The International Convention on the Control of Harmful Anti-Fouling Systems on Ships

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Plan

1. Fouling and the need for control
2. Introduction to antifouling systems
3. TBT – a proven environmental pollutant
4. Overview of the AFS Convention and associated Guidelines

Fouling and the need for its prevention

A fouled hull is an economic and environmental disaster for a ship owner:
What is Fouling?

- "Macro-fouling" = Weed + Animal
- "Micro-fouling" = Slime

Some 4000 fouling species exist globally.

High water temperatures promote fouling.

The Fouling problem

- High water temperatures promote fouling.
- High nutrient levels in water promote fouling.

Severe Fouling

- FPSO, static in North Sea for 55 months
- No A/F – A/C only
- 100% fouled
- Weight of fouling > 225 tonnes of mussels
Slime: 250~400µ AHR

Weed: 400~650µ AHR

Shell Fouling: > 650µ AHR
The importance of hull roughness


% FUEL PENALTY vs. INCREASED ROUGHNESS

Roughness (microns)

Economic impact of a fouled hull

A totally fouled hull is an economic disaster:
- vessel burns 40% more fuel

In context:
- a 260 000 DWT crude oil carrier burns an extra 24 tonnes fuel per day
- if the world’s commercial fleet were totally fouled an extra 70.6 million tonnes fuel would be burned each year

A totally fouled hull is an economic disaster:
- vessel operates with reduced efficiency and safety, forcing dry-docking

In context:
- docking costs > EURO 1 000 000 per day for a large vessel
A fouled hull increases environmental impact of shipping:

If the world fleet were totally fouled, an extra 76.6 million tonnes of valuable fossil fuel would be burned, leading to:

- an extra 210 million tonnes CO$_2$ → Global warming
- an extra 5.6 million tonnes SO$_2$ → Acid rain

Increased air pollution

A fouled hull forces vessels to dry-dock, increasing pollution from shipyards.

A fouled hull causes a serious risk of transport of invasive species into sensitive ecosystems.

Niche areas significant problem.
Impacts of species invasions

Ecological: alters competition between species, predation and population dynamics in sensitive areas.
Economic: impacts on fisheries and aquaculture, infrastructure damage, impacts on tourism, costs of management.
Human Health: toxic species can be introduced eg. disease causing bacteria.

A clean hull is not the full story

Grates of sea chests – free of fouling
Conclusion so far:

There is a need to prevent fouling of the immersed areas of ships hulls for safety, economic and environmental reasons.

How it is prevented is a key issue...

Antifouling coatings

Antifouling paints are applied to ships hulls and immersed surfaces to prevent fouling.

Two main types on the market today:

- Biocidal
- Non-Biocidal
Biocidal anti-fouling paints

- Biocide is released from paint film on the ship's hull, creating a thin layer of toxicity at the paint surface, preventing settling of organisms.

Non-biocidal foul release coatings

- Provide a low energy (non-stick) surface to which organisms can only weakly adhere.

Organisms that do adhere are removed during vessel operation or mild cleaning.

Slime washed off at D/D
TBT antifouling paints – the case against

Case against TBT antifouling paints

- From ~1980s - 2003 biocidal antifouling paints containing TBT were used by the majority of the world fleet (including pleasure craft)
- TBT = highly effective biocide
- Highly controlled release rate mechanism

Case against TBT antifouling paints

Coastal and deep sea snails - clear cause and effect relationship at low concentrations (2 ng/L)
Persistent in marine sediments for duration of many years
Bioaccumulating - Bioaccumulation factors of > 6000 measured
Bioconcentration observed
Residues detected in marine mammals (dolphins, seals, birds etc)
PROVEN ENVIRONMENTAL CONTAMINANT
Develop of AFS Convention

The harmful effects of anti-fouling systems were considered by IMO for the first time in 1988, when the Paris Commission requested MEPC to consider measures to restrict the use of TBT compounds in the Anti-fouling systems on ships.
AFS Convention - Current Status

Adopted in 5 October 2001

Entered into force on 17 September 2008

51 Parties, representing about 78.81% of the world’s merchant fleets

AFS Convention – status of ratification

Main content:

– requirements on phasing out the use of harmful organotin compounds (TBT) as biocides in anti-fouling paints;

– requirements on disposal of wastes from the removal of TBT-based paints in a safe and environmentally sound manner;

– establishment of a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems; and

– requirements on survey and certification for ships’ anti-fouling systems
Key Features

The Convention uses similar structure as other IMO Conventions.

Articles—legal and contractual provisions, principal technical requirements

Regulations in Annexes—detailed technical requirements

AFS Convention

Key Features - Operative Articles

Article 3 Application
Article 4 Controls on anti-fouling systems
Article 5 Controls of Annex I waste materials
Article 6 Process for proposing amendments to controls on anti-fouling systems
Article 7 Technical Groups
Article 8 Scientific and technical research and monitoring
Article 9 Communication and exchange of information
Article 10 Survey and certification
Article 11 Inspection of ships and detection of violations
Article 12 Violations
Article 13 Undue delay or detention of ships

AFS Convention

Key Features - Non-operative Articles

Article 1 General Obligations
Article 2 Definitions

Article 14 Dispute settlement
Article 15 Relationship to international law
Article 16 Amendments
Article 17 Signature, ratification, acceptance, approval and accession
Article 18 Entry into force
Article 19 Denunciation
Article 20 Depository
Article 21 Languages
AFS Convention, Key Features - Annexes

Annex 1 – Controls on anti-fouling systems
Annex 2 – Required elements for an initial proposal
Annex 3 – Required elements of a comprehensive proposal
Annex 4 – Surveys and certification requirements for anti-fouling systems

AFS Convention, Key Features - Conference Resolutions

1. Early and Effective application of the AFS Convention
2. Future Work of the IMO relating to the AFS Convention Guidelines
3. Approval and Test methodologies for AF systems
4. Promotion of Technical Co-operation - ratification, national legislation, training, ...

AFS Convention, Key Features - Guidelines

Survey and certification of anti-fouling systems on ships, adopted by resolution MEPC.192(48), subsequently revoked by 2010 GUIDELINES FOR SURVEY AND CERTIFICATION OF ANTI-FOULING SYSTEMS ON SHIPS MEPC.195(51)

Brief sampling of anti-fouling systems on ships, adopted by resolution MEPC.194(49), and

Inspection of anti-fouling systems on ships, adopted by resolution MEPC.45(49).
AFS Convention, Article 3 - Application

(a) ships flying the flag of a Party;

(b) ships not entitled to fly their flag but which operate under their authority; and

(c) to all ships that enter a port, shipyard or offshore terminal of a Party. (Art. 3)

AFS Convention, Article 3 - Application

"Ship" means a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air cushion vehicles, submersibles, floating craft, fixed or floating platforms, floating storage units (FSUs) and floating production storage and off-loading units (FPSOs). (Article 2.9 of the Convention)

AFS Convention, Article 3 - Application

Not applicable to any warships, naval auxiliary or other ships owned or operated by a Party and used, for the time being, only on government non-commercial service. Such ships should act in a manner consistent with the Convention (Art. 3)
AFS Convention, Article 4 - Controls

Prohibits and/or restricts the use of harmful anti-fouling paints used on ships (Art. 4).

Anti-fouling systems to be prohibited or controlled are listed in Annex 1.

AFS Convention, Annex 1 - Controls

by 1/1/2003, do not apply or re-apply organotins compounds which act as biocides in anti-fouling systems (Partial ban);

by 1/1/2008 ships either (Total Ban):

- shall not bear such compounds on their hulls or external parts or surfaces; or
- shall bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling systems.

Interpretation of the wording:

“organotin compounds which act as biocides in anti-fouling systems”

Clarified in appendix of Resolution MEPC 195(61):

An organotin compound in a coating must not provide a biocidal effect to the coating.

Practical guidance – organotin compound must not be present above 2500 mg total tin per Kg dry paint.
Two options after total ban with regard to anti-fouling systems using organotin compounds as biocides

1. Remove all TBT from the hull by grit-blasting or other equivalent methods;
2. Over-coating with a sealer-coat

Coatings industry is able to provide “sealer-coats”

“sealer-coats” may not be appropriate for every ship

re-blasting a ship’s hull may be over four times the cost of applying a “sealer-coat”

Graph: Control corrected average leaching rate / µg/cm²/day

- No Sealer coat (Brass)
- With Sealer coat
AFS Convention, Annex 1 - Controls

The Convention provides controls harmful anti-fouling systems:
- restricted/banned systems are listed in annex 1
- it does not provide an “approval list”

i.e. it takes a ‘black-list approach’

ARTICLE 6 - Amending Annex 1 (Controls on anti-fouling systems)

Annexes 2 and 3 set out details that must be included in an initial and, if warranted by MEPC (Party States only), a comprehensive proposal to be considered.

MEPC establishes technical group to review and report on comprehensive proposal according to specific evaluation criteria (Art. 7).

Report forwarded to all Member States before Committee, acting as a meeting of Parties, considers document - Parties only take decisions.

ARTICLE 5 - Waste Materials

A Party shall take appropriate measures in its territory to require that wastes from the application or removal of anti-fouling system controlled in Annex 1 be collected, handled, treated, and disposed of in a safe and environmentally sound manner to protect human health and the environment.
ARTICLE 8 & 9

Parties shall promote and facilitate scientific research and monitoring of effects of AF systems. Promote availability of and undertake to communicate and exchange information (nominated surveyors, approved or registered AF systems etc).

ARTICLE 10 - Survey and Certification

A Party shall ensure that its ships or those under its authority are surveyed and certified in accordance with regulations in Annex 4.

The Administration shall establish appropriate measures for ships that not subject to survey regulation in order to ensure that this Convention is complied with.
ARTICLE 11 - Inspections and detections of violations

May be carried out in any Port, shipyard or offshore terminal to determine compliance:
- International AF System Certificate or Declaration
- Brief Sampling (using Guidelines)
- No delay

If grounds for violation
- Thorough inspection (using Guidelines)

A brief sampling is included in the process of initial inspection;

The time required to process the result of such sampling shall not be used as a basis for preventing the movement and departure of the ship

ARTICLE 12 - Violations

Article 12 enables the Authority to prosecute offences against the Act
ARTICLE 13 - Undue delay or detention of ships

(1) All possible efforts shall be made to avoid a ship being unduly detained or delayed under article 11 or 12.

(2) When a ship is unduly detained or delayed under article 11 or 12, it shall be entitled to compensation for any loss or damage suffered.

ARTICLE 16 Amendments

Standard procedure with MEPC acting as a Meeting of Parties

Articles—explicit acceptance procedure

Annexes—tacit acceptance procedure

Amendments to articles are subject to explicit acceptance:

1. Amendments shall be adopted by a two-thirds majority of Parties present and voting.
2. Amendments shall be deemed to have been accepted on the date when at least two-thirds of Parties have accepted it.
3. The amendments shall enter into force after a certain period (six months) after the date of the acceptance.
ARTICLE 16 Amendments

Amendments to annexes are subject to tacit acceptance

1. Amendments shall be adopted by a two-thirds majority of Parties present and voting;

2. Amendments shall be deemed to have been accepted after six months, unless by that date at least one-third of the Parties communicated objections;

3. The amendments shall enter into force after a certain period (six months) after the date of the acceptance.

AFS—Survey and Certification

Guidelines for survey and certification of anti-fouling systems on ships, adopted by resolution MEPC.102(48); subsequently revoked by 2010 Guidelines for survey and certification of anti-fouling systems on ships, adopted by resolution MEPC.102(48).

Guidelines for brief sampling of anti-fouling systems on ships, adopted by resolution MEPC.102(48).

Ships subject to survey and certification

- 400 gross tonnage and above
- engaged in international voyages
- excluding fixed or floating platforms, FSUs, and FPSOs

(annex 4, regulation 1)
**AFS—Survey and Certification**

**Types of survey**

Initial survey (issuance of International Anti-Fouling System Certificate)
- newbuilding
- existing ship, before the International Anti-fouling System Certificate is issued for the first time.

Subsequent survey (endorsement on the Certificate)
- anti-fouling system is changed or replaced

may be needed upon transfer a ship to the flag of another State.

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**AFS—Survey and Certification**

The surveyor should verify:

- verify that anti-fouling system specified by the documentation complies with the Convention;
- verify that anti-fouling system being applied is the same as described in the survey request (including sampling when necessary).

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**AFS—Survey and Certification**

Type Approval of anti-fouling systems

- Voluntary, not required by the Convention
- Common in classification society
- list of type approved anti-fouling systems, facilitating the ship survey process
- sampling is usually not required during ship survey when anti-fouling system is type approved

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**AFS—Survey and Certification**

*International Anti-Fouling System Certificate*

Model form is contained Appendix 1 to annex 4 of the Convention.

Supplemented by a Record of anti-fouling systems

Declaration on anti-fouling systems

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**AFS—Port State Control Inspection**

*Guidelines for inspection of anti-fouling systems on ships, adopted by resolution MEPC.105(49)*

*Draft 2011 Guidelines for inspection of anti-fouling systems on ships*

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**AFS—Port State Control Inspection**

*MEPC.105 (49)*

Initial inspection

Detailed inspection

Violation detection
AFS—Port State Control Inspection

Draft 2011 Guidelines

Initial inspection

Detailed inspection

Violation detection

AFS—Port State Control Inspection

More Detailed Inspection

- sampling and analysis may be included, subject to practical feasibility or to constraints relating to the safety of persons, the ship or the port;
- sample may be taken by contracted specialist company or trained PSCO

AFS—Detention

Detention could be appropriate in any of following cases:

1. certificate is invalid or missing;
2. ship admits it does not comply with Convention
3. sampling proves that it is non-compliant
Guidelines for brief sampling of anti-fouling systems on ships; adopted by resolution MEPC.104(49).

- Main body provides general terms;
- Appendices provide examples of sampling and analytic methods

For practical reasons sampling of the anti-fouling system is very often reserved for occasional checking or where there are clear grounds for believing that the anti-fouling system intended to apply or presenting on the hull does not in compliance with the Convention.

Sampling from wet paint:

1. Take samples from a newly opened container;
2. Stir the paint to ensure even consistency before sampling;
3. Take the samples and store them in appropriate sealed packaging;
4. For coatings where on-site mixing of several components is required, take samples of each component, and record the required mixing ratio;
5. Record details of the paints;
6. Triplicate specimens
Sampling device

Figure 1: Schematic diagram of sampling device.

Sample analysis

Diagram B: Flow diagram illustrating the two-step analysis procedure.
AFS—Sampling

ICP-MS: Inductively Coupled Plasma Mass Spectrometry
ICP-OES: Inductively Coupled Plasma Optical Emission Spectrometer
AAS: Atomic Absorption Spectrophotometer
XFR: X-ray fluorescence analysis
GC/MS: Gas Chromatography mass spectrophotometry

“Tolerance range” means the numerical range added to the threshold value indicating the range where detected concentrations above the threshold value are acceptable due to recognised analytical inaccuracy and thus do not compromise the assumption of compliance.

Less than 30% tolerance range.

Thanks for your attention!