Ministry for Primary Industries
Manatū Ahu Matua

Technical Guidance on Biofouling Management for Vessels Arriving to New Zealand

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Key messages

Vessel biofouling is a major pathway for the introduction of non-indigenous species into New Zealand's marine ecosystems.

The management of vessel biofouling on hull and niche areas is primarily achieved by the application or installation of suitable antifouling systems.

The choice of antifouling system(s) should be based on a vessel's operational profile. To ensure best practice, details of the vessel's operational profile should be discussed with antifouling system manufacturers or suppliers.

Discussions of biofouling management practices with other vessel operators with similar operational profiles can also help vessel operators to make informed choices.

To achieve biofouling minimisation across hull and niche areas, a vessel may need several different types of antifouling systems applied or installed.

Operators should have contingencies in place for instances when a vessel operates outside its usual operational profile, or is subject to failures or damage to antifouling systems.

In-water cleaning and treatment are important tools for reducing the biosecurity risks during the in-service period of vessels. Where applicable, proactive in-water cleaning or treatment is considered best practice for ongoing hull maintenance.

Records should be kept of all antifouling systems applied or installed on the vessel.
The preferred form of documentation is:

- biofouling management plan and biofouling record book, and
- an antifouling system certificate or declaration on antifouling coating system.

This document presents technical guidance for managing the biofouling risk of short-stay vessels arriving to New Zealand.

1 Introduction

Vessel biofouling is a major pathway for the introduction of non-indigenous species into New Zealand's marine ecosystems. To manage the biosecurity risks associated with biofouling, vessels must comply with the Craft Risk Management Standard (CRMS): Biofouling on Vessels Arriving to New Zealand.

The CRMS requires international vessels to arrive in New Zealand with a "clean hull". The CRMS aims to reduce vessel biofouling by requiring vessels to take out preventative measures and maintain a clean hull before they arrive into New Zealand.

This document provides technical guidance for operators of short-stay vessels to comply with the CRMS through "continual maintenance using best practice". This advice includes biofouling management options for a variety of immersed surfaces including the general hull and niche areas.

Short-stay vessels are those vessels staying in New Zealand for 20 days or less, and only visiting ports that are Places of First Arrival. Most short-stay vessels arriving into New Zealand are commercial trading and passenger vessels. Commercial trading vessels include bulk carriers, roll-on-roll-off, container vessels, oil and gas tankers, livestock carriers and general cargo vessels. MPI encourages short-stay vessels to meet the thresholds by applying continual maintenance using best practice.

This document assumes that vessel operators comply with the International Convention on the Control of Harmful Antifouling Systems on Ships (AFS) 2001, ratified on 17 September 2008.

2 What is best practice for biofouling management?

Best practice for management of biofouling involves continual maintenance and is based on:

- antifouling system efficacy (e.g., biocide(s) used, biocide concentration(s) within the coating system and release rate(s) from coating system or installation),
- vessel operational profile (e.g., speed, residency times, operating environment),
- compatibility of vessel materials with proposed system(s),
- effective surface preparation prior to application,
- correct application to achieve required service life (i.e., final dry film thickness),
- maintenance of vessel operational profile within system specification,
- performance monitoring (Section 7),
- contingency planning (Section 8), and
- renewal of system(s) within their service life.

3 Antifouling coating systems

The management of vessel biofouling on hulls and other immersed surfaces is mainly achieved by applying antifouling coating systems designed to prevent or minimise the settlement and attachment of biofouling organisms. Antifouling coating systems are formulated to meet different cost and performance requirements. A description of the main types of antifouling coating systems and their qualities is provided below:

3.1 BIOCIDAL ANTIFOULING COATING SYSTEMS

Biocidal coating systems release biocides, such as copper compounds, to prevent the settlement of biofouling organisms. Four main types of biocidal coating systems exist:

3.1.1 Self-polishing copolymer (SPC) coating systems

These coating systems release biocides as a result of hydrolysis, which causes the surface to 'erode' when a vessel is moving. These coating systems are based on copper, zinc, and silyl acrylate and are effective for periods up to 60 months.

3.1.2 Soluble matrix, controlled depletion polymer (CDP) or ablative antifouling coating systems

These coating systems contain a binder that is slightly soluble in seawater. Hydration causes the coating surface to slowly dissolve, releasing the freely associated biocide. CDP coating systems are the modern version of soluble matrix coating systems. These coating systems better control the dissolution rate by using a combination of high-performance polymeric ingredients with seawater-soluble binders. These coating systems are effective for periods of up to 36 months.

3.1.3 Insoluble matrix, contact leaching, or diffusion coating systems

These coating systems use an insoluble binder that contains a high concentration of biocide released from the coating system through a diffusion process. The release of biocides from these coating systems is typically non-uniform, with high initial release rates followed by a sharp reduction over time. The effective period of these coating systems rarely exceeds 18 months and their use is largely restricted to the recreational market.

3.1.4 Metallic coating systems

These coating systems use copper or copper-nickel alloy as either metal sheathing or metal particles mixed into a coating system. These coating systems are not considered practical for widespread application to vessels—rather, they are applied to offshore and fixed installations where long-term (up to 20 years) minimisation of biofouling growth is needed and renewal of antifouling coating systems is not possible.

3.1.5 Summary - biocidal coating systems

Insoluble matrix, soluble matrix, contact leaching and CDP coating systems, including hybrid CDP/SPC coating systems, are all less expensive to purchase and apply than SPC coating systems, however they all have shorter service lives and lower antifouling reliability. Metallic systems are not practical for application on vessels.

3.2 BIOCIDAL-FREE COATING SYSTEMS

The mechanisms of action of biocide-free coating systems are reliant on their physical properties rather than on the incorporation of biocides into the matrix. Two main types of biocide-free coating systems exist:

3.2.1 Fouling release coating systems

These coating systems rely on non-stick, low surface energy compounds, such as silicone or fluoropolymers, to impair the adhesive attachment of biofouling. To enable the 'self-cleaning' process, fouling release coating systems require a high-activity and medium- to high-speed vessel operating profile.

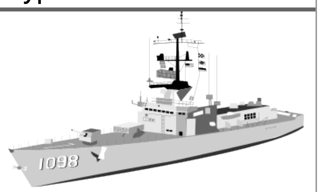
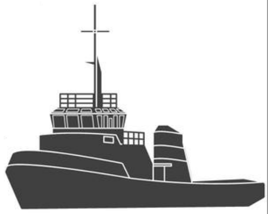
3.2.2 Mechanically resistant coating systems

These coating systems do not contain measures to prevent biofouling settlement or growth, rather they are tough and highly durable to withstand the regular in-water cleaning required to keep them free of macrofouling.

4 Choice of antifouling system

In general, application or installation of a suitable antifouling system is identified as best practice for minimising the settlement and growth of biofouling on the general hull and niche areas, respectively. To ensure that biofouling accumulation is minimised between scheduled dry-dockings, the choice of antifouling system(s) should be based on a vessel's operational profile.

A detailed knowledge of the vessel's operational profile better informs the system design provided by antifouling system manufacturers or suppliers. An uncertain operational profile requires consideration of a more conservative approach to system design—otherwise, there will be an increased likelihood of system failure resulting in the accumulation of biofouling. For example:

Example	Operational profile	Antifouling system coating	Types of vessel
Vessel type 1	Low to medium (slow-steaming) speed Low-activity Uncertain operational profile and a high likelihood of long lay-up periods	Faster-polishing, higher thickness antifouling coating system(s) are recommended. These coating systems generally have a greater cost than the slower-polishing systems. Fouling release coating systems readily foul on low-activity vessels. While proactive cleaning can maintain a clean surface, care must be taken to ensure cleaning methods do not cause surface damage or result in depletion of key coating system components.	 
Vessel type 2	Has a medium to high speed High-activity Predictable operational profile	Fouling release or slower-polishing, lower thickness antifouling coating system(s) are recommended.	 

Given the importance of a vessel's operational profile to antifouling system design and selection, it is essential that the appropriate technical advice is obtained from the system manufacturer or supplier to ensure that the approach designed is capable of meeting or exceeding the planned in-service period. This advice should be supplemented by discussions with other operators of vessels that have similar operational profiles. Operators can use vessel positional data to identify past operational profiles and inform future ones, as applicable.

The operational profile of the vessel should take into account:

- the planned in-service period (i.e., time between dry-dockings, this dictates the choice of the paint and its application),
- vessel speed,
- distance travelled per year,
- operational locations and itineraries,
- frequency and length of lay-up periods (i.e., how frequently and long does the vessel remain idle),
- planned ongoing maintenance (e.g., proactive in-water cleaning), and
- Contingency planning (Section 8).

5 Antifouling system options and application: area specific considerations

Accumulation of biofouling on submerged surfaces is variable due to action of hydrodynamic forces on the different parts of a vessel. As a result, there are intrinsic differences in the ability to prevent biofouling on different areas of the vessel, such as the boot-top, hull areas and niche areas. For example:

- The high light and high turbulence conditions of the boot-top, coupled with high biocide tolerance, enable the settlement and growth of macroalgal species. Compromised antifouling in this region—due to turbulent water movement, paint degradation from wet and dry cycles or UV degradation of the biocide—may further facilitate macroalgal establishment and growth.
- Differences exist within hull areas, as the sides are nearly constantly immersed and exposed to light during the day, while the flat bottom is always immersed and in permanent darkness.
- Niche areas tend to be more susceptible to biofouling due to different hydrodynamic forces, susceptibility to system wear or damage, or being inadequately (or not) painted (e.g., sea chests, bow thrusters, propeller shafts, inlet gratings, dry-docking support strips).

The above differences should be considered by the vessel operator and discussed with antifouling system manufacturers and suppliers to inform a specific performance-based antifouling system for each of these vessel areas. The type of system that will be most effective will vary depending on the area of application or installation, and several different systems may be needed on any one vessel to achieve overall biofouling minimisation.

5.1.1 Hull and boot-top

Irrespective of the in-service period, prevention and minimisation of biofouling appear to be best achieved through application of either self-polishing copolymer coating systems or fouling release coating systems.

Self-polishing copolymer coating systems of the appropriate grade (i.e., dry film thickness, biocide content, polishing rate, etc.) are suitable for all vessels, whereas fouling release coating systems are appropriate only for high activity vessels operating at medium to high speeds.

Exposed edges and weld joints should be faired and coated to ensure adequate coating thickness.

5.1.2 Niche areas – general

To optimise coating system durability and antifouling service life, careful application of anticorrosive and antifouling coating systems is required to ensure adequate coating thickness and adhesion to corners and edges.

Coating system adhesion and durability are improved where angles, corners, and pipes and tunnel openings are bevelled or radiused.

Structural and functional projections are prone to fouling and require careful surface preparation, coating system repair and application. Edges should be stripe coated and surfaces inaccessible by spray should be touched up with brushes or rollers.

5.1.3 Sea chests and internal seawater systems

Suitable antifouling systems should be applied to the internal surfaces of sea chests, taking the specific flow conditions of these niches into account. Biofouling prevention appears to be best achieved with faster polishing “soft” biocidal coating systems. The importance of good coating system application at a suitable thickness on all surfaces within sea chests cannot be understated.

Sea chest grates should consist of rounded bars. Application of fouling release coating systems to these grates can reduce paint breakdown and prevent biofouling attachment and growth. Installation of hinged grates enable diver access for in-water biofouling surveys and maintenance.

Regular use of steam blow-out pipes fitted within sea chests may prevent and minimise fouling growth. As with all structural and functional projections, the external surfaces of the blow-out pipes and holding brackets require application of a suitable antifouling coating system.

Care should be taken to ensure that any marine growth prevention systems (MGPS) fitted are effective in preventing settlement of fouling organisms and optimally positioned to achieve their intended purpose. Discussions with system providers and other operators of vessels with similar operational profiles can help inform system choices.

5.1.4 Sea inlet pipes and overboard discharges

The antifouling coating system should be applied inside pipe openings and accessible internal surfaces.

Selection of anti-corrosive and primer coatings should be appropriate to the specific pipe material.

The application of fouling release coating systems to sea intake grates may reduce paint breakdown and prevent biofouling attachment and growth.

5.1.5 Painted niche areas

Although painted, these niche areas remain particularly susceptible to biofouling settlement and growth.

5.1.5.1 Propeller and shaft

The application of fouling release coating systems to propeller blades can:

- prevent and minimise settlement and growth of biofouling,
- maintain propulsion efficiency,
- enable self-cleaning thus alleviating the need for regular polishing, and
- simplify cleaning if biofouling does establish.

Exposed sections of stern seal assemblies and the internal surfaces of rope guards should be carefully painted with suitable antifouling coating systems.

5.1.5.2 Docking support strips

Where practical, positions of docking blocks and supports should be varied at each dry-docking to ensure antifouling coating system application to areas under blocks at alternate dry-dockings.

The application of specialised coating systems or procedures should be considered for areas where it is not possible to alternate the position of docking-support strips.

5.1.5.3 Bow and stern thrusters

Appropriate antifouling coating systems should be applied to resist cavitation damage.

Grates should consist of rounded bars. The application of fouling release coating systems to intake grates may reduce paint breakdown and prevent biofouling settlement and growth.

5.1.5.4 Bilge keels, cooling scoops and propulsion scoops

To ensure adequate coating thickness, care should be taken to stripe coat the outer edge of bilge keels, scoops and hull weld joints with the appropriate anticorrosive and antifouling coating systems.

5.1.5.5 Rudder hinges and stabiliser fin apertures

Careful application of suitable antifouling coating systems is required for recesses within rudder hinges and behind stabilisers. To ensure complete coverage, rudders should be moved port and starboard and stabiliser fins can be extended during the painting process.

5.1.6 Unpainted niche areas

For operational reasons, some niche areas cannot have antifouling coating systems applied to them.

5.1.6.1 Cathodic protection (CP) anodes

Anodes should either be flush-fitted to the hull, or have a rubber backing pad inserted in the gap between the anode and the hull.

Where the above cannot be reasonably achieved, the hull surface under the anode and the anode strap should be stripe coated with a suitable antifouling coating system.

All attachment bolt recesses should be sealed.

5.1.6.2 Echo sounders and velocity probes

Where fitted, antifouling systems suitable for static conditions should be applied to internal surfaces of retractable pitot tubes.

6 Surface preparation and antifouling coating system application

The service life of antifouling coating systems is influenced by the effectiveness of surface preparation prior to application. To facilitate optimal adhesion and durability of antifouling coating systems, care is required during dry-docking to ensure all residual biofilm, biofouling residues or other surface contamination are completely removed prior to coating system application.

The conditions under which the antifouling coating system is applied (favourable weather conditions: temperature/humidity, not raining) and experience and skill level of the applicator should be taken into account.

The importance of good coating system application at a suitable thickness on all surfaces cannot be understated—this is essential to ensure that the coating system service life matches the vessels' operational profile. To achieve suitable adhesion and optimum performance, coating system specifications and product data sheets should be consulted to obtain information on surface preparation, application method, curing time, etc.

Proper application and choice of an appropriate antifouling system(s) will result in the following benefits:

- decreased rate of fouling accumulation,
- decreased fuel consumption and associated costs,
- decreased CO_2 emissions,
- decreased biocide loadings into the environment,
- decreased costs associated with the requirement for more frequent and ongoing maintenance, and
- increased vessel stability during transit and increased crew safety.

7 Performance monitoring

Vessel operators should monitor antifouling system performance and have a planned schedule of biofouling surveys, repairs and maintenance activities.

Performance changes

Vessel performance changes that may indicate the presence of fouling include:

- reduced speed (e.g., 1 knot) with shaft revolutions per minute (r/min) set for standard speed,
- increased fuel consumption (> 5 %) to maintain a specified shaft r/min (such as for standard speed), with propulsion and auxiliary machinery at optimum efficiency,
- a > 5 % increase in shaft r/min to maintain a given speed,
- an increase in pressure required for the main turbine first stage shell to maintain a given shaft r/min (for steam-propelled vessels, assuming a constant main condenser vacuum and main steam supply pressure and temperature), and
- an increase in torque at a given shaft r/min (for vessels equipped with main shaft torsion-meters).

Vessel owners should be aware of the International Organisation for Standardisation (ISO) documents regarding measurement of changes in hull and propeller performance. These standards may assist the vessel operator's approach to performance monitoring:

ISO/DIS 19030-1
Ships and marine technology – Measurement of changes in hull and propeller performance – Part 1: General principles.

ISO/DIS 19030-2
Ships and marine technology – Measurement of changes in hull and propeller performance – Part 2: Default method.

ISO/DIS 19030-3
Ships and marine technology – Measurement of changes in hull and propeller performance – Part 3: Alternative methods.

Decreases in performance may be due to a variety of causes, therefore an in-water biofouling survey should be conducted prior to undertaking any remedial action.

7.1 UNDERWATER BIOFOULING SURVEYS AND MAINTENANCE

Vessel operators should carry out scheduled underwater biofouling surveys and maintenance events (e.g., propeller polishing). During these activities the divers should be directed to move from forward to aft in an S-shape to observe the condition of the antifouling system(s) as well as the presence, degree and type of hull and niche area fouling. Niche areas should be identified and mapped prior to the dive to enable their efficient targeting.

Areas that should be specifically inspected by divers include:

- sea chests,
- sea chest and bow/stern thruster tunnel grates and props,
- rudder stock and hinge,
- stabiliser fin apertures,
- rope guards, propeller and propeller shafts,
- cathodic protection anodes,
- sea inlet pipes and overboard discharge outlets,

- bilge keels, cooling scoops and propulsion scoops,
- echo sounders and velocity probes,
- areas of antifouling system damage or grounding,
- chine, and
- bulbous head.

Viewing the vessel at anchorage either by launch, remotely operated vehicle or pole-camera can also provide data on the hull condition. The vessel's in-water cleaning records can provide an indication of the performance of the system(s) applied during the last dry dock.

On-board sea water systems that operate while the vessel is in port are particularly vulnerable to fouling and require frequent monitoring.

All biofouling surveys should be documented (Section 10).

8 Contingency planning

Operators should have contingency plans in place for instances when a vessel operates outside its usual profile, or is subject to failures or damage to antifouling systems. Such contingencies may include more frequent biofouling surveys, system repair, proactive in-water cleaning or application of reactive treatment to sea chests and internal pipework.

In-water repair should be applied where antifouling system damage has occurred, even if the area of damage is relatively minor.

9 In-water cleaning or treatment

This section has been updated from the Australian and New Zealand Guidelines for antifouling and in-water cleaning as a result of the specific context (i.e., arrival of international vessels into New Zealand) and recent technological advancements.

In-water cleaning and treatment are important tools for reducing the biosecurity risks during the in-service period of vessels. From a biosecurity perspective there are two drivers for using in-water cleaning or treatment:

- Proactive: to reduce the accumulation of microfouling (i.e., slime) on the vessel as part of biofouling management programme (also known as hull grooming)

Examples of microfouling (slime layer) (Images: Lewis 2016).

- Reactive: to remove or treat biofouling (i.e., macrofouling) from unmanaged or poorly maintained vessels or areas where antifouling coatings have failed or become damaged. Macrofouling is more difficult to remove and may contain a diverse range of organisms that are reproductively mature.

Examples of macrofouling (e.g. barnacles, bivalves, algae, tubeworms) (Images: Lewis 2016).

The type of biofouling on a vessel and therefore, the type of in-water cleaning required can be determined by an in-water biofouling survey.

In-water cleaning and treatment can pose two types of environmental risk:

1. The release and accumulation of chemical contaminants in the marine environment, and
2. The release of non-indigenous species (as adults, larvae or viable propagules) into new environments.

Therefore, in-water cleaning or treatment should only be undertaken when the biosecurity and chemical contamination risks are acceptable, and where the antifouling coating system is not damaged by use of the equipment. Prior to undertaking an in-water cleaning or treatment, including propeller polishing and sea chest and internal pipework treatment, approval from the relevant authority must be granted (e.g., MPI, EPA, Regional Councils).

Proactive in-water cleaning and treatment can manage biofouling, at the slime layer stage, to optimise vessel operational efficiency. The economics of removing the slime layer by proactive in-water cleaning are well documented. Proactive in-water cleaning of a slime layer can be undertaken without the need for full containment of biofouling waste, provided the cleaning method is consistent with the antifouling system manufacturer's recommendations and discharges meet local standards or requirements. A gentle, non-abrasive technique will minimise the release of unacceptable levels of chemical contaminants.

Proactive in-water cleaning or treatment is considered best practice for ongoing hull maintenance. Where operationally and economically practical, vessels should be dry-docked in preference to undergoing reactive in-water cleaning or treatment.

Reactive in-water cleaning or treatment should not be considered a replacement for vessel dry-docking. Reactive in-water cleaning can:

- facilitate release and establishment of non-indigenous marine species,
- physically damage antifouling coating systems,
- shorten coating system service life, and
- release a pulse of biocide or other contaminants into the environment.

Depleted antifouling coating systems on hulls will also rapidly re-foul, subsequently increasing biosecurity risk and reducing vessel efficiency.

Information regarding the suitability of an antifouling coating system for in-water cleaning or treatment and the appropriate methods and equipment should be obtained from the system manufacturer or supplier. Developers of cleaning or treatment equipment should be able to provide evidence that their equipment will not damage the types of antifouling coating system that it is designed to be operated on and that the equipment will meet applicable biosecurity and environmental contamination requirements.

The cleaning or treatment of sea chests, internal pipework and other niche areas may be permitted provided that the biosecurity risks and any environmental contamination risks are managed.

All reactive in-water cleaning and treatment systems must be approved by MPI and applied by an MPI approved supplier. Currently, there are no approved providers in New Zealand. The best approach is to do continual maintenance, and to manage biofouling before it gets to an unacceptable level.

The following points should be considered prior to application of in-water cleaning or treatment:

1. In-water cleaning or treatment methods are acceptable only if the contaminant discharges from the activity comply with the standards or requirements set by the relevant authority.
2. Microfouling, regardless of origin, may be removed or treated without the need for full containment of biofouling waste, provided the cleaning method is consistent with the antifouling coating system manufacturer's recommendations. Where microfouling is removed using a gentle, non-abrasive cleaning technique, the chemical contamination risk is likely to be minimised to an acceptable level.
3. Proactive in-water cleaning or treatment is an effective measure to limit biofouling accumulation. For biocidal or fouling release coating systems, in-water cleaning at regular (i.e. 6–12 monthly) intervals is recommended for all submerged surfaces, particularly propellers and other niche areas. Mechanically resistant coating systems require proactive interventions at much shorter intervals.
4. Reactive in-water cleaning or treatment should not be used to routinely remove or treat mature and extensive macrofouling. Reactive in-water cleaning or treatments are not substitutes for earlier or better maintenance practices.
5. Ideally, all in-water cleaning or treatment of vessels should be carried out before departing to new destinations, not after arriving at those destinations (i.e., clean/treat before you leave).
6. All in-water cleaning and treatment systems should only be used on suitable antifouling coating systems. Information on the suitability and ability of an antifouling coating system to withstand in-water cleaning or treatment without damage and effects on service life, and on appropriate cleaning or treatment methods, should be obtained from the antifouling coating system manufacturer or in-water cleaning or treatment supplier.
7. In-water cleaning or treatment should not be performed on vessels with antifouling coating systems that have reached or exceeded their planned in-service period. When the antifouling coating system has reached the end of its service life, the vessel should be dry-docked and a new antifouling coating system applied.
8. In-water cleaning or treatment of biofouling should only be carried out using technology that does not harm the underlying antifouling coating system or result in excessive release of contaminants. The capabilities of new cleaning or treatment technologies should be verified independently. Information on the suitability of particular cleaning or treatment methods can be obtained from antifouling coating system manufacturers.
9. Reactive in-water cleaning technologies must capture debris greater than 12.5 micrometres (μm) in diameter, which will minimise release of viable adult, juvenile and larval stages of macrofouling organisms. Any cleaning debris collected must either be rendered non-viable or disposed of on land and in compliance with the waste disposal requirements of the relevant authority.
10. Applications seeking approval of in-water cleaning or treatment must be lodged with the administering authority at least 10 working days prior to the proposed commencement of the work.

Documentation of antifouling coating system type, date of application, vessel itinerary and the planned in-service period should be kept, as these details are required when considering requests for reactive in-water cleaning or treatment. If this information is not available, permission to undertake reactive methods may not be granted.

A post-cleaning or -treatment survey of biofouling should immediately follow the activity to ensure adequate quality control of the operation and identify any hull or paint damage that may have been hidden by the fouling or caused by the cleaning or treatment.

10 Record keeping

To show that your vessel is compliant with the CRMS, records should be kept of all antifouling coating systems applied or installed on the vessel including Antifouling System Certificates and documentation of compliance with the IMO AFS Convention, where necessary.

For commercial vessels, the preferred form of documentation is:

- biofouling management plan and biofouling record book, and
- an antifouling system certificate or declaration on antifouling coating system.

Records should include documentation of antifouling system specification and product data sheets, date of application, vessel itinerary, the planned in-service period and any biofouling surveys undertaken (including diver reports, and photos).

Suitable examples for keeping and maintaining information on antifouling systems and hull maintenance are the Biofouling Management Plan and the Biofouling Record Book recommended in the International Maritime Organization *Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species*.
Another example of suitable formats for keeping and maintaining information is provided by IMarEst/IPPIC.

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12 Glossary

Antifouling coating system

The combination of all component coatings, surface treatments (including primer, sealer, binder, anti-corrosive and anti-fouling coatings) or other surface treatments, used on a ship to control or prevent attachment of unwanted aquatic organisms.

Antifouling system

A coating, paint, surface treatment, surface or device that is used on a ship to control or prevent attachment of unwanted organisms.

Biocide

Any substance used with the intention of destroying, deterring, rendering harmless, preventing the action of, or otherwise exerting a controlling effect on, any harmful organism by any means other than mere physical or mechanical action. Examples include disinfectants, preservatives, antiseptics, pesticides, herbicides, fungicides and insecticides.

Biofouling

The accumulation of aquatic organisms such as micro-organisms, plants and animals on surfaces and structures immersed in or exposed to the aquatic environment.

Boot-top

The area of the hull that is subject to alternating immersion due to a vessel's movement or loading conditions.

Dry film thickness

The measured thickness of the final dried film applied to the substrate.

Hull area

The immersed surfaces of a vessel excluding niche areas and boot-top.

In-water cleaning of biofouling

The physical removal of biofouling organisms from a surface.

In-water treatment systems

Treatments that are applied directly to the fouled area of the vessel to render biofouling organisms non-viable *in situ*, but which do not remove the organisms physically. Surface-treatments may include, but are not limited to, systems that apply heat, biocides or ultrasound to biofouled areas of the vessel.

Macrofouling

Distinct multicellular biofouling organisms that are visible to the human eye, such as barnacles, tubeworms, hydroids or fronds of algae. Does not include microscopic organisms that comprise the slime layer.

Marine Growth Prevention System (MGPS)

An antifouling system used for the prevention of biofouling accumulation in internal seawater cooling systems and sea chests and can include the use of anodes, injection systems and electrolysis.

Microfouling
A layer of microscopic organisms including bacteria and diatoms and the slimy substances they produce. It is often referred to as a 'slime layer' and can be easily removed by gently passing a finger over the surface.

Niche area
Areas on a vessel hull that are more susceptible to biofouling due to different hydrodynamic forces, susceptibility to antifouling system wear or damage, or being inadequately, or not, painted, e.g., sea chests, bow thrusters, propeller shafts, inlet gratings, dry-dock support strips, etc. Includes appendages.

Non-viable
Biological material (adult, tissue or propagules) that is not capable of living and developing to reproductive maturity in the marine environment.

Proactive in-water cleaning/treatment
Removal or treatment of microfouling from a vessel as part of biofouling management programme (also known as hull grooming).

Reactive in-water cleaning/treatment
Removal or treatment of biofouling (i.e., macrofouling) from unmanaged or poorly maintained vessels or areas where antifouling coatings have failed or become damaged.

Vessel activity
Vessel activity may be broken down into the following broad categories:

- Low activity: active < 50% of time,
- Medium activity: active 50-75% of time, and
- High activity: active > 75% of time.

Vessel speed
Vessel speed may be broken down into the following broad categories:

- Low speed: < 10 knots,
- Medium speed: 10-20 knots, and
- High speed: > 20 knots.

Wet film thickness
The initial thickness of the wet coating applied to the substrate.

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