

CADMIUM IN GENERAL AND COPPER-BASED PAINTS

REPORT

19 November 2012

1. INTRODUCTION

The original proposal by the Commission to amend the REACH restriction provisions concerning cadmium entry 23 in Annex XVII of REACH contained the following provision dealing with the placing on the market of paints:¹

"Paints [3208] [3209] shall not be placed on the market if the concentration in cadmium (expressed as Cd metal) is greater than 0.01% by weight."

With this specific amendment the Commission intended to amend paragraph 1 b) of the entry.

However, CEPE, a representative association for the paints, printing inks and artists' colours industry in Europe, intervened to claim that this new provision, and in particular the 0.01% limit value, would adversely impact the market for antifouling paints based on recycled copper, which can contain cadmium as an impurity due to the nature of the copper's previous uses. CEPE proposed a limit of 0.0175% cadmium for paints with a copper content exceeding 20% by weight. Due to the late and limited availability of information on the technical and socio-economic aspects of the issue, it was decided not to adopt the proposal to amend the provision.

The Commission services requested ECHA on 28 September 2011 to investigate the issue of cadmium in recycled copper-based paints and to collect the available technical and socio-economic information on the topic. Following the outcome of this investigation, ECHA should give advice as to whether Entry 23 of Annex XVII should include a specific provision to restrict the placing on the market of paints with TARIC codes [3208, 3209] which contain cadmium, and, if so, to propose the appropriate limit values.

2. METHODOLOGY

For the purposes of this investigation, ECHA has carried out:

- (a) consultation with Member States and relevant industry stakeholders with a request for any available information of a technical or socio-economic nature on the use of cadmium in paints;
- (b) internal consultation with experts on the Biocides Legislation which covers antifouling agents;
- (c) a review of available REACH sources (e.g. Registration dossiers, Classifications and Labelling notifications) and relevant scientific literature or reports relating to cadmium in paints.

In the course of this investigation, ECHA has established contacts with: (a) *Industrial stakeholders* that either raised the issue (e.g. CEPE on paints based on recycled copper) or might be expected to possess relevant information due to the nature of their activities (e.g. International Association of Cadmium Manufacturers (ICdA)); (b) *Member States* both directly (such as the FR evaluating body for the assessment of copper compounds under the biocides regulation) and via a CIRCABC² consultation

¹ As detailed in the minutes of the REACH Committee meeting on November 2010

² CIRCABC is a website that ECHA uses for sharing documents and consulting with Member States.

launched in May 2012; (c) *Health Canada and Environment Canada* that have provided some information on their existing legal provisions and scientific studies concerning cadmium.

To collect the information, ECHA made the following general requests (adapted to the nature of the organisation):

- (a) Have you identified any types of paint containing cadmium, either manufactured or imported in the EU?
- (b) Regarding copper-based anti-fouling paints specifically, are you aware of any potential impacts to the environment or human health as a result of their cadmium content?
- (c) What would be the technical and socio-economic implications (e.g. impact on volume of recycled copper based paints manufactured, imported and/or used per year) for the associated industries, at national or EU level, if the concentration of cadmium (expressed as Cd metal) in anti-fouling paints based on recycled copper was limited to: (i) 0.01%; or (ii) 0.0175%?

The main findings of the consultation are discussed in the next sections.

3. THE ISSUE OF CADMIUM IN PAINTS

3.1 General paints (with TARIC codes 3208, 3209)

3.1.1 Existing legislation

According to paragraph 2 (previous para 1b) of Entry 23 of Annex XVII of REACH:

"Cadmium and its compounds shall not be used in paints [3208] [3209]. For paints with a zinc content exceeding 10 % by weight of the paint, the concentration of cadmium (expressed as Cd metal) shall not be equal to or greater than 0,1 % by weight. Painted articles shall not be placed on the market if the concentration of cadmium (expressed as Cd metal) is equal to or greater than 0,1 % by weight of the paint on the painted article."

Therefore, the existing provision prohibits the use of cadmium in the production of paints with these specific TARIC codes. According to Council Regulation (EEC) No 2658/87, the CN codes 3208 and 3209 refer to certain types of paints and varnishes (including enamels and lacquers) that are mainly based on synthetic or chemically modified natural polymers, dispersed or dissolved in non-aqueous (CN 3208) or aqueous medium (CN 3209). CEPE, who raised the issue of the concentration limit, has confirmed that copper-based paints used for antifouling purposes belong to these TARIC codes. This would appear to indicate that such paints do not comply with the current restriction. However, according to CEPE, cadmium does not have a role in the functionality of antifouling paints, and any cadmium appearing in them is present as an impurity only, rather than being intentionally 'used'. Due to the wording of the restriction, therefore, the legal status of existing copper-based antifouling paints is ambiguous.³

³ Note that the restriction on the cadmium content of paint on painted articles refers only to a specific concentration, not whether it is intended, because of some specific 'use', or not. However, this restriction relates only to paint on painted articles, not to paint which is marketed as a stand-alone product.

Following the Commission request to ECHA for investigation, this report considers the issue of the restriction on the placing on the market of paints containing cadmium.

3.1.2 Information received from stakeholders on cadmium in paints

CEPE provided a statement to the Commission on 22 October 2010 as a response regarding the proposed restriction on the uses of cadmium in paints that the restriction of the placing on the market of paints containing cadmium above a certain threshold was missing from the draft proposal. Based on common occurrence of cadmium in minerals and alloys, the Commission then inserted the restriction limit of 0.01% by weight of paint in the draft provision. This draft restriction, though, was subsequently withdrawn from the final Commission proposal for the amendment of cadmium restrictions, due to the issue which emerged with copper-based antifouling paints (see the letter from CEPE to the Commission dated 12 November 2010).

During ECHA's consultation with Member States in 2012, information was received from Norwegian and Swedish Competent Authorities on paints containing cadmium. Norway reported a now-defunct application of cadmium compounds in paints used for road marking. Sweden reported information from their National Products Register on company testing of non-antifouling paints which found a small number to contain cadmium impurities, as follows:

(i) *Testing of paint and varnish samples:* six out of 9902 (0.06%) of paints and varnishes tested in Sweden in 2010, which corresponds to 397 tonnes out of a total of 338,636 tonnes (0.1%), were reported to contain cadmium impurities. SE reported that as an impurity the cadmium content in the products is reported as a calculated value of 1/1000 or 1/2000 of the zinc content. One additional product was reported in 1999 to contain cadmium at levels above those which might be expected as a result of impurity (and resulted in the company involved switching suppliers).

(ii) *Levels of cadmium:* Cadmium is present as an impurity from the use of zinc in four out of six paints containing cadmium impurities (in which zinc content is higher than 10%). For the other two cadmium containing products, the impurity comes from other metals in the raw material and companies have reported cadmium impurities at 0.00005% and 0.00008% respectively.

Furthermore, the Swedish Competent Authority (KEMI) reported that only one of the six paints identified with cadmium impurities was intended for domestic use, the remainder being for professional uses. The product with cadmium content above impurity levels was also reported as not being supplied to domestic users. Only one of the products containing cadmium was manufactured in Sweden, the others being imported into Sweden from elsewhere in the EU (it was not known whether these imports were manufactured in the EU or outside).

Both CEPE and ICdA reported that they are not aware of any paints currently placed on the market in the EU which contain cadmium with an intentional use rather than as an impurity.

3.1.3 Information on the literature about cadmium in paints

Relevant reports contain no information about uses of cadmium and its compounds in any type of paints at the EU level (e.g. RPA, 2000, 2010, EURAR 2007 etc.). The scientific evidence on exposures available in the literature is also scarce. A recent intake study on paint fragments collected in an urban environment in Plymouth (UK)

(Turner and Sogo 2012) revealed greater bio-accessibility of cadmium in the stomach than the intestine compared with other heavy metals. Furthermore, a study undertaken in Nigeria (Orisakwe et al., 2007) identified cadmium among the industrial metals used as part of paint varnishes that have been reported to have adverse implications. Their results showed that occupational exposure of humans to paints increased blood cadmium levels by about 50% compared with non-paint factory workers.

3.2 Copper-based paints

3.2.1 Information provided by CEPE

At the REACH meeting discussions of November 2010, CEPE strongly opposed a restriction on the placing on the market of paints containing cadmium at a limit lower than 0.0175% cadmium for paints based on recycled copper whose copper content exceeds 20% by weight of the paint. At that time CEPE stated that these paints were exclusively used in marine antifouling coatings and cadmium traces are unavoidable due to the existence of cadmium in the recycled copper scrap which is manufactured from a variety of raw material sources, including cadmium copper alloy used in applications such as trolley wire and heating pads. (See Section A-2 of the Annex for more details.) They claimed that their proposed limit matches closely the Australian Pesticides and Veterinary Medicines Authority (APVMA) standard for copper oxide in marine antifouling paints and in the proposed Green Label for marine antifouling coatings in China.

According to APVMA (2009), the limit on cadmium impurities related to the use of copper oxide in marine coatings and antifouling paints is given by the simple formula:

Maximum Cd concentration (mg/kg) = Copper concentration (g/kg) / 10.

Accordingly, a 20% copper concentration in antifouling paints is equal to 200g/kg, which translates into a maximum permitted cadmium concentration of 20mg/kg, or 0.02%, which is similar to the limit of 0.0175% proposed by CEPE.

CEPE claimed that recycled copper is used as an economical supplement to virgin copper sources, being cheaper, more energy efficient and hence more environmentally friendly. They further claimed that, while scrap dealers make efforts to segregate scrap to various levels of purity to maximise the scrap value, recycled scrap can be contaminated at levels such as 0.01% when sources get mixed into truck or trainload quantities.

CEPE stated that, to the best of their knowledge, there are no intentional uses of cadmium in antifouling paints.

3.2.2. Information provided by other stakeholders

Ten Member State Competent Authorities (CAs) responded to the ECHA request for information during the consultation in May (through CIRCA BC). In most cases, the CAs replied that either there are no antifouling agents based on recycled copper in their market or that no relevant data are available.

Sweden reported that their national testing indicates that copper-based antifouling products registered in their products register contain less than 0.01% cadmium.

Norway reported that some manufacturers had indicated that, due to the presence of cadmium in scrap copper, they might have difficulty meeting a limit value of 0.01% cadmium in antifouling paints based on recycled copper. Meeting such a limit would require firms to switch to more expensive virgin copper.

Both Slovakia and Italy reported no objections or negative impacts associated with a 0.0175%, as opposed to 0.01%, limit value. (Italy noted that recycled copper-based paints containing cadmium are not marketed in that country.)

3.2.3. Copper-based paints and Biocides Regulation

Under the Biocides Regulation ((EU) No 528/2012) there is a requirement to identify relevant and significant impurities of the active substance (as per the technical guidelines at http://ihcp.jrc.ec.europa.eu/our_activities/public-health/risk_assessment_of_Biocides/doc/TNsG/TNsG_DATA_REQUIREMENTS/TNsG-Data-Requirements.pdf) and to set specifications for these impurities. The relevance of a significant impurity is determined on the basis of its known toxicological and ecotoxicological properties and should be chemically identified if technically possible, and included in the technical specification, with stated maximum concentrations.

Under this regulatory framework, there is an on-going assessment of antifouling paints based on copper compounds (copper oxide, copper (II) oxide (EC No: 215-270-7; CAS No: 1317-39-1) and copper thiocyanate (EC No: 214-183-1; CAS No: 1111-67-7)). ANSES, the French Agency for Food, Environment and Occupational Health and Safety, is the evaluating body appointed by the French Ministry for the Environment (which is the Competent Authority for biocides in France) to perform the assessment of these copper compounds. It has the task of proposing a specification for cadmium in the copper compounds, as cadmium is considered a relevant impurity. The Competent Authorities of the Biocide Directive confirmed this in July 2011.⁴

The specification of the limit value will be based on an analysis of cadmium concentrations in the relevant sources intended for use in antifouling paints. Each company participating in the review will provide five batches of the copper compounds from the sources they (would) use to produce their product. These batches are then pooled, and the cadmium concentration equal to the mean plus three standard deviations from the mean is determined. This sets the limit for cadmium, expressed in terms of the level of impurity in the copper (the active substance, rather than in the product, i.e. the paint). Thus, the limit value is set based on concentrations found in batches supplied by participating firms rather than by a comparison of the costs and benefits of any particular limit value.

If and when the copper substances under assessment are included in BPR Annex I, or its successor the 'Union list', industry will have to submit an application for authorisation within two years, after which they will not be allowed to place antifouling paint products on the market without an authorisation. To gain authorisation, applicants will need to comply with the limit value set via the earlier assessment and review.⁵ This cadmium specification is analogous to a limit value under REACH.

⁴ Representatives of Member States Competent Authorities for the implementation of Directive 98/8/EC concerning the placing of biocidal products on the market (42nd CA meeting, CA-July 11-Doc.3.4). This document is confidential as it contains information on the composition of the active substance.

⁵ Setting the limit value based on the mean plus three standard deviations of the values obtained from samples provided by firms participating in the review implies a number of things. If the

Because it is set in terms of concentration in the active substance, the actual concentration in the product itself could vary, whereas under REACH the actual concentration is likely to be fixed, but the end result is the same. It should be noted that if the cadmium content of paints has a limit value in Annex XVII, this value may be higher or lower than the limit value of cadmium for the active substance (copper) under the Biocides Directive.

France is expected to report on its evaluation of copper compounds in antifouling paints in mid 2013. Hence this dossier will be part of the handover from JRC to ECHA, as ECHA takes over the Review Programme from DG JRC from January 2014 onwards. Given the timelines for opinion-making in the Biocidal Products Committee and for decision-making in the Commission, the approval of copper as an active substance in antifouling paints is likely to take place in the second half of 2014. Companies then have two years to submit their applications for authorisation, with Member States needing to take a decision within a further two years. This means authorisations will be granted at the earliest in the second half of 2016 and at the latest in the second half of 2018

Copper (II) oxide (EC No: 215-269-1; CAS No: 1317-38-0) has already been added to the list of active substances provided under Annex I to Directive 2012/2/EU (Biocidal Products Directive (BPD)) (repealing Directive 98/8/EC) for use in product type 8. These are wood preservatives with a required 976g/kg minimum purity of the active substance in the biocidal product as placed on the market. Under the Biocidal Products Directive, cadmium specifications have been set for wood preservative biocidal products based on copper compounds, as follows:

- Copper (II) oxide: max 0.0002% w/w
- Basic copper carbonate: max 0.0001% w/w
- Copper hydroxide: max 0.0005% w/w

These concentrations are much lower than those discussed here in the context of antifouling paints, which presumably reflects the much lower concentrations of copper in wood preservative products (indicated in the French assessment report to be between 0.317% and 0.57%) than in antifouling paints (e.g. 25%). To convert the concentrations to antifouling paint-equivalents, 0.4% is used as the average concentration of copper in wood preservatives. With this assumption a maximum concentration for cadmium derived from copper (II) oxide, assuming a copper concentration of 25% in paints compared with 0.4% concentration in wood preservatives would be 0.0125% (i.e. $25\%/0.4\% \times 0.0002\%$). Using the range 0.317-0.57% indicated in the French assessment, this translates into a range of 0.008772-0.015773% w/w. These figures for copper (II) oxide appear to be of the same order of magnitude as those discussed in the current context.

Distribution of sample values obtained in the review is normal, 99.85% of sample values will be lower than a limit set at three standard deviations above the mean. Further, the higher the proportion of total firms which participates in the review, the closer will the samples obtained in the review reflect all potential applicants in the industry. In the limit, if all firms participated in the review and the values obtained from the samples they provided were normally distributed, the limit value which was set would only prevent 0.15% of sources being eligible for authorisation. If a smaller proportion of firms participate in the review, and/or if the sample values obtained in the review are not normally distributed, the impact on the limit value and subsequent authorisation depends on the extent to which the sources used by the review firms tend to contain higher or lower concentrations of cadmium than the sources used by other firms.

3.2.4 Screening of literature and REACH registration/notification reports

Uses of copper compounds in antifouling paints are covered in Chemical Safety Reports registered under biocides legislation rather than REACH. This is indicated in Article 15 of REACH ('Substances in plant protection and biocidal products') according to which, '*Active substances manufactured or imported for use in biocidal products only and included [...] shall be regarded as being registered and the registration as completed for manufacture or import for the use in a biocidal product*'. As might be expected, therefore, a search on the main reported copper compounds (copper oxide, copper (II) oxide and copper thiocyanate), on which existing antifouling applications are based, found no registered use of cadmium and its compounds in any type of paints. Section A-1 of the Annex presents information obtained from Registration and Downstream Users' reports and Classification and Labelling notifications for these specific copper compounds.

No data relevant to cadmium in antifouling agents have been found in various cadmium relevant EU reports (e.g. EU RAR, RPA studies etc). In the literature, there is reference to a study undertaken by Singh (2009) on antifouling paint residues collected from the hard-standings of a marine leisure boat facility in the UK. Measurement revealed the presence of 75 µg/g traces of cadmium in this specific paint (accounting for less than 0.01% per weight).

4. CEPE INPUT CONCERNING CADMIUM LIMIT IN COPPER PAINTS

This section is based on information that ECHA received from CEPE during the consultation in 2012.

4.1 Human exposure to cadmium in copper-based paints

According to CEPE, the infrequent and quasi-professional use of antifouling coatings means that potential human exposure is largely restricted to application and removal procedures only, as the product is used on the hull of vessels submerged in water, thus limiting human contact. In addition, these coatings are classified as hazardous due to non-metallic components, and, accordingly, proper personal protective equipment is prescribed during application and removal, and applicators are aware of the need to limit exposure.

4.2 Environmental impact of cadmium in copper-based paints

CEPE has estimated that lowering the cadmium concentration limit in copper-based antifouling paints from 0.0175% to 0.01% would reduce the direct input of cadmium to EU waters by 97 kg. This estimate is based primarily on relevant OSPAR reports (details given in section A3 of the Annex) and is intended to indicate the maximum additional benefit of reducing the limit value further than that originally suggested for Entry 23. The figure is an upper-bound estimate because it assumes that the average cadmium concentration prior to the imposition of the 0.01% limit is 0.0175% whereas this is a maximum concentration and the average is likely to be lower. This reduction is, according to CEPE, less than half the quantity that OSPAR concluded was 'a minor fraction (201 kg). CEPE argued that, given existing cadmium levels in seawater in the EU, this 97 kg reduction would effectively provide no additional environmental protection.

CEPE were unable to respond to ECHA's requests for further explanation of this estimate. Instead they provided a copy of a report by Safinah (2010), which, on the basis of a number of assumptions, estimated the total amount of copper leached from antifouling paints into EU waters to be 4418 tonnes per year, with a range of 2209 tonnes to 6627 tonnes. Assuming all paints contain the maximum permitted concentration of cadmium, the average amount of cadmium released into EU waters from this quantity of copper leachate would be 773 kg if the concentration was 0.0175%, and 442 kg if the concentration was 0.01%. The difference between the two limits is 331 kg per year giving an order of magnitude of the effect of two possible limit values (see Table 1).

Table 1: Estimated annual releases of cadmium to EU 27 water from copper-based antifouling coatings assuming an average content of 0.01% or 0.0175% of cadmium content

	Lower range	Average	Higher range
Total copper leachate	2209 te	4418 te	6627 te
Cadmium releases with average content of 0.01%	221 kg	442 kg	663 kg
Cadmium releases with average content of 0.0175%	387 kg	773 kg	1160 kg
Difference	166 kg	331 kg	497 kg

1) Source: For copper leachate: Safinah,(2010). The releases: own calculations based on the assumptions.

For reference, OSPAR (2009) estimated cadmium releases from ships' coatings and anodes of 72 kg to the Netherlands Continental Shelf, and of 201 kg to the Greater North Sea, with a total riverine input of cadmium to European seas of 72 tonnes, and direct discharge of 1 tonne in 2006 (approximate figures read from graphs 0.2, 3.3, 4.14, 5.2 of OSPAR (2009)). In comparison, the figures presented in Table 1 seem to be relatively low.

4.3 Impacts on industry of cadmium limit value of 0.01%

CEPE have claimed that restricting to 0.01% the amount of cadmium in antifouling-grade scrap copper would reduce the availability of high grade scrap copper and/or necessitate an additional re-purification stage which would increase the cost of scrap copper, both financially and environmentally (e.g. in terms of energy use). However, CEPE have not been able to provide any cost analysis to estimate the additional burden. ECHA requested additional information on a number of aspects (see Section A-4 of the Annex), but CEPE were unable to provide this information in the timescale of this consultation. Therefore, it was not possible for ECHA to establish if there were any economic impacts to paint manufacturers, ship builders or operators or any other economic operator from a possible restriction of cadmium on the basis of currently available information.

5. CONCLUSIONS

The consultation with Member States and industry has led to the following conclusions:

- No intended use of cadmium in paints (TARIC codes 3208, 3209) manufactured or imported in the EU area has been identified. Information from the Swedish Competent Authority has indicated a very small number (0.06%) of tested (non-antifouling) paints containing traces of cadmium as an impurity. On this basis, it seems that a restriction on the cadmium content of these paints at concentrations above 0.01% by weight of the paint would have little or no impact on the costs or competitive position of the associated industry sectors.
- It has not been possible to validate claims made by the industry body, CEPE, that a 0.01% limit value on cadmium in antifouling paints would generate unacceptable costs for industry, as compared with a limit of 0.0175% for paints with a copper content above 20%. In the timescale of this consultation, CEPE were not able to substantiate the basis for suggesting the limit value of 0.0175%.
- The cadmium content of antifouling paints is in the process of being regulated through the Biocidal Products Regulation (BPR). This does not remove the need to consider these products further within the REACH context, because biocidal products are not exempted from Title VIII of REACH (Restrictions), and the cadmium content of antifouling paints means that they are regulated *de facto* under Entry 23 of REACH Annex XVII. However, there is a clear need to ensure that the regulation of cadmium under REACH (via Entry 23) and the BPR (via the regulation of copper-based antifouling paints) is consistent. This is because neither REACH nor BPR takes precedent over the other when regulating the same substance, so each needs to take account of the other to ensure the desired regulatory outcome is achieved.

The resolution of this issue comes down to a comparison of the limit set for cadmium via copper in antifouling paints under the BPR, and the limit set for cadmium in general paints (Taric codes 3208 and 3209) under Entry 23. In the absence of any specific derogation, whichever is the tighter limit will 'bind', that is, will be the one which actually applies in practice to cadmium in antifouling paints. It is appropriate that the BPR actively regulates cadmium in antifouling paints, given both the remit of that regulation and the fact that regulatory processes are already in motion to set such a limit under BPR. If the limit value set under BPR is lower than that set under Entry 23, BPR will 'bind' and there will be no need for any further action. However, if the limit value set under Entry 23 is tighter, a derogation might be needed to be placed in that entry to the effect that any cadmium limit for copper-based antifouling paints set by the BPR should apply. This would ensure that the limit set under BPR 'binds'.

Overall, ECHA concludes that a revision to the provision in Entry 23 of Annex XVII is needed to set a limit value for general paints based on content, and to remove the current ambiguity relating to the status of paints which contain cadmium as an impurity rather than for an intended use. It should also ensure that appropriate reference is made to the regulation of antifouling paints under the Biocidal Products Regulation.

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ANNEX

A-1 Screening of information on copper compounds from REACH registration/notification reports

Registrations and Downstream User reports

Registered information on copper oxide (REACH-IT search, July 2012) includes 18 full registrations from companies (manufacturers, importers and only representatives) and approximately 500 pre-registrations. Tonnage levels for the registered data vary from seven registrations of 100 to 1000 tons, five registrations for both 10 to 100 and for more than 1000 tons, and only a single registration of 1 to 10 tons.

Identified uses of copper oxide in submitted CSRs include uses in ink and coatings. The uses of copper oxide in antifouling paints are not covered by the CSRs registered under REACH but instead under the EU biocidal directive (98/8/EC). As noted in the CSR, copper oxide has uses in product types that fall outside the scope of the REACH regulation, e.g. as an active ingredient in biocidal products, plant protection products, pharmaceuticals and food/feed additives.

On dicopper oxide (CAS number 1317-39-1), eight full registrations and 276 pre-registrations were received. Tonnage levels are: three registrations with volumes above 1000 tons/year, four between 100-1000 tons/year and one registration between 10-100 tons/year. Identified uses of dicopper oxide include biocide substance, however as for copper oxide, the registrants refer to the biocidal directive. Also inks, coatings, colouring agents and pigments are mentioned as identified uses of copper oxide. For copper thiocyanate (CAS number 1111-67-7) no full registrations have been submitted while 71 pre-registrations are noted.

Classification and labelling notifications

102 classification and labelling notifications have been submitted to ECHA on copper oxide (REACH-IT search July 2012, 44 bulk notifications). On dicopper oxide and copper thiocyanate, 42 and 5 classification and labelling notifications are registered, respectively, and 23 and 4 bulk notifications, respectively. Dicopper oxide is classified to be acute toxic to humans (hazard statement H302, harmful if swallowed), and very toxic to aquatic life with both long lasting and acute effects (hazard statement H410).

A-2 CEPE input on the source of cadmium in copper based paints (April 2012)

Cuprous compounds are manufactured from a variety of raw material sources including copper cathode, spent circuit board etchant and recycled copper. Cadmium copper is used in applications such as trolley wire, heating pads, electric blanket elements, spring contacts, connectors, and high strength transmission lines. Cadmium copper is used for trolley wire because it is extremely resistant to arc erosion. An extremely heat resistant cadmium oxide forms on the surface of the wire during arcing and protects it from eroding. This enables the cadmium copper wire to retain its strength under the high temperature conditions of the electric trains. Recycled scrap copper from sources such as this is a valuable and efficient resource in that it can be used without further refining

in some applications, thereby saving energy costs and preventing the generation of unnecessary greenhouse gases. Recycled copper is an economic supplement to virgin copper sources and the use of recycled copper encourages further recycling efforts. Recycled scrap copper has a number of different grades that may contain traces of many other metals, and end use of the different grades of recycled copper reflects the extent of the trace impurities. For example, recycled copper used in industries where consumer contact with the end use copper compound may be assumed, necessitates high grade scrap copper to minimise risk to the consumer.

- Lead is present in trace amounts in many forms of recycled copper as it is a common solder;
- Tin often is present in recycled copper as a coating on copper wiring;
- Arsenic, mercury, chromium and cadmium are generally not found at significant levels in recycled copper but they can at times be present.

A-3

A3.1 CEPE original input (April 2012) on the environmental input of cadmium in copper based paints

Direct inputs: In order to assess the significance of the environmental input of cadmium from antifouling uses of copper, the reader's attention is directed to Reference 1, wherein OSPAR (the Oslo and Paris Commissions) has recently reported on cadmium input into ocean regions. This latest OSPAR report summarises data collected over 16 years (1990–2006) of riverine inputs and direct discharges to the seas in the OSPAR Regions (OSPAR, 2009a); Region I (Arctic Waters), Region II (Greater North Sea) and Region III (Celtic Seas).

To demonstrate the impact on the environment, the information cited in this response is drawn from OSPAR Region II, the Greater North Sea, however can be extrapolated for all EU waters. The report indicates that for the period 2003-2006, riverine input of cadmium in to Region II is approximately 20 tonnes per annum.

Estimates (Ref 2) for the Netherlands' Continental Shelf suggest that in 2007, 72 kg cadmium have leached from anodes to the sea, extrapolated to 201 kg when considering the Greater North Sea region (Region II). OSPAR concluded "this is a minor fraction of inputs of cadmium to Region II". Using the cuprous oxide tonnage from the same report as the basis of the estimate (46 tpa for the Netherlands' Continental Shelf), and assuming that this entire tonnage contains cadmium at the upper limit of 0.0175%, this is equivalent to approximately 225 kg cadmium for Region II. Reducing this upper limit to 0.01% would reduce this to 128 kg, a reduction of approximately 97 kg, and less than half the quantity that OSPAR concluded was "a minor fraction". The reader's attention is directed to the fact that this theoretical calculation is based upon an assumption that all cuprous oxide contains cadmium at the specified limits, which can be considered an exceptional case, and the additional tonnage can be expected to be considerably lower than 97 kg.

Existing levels in natural seawater: The average cadmium content of seawater is about 5-20 ng/l in open seas. Concentrations measured in European rivers vary from 10 to 100 ng/l (OSPAR (2004), Finnie (2008)). For information, in 1997 OSPAR adopted

Ecotoxicological Assessment Criteria (EACs) for cadmium at 0.01- 0.1 µg/l (10 – 100 ng/l) for water.

Assuming a copper leaching rate of 10 µg/cm²/day, (Hulskotte & Oonk (2007)), Factsheet gives like-for-like cadmium leaching rates of 0.00175 and 0.001 µg/cm²/day. Finnie (2008) has demonstrated that leaching is controlled by the paint matrix, not the substance properties, therefore this assumption can be considered as valid. Using standard parameters defining emissions to an EU open shipping lane as required for assessment of antifouling substances under Directive 98/8/EC, these leaching rates would give rise to additional (i.e. above background) environmental concentrations of;

0.00175 µg/cm²/day; Resultant concentration = 4.6×10^{-5} ng/l

0.001 µg/cm²/day; Resultant concentration = 2.6×10^{-5} ng/l

Comparing the additional concentrations to natural background levels, it is clear that a reduction from 0.0175% to 0.01% would provide no additional level of protection to the environment.

A3.2 ECHA questions to CEPE for clarification on the analysis of the environmental impacts

(1) With reference to the Dutch report of Hulskotte and Oonk (2007), 72kg of cadmium is estimated to be leached from the anodes to the sea of the Netherlands' Continental Shelf. Can you please provide information on how this 72kg of cadmium is estimated as it is not clear from the report of Hulskotte and Oonk (2007)?

(2) The potential reduction of direct inputs of cadmium from 0.0175% to 0.01% is estimated to be 97kg cadmium/year, if all copper paints contain the maximum allowed cadmium concentration. The figures are based on an estimate of copper release of 46 tonnes/year for the Netherlands' Continental Shelf. Can you please provide information on how this Cu release of 46 tonnes/year is estimated?

(3) For the direct inputs of cadmium to region II waters, estimates are based on data from the Netherlands' Continental Shelf. On what background is the conversion from the Netherlands' Continental Shelf to Greater North Sea (region II) based on?

(4) Redoing the calculations of CEPE based on the same figures stated in the answer, we end up with different results than CEPE on direct input and sea water concentration of cadmium. Can you please provide us your calculations for both direct input and sea water concentration?

Direct input:

Amount of CuO released to region II (46000kg / (72/201) ¹ =)	Kg	128416.7	128416.7
Fraction of Cd in Cu-paint		0.000175	0.0001
Additional Cd to sea/year (amount of CuO · fraction of Cd in paint)	Kg	22.5	12.8

1) Conversion factor and un-identified. Both 72kg and 201kg are read from CEPES answer.

Sea water concentration:

Cd leaching rate	(µg/cm²/day)	0.00175	0.00175	0.001	0.001
		Small boat	Big boat	Small boat	Big boat
Cd leaching rate ¹	g/day	0.00035	0.0875	0.0002	0.05
Volume of sea ²	L/day	7.5E+11	7.5E+11	7.5E+11	7.5E+11
Additional concentration, (g/day) / (L/day)	g/L	4.67E-16	1.17E-13	2.67E-16	6.67E-14
Additional concentration	ng/L	4.67E-07	1.17E-04	2.67E-07	6.67E-05

1) Conversion un-identified, but one for TBT is found in this report: From g/cm²/day to g/day => <http://www.atsdr.cdc.gov/toxprofiles/tp55-c6.pdf> . Conversion factor: Small boat 1/5. Big boat 50/1.

2) Volume of sea read from graph in report of OSPAR, 2009; Trends in waterborne inputs – Assessment of riverine inputs and direct discharges of nutrients and selected hazardous substances to OSPAR maritime area in 1990-2006. OSPAR Commission, London, 2009. Publication 448/2009.

A-4 ECHA questions to CEPE for clarification concerning market/price and cost relevant information

(1) Market information on antifouling paints

- How much antifouling paints are placed in EU market (tonnes per year)?
- How much of this is i) produced in the EU and ii) imported (%)?
- How much antifouling paints are exported from EU (tonnes per year)?

(2) Market information on copper based antifouling paints

- How much copper based antifouling paints are placed on the market in EU (tonnes per year)?
- How much of this is i) produced in the EU (%) and ii) imported (%).
- How much copper based antifouling paints are exported from EU (tonnes per year)

(3) Copper content in antifouling paints

- How much copper is present in different types of antifouling paints? Please specify the different segments (e.g. 10-20% and 20-30%)
- What are the market shares of different segments (%)?

(4) Price information on paints

- What is the average price of different antifouling paints (€ per tonne)? Please provide information for different segments (e.g. copper-free, between 10-20% copper, between 20-30% copper).
- What are the technical reasons for having different copper contents?

(5) Cadmium content in copper based antifouling paints

- How much cadmium is in average in copper-based antifouling paints (%)?
- What is the distribution of cadmium content in copper-based antifouling paints? E.g. share of paints containing i) less than 0,01%, ii) between 0,01 and 0,0175 and iii) more than 0.0175%. If possible, please provide also the data behind the information.

(6) Information on different copper grades

- What copper grades are available for production of antifouling paints)? E.g. virgin copper, recycled "normal" grade, recycled high grade, recycled purified.
- What is the distribution of cadmium in different copper grades? This information may be provided also under question 5.
- What are the average prices of different copper grades (€ per tonne)? Alternatively, please provide indication on the price difference.