Health and Safety Executive **Information Document**
HSE 730/15

SAFE USE OF TIN-FREE, MARINE ANTI-FOULING COATINGS

Contents **Paragraph**

Executive Summary	1-2
Introduction	3-8
Background	9-12
Health hazards	13-16
Operator exposure	17-25
The Control of Pesticides Regulations 1986	26-39
The Biocidal Products Regulations 2001	40-42
The Control of Substances Hazardous to Health Regulations 1999	43-54
The Health and Safety at Work etc Act 1974	55
Non-biocidal Anti-fouling	56-59
Checklist of key issues	Appendix

EXECUTIVE SUMMARY

1 The use of booster biocides in marine anti-fouling coatings is increasing. Only biocides approved under the Control of Pesticides Regulations 1986 or the Biocidal Products Regulations 2001 for use in anti-fouling coatin gs may be used. A recent review of booster biocides resulted in approval being granted for the continued use of 4 substances in anti-fouling coatings, some of which can cause skin sensitisation. Conditions of use established as part of the review process have to be detailed on the product labels. Users of anti-fouling coatings have to comply with these conditions including wearing the required personal protective equipment (PPE) including respiratory protective equipment (RPE). In some cases air-fed RPE has to be worn with a higher level of protection than is normally required for the application of anti-fouling coatings.

2 Under the Control of Substances Hazardous to Health Regulations 1999 an assessment has to be made of the risks to health ar ising from the use of the anti-fouling coatings. This has to take into account the risks both to the user and to others who may be affected. Precautions have to be taken to reduce the risk to health including the use of engineering controls and the provision of suitable washing facilities. However, such measures are in addition to , and not an alternative to, those detailed on the product labe l. Alternative, less hazardous means of controlling fouling are available although they have limitations.

INTRODUCTION

3 This document is directed at professional ship painters, shipyard managers and ship owners. It contains internal guidance which has been made available to the public. The guidance is considered good practice (rather than compulsory) but you may find it useful in deciding what you need to do to comply with the law. However, the guidance may not be applicable in all circumstances and any queries should be directed to the appropriate enforcing authority. The Appendix provides a checklist to help in deciding appropriate action in certain circumstances.

4 Booster biocides are increasingly used to improve the performance of anti-fouling coatings containing cuprous oxide and cuprous thiocyanate. This document seeks to:

(1) raise awareness of the associated health risks;

(2) provide data on operator exposure to copper-based anti-fouling coatings;

(3) outline the health and safety legislation affecting their use; and

(4) briefly explain the non-biocidal methods of anti-fouling that are available.

5 Anti-fouling coatings containing tin compounds such as tributyltin (TBT) are also used, although see paragraphs 9-10. For advice on this and on anti-fouling coatings in general see *Guidance on the safe application of antifoulings* produced by the British Coatings Federation, issued by the Shipbuilders and Ship-repairers Association (SSA). This advises on the health risks and fire risks associated with such coatings and is one of a series of guidance notes produced by the SSA regarding health and safety in shipyards.

6 For an annual subscription SSA members get an up-to-date set of guidance notes and any updates or new notes issued during that year. Members can also obtain additional sets of guidance notes for £17.50. Non-members can obtain a set for £29. The SSA can be contacted at Marine House, Thorpe Lea Road, Egham, Surrey TW20 8BF, tel 01784 223770 fax 01784 223775; email: office@ssa.org.uk; website: http://www.ssa.org.uk.

7 The guidance contained in this document is not exhaustive and should be read in conjunction with the product's safety data sheet. If this is not provided by the product supplier it is important to obtain it. A number of suppliers provide access to their safety data sheets via their websites from where they can be downloaded.

8 All publications referred to are published by HSE unless otherwise stated and can be obtained from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA tel: 01787 881165 or via their website http://www.hsebooks.co.uk. Advice on health and safety is also available online from hsedirect, a joint venture between HSE and Butterworths Tolley. This provides access to HSE guidance and health and safety legislation.

BACKGROUND

9 In 1999 the International Maritime Organisation (IMO), the United Nations Agency concerned with the prevention of marine pollution, agreed a resolution which calls for:

(1) a global prohibition on the application of organotin compounds acting as biocides, in anti-fouling coatings on ships by 1 January 2003; and

(2) a complete prohibition on the presence of such compounds, in anti-fouling coatings on ships by 1 January 2008.

10 An amendment of the Marketing and Use Directive will require European Union Member States to adhere to the IMO resolution by the time-scales set. As a result it is proposed that HSE's Biocides and Pesticides Assessment Unit (BPAU) which oversees the use of approved products, will issue Notices of Revocation to all TBT products banning their sale, supply, storage, use and advertisement after 31 December 2002. The time-scale for their disposal has as yet, still to be agreed although it is likely to be 31 December 2007.

11 Consequently, there has been considerable effort to find alternative methods of controlling fouling including the increased use of cuprous oxide and cuprous thiocyanate as biocides. They are physically bound within a medium which contains a 'solubiliser' to allow release. The copper dissolves from the paint, leaving a toxic layer on the surface of the hull.

12 Some forms of algae are however, tolerant to copper. As a result, manufacturers of anti-fouling coatings have introduced additional biocides to work alongside the copper (although they are occasionally also used with TBT compounds) improving the coating's effectiveness. These are referred to as booster biocides.

HEALTH HAZARDS

13 Cuprous oxide and cuprous thiocyanate are harmful if swallowed. Inhalation of droplets of copper salts is reported to cause irritation of the nasal mucous membranes and sometimes of the pharynx. It has an occupational exposure standard (OES) for dusts and mists of 1 mg/m^3 (as copper) over an 8-hour reference period and 2 mg/m^3 over a 15-minute reference period (comparable figures for organic tin are 0.1 mg/m^3 and 0.2 mg/m^3). This reflects the level of exposure at which (based on current scientific knowledge) there is no indication of risk to the health of people exposed by inhalation day after day. For further guidance see Guidance Note EH 40 *Occupational Exposure Limits* which is revised annually.

14 The use of booster biocides to improve the copper's performance introduces additional health hazards. Some of the booster biocides approved for use in anti-fouling coatings (see paragraph 29) have the potential to cause skin sensitisation (or allergic contact dermatitis). This can damage the skin's barrier function leaving it dry, cracked and scaly. An HSE study focusing on operator exposure to anti-fouling coatings during their application (see paragraphs 17-25) identified that the potential for skin contamination was high. It is therefore essential that adequate precautions are taken to control the associated risk of dermatitis.

15 Booster biocides can also be irritating to the respiratory system. The risk to health from exposure by inhalation should therefore be assessed and appropriate precautions taken.

16 The majority of anti-fouling coatings also contain solvents which are harmful by inhalation and by skin or eye contact. They can have a narcotic effect resulting in the following symptoms: headache, dizziness, irritability and mental confusion. Skin contact can cause defatting of the skin and dermatitis, either through their own action or by permitting other substances to affect the skin. If anti-fouling coatings are used which contain solvents, adequate precautions will need to be taken to protect against these hazards.

OPERATOR EXPOSURE

17 Measurements of operator exposure to anti-fouling coatings were gathered as part of an HSE research project (*Copper and organotin compounds - Exposure during application of anti-fouling paints* by D Llewellyn). This was designed to improve HSE's knowledge and understanding of the risks associated with the use of anti-fouling coatings. It looked at operator exposure via inhalation and skin contact. The impact of the following factors on exposure was also explored:

(1) the task;

(2) the location;

(3) environmental conditions;

(4) operator practice; and

(5) personal protective equipment (PPE).

18 The exposure of 30 operators to copper-based anti-fouling coatings was measured in a number of shipyards. All the operators involved wore some form of PPE, mainly disposable boiler suits and gloves. Respiratory protective equipment (RPE) was worn by all the spray painters, and by most of the other operators when working in the dock bottom. Personal atmospheric samples were taken from the operators breathing zone. Five operators, all of whom were sprayers, exceeded the 8-hour OES of 1 mg/m^3. Three of these operators also exceeded the short-term exposure limit of 2 mg/m^3. The highest level of exposure was 5 times the OES, confirming the need for adequate precautions to be taken against the associated risks to health. Wearing suitable RPE is particularly important (see paragraphs 34-35).

19 Tenders on and pot men both had exposure levels within the OESs. Pot men however, had the lowest levels of exposure as they , unlike the tenders on, generally worked well away from the sprayers.

20 The study identified that regardless of the task, it is virtually inevitable that clothing will become contaminated. Wearing the correct protective clothing is therefore essential if skin contact with the anti-fouling coating is to be avoided. In particular the protective clothing has to be suitable both in terms of its coverage and its ability to prevent the anti-fouling coating from soaking through.

21 Sprayers had by far the greatest potential for skin contamination followed by pot men and then tenders on. In the case of sprayers the contamination was evenly distributed over their clothing indicating that contamination was due to contact with the paint aerosol rather than through splashing, dripping or contact with sprayed surfaces. Pot men were most heavily contaminated in the thigh and ankle regions suggesting that their contamination arose from dripping and splashing, whilst decanting or mixing the paint. The use of a stick to manually mix the paint resulted in higher levels of exposure than when using an automatic mixer unit.

22 Sprayers painting the flat bottom of a barge in dry dock had the highest levels of exposure to airborne copper. They also had the highest levels of skin contamination. When working from the dock bottom, pot men had higher levels of exposure to airborne copper than when they worked dock side.

23 The only effect of environmental conditions detected was that the sprayer with the lowest exposure to airborne copper worked in strong winds , the wind blowing the paint overspray away from his breathing zone. The effect of the wind on exposure however, varied depending on the direction of the wind in relation to the direction of spray and the position of the spray operator.

24 The study identified that although protective gloves were worn, people 's hands still became contaminated. This was attributed to:

(1) inappropriate gloves being worn;

(2) skin contamination occurring before the gloves were put on;

(3) contamination of the inner surfaces of the gloves during storage; and

(4) contamination occurring as the protective gloves were removed.

25 Despite the importance of PPE in helping to control the risks to health, the study identified the following concerns:

(1) respiratory protective equipment was not always properly used, stored or regularly maintained; and

(2) the maintenance of protective clothing required improving as there was evidence of grossly contaminated overalls being worn.

LEGAL CONSIDERATIONS

The Control of Pesticides Regulations 1986

26 Under the Control of Pesticides Regulations (CoPR) 1986 anti-fouling coatings containing active ingredients designed to kill fouling organisms, cannot be used without Ministerial approval. The current approval regime will however eventually be replaced by approval under the Biocidal Products Regulations 2001 (see paragraphs 40-42).

27 Anti-fouling coatings containing booster biocides have to meet the above requirement. The presence of an HSE number on the coating's label such as **HSE 9999** indicates that approval has been granted. Currently, approved products are numbered from 3000 upwards. A list of approved pesticides has previously been published annually by The Stationary Office as *Your guide to approved pesticides*. However, this list is now only available on the websites of HSE's Biocides and Pesticides Assessment Unit (BPAU) at www.hse.gov.uk/hthdir/noframes/pestpubs.htm. and the Pesticides Safety Directorate whose web site address is www.pesticides.gov.uk. Additional advice on product approvals can be obtained by phoning the BPAU on 0151 951 3535 or by emailing them at biocides@hse.gsi.gov.uk.

28 Ministerial approval is not required for non-biocidal anti-fouling coatings designed to cause the release of fouling organisms by physical means (see paragraph 57). While such products were approved under the CoPR this has now been removed. However, this was due to a change in the scope of the regulations when they were amended in 1997 and not due to concerns regarding possible health risks.

Booster biocides review

29 An independent committee, The Advisory Committee on Pes ticides (ACP) advises Ministers on whether or not substances covered by the CoPR should be approved. A recent review of booster biocides by the ACP resulted in the continued use of 4 substances in approved anti-fouling products. These are detailed below:

Organic booster biocides	**Metal-based booster biocides**
dichlofluanid	zinc pyrithione
dichloro-octyl-isothiazolone	zineb [zinc ethylenebis (dithiocarbamate)]

30 Approval for the continued use of 3 booster biocides in anti-fouling products was however revoked. These are detailed below:

Booster biocide	Professional use - approval revoked for:	As from:
chlorothalonil	Sale/advertisement	08/07/02
	Supply/storage/use	08/07/03
	Disposal	08/07/04
Diuron	Sale/advertisement	21/11/01
	Supply/storage/use	21/11/02
	Disposal	21/11/03
IRGAROL 1051 (trade name)	Sale/advertisement	08/07/02
	Supply/storage/use	08/07/03
	Disposal	08/07/04

31 Anybody with stocks of anti-fouling products containing the above biocides will have to either use them or dispose of them safely by the dates shown. Possession of such products after the deadline for disposal has passed will be an offence under the Control of Pesticides Regulations. Advice on the safe disposal of pesticides used for non-agricultural purposes is contained in Appendix 4 of *The safe use of pesticides for non-agricultural purposes - Control of Substances Hazardous to Health Regulations - Approved Code of Practice* L9 (rev) ISBN 0717605426. Further information on disposal may also be obtained from the manufacturer or supplier or the local waste disposal authority.

Conditions of use

32 As part of the approval process the biocides were assessed for risks to human health and the environment. On the basis of these assessments, conditions of use were introduced for those booster biocides that were approved . These include restrictions on the maximum concentration of booster biocide that may be used and their field of use, shown in the table below.

Booster biocide	Maximum concentration (%w/w)	Amateur/professional use
dichloro-octyl-isothiazolone	10	professional use only
dichlofluanid	10	amateur and professional use
zinc pyrithione	4	amateur and professional use
zineb	20	amateur and professional use

33 The following precautionary phrases have also to appear on the product labels of professional anti-fouling coatings containing the biocides:

(1) Wear suitable protective clothing (a disposable outer coverall with a hood **and** a second inner coverall of a contrasting colour to the product being applied), suitable gloves and impervious footwear that protects the lower leg;

(2) Dispose of protective gloves after use

(3) Do not breathe spray mist; and

(4) Unprotected persons should be kept away from treated areas.

34 The product approvals also require respiratory protective equipment (RPE) to be worn when spraying is carried out. The need to wear RPE and the type of RPE required has to be detailed on the product label. For anti-fouling coatings containing dichloro-octyl-isothiazolone, this consists of powered filtration with combined protective helmet and visor. However, for the remaining booster biocides the product approvals require the use of air-fed respiratory protective equipment. This is a higher level of protection than is normally required for the application of anti-fouling coatings.

35 The need for RPE extends beyond the spray operator, as the product approvals also require suitable RPE to be worn by anyone working in the vicinity of the spray plume. However, unlike for persons carrying out spraying, the RPE may be a 'disposable respirator' with FF P3 filtration efficiency or an equivalent standard. The need for RPE has again to be detailed on the product label. This applies to anti-fouling coatings containing the following booster biocides:

(1) zinc pyrithione; and

(2) dichloro-octyl-isothiazolone.

36 Users of anti-fouling coatings have to comply with the conditions of use detailed on the product label. It is therefore essential that a coating's label is read to establish exactly what these conditions are. If it is not possible to read the label for whatever reason, the coating should not be used. However, it is important that as well as reading a product's label its safety data sheet is also read.

37 The exact requirements for PPE and RPE should be determined as far in advance of the work commencing as is possible. This is to ensure the correct equipment is made available. This is particularly important given the variations in the product approvals granted, especially in relation to RPE. However, in the event of there being a delay in receiving the required product information a default set of PPE and RPE should be retained which affords the highest level of protection that may be required. It is essential however that an assessment of the health risks associated with the planned work is still conducted prior to the work commencing (see paragraphs 43-45). To be adequate the assessment needs to consider the information contained on both the product's label and its safety data sheet.

38 The performance of a tight-fitting face mask (filtering facepieces, half and full-face masks) depends on a good contact between the wearer's skin and the faceseal of the mask. If this type of RPE is worn it is therefore important that checks are made to ensure that it fits the wearer correctly. This can be carried out by qualitative and quantitative face -fit tests. For further guidance on RPE see HSG 53 *The selection, use and maintenance of respiratory protective equipment, a practical guide* ISBN 0717615375.

Supplementary guidance

39 The product approvals also recommend that the following guidance should appear on literature supplied with the products, advising that for operators exposed to the biocides:

(1) all bare skin should be covered;

(2) disposable coveralls should normally be used for no more than one spraying session;

(3) the inner coverall should be changed regularly and whenever paint breakthrough has been detected; and

(4) impermeable gloves of the type recommended by the paint manufacturer as sui table should be worn and should be chang ed regularly, eg after one-2 days.

The Biocidal Products Regulations 2001

40 The Biocidal Products Regulations implement a European Directive, the Biocidal Products Directive. This is designed to promote the free trade of biocidal products whilst providing protection for humans and the environment. The regulations apply to anti-fouling products, which will be required to undergo a pre-authorisation risk assessment.

41 Only authorised products can be used and only if they are used in accordance with the conditions of the authorisation. However, there will be no immediate impact on the supply and use of existing products as the current approval regime (described above) will remain in place until all active substances and products have been reviewed under the biocides regulations. This is not expected to be completed until approximately 2012. The Biocidal Products Regulations have, however, an immediate effect for active substances that were not on the European Union market at 14 May 2000. These substances will be approved under the new regime and not under the CoPR.

42 For further guidance on the Biocidal Products Regulations see *A guide to the Biocidal Products Regulations for users of biocidal products* HSG215 ISBN 0717618218 and free leaflet INDG321 *A simple guide to the Biocidal Products Regulations*. A series of free fact sheets on the Regulations has also been produced by BPAU. The sheets and further information can be found on the HSE website at http://www.hse.gov.uk/hthdir/noframes/bpau.htm.

The Control of Substances Hazardous to Health Regulations 1999

Assessment

43 The Control of Substances Hazardous to Health Regulations 1999 (COSHH) require a suitable and sufficient assessment to be made of the risks to health from working with hazardous substances such as anti-fouling coatings . The assessment has also to consider ways of preventing or reducing exposure, over and above any measures imposed by the product approval.

44 The assessment should include anyone who may be exposed to the anti-fouling coating, including:

(1) people directly or indirectly involved in the task, such as the sprayer and the pot man; and

(2) anyone in the nearby vicinity who may be affected (efforts should however be made to clear the area of all non-essential people).

45 The chemical compositions of the different types and makes of anti-fouling coating vary. It is therefore important that the COSHH assessment considers the risks to health from the anti-fouling coating that will actually be used. Any additional risks created by the use of booster biocides should also be identified and appropriate precautions taken. The location in which the coating is applied can affect exposure levels (see paragraph 22) and should also be considered by the assessment.

46 It is essential that the main findings of the assessment are brought to the attention of all relevant employees so they are fully aware of the associated hazards and the precautions that need to be taken.

Control measures

47 In reducing the risk to health a hierarchy of measures has to be followed consisting of elimination, substitution, isolation (ie separating the process from those not directly involved), control using engineering means and personal protective equipment (PPE) including RPE. For certain applications the use of anti-fouling coatings containing booster biocides can be avoided by using less hazardous forms of control (see paragraphs 56-59).

48 Ways of reducing exposure by engineering means include:

(1) using automatic mixing units to mix the paint rather than mixing it by hand;

(2) using paint pumps which have a suction unit that can be inserted directly into the paint tin to further avoid spillage;

(3) selecting appropriate nozzles (eg deflector nozzles);

(4) adjusting spray pressures to minimise the production of mists and overspray or using a high -volume low-pressure spray gun rather than a conventional spray gun;

(5) fitting shrouds over spray heads where practicable; and

(6) when applying anti-fouling coating from a mobile elevating working platform (MEWP), applying it from the bottom of the vessel up and frequently moving the ME WP to avoid spraying at full stretch and the resulting increase in overspray caused by a loss of accuracy.

49 The use of PPE as a control measure is likely to be essenti al, particularly where it is a condition of the product approval. The PPE detailed on the product label has to be worn as a minimum. The COSHH assessment should identify any additional PPE that may be necessary for the particular circumstances of use. Given the importance of PPE anybody who has to wear it should know:

(1) they have to wear it;

(2) why they have to wear it;

(3) how to wear it correctly; and

(4) how often it should be changed.

50 The PPE should be stored correctly when not in use to avoid possible contamination. The use of PPE should be supervised to ensure it is used as instructed. For further information on PPE see *Personal protective equipment at work - Guidance on regulations - The Personal Protective Equipment at Work Regulations 1992* L25 ISBN 0118863347.

51 While priority should be given to using the above control measures to avoid skin contact with anti-fouling coatings, the risk of such contact occurring may remain. It is therefore essential that suitable washing facilities are readily accessible. Where the work is undertaken by contractors, special arrangements may be needed for their employees to access the yard's welfare facilities particularly if working ‘out of hours’. The washing facilities should include washbasins or troughs with a constant supply of hot and cold or warm running water, soap and suitable means of drying hands. Showers will also be needed where the work may result in whole body contamination such as with spray application.

Health surveillance

52 As booster biocides can cause dermatitis health surveillance should be provided. This is to help detect early symptoms of the condition or any other health effects resulting from skin contact. The health surveillance may consist of administering a brief employee questionnaire and conducting regular inspections of areas of skin where exposure may have occurred.

53 The questionnaire and the skin che cks may both be conducted by a responsible person who has received suitable training from an occupat ional nurse or doctor. This training should include recognition of the early stages of dermatitis. Employees however, should also be encouraged to conduct self -inspection and to report any symptoms indicative of the condition.

54 For further general advice on how to control the risks from skin exposure to chemical agents see *Assessing and managing risks at work from skin exposure to chemical agents* HSG205 ISBN 0717618269. Additional advice is also contained in *Cost and effectiveness of chemical protective gloves for the workplace* HSG206 ISBN 0717618285 and *Choice of skin care products for the workplace* HSG207 ISBN 0717618250. For further guidance on the COSHH Regulations see *The safe use of pesticides for non-agricultural purposes - Control of Substances Hazardous to Health Regulations - Approved Code of Practice.*

The Health and Safety at Work etc Act 1974

55 The Health and Safety at Work etc Act 1974 places a duty upon employers to protect the health and safety of their employees and anyone else, who may be affected by their work activities. The spray application of anti-fouling coatings can give rise to spray drift. As well as increas ing the exposure of the spray operator to hazardous substances other people in the area may also be similarly exposed. Where anti-fouling coatings are applied on a harbour slipway this could include for example, other boat owners or people working on their behalf. Precautions should therefore be taken to prevent spray drift from occurring, some of which are detailed in paragraph 48. Additional action that could also be taken includ es the use of screens or partitions, where appropriate.

NON-BIOCIDAL ANTI-FOULING

56 A limited range of anti-fouling methods are available which function by physical means rather than by using biocides . However, such methods tend to be more expensive than traditional, biocide anti-fouling coatings and their practical application is more limited. Some of these products are also at an early stage of development. Nonetheless, if such products are chosen carefully they can prove to be useful alternatives.

57 One type of non-biocidal control that has been developed is a non-toxic, anti-fouling coating system which retards the growth of fouling organisms by utilising a mixture of enzymes and micro-organisms. This results in the removal of critical nutrients from the microf ilm of water on the hull's surface and the release of antibiotics which together help prevent the accumulation of fouling organisms. 'Flock'

coatings have also been developed which when applied to the surface of a ship's hull form a dense layer of individual synthetic fibres. This creates a continuously moving surface onto which fouling organisms find it difficult to attach themselves. Those that do attach themselves are eventually pulled off by their own weight.

58 Fouling may also be controlled by using a silicone -based paint. When applied to a ship's hull it results in an ultra-smooth, slippery, non-stick surface upon which fouling organisms find it difficult to settle. Any organisms that do settle can usually be easily removed either by low pressure water washing in dry dock or by self -cleaning in-service. However, for the latter to work the vessel needs to have a minimum operating speed of 15 knots. While the product is biocide-free it does contain solvents when applied.

59 Alternative forms of control that are available include a device which creates and transmits timed, electromagnetic impulses through a metal band fixed to a ship's hull. The impulses radiate out from the band along the hull, preventing the micro-organisms from attaching themselves. Sonic anti-fouling systems have also been developed which utilise low-frequency sonic waves to create a micro-thin layer of rapidly moving water over the hull's surface which makes it very difficult for fouling organisms to attach themselves.