Sustainable use of Biocidal Antifouling Products

Contents

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1. Introduction

Biocidal products are a key tool in protecting all manner of materials and articles from biodegradation, fouling and spoilage, thus enhancing service life and efficiency of use. In the specific case of antifouling coatings, they prevent excessive biofouling of ships and marine structures which can result in erosion/corrosion of the structure, increased drag and fuel consumption, leading to an increase in emissions of carbon dioxide (CO^2), nitrogen oxides (NOx) and sulphur oxides (SOx). Biofouling can also lead to the unwanted introduction of non-indigenous species to new locations. These factors are all considered in later chapters of this document.

Sustainable use strategies may include:

1. Consideration of non-chemical alternatives, where appropriate.
2. Ensuring that a sufficient number of effective biocidal antifouling products can remain available to be used where non-chemical approaches are not appropriate or practical.
3. An effective regulatory landscape which ensures that products approved are effective, safe to use and do not pose unacceptable risk to the environment under relevant protection goals.
4. Promotion of best practices for selection and use of biocidal antifouling products as a means of reducing use to a minimum, whilst still achieving adequate protection.
5. Provision of clear information about the risks of biocidal antifouling products to users, and promotion of safe use to minimise risks to human and animal health, and the environment.
6. Management of tolerances to biocidal active substances.

The purpose of this document is to explain the importance of biocidal antifouling products, to outline the scope of their patterns of use and to present an overview of the measures currently in place which promote the sustainable use of biocidal antifouling products.

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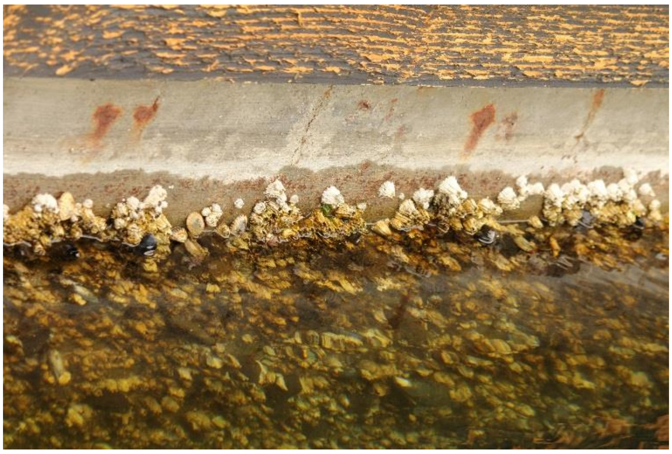
2. The Need for Fouling Control Using Antifouling Paints in the EU

There are thousands of marine organisms that can be classified as fouling organisms[1]. The act of settlement is an integral stage in the life-cycle of many aquatic organisms such as bryozoans, bivalves and hydroids, and occurs in all natural aquatic ecosystems. Unfortunately, when this settlement occurs on man-made structures such as port constructions, coastal defences, oil rigs, floating objects and vessels[2], this can potentially cause a number of unwanted effects. These effects include serious damage to the corrosion protection system of the colonized objects. This leads to strongly increased drag on moving objects such as ships and consequentlyto reduced manoeuvrability and significantly higher fuel consumption. The settled organisms will subsequently reproduce and heavily populated areas can be used as habitat by even more organisms. If this habitat is moving, for example the hull of an ocean-going vessel, such guests will be transported on the fouled surface and these organisms will be relocated to new habitats, potentially where they may have no natural predators, and where their presence may have detrimental effects on the existing ecosystems.



2.1 Effects of fouling

Static structures may need protection from fouling to prevent erosion and corrosion. It is even more important to protect vessels from fouling because fouling on vessels may cause all of the three negative aspects mentioned above, and expanded below.

- Corrosion may greatly reduce the ship's life expectancy. This will reduce the viability of shipping and can lead to increased use of transportation methods with a larger environmental footprint. It can also lead to a greater demand for steel and increased energy consumption and environmental emissions in the related industries. For the production of one tonne of steel almost two tonnes of CO^2 are emitted.
- Greater drag leads to reduced manoeuvrability and higher fuel consumption of moving vessels. Reduced ability to navigate a vessel can result in a serious safety hazard. It has been estimated that fuel consumption of a heavily fouled ship may be over 50 % greater than that

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[1] [1]European Biocidal Product Regulation EU (No) 528/2012 (BPR)

[2] Wikipedia January 2, 2017, https://en.wikipedia.org/wiki/Biofouling note 7 (*Almeida, E; Diamantino, Teresa C.; De Sousa, Orlando (2007), "Marine paints: The particular case of antifouling paints", Progress in Organic Coatings, **59** (1): 2–20, doi:10.1016/j.porgcoat.2007.01.017, retrieved 6 June 2011)*

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of an identical ship with a clean hull. Greater fuel consumption will not only put more demand on non-renewable fuel resources but will also lead to increased carbon dioxide emissions. Currently the emission of carbon dioxide resulting from marine shipping is estimated at 3 % (over 1 billion tonnes) of the total CO^2 emission[3] and an increase of 50% in fuel consumption would raise this to 4.5 %. The EU has incorporated reduction of CO^2 emission in its environmental policy, wherein a target of a 50 % reduction of CO^2 emissions by 2050 compared to the 2005 emissions[4] has been set. Fuel consumption by non-commercial vessels will also increase by a similar percentage, but here the impact is less as the total fuel consumption is much lower.

- Introduction of non-indigenous species has been shown to have a significant biological impact. The new species may either be predators of the native organisms or simply colonize their habitat. In either case, new species are a serious threat to existing ecosystems and biodiversity. Non-indigenous species can be carried by commercial vessels over large distances and leisure craft may contribute to the local distribution.

In order to prevent these potential adverse consequences, fouling has to be managed, either by removal[5] or prevention. Antifouling measures have been employed for centuries. Sustainable shipping without measures to manage fouling is not possible, and sustainable transportation without shipping is practically not possible today.

2.2 Other ways to fight fouling

There are non-biocidal methods on the market which control biofouling. Most of these are targeted to vessels with specific activity profiles and are, in general, not suitable for all ships and boats. These non-biocidal methods are outside the scope of this document.

[3] http://whatsyourimpact.org/greenhouse-gases/carbon-dioxide-emissions
[4] Com (2013) 479 final (https://ec.europa.eu/clima/sites/clima/files/transport/shipping/docs/com_2013_479_en.pdf

[5] For entry into the territorial waters of some coastal states an adequate fouling prevention system is necessary. Even structural removal is not considered sufficient protection for their sensitive ecosystems (e.g. Australia))

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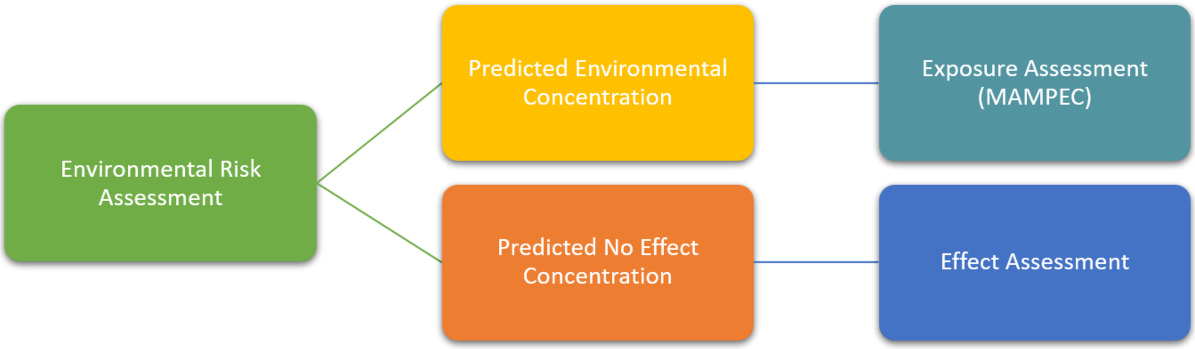
3. Biocidal Antifouling Use Scenarios

The use of biocidal antifouling products in the EU is governed by the Biocidal Products Regulation (EU) 528/2012 (BPR). One of the aims of the BPR is to ensure a 'high level of protection for humans, animals and the environment'. It achieves this by evaluating the active substances used in biocidal products and then assessing products that contain them. The evaluation of the active substance examines the hazards and risks associated with the substance itself, whereas the evaluation of the product assesses the hazards and risks associated with using the product in accordance with the label instructions. In addition to evaluating the hazards and risks it is equally important to understand the benefits of effective antifouling systems, as described in Chapter 2.



When considering the uses of biocidal antifouling paints in the EU, it is necessary to recognise that they are applied using a variety of methods, to a wide range of vessel types and by both professional and consumer users. Consequently, a variety of human risk assessment scenarios must be satisfied prior to authorisation of antifouling products. Authorisations to allow or restrict the use of products will be dictated according to the outcome of these human exposure assessments.

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It is generally agreed that risks of environmental exposure from application activities (painting) and removal activities (such as blasting or sanding) can be mitigated by good practices such as those described in Chapter 9. Legal requirements are included in all antifouling biocidal active substance approvals and will also be included in all subsequent biocidal product authorisations:

"Labels and, where provided, safety data sheets of products authorized shall indicate that application, maintenance and repair activities shall be conducted within a contained area and on hard impermeable standing with bunding to prevent direct losses and minimize emissions to the environment, and that any losses or waste containing registered biocidal antifouling product shall be collected for reuse or disposal."

As a result of this, the main emission to the environment from biocidal antifouling products is in-service leaching. This leaching is inherent in the design and mode of action of effective products.

These in-service scenarios are:

Commercial Vessels

For biocidal antifouling products to be used on commercial vessels, acceptable risk for the environment must be demonstrated using a representative generic commercial saltwater harbour scenario.

Risk assessments should be based on average dissolved Predicted Environmental Concentrations (PECs) derived for the wider environment simulated by MAMPEC as concentrations in the 'surrounding' area (i.e. for the area immediately outside the Commercial Harbour).

Pleasure Craft

Pleasure craft >24m in length - also referred to as superyachts; these large vessels are mainly in marine environments and it is deemed that the commercial saltwater harbour is the most appropriate scenario to assess the acceptability of products used on these vessels.

Pleasure craft <24m in length; for biocidal antifouling products to be used on pleasure craft, a number of scenarios may be considered depending on expected use patterns. For all applications, acceptable risk should be demonstrated using a generic "marina" scenario.

The EU Biocidal Products Committee Working Group on the Environment has considered the use of a more extensive set of saltwater and freshwater marinas for environmental risk assessment.

Other Uses of Antifoulings

If an antifouling product requires approval for use in other situations such as freshwater commercial shipping (e.g. barges on rivers/canals), offshore structures or aquaculture, then product environmental risk assessments have to be carried out to demonstrate acceptable risk in these scenarios.

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4. Types of Antifouling Users

The types of users involved in antifouling paint application and removal are professional and non-professional users.

Professional users are trained workers within their field of work, which means they are familiar with the wearing of personal protective equipment such as respirators, breathing-masks, overalls, boots, gloves and goggles to reduce exposure if needed.

Professional users are involved in the application and removal of antifouling paint in shipyards and boatyards during new building activities or maintenance and repair. Application and removal of antifouling paint involve a number of tasks performed by different type of workers. An important party is the professional painter who applies the antifouling paint by means of high-pressure spraying or brush/roller. Spray application also involves a potman to mix and load antifouling paint from the supply container to the high-pressure pump in order to ensure continuous supply to the spray gun. Other ancillary workers keep paint lines free, manoeuvre mobile spray platforms as well as performing other tasks intended to aid the sprayer's job.

Old and expired antifouling paint may be removed by blasting or high-pressure water cleaning by a blast worker and may involve a grit filler to mix and load grit to the high-pressure pump to ensure continuous supply to the spray gun.

Non-professional users are consumers/amateurs that use antifouling paint for do-it-yourself (DIY) maintenance and repair of pleasure boats. Consumers involved in applying antifouling paint are regularly carrying out a task that requires health and safety awareness beyond what is expected for a "normal" consumer and can therefore be considered "specialist consumers" with a better understanding of the appropriate personal protective equipment required than that of the typical consumer user in other product categories.

To support these non-professional users, the antifouling paint industry provides targeted information on safe use of the products that goes beyond the basic requirements necessary for labelling and safety data sheets. Manufacturers, trade associations and various organisations within the boating industry provide a variety of information for consumers in 'boat painter guides', 'best practice leaflets' and websites. An example is the British Coating Federation's 'DIY Applications of Antifouling Paints'[6], which raises awareness among boat owners of the potential hazards associated with applying biocidal antifouling paints to their boats and highlights the importance of using the appropriate Personal Protective Equipment.

[6] https://www.coatings.org.uk/Publications/Health_and_Safety_Publications.aspx

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5. Antifouling Active Substances

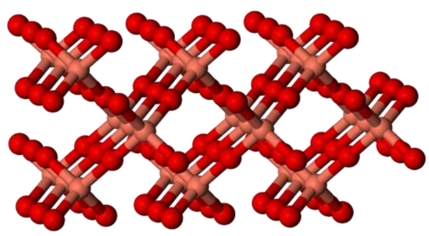
Of the fifty-one existing active substances that were originally notified under BPR for use in antifouling, only ten were supported through the review process. In addition to these ten "existing" active substances, two "new" active substances were approved for use in antifouling products.

The review of these active substances carried out by the European Commission and the Member States has subsequently resulted in the removal from the market of three of the "existing" antifouling substances and a specific exclusion on non-professional use for one substance. One substance remains under review. This reduction has resulted in a significant increase in reliance upon the remaining substances.

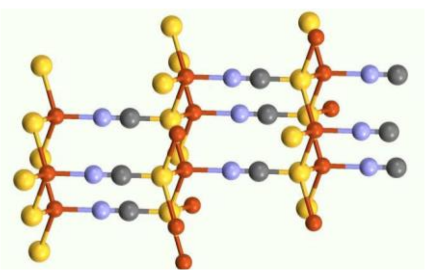
Sustainable use of biocidal antifouling products is supported by the availability of active substances with different modes of action. Due to the wide range of fouling organisms, antifouling active substances by necessity, have a broad range of efficacy; however, they are of two general types, those used primarily to control "hard" fouling such as barnacles and those primarily intended to control the growth of "soft" fouling such as slimes and weeds.

5.1 Hard (and Soft) fouling control

Copper compounds (copper, dicopper oxide, copper thiocyanate)



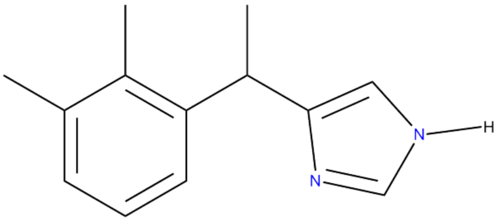
Copper oxide



CuSCN

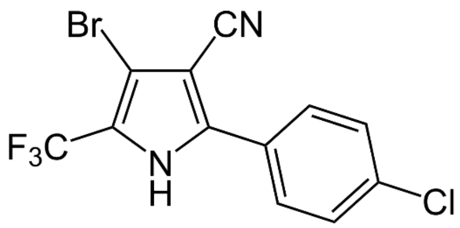
When copper from metallic copper, dicopper oxide or copper thiocyanate leaches into marine water in presence of oxygen, the predominant form of the copper is the active substance, the cupric ion, Cu^{2+} . The cupric ion acts to retard settlement of planktonic fouling organisms within a microlayer of water at the paint surface via two mechanisms: (1) the ion retards organisms' vital processes by inactivating enzymes, (2) the ion acts more directly by precipitating cytoplasmic proteins as metallic proteinates.

Medetomidine (Selektope®)



Selektope® is a synthetic compound that binds to the invertebrate specific octopamine receptor. The receptor binding activates a physiological response, which results in increased motility of barnacles and tubeworms leading to an anti-settling effect.

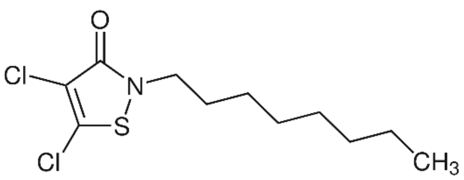
Tralopyril (ECONEA®)



ECONEA® exerts its biological activity as an antifouling agent by uncoupling the process of oxidative phosphorylation within the mitochondria of cells (production of ATP); it dissociates protons into the more basic interior of the mitochondria, disrupting the proton gradient across the mitochondrial membrane, inhibiting ATP production and leading to cell death.

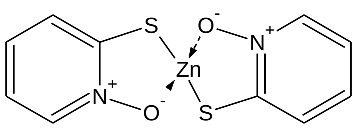
5.2 Soft (and Hard) fouling control

DCOIT (SeaNine™)

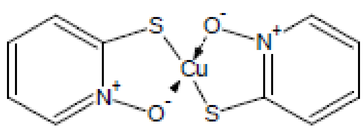


SeaNine™ reacts with the proteins of organisms that come in contact with the coating surface (for example, algae, seaweed, barnacles). This results in interruption of the metabolic processes that utilize these proteins. Fouling organisms initiate specific physiological activities involved in attaching to solid surfaces that are disrupted by SeaNineTM. As a result, the organisms do not successfully colonize the treated surfaces and biofouling is minimized.

Zinc pyrithione (Zinc PYRION™, Zinc OMADINE™), Copper pyrithione (Copper OMADINE™)



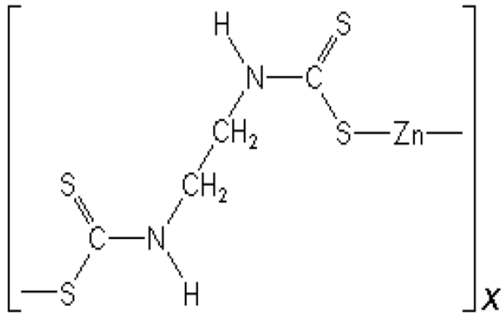
Zinc pyrithione



Copper pyrithione

Pyrithione is the active portion of copper and zinc pyrithione. Pyrithione acts on cell membranes by influencing ion gradients that are important to cell function. Specifically, its activity may directly or indirectly inhibit membrane-associated proton pumps. Consequently, the transport of nutrients is disturbed, leading to starvation and inhibition of growth.

Zineb



Zineb acts as a general inhibitor of metabolic pathways within fouling organisms. This is achieved through interaction with thiol groups (-SH) within metabolically active proteins. It is considered that this will manifest itself in a reduction in growth rate that will be most profound on young (presettlement stage) individuals of common fouling species.

In conclusion, all approved antifouling active substances are approved on the basis that they are considered acceptable for use with respect to environmental and human health risks as long as they are used as per label instructions.

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6. Assessing the Environmental Impacts of Antifouling

Industry is constantly working to improve the human health and environmental safety profile of biocidal antifouling products. In this context, we have seen the worldwide ban of tributyltin (TBT), continuing with the thorough review of the biocidal active substances in use today. Conventional environmental concerns about wide-spread exposure of water, soil and air is largely unwarranted because of the chemical and physical characteristics of antifouling biocidal active substances and their formulated products. The extensive review process currently underway in the EU aims to ensure that only products considered safe to both human health and the environment will be authorised. However, the potential for fouling species to adversely impact human safety and wide areas of the environment is proven, as discussed in Chapter 2.

The environmental properties of the current antifouling biocidal active substances fall into two broad categories; (1) degrading substances and (2) precursors to ionic species capable of rapid transformation. These substances demonstrate efficacy in the immediate vicinity of the treated surface but are quickly transformed by various mechanisms to much less harmful substances, such that their expected overall impact on the environment is inconsequential when compared to the environmental damage caused by biofouling.

The risk assessments performed by the Member States experts during the biocidal active substances review process demonstrated that, in the environment adjacent to commercial harbours and marinas, there is a high level of protection afforded by the responsible use of the approved biocidal antifouling products.

Near to vessels in commercial harbours and densely populated marinas with high levels of yachting activity, conservative model estimations suggest that some biocidal active substances may reach concentration levels which could potentially affect more sensitive organisms/life-stages. However, there is little evidence of this occurring in real life. Instead, extensive chemical monitoring data, often supported by direct testing of the effect of these waters on sensitive species indicate little or no evidence of direct impact of the biocidal antifouling products.

In more secluded marinas with transient yachting activity, based upon the available modelling and the identified protection goals, it is highly improbable that the environment would be impacted by the use of biocidal antifouling products; by contrast, these areas would be particularly susceptible to ecosystem damage through colonization by invasive species, transported on poorly protected vessels.

The regulatory framework in the EU ensures that only substances with appropriate physico-chemical properties, which preclude the risk of secondary poisoning through food chain contamination, are permitted for use.

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7. Antifouling Tolerance

"Tolerance" is the normal species adaption to living in challenging conditions. "Resistance" in microorganisms (typically) is the genetic ability to withstand the effects of a single (chemical) stressor. Some species have evolved mechanisms to cope with a range of environmental stressors, both physical and chemical in nature, or have a higher capacity to regulate essential nutrients as required for improved development and growth. These species may be considered more physiologically robust than other, less well adapted species, but this is not an indicator of "development of resistance" to a particular substance. Resistance, in contrast, may evolve naturally through random mutation, but it could also be engineered by applying continuing stress to a population.

The fouling community is not a naturally occurring marine community, but one that has been assembled by selecting individual species out of unrelated communities that have the characteristics and tolerance that enables them to settle on vessel hulls and survive transport through highly variable environmental conditions. Successful fouling organisms attaching to vessels moving between continents and hemispheres need to manage multiple stressors such as temperature extremes, nutrient deficient environments and variable salinities. This would indicate that fouling species are, by nature, physiologically robust with high phenotypic plasticity.

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While “tolerance” of some phyla has been reported to some individual antifouling biocidal active substances, this is to be expected from such a diverse fouling community, and is the primary rationale in the development of multiple-active substance containing products. There are no reported incidences of resistance developing in fouling organisms to antifouling biocidal active substances, which is considered to be a consequence of the general mode of action of these substances with the requirement to control a broad-spectrum of fouling species.

It is unlikely that development of tolerance will be observed in the highly dynamic marine aquatic environment, where for colonization purposes, larval stages develop predominantly in non-impacted areas where generational traits such as resistance will not be developed in the absence of repeated exposure to antifouling active substances.

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8. Regulatory Review of Antifoulings and Label Instructions

The review of antifouling biocidal active substances, and of the products containing them, conducted by the European Commission and EU Member States is an essential step in sustainable use. After review, the scope of permitted uses of an active substance takes into consideration likely risks to human health and the environment, and these are protected at a more refined level by specific requirements on the label of authorised products.

Under the EU Water Framework Directive (EC 2000/60), Member States are empowered to identify priority substances of environmental concern and conduct environmental monitoring for specific substances, including those active substances approved for use in antifouling paints. The results of such monitoring can permit a review of existing use instructions and limitations on the use of biocidal active substances, and these can be amended at the product renewal stage if those currently in place are shown to be ineffective. To date, none of the active substances approved for use in biocidal antifouling products have been identified as priority pollutants

The provision of easily-understood label use requirements, and their rigorous adoption by both professional and non-professional antifouling paint users, are essential to sustainable use of biocidal antifouling products. It is therefore important for the antifouling paint industry to inform the users to follow the label instructions. Of particular importance to the users of antifouling paints is the use of personal protective equipment, which should be strongly encouraged through labels and other available literature such as technical datasheets, painting guides, etc..

The approval conditions of all active substances contain a provision that obliges persons making antifouling products available on the market for non-professional users to supply these products with appropriate gloves[7]. Hence, all antifouling paints, authorised under BPR for non-professional use, are supplied with gloves.

[7] COM(2016) 151, section 2.1.1 (https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-151-EN-F1-1.PDF

9. Best Practice Guidelines

The controlled release of biocidal active substances from approved antifouling paints performs a vital function in keeping hulls clean, which has many environmental benefits. However, while those approved paints have been shown to be safe for use under label conditions, the sustainability of biocidal paints is further enhanced by the adoption of Best Practice to minimise human exposure and the uncontrolled release of biocidal active substances to the environment.

In general, the "in-life" stage of biocidal antifouling paints entails the controlled released of the biocidal active substance(s) at levels which have been approved as safe for use. Uncontrolled releases during application, maintenance and repair may lead to unnecessary exposure, and measures need to be taken in order to minimise them.

Commercial vessels

The industrial scale application of antifouling paints in shipyards and the subsequent human and environmental exposure is actively regulated under many EU Directives which ensure that best practice is integral to the everyday functioning of these facilities. Environmental emissions from installations for the building of, and painting or removal of paint from ships, are reported annually to the European Pollutant Release and Transfer Register and provide clear evidence of the incorporation of best practice at these facilities.

Pleasure craft

There has been increasing awareness of the potential for adverse impacts caused by uncontrolled emissions of antifouling paints over the past decade, with national organisations and paint suppliers taking an active lead in the development of best practice guidance to control this unintended exposure. Good examples are from the British Coatings Federation[8] and the German Environment Agency[9].

[8] https://www.coatings.org.uk/Publications/Health_and_Safety_Publications.aspx

[9] https://www.umweltbundesamt.de/publikationen/antifouling-im-wassersport-was-ist-das-beste-fuer

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Because of the environmental benefits of an effective antifouling system, all factors need to be considered to ensure a successful, fit for purpose coating. Best Practice guidance advocates decisions based upon the overall goal of minimising any unwanted exposure or emissions, particularly during the application and removal stages of the paint's life-cycle, while ensuring the most appropriate level of performance.

Ultimately, the selection of the most appropriate antifouling system or paint comes down to the best option for the vessel's substrate, the environment, and the intended use of the vessel. It may be that a biocidal antifouling system is not the best choice for a particular situation, and a non-biocidal alternative would provide sufficient protection.

The choice of antifouling system will depend on several factors including:

- What is the local fouling challenge?
- How much fouling is the owner willing to accept on their vessel?
- What are the local restrictions on using biocidal systems?
- How much time (and money) is the owner willing to put in to hull maintenance?

Price per litre is not an adequate representation of the true cost when it comes to antifouling. There are many cost factors at work such as:

- Does the coating require professional application, or can it be applied by the boat owner?
- Does it lead to greater fuel efficiency?
- How often will it require repainting or cleaning?
- What cleaning procedures will be required?
- What is the lifespan of the coating?

If a biocidal antifouling system is considered the best option taking these factors into account, the focus then turns to minimising operator and environmental exposure during the surface preparation and paint application stages. Best practice advice is available from many sources, and most advice provides general rules to ensure risk is minimised.

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DOs DON'Ts

- ✓ Choose a safe, secure and appropriate location e.g. boatyard or marina, not a public space
- ✓ Consult literature & labelling information on safe use of antifouling paints before starting the project
- ✓ Follow all rules, procedures and instructions provided by the boatyard / marina
- ✓ Wear the recommended Personal Protective Equipment (PPE),
- ✓ Keep the PPE on throughout the whole process until the end of cleaning up
- ✓ Capture debris, scrapings and contaminated items for safe disposal, use a dust sheet or tarpaulin
- ✓ Keep dust to an absolute minimum, use wet abrasion techniques
- ✓ Thoroughly clean up the whole area after hull preparation has been completed
- ✓ Use suitable (antifouling paint resistant) equipment (paint tray, rollers and brushes)
- ✓ Wash any paint splashes off exposed skin with warm soapy water or specialist cleaners as soon as possible
- ✓ Dispose of all waste responsibly and in accordance with local marina / boatyard guidance

- × Eat, drink or smoke whilst working on the project
- × Allow bystanders to come close to the area of activity
- × Use dry abrasive paper or dust-creating techniques to remove old antifouling paint
- × Create dry paint dust during the whole process
- × Create paint fumes by using blow lamps or gas torches to strip the paint
- × Remove PPE before the job has been completed
- × Airless spraying of antifouling paint – this should only be done by professionals
- × Use solvents or thinners to wash paint splashes from skin
- × Pour waste antifouling paint down the drain

Modern biocidal antifouling systems are formulated to require a minimum of maintenance in use. Generally, in situ cleaning is not recommended because this can lead to premature deterioration of the coating and unnecessary additional environmental burden. If considered necessary, Best Practice recommends the use of minimal abrasion of the active surface during in-water cleaning.

Additional sources of information on Best Practice:

[8] https://www.coatings.org.uk/Publications/Health_and_Safety_Publications.aspx

[9] https://www.umweltbundesamt.de/publikationen/antifouling-im-wassersport-was-ist-das-beste-fuer

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11. Conclusions

Antifouling paints offer essential benefits. By limiting the possibility for aquatic organisms to adhere to ships hulls they reduce fuel consumption, and hence reduce CO^2 emission. They also reduce the potential for invasive species to affect our natural ecosystems and prevent organisms affecting the intrinsic property of the coating, thereby delaying corrosion and increasing the service-life of vessels. This counts for boats and vessels in fresh water as well as in sea water.

There are currently no effective alternatives applicable for all situations.

Effective antifouling paints depend on the availability of biocidal active substances. The BPR in the EU has significantly reduced their availability, from more than fifty notified substances to only nine remaining substances, available to control both hard and soft fouling from an enormous diversity of natural organisms that search for a substrate to live on.

These remaining active substances cannot at all be compared with substances that were previously withdrawn worldwide from antifouling uses, such as TBT. Their transformation is much faster, and they are not subject to long range transport in nature. Their acceptable risk is examined during review under the BPR and they cannot be approved in case of unacceptable risk, both for Human Health and the Environment.

In addition, other EU legislation protects workers at the workplace (OSH) and protects the environment under, e.g., the Industrial Emission Directive and local environmental permits. Consumers that apply anti-fouling paints are more effectively provided with safety advice and best practice recommendations than other consumers that use biocidal products This is made available at the paints' point of sale in marinas, and from the comprehensive information on safe-use made available on the internet by the paint manufacturers.

The benefits of antifouling paints should be considered when evaluating their request for authorization under the BPR and when setting protection goals. Taking a holistic view is the best regulatory approach and for biofouling this includes minimising fuel use with the associated CO^2, NOx and SOx emissions and in addition minimising the risks associated with invasive species.

The sustainable use of antifouling paints is an approach that integrates all these elements. Currently biocidal active substances are an integral part of the sustainable use of antifouling paints. Innovation has taken place already, and will continue, to maintain the essential benefits while minimising adverse effects to Human Health and to the Environment.

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