micro-fouling = Slime

Macro-fouling = Weed + Animal

WEED
- Red
- Brown
- Green

ANIMAL
- Soft Bodied
  - Barnacles
  - Tube Worms
- Hard Shelled
  - Mussels
  - Other
1. How does it impact? – ① Primary problem

Disturbance on Marine Eco-system

- The introduction of invasive aquatic species to host environments has been a major threat to the conservation of biodiversity.

- Since the volumes of seaborne trade continue to increase, the problem even may not yet have reached its peak.

Such ecological damage is often irreversible.

Increased Frictional Resistance

A fouled hull

↓

Hull resistance increase

↓

Fuel consumption increase

↓

Uneconomical ship operations

Table 1. Effect of Fouling after Six Months out of Dock in Temperate Waters

(Frictional resistance assumed to increase \( \frac{1}{4} \) percent per day)

<table>
<thead>
<tr>
<th>Type of Ship</th>
<th>Standard Displacement Tons</th>
<th>Loss of Maximum Speed Knots</th>
<th>Percentage Increase in Fuel Consumption* to Maintain a Speed of</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 Knots</td>
</tr>
<tr>
<td>Battleship</td>
<td>35,000</td>
<td>( \frac{1}{2} )</td>
<td>45</td>
</tr>
<tr>
<td>Aircraft carrier</td>
<td>23,000</td>
<td>( \frac{1}{4} )</td>
<td>45</td>
</tr>
<tr>
<td>Cruiser</td>
<td>10,000</td>
<td>( \frac{1}{4} )</td>
<td>50</td>
</tr>
<tr>
<td>Destroyer</td>
<td>1,850</td>
<td>2</td>
<td>50</td>
</tr>
</tbody>
</table>

* These figures are based on the fuel consumptions for propulsion only, i.e. auxiliaries are not included.

Marine Pollution Caused by Usage of Anti-fouling Paint

Although at present copper antifouling paints present the BPEO available to the marine industry, there are a number of potential environmental impacts that may occur from using copper antifouling paints. Copper present in the water and sediments can be accumulated by benthic animals causing, for example, reduced respiration rates and impaired growth in mussels, clams and other shellfish (Sobral & Widdows 1997). The toxicity and accumulation of copper varies greatly depending on concentration levels, exposure, temperature and salinity, the presence of other metals and the type, size and age of the marine organism. It is therefore difficult to generalise about the toxicity of copper to marine organisms, there is evidence that certain species of fish are sensitive to quite low levels of copper even though other species are tolerant of much higher levels. Benthic marine organisms are thought to be slightly more sensitive to copper than fish, although some species demonstrate a capacity to adapt to elevated levels.

http://www.ukmarinesac.org.uk/activities/ports/ph4_3_1.htm

“There are a number of potential environmental impacts that may occur from using copper antifouling paints.”
Summary of the Solutions and the Problems

- Ineffective Biofouling control under IMO Rules
- Marine pollution caused by usage of anti-fouling paint

1. Monitoring Control

2. New Paint

Supportive Rules

IMO
Proposal 1

① Primary Problem - Disturbance on Marine eco-system
② Secondary Problem 1 - Increased frictional resistance
### Biofouling Management Plan

5.2 It is recommended that every ship should have a biofouling management plan. The intent of the plan should be to provide effective procedures for biofouling management. An example of a Biofouling Management Plan is outlined in appendix 1 of these Guidelines. The Biofouling Management Plan may be a stand-alone document, or integrated in part or fully, into the existing ships’ operational and procedural manuals and/or planned maintenance system.

5.3 The biofouling management plan should be specific to each ship and included in the ship’s operational documentation. Such a plan should address, among other things, the following:

1. relevant parts of these Guidelines;
2. details of the anti-fouling systems and operational practices or treatments used, including those for niche areas;
3. hull locations susceptible to biofouling, schedule of planned inspections, repairs, maintenance and renewal of anti-fouling systems;
4. details of the recommended operating conditions suitable for the chosen anti-fouling systems and operational practices;
5. details relevant for the safety of the crew, including details on the anti-fouling system(s) used; and
6. details of the documentation required to verify any treatments recorded in the Biofouling Record Book as outlined in appendix 2.

5.4 The biofouling management plan should be updated as necessary.

### Need of Monitoring System

“Management plan - Advised to address hull locations susceptible to biofouling”

“Future work – Advised to encourage and Support research of shipboard monitoring and detection of biofouling”
2. Proposal 1

Introduction of Monitoring System

<table>
<thead>
<tr>
<th>Monitoring Devices</th>
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<tbody>
<tr>
<td><img src="shutterstock" alt="Eye" /></td>
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</table>

<table>
<thead>
<tr>
<th>Fouling Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Size of entities</td>
</tr>
<tr>
<td>• Density</td>
</tr>
<tr>
<td>• Thickness</td>
</tr>
<tr>
<td>• Solidity</td>
</tr>
<tr>
<td>• Attachment Strength</td>
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</tbody>
</table>
2. Proposal 1

Monitoring Device Arrangement

Propulsion Section

Bottom Section

Alongside wetted surface

Infrared camera

Ultrasonic sensitive sensor

Visual Observation
2. Proposal 1

Severity Assessment Process

IMO

Rules

Current ship data

Database (Big data)

Vessel Main Server

A.I. Deep learning

Resultative Data

Safe

Caution

Danger

Fouling Light Signal

Deep Neural Network

A.I.
2. Proposal 1

How to Share the Resultative Data?

**Data Accumulation**

- Current ship data
- Safe
- Caution
- Danger
- Fouling Light Signal

Vessel Main Server

**Data Submission**

Management Instruction

Port authority

Ship classification

Ship bridge console

Data Accumulation and Submission to the Institutions / Bridge consoles
Amendments to MEPC 207(62)

Complementary Proposal

5.9 Every ship is obligated to be equipped with a monitoring system within the deadlines set depending on types and purposes of operations.

.1 if an existing vessel of at least 20,000 DWT but less than 40,000 DWT, not later than June 1, 2020, If more than 40,000 DWT, not later than January 1, 2020, be equipped with monitoring system.

.2 if a vessel anchored or not operating for more than 3 months in a year, or on purpose of intercontinental trade, not later than January 1, 2020, be equipped with monitoring system.

.3 if a vessel that was warned by the government authority or IMO in recent 1 year for its severe fouling extent, not later than January 1, 2020, be equipped with monitoring system.
2. Proposal 2 - MEPC207(62)

Proposal 2

Marine Pollution caused by usage of Anti-fouling paints

1. Regulate the Toxic Paint Usage

2. Support for Paint Developers

3. Increase the Ecofriendly Paints Usage

4. Encourage the New Paints Development

Marine Environmental Pollution by paint shall decrease
6 ANTI-FOULING SYSTEM INSTALLATION AND MAINTENANCE

6.1 Anti-fouling systems and operational practices are the primary means of biofouling prevention and control for existing ships’ submerged surfaces, including the hull and niche areas. An anti-fouling system can be a coating system applied to exposed surfaces, biofouling resistant materials used for piping and other unpainted components, marine growth prevention systems (MGPSs) for sea chests and internal seawater cooling systems, or other innovative measures to control biofouling.

6.2 The anti-fouling system used should comply with the AFS Convention, where necessary.

Choosing the anti-fouling system

6.3 Different anti-fouling systems are designed for different ship operating profiles so it is essential that ship operators, designers and builders obtain appropriate technical advice to ensure an appropriate system is applied or installed. If an appropriate anti-fouling system is not applied, biofouling accumulation increases.

6.4 Some factors to consider when choosing an anti-fouling system include the following:

1. planned periods between dry-docking – including any mandatory requirements for ships survey;
2. ship speed – different anti-fouling systems are designed to optimize anti-fouling performance for specific ship speeds;
3. operating profile – patterns of use, trade routes and activity levels, including periods of inactivity, influence the rate of biofouling accumulation;
4. ship type and construction; and
5. any legal requirements for the sale and use of the anti-fouling systems.

MEPC.207(62)
Ch 6 ANTI-FOULING SYSTEM INSTALLATION AND MAINTENANCE

6.2-6.5 Choosing the anti-fouling system

6.6-6.8 Installing, re-installing, or repairing the anti-fouling system

6.9 Procedures for ship maintenance and recycling facilities

There is no provision for regulating usage of the toxic paints
2. Proposal 2-1

Suggestion for Rule Amendment

<table>
<thead>
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<th>MEPC 62/24/Add.1</th>
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<tr>
<td>Annex 26, page 10</td>
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</table>

6. ANTI-FOULING SYSTEM INSTALLATION AND MAINTENANCE

Procedures for ship maintenance and recycling facilities

Complementary Proposal

6.10 As the humanity is in the communal obligation of preserving the marine environment, there shall be a regulation for each nation on the usage of the toxic paints.

.1 The governments should regularly dispatch inspectors to the vessels.

.2 A vessel that exceeds the limitation of toxic paint usage allowance shall pay the penalty according to the regulation set by IMO.
Problems of Current Tin-free Anti-fouling Paints

- **Functional & Economical but Non – Ecofriendly**

  **Ex 1) Copper base Self Polishing Copolymer Type**

  Acute toxicity indicates that substances such as Cu paints have a similar or rather stronger toxic effect than TBT, a very potent toxic substance to aquatic organisms. So California's Department of Pesticide Regulation has proposed a new regulation requiring all new copper-based antifouling paint and coating products to submit the estimated Mean Copper Release Rate of the product when registering.

- **Ecofriendly & Functional but Non - Economical**

  **Ex 2) Silicon base Foul Release Type**

  Silicon base Foul Release Type Anti-fouling paints do not contain biocide – there is no environmental problems, but the painting processes and post-painting managements are very difficult also, it is prone to biofouling and expensive. So it is burdensome for shipowners to adopt.
The Current Difficulties in the Development Procedures

Antifouling paints typically require five to eight years of development and testing to reach the market, including the time to get a new biocide registered with the EPA. This is a long and expensive process. Similarly, it may take a company that manufactures biocides as much as $5 million in testing before it can provide it to the paint companies.

Even a development of new AF paint takes much expense and time

- It is too burdensing to develop a new eco-friendly AF paint
- Ship-owners are reluctant to use an eco-friendly AF paint
- An easy way to approach the development is needed for researchers

Therefore it is required for IMO to take supportive actions to encourage developers
IDEA for the developments of new paint

How to give supports to developers?

Proposal of establishing a new public utilities agency to encourage Developments and applications of the environmentally friendly paints

Plan of Encouragement

Provision of Specified Standards

Communal Benefits of Humanity and Nature

Future Work

Encourage the development and application of environmentally friendly paints

Sub Committee on Environmental Consultative Support

Assembly

Secretary

IMO

Facilitation Committee FAL

Technical Co-operation Committee TC

Legal Committee LEG

Marine Environmental Protection Committee MEPC

Maritime Safety Committee MSC

Company

Governments

Ship classification
2. Proposal 2-2

Agenda Details

X.XX As the humanity is in the communal obligation of preserving the marine environment, Paint companies, Ship owners, Ship companies, Shipyards, Port states, Classifications and IMO should consider this guidance document.

.1 The members of the committee are to be designated from each institution (Paint companies, Ship owners, Ship companies, Shipyards, Port states, Classifications and IMO), and the regular conference shall be held every 6 months on the agendas from the respective institutions.

.2 Any Party of ECS should provide specified environmental standards, the maintenance and application plan and the expected price and confirm possibilities thereof until the next conference.

.3 Any Party of ECS may propose an encouraging development plan of new eco-friendly paint to ECS.
Conclusion & Prospective
3. Conclusion

<table>
<thead>
<tr>
<th>Problems</th>
<th>Proposals</th>
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<tr>
<td>There is a rule to manage the foul, but the effect is insignificant.</td>
<td>The installation of a monitoring system combined with artificial intelligence technology.</td>
</tr>
<tr>
<td></td>
<td>The establishment of ECS that can activate eco-friendly paints development.</td>
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</table>
3. Conclusion

1. Phasing in Monitoring system and Forming up DB to facilitate bio-fouling observation

2. There no longer will be any passing ship that does not comply with the regulations

Less burden on Developing procedure will activate developments of superb ecofriendly antifouling paints

Environmental pollution of marine eco-system by paint can decrease

As a result of reduced fouling of the ship, disturbance of the marine ecosystem, Increase of ship resistance, environmental pollution caused by antifouling paints will reduce consequently
3. Prospective

Future vision of Monitoring system

- **Active adaptive Anti-fouling management system** considering ship type, age and navigation area using Big data Processing Technology and Deep-Learning Technology

- **IMO shall revise the rules** properly following the circumstances by analysis with accumulated database

![Diagram showing future vision and technology components](image.png)
References

Ocean & Human

“If you want to go fast, go alone, if you want to go far, go together.”
Thank you