Australian Government

Australian Pesticides and Veterinary Medicines Authority

Anti-fouling paint for use on boat hulls

Environmental assessment

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1 TECHNICAL NOTE ON ENVIRONMENTAL REQUIREMENTS

The Regulatory Acceptable Concentration (RAC) is determined from the active constituent's toxicity to aquatic and sediment dwelling species. For the determination of the Predicted Environmental Concentration (PEC), the guidance needs to be based on the release rate of active constituent form the painted surface (µg/cm^2/day). The guidance could then established based on product-specific parameters. However, a guidance for each of these parameters cannot be established as they are inter-related in the determination of the outcome release rate. The model and methodology is described below.

1.1 Methodology

The worst-case was determined to involve an Australian large marina, with application of the anti-foulings to all types of craft including pleasure craft.

The average PEC was modelled using MAMPEC 3.1 (van Huttum et al. 2017), which includes an updated hydrodynamic harbour exchange module. This leads to a slightly lower (~6 per cent) predictions compared to previous MAMPEC versions for the default OECD marina. The average PEC value was considered appropriate as several input parameters are conservative.

The MAMPEC inputs require:

- the environment (eg a marina of specific dimensions)
- the chemical properties
- the release of the active constituent from the anti-fouling paint to determine the PEC.

Until more recent data were available from the NZ EPA (Gadd et al. 2011) and from a survey of the Australian Marina Industry (RMRC 2013), the default OECD marina (van Huttum et al. 2017) has been used in the determinations of the PEC. The determination of settings for an Australian marina for the MAMPEC model are detailed below.

1.2 Settings for the environment

RMRC (2013) in its survey of marinas, classified them in three categories small, (< 100 spaces), medium 100–250, large >250. Queensland had the largest marinas and had an average of 270 berths/pens and moorings, for all categories. Based on this data a worst-case Australia Marina was determined to have 500 berths/pens and moorings. The size of the marina was then determined by comparing the ratio of the hull surface area (15 350 m^2) to marina area (22 000 m^2) for the OECD default marina. A factor of 1.43 was determined and this was applied to Australian marinas.

The hull surface area for Australian marinas was determined by using the methodology described by Gadd et al. (2011), where the surface area of the hull may be estimated from the from the length and type (motor boat, sail boat, sail boat deep keel) of vessel. The vessels were combined into four categories (5–11, 12–20, 21–30 and 31–40 m) and the average length (rounded up to the nearest metre) for each category was used to calculate the surface areas. As the each type of boat has a different length to surface ratio a weighted average was used. No information is available for the proportion of sail boats which are deep keel, so a 50:50 split was assumed. However, according to RMRC (2013) the proportion of power boats to sail boats is approximately 70:30. The weighted average surface area based on each class length was calculated from the analysis by Gadd et al. (2011) on surface area for power boats and sail boats as follows.

The percentage of berths/pens and moorings by length class was determined by RMRC (2013) and this was applied to the Australian worst-case marina with 500 berth/pens or moorings.

The marina surface area is estimated as 47300 m^2 (33077 m^2 × 1.43) which was modelled assuming square dimensions of 217 m (x2) × 217 m (y1).

Table 1: Boat hull surface area based on categories proposed by Gadd et al (2011)

Marina length class (m)	Surface area (m^2)
5–10	25
11–20	78
21–30	152
31–40	276

Table 2: Australian large marina settings

Length	5–10 m	11–20 m	21–30 m	31–40 m	Total
Number	157	316	26	2	501*
Surface area (m^2)	3925	24648	3952	552	33077

1.3 Settings for the chemical properties

Settings for the chemical properties are obtained from the public domain including APVMA (2001, 2011), MAMPEC 3.1 model (van Hattum et al. 2017) and (Hellio and Yebra 2009), EC (2009), ECHA (2015, 2016b), and Madsen et al. (2000).

1.4 Settings for the release of the active constituent

The settings for the release of the active constituent are based on the surface areas described above (Tables 1 and 2). In addition, to account for vessels not using the active or vacant moorings, an application factor of 90 per cent was used. This is the current OECD (2005) default level but also reflects high occupancy rates in Australian marinas, with half reporting greater than 90 per cent (RMRC 2013). The input parameters for the model assume that all vessels are moored (the number moving through the marina at any one time is negligible). However, the release of active constituent in µg/cm^2/day as a required input of the model is calculated by the CEPE (2003) method, which is for moving vessels. Finnie (2006) recommends a correction factor of 2.9 extrapolated from available laboratory and field data. Accordingly the guidance will be established on the release of active constituent in µg/cm^2/day for moored vessels as modelled by MAMPEC with the above settings, multiplied by 2.9.

1.5 Determination of release rate of active constituent from product-specific parameters

The release rate of the active constituent can be calculated from product-specific parameters using the CEPE (2003) methodology and considering that the fraction of solids is in w/w%.

Equation 1: Worst case calculation of release of active constituent from product- specific parameters

$$\overline{R} = \frac{0.9 \times a \times w_a \times N \times 3.29}{C \times 12}$$

Where:

- *a* is the mass fraction of biocide in the biocidal ingredient; (in general a is equal to 1 for most active constituents)
- *wa* is the content of biocidal ingredient in the paint formulation as manufactured, in g/L
- *C* is the theoretical coverage in m^2 for each litre of paint (single coat)
- *N* is the maximum number of coats
- 3.29 is the conversation factor for calculating months/day and cm^3/dm^3 and g/L to %
- 12 is the number of months per year (worst case service life).

1.6 Regulatory acceptable concentrations

Terrestrial vertebrates

Exposure of terrestrial vertebrates to the active constituents of anti-foulings is considered to be negligible. Risks of anti-fouling to terrestrial vertebrates are considered to be acceptable.

Non-target aquatic organisms

There are three potential exposure routes of the active constituents into the aquatic environment:

- during application via spray drift
- during service by continuous direct release from the coated surface immersed in water
- during removal of paint close to the water.

Exposure during application and paint removal are mitigated by the following label restraint:

DO NOT contaminate soil or waterways with paint, dust and scrapings, or with used containers.

Maximum leaching rates for each active constituent have been established to address the risks to non-target aquatic organisms during service lifetime.

Copper present as cuprous oxide

The key regulatory endpoint was obtained from ECHA (2016a) which is based on 56 high-quality chronic No Observable Effect Concentration (NOEC) or EC_{10} values resulting in 24 different species-specific NOEC values covering different trophic levels (fish, invertebrates, algae).

The NOEC values were related to the dissolved oxygen concentrations (DOC) of the marine test media. Species-specific NOEC values were therefore calculated after DOC-normalising the NOEC values. These species-specific NOEC values were used for the derivation of a species sensitivity distribution (SSD) and $HC_{5\text{-}50}$[1] values. For the marina scenario, the typical DOC level is 2 mg/l resulting in an $HC_{5\text{-}50}$ value of 5.2 µg Cu/L.

The resulting RAC is 5.2 µg Cu/L (no assessment factor is applied to the $HC_{5\text{-}50}$). None of the underlying studies cited by ECHA (2016a) are protected in Australia.

Copper pyrithione

The key regulatory endpoint is based on inhibition of the growth rate of the marine diatom Skeletonema costatum following static exposure (NOEC 0.18 µg ac/L, geomean based on time-weight average concentrations from four studies). The resulting RAC is 0.18 µg ac/L (no assessment factor is applied to the NOEC). The underlying studies are ABC Laboratories (2010), Mayer et al. (2002), Minderhout et al. (2008) and TR Wilbury Laboratories (2004), which were cited by ECHA (2015). The underlying studies are not protected in Australia.

Copper thiocyanate

The key regulatory endpoint is based on acute immobilisation of the water flea *Daphnia magna* based on measured concentrations following 48 hours of static exposure (EC_{50} 20 µg ac/L). The resulting RAC is 2.0 µg ac/L (EC_{50} divided by assessment factor of 10). The underlying study is Cameron et al. (1989), which was cited by ECHA (2016b). The underlying study is not protected in Australia.

Dichlofluanid

The key regulatory endpoint is based on inhibition of the growth rate of the marine diatom *Skeletonema costatum* following 72 hours of static exposure (NOEC 0.64 µg ac/L). The resulting RAC is 0.64 µg ac/L (no assessment factor is applied to the NOEC). The underlying study is Scheerbaum (2004) which was cited by ECHA (2016c). The underlying study is not protected in Australia.

Diuron

The key regulatory endpoint was obtained from APVMA (2011) which is based on 28 chronic values for primary producers (algae and aquatic plants). These NOEC values were used for the derivation of a SSD and HC_5 value (1.6 µg ac/L). The resulting RAC is 1.6 µg ac/L (no assessment factor is applied to the HC_5). The underlying studies are listed in Appendix E of APVMA (2011) and are not protected.

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[1] $HC_{5\text{-}50}$ is the median fifth percentile of the SSD

Zinc pyrithione

The key regulatory endpoint is based on reduced survival and growth and increased incidence of bent spinal columns in the early life stage of the fathead minnow *Pimephales promelas* following long-term exposure to 2.8 µg ac/L (NOEC 1.2 µg ac/L). The resulting RAC is 1.2 µg ac/L (no assessment factor is applied to the NOEC). The underlying study is Boeri et al. (1999), which was cited by APVMA (2001) and USEPA (2004). The underlying study is not protected in Australia.

Zineb

The key regulatory endpoint is based on reduced survival and growth in the early life stage of the fathead minnow *Pimephales promelas* following long-term exposure to 4.6 µg ac/L of mancozeb (NOEC 2.2 mg ac/L). Mancozeb is used as a surrogate for zineb because both are structurally similar as ethylenebisdithiocarbamate (EBDC) polymers and only the EBDC anion is considered to be of ecotoxicological significance. The resulting RAC is 2.2 µg ac/L (no assessment factor is applied to the NOEC). The underlying study is Rhodes et al. (1994), which was cited by EC (2009), PMRA (2013) and USEPA (2005). The underlying study is not protected in Australia. The mancozeb endpoint was utilised by ECHA (2013) in its assessment of zineb as an anti-fouling paint.

Bees and other non-target arthropods

Exposure of bees and other non-target arthropods to the active constituents of anti-foulings is considered to be negligible. Risks of anti-foulings to bees and other non-target arthropods are considered to be acceptable.

Soil organisms and non-target terrestrial plants

Direct exposure is possible during application or removal of paint from pleasure craft. Exposure to soil is not considered a typical case scenario but depends on the control measures of the boat yard. Exposure of soil is mitigated by the following label restraint:

DO NOT contaminate soil or waterways with paint, dust and scrapings, or with used containers.

Appendix

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