ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

OFFICE OF PREVENTION, PESTICIDES, AND TOXIC SUBSTANCES

DP Barcode: D362199
Chemical: Zinc Pyrithione
PC Code: 088002

March 25, 2009

Memorandum:

Subject: Ecological Hazards and Risk Assessment Chapter for Antifoulant Use of Zinc Pyrithione

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Attached is the ecological hazard and risk assessment for zinc pyrithione (ZnPt). RASSB's 2004 *Zinc Pyrithione Ecological Hazard and Environmental Risk Characterization Chapter for the Reregistration Eligibility Decision (RED) Document*[1] addressed indoor uses of ZnPt. The antifoulant use was not assessed, because several studies required to support the outdoor use had not yet been submitted. Those studies have now been submitted and reviewed. Due to potential exposure of aquatic organisms from leaching of ZnPt from paint applied to new or repaired boat hulls into freshwater and saltwater bodies, a risk assessment has been conducted. Several of the antifoulant paints containing ZnPt also contain a second active ingredient (mostly cuprous oxide but also cuprous thiocyanate or econea). Each of these active ingredients also is currently registered as an antifoulant paint/coating, but they are not addressed in this assessment.

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[1] Zinc Pyrithione Ecological Hazard and Environmental Risk Characterization Chapter for the Reregistration Eligibility Decision (RED) Document, April 15, 2004, K. Montague, AD/RASSB

However, it should be emphasized that these actives will be leaching along with zinc pyrithione from these paints into the aquatic environment, and adverse affects to aquatic organisms may occur from simultaneous exposure to both active ingredients. Some literature data are available demonstrating synergist effects when zinc and copper occur together, and transchelation also may occur in the presence of other metals (e.g., manganese). Such risk is acknowledged in the assessment but is not addressed quantitatively.

Exposure scenarios modeled (MAM-PEC) for ZnPt in aquatic environments include inland and coastal marinas and an estuarine harbor. EECs are calculated for the water column and sediment within each setting. RASSB's hazard and risk conclusions are summarized below and presented in more detail in the attached ecological risk assessment.

Ecological Hazard and Risk Conclusions:

- ZnPt is very highly toxic to freshwater and saltwater fish and aquatic invertebrates and slightly to moderately toxic to terrestrial animals; based on acute toxicity, a precautionary hazards statement is required for aquatic organisms (see label requirements below)

- For indoor uses, minimal exposure and risks are expected for terrestrial and aquatic organisms; therefore, a risk assessment is not conducted for those uses.

- For antifoulant use, two freshwater (inland) and two saltwater (coastal) scenarios were modeled using exposure predictions from MAM-PEC. The following LOCs are exceeded for acute and chronic risks to aquatic organisms exposed to ZnPt in the water column:

	LOCs exceeded	
Scenario	**Listed spp.[2]**	**Non-listed spp.**
Inland Marina:	Fish, acute Aquatic invertebrates, acute	None
Inland Small Marina:	Fish, acute Fish, chronic Aquatic invertebrates, acute Aquatic plants	Fish, acute Fish, chronic Aquatic plants
Coastal Marina:	Aquatic invertebrates, acute	None
Coastal Harbor:	None	None

- Based on extremely low predicted concentrations in sediment after one year in relation to the sediment-based toxicity of ZnPt to freshwater and marine amphipods, minimal risks are presumed for exposure to sediment containing ZnPt leached from watercraft hulls

[2] Federally designated endangered or threatened species

- Synergistic toxic effects of ZnPt and Copper on aquatic organisms are reported in the literature; because copper also is an active ingredient in most of the formulated ZnPt antifoulant products, acute and chronic risk estimates in this assessment may underestimate actual risks and strongly emphasizes the need for testing mixtures of the active ingredients contained in the formulated products

- Two degradates tested are only slightly to practically nontoxic to aquatic plants and animals

- ZnPt is not presumed to pose risks to terrestrial animals, due to its low toxicity to birds and mammals and little potential for bioaccumulation

Label requirements:

All product labels must have the following **ENVIRONMENTAL HAZARDS** statement:

> "This pesticide is toxic to fish and other aquatic organisms. Do not apply directly to water by cleaning of equipment or disposal of wastes. Do not allow chips and dust generated during paint removal to enter water. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authorities are notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA."

Required guideline studies for antifoulant use:

Indoor uses

The ecological effects database is adequate to support the current indoor uses.

Antifoulant use

No additional guideline studies are required at this time. However, when additional information becomes available (see below) to enable a more refined risk assessment for U. S. waters, the following studies may be required:

Fish life cycle (850.1500) - reserved; and

Monitoring of representative U. S. waters (no guideline number) – reserved [If environmental monitoring data, based on the additional information cited below, do not show that EECs are much lower than those calculated by the Agency (resulting in a lack of LOC exceedances for all tested species), then actual field residue monitoring data from multiple locations may be required. Such monitoring would determine levels of zinc,

zinc pyrithione, and/or major metabolites/degradates in surface waters and sediments where major boat/ship use may occur. Submission and Agency approval; of a protocol is required before this study is undertaken. Further, note that levels of zinc and other chemical species determined from this field study would need to be low enough such that calculation of RQs would result in a lack of LOC exceedances for all tested species.]

Additional information needed for antifoulant use:

Additional information is needed to better refine the risk assessment for U. S. harbors and marinas. Such information includes but is not limited to the following:

- Dimensions of marinas and harbors
- Number and sizes of watercraft in the facility, including seasonal and geographical variations
- Environmental inputs including tides and currents, water temperature, salinity, pH, sediment density, and others

Acknowledgements

Thanks to the following RASSB scientists for their contribution to the ecological risk assessment:

S. Mostaghimi, Senior Scientist: MAM-PEC modeling
J. Breithaupt, Agronomist: environmental fate
N. Shamim: environmental fate

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Ecological Hazards and Risk Assessment
Zinc Pyrithione (ZnPt)

ZnPt is registered for both indoor and outdoor antimicrobial uses. Outdoor use is limited to antifoulant paints applied to recreational and commercial boat hulls (below the water line) for control of slime, algae, and marine fouling organisms (e.g., barnacles, tubeworms) in fresh, salt, or brackish water. The antifoulant paints are applied by brush, roller, or by spraying (airless). Indoor uses include preservative use in food packaging adhesives, food packaging materials, conveyor belts, and repeat use polymeric food contact materials, control of bacterial growth on laundered products, preservation of adhesives, caulks, patching compounds, sealants, grouts, latex paints, coatings, dry wall, gypsum, pearlite, plaster, and ductwork (HVAC use). ZnPt also is used for the control of mildew in nonfood contact polymers and control of mildew and bacteria in styrene butadiene rubber and thermoplastic resins (e.g. air ducts). Materials preservation uses include in-can preservation of clay, mineral, pigment and guar gum slurries, latex emulsions, and similar high solids aqueous media.

For all currently registered indoor and outdoor uses, a hazards assessment is conducted to meet current labeling requirements for precautionary statements for all ZnPt products and to determine hazard endpoints for the ecological risk assessment. A risk assessment is conducted for the antifoulant use, because the intended application of ZnPt paints to boat hulls will result in exposure of aquatic organisms due to leaching of the active ingredient from treated hulls into the aquatic environment.

Ecological Hazards Assessment

The toxicity endpoints used in OPP's assessments are obtained from guideline toxicity studies conducted for wildlife, aquatic organisms, and plants (40 CFR §158). Guideline studies are required to provide acute and reproductive/chronic measures of effect for one or more test species in several taxonomic groups. Some studies are only required on a case-by-case basis, depending on factors such as use patterns and environmental fate characteristics.

The full complement of acute and chronic ecotoxicity data available for ZnPt and two degradates (pyridine sulfonic acid and pyrithione sulfonic acid) are presented in Appendix A. The most sensitive species in each taxa/group is used in the assessment. Those data are tabulated below (Table 1). The data characterize ZnPt as being highly to very highly toxic freshwater and saltwater fish and invertebrates and slightly to moderately toxic to birds and mammals. A precautionary hazards label statement is required for aquatic organisms.

Table 1. Ecotoxicity Data Used in the Hazard and Risk Assessment

Category/ Species	Measurement endpoint	Toxicity endpoint	Toxicity category
Birds:			
Northern bobwhite	acute LD50	60 mg ai/kg bw	moderately toxic
	dietary LC50	1063 ppm ai	slightly toxic
Mammals:			
Laboratory rat	acute LD50	630 mg ai/kg bw (♂) 460 mg ai/kg bw (♀)	slightly to moderately toxic
Freshwater fish:			
Fathead minnow	acute LC50	2.6 µg ai/L	very highly toxic
	chronic NOEC	1.2 µg ai/L	
Freshwater invertebrates:			
Waterflea	acute EC50	8.2 µg ai/L	very highly toxic
	chronic NOEC	2.7 µg ai/L	
Estuarine/marine fish:			
Sheepshead minnow	acute LC50	400 µg ai/L	highly toxic
	chronic NOEC	no data	
Estuarine/marine invertebrates:			
Mysid shrimp	acute LC50	4.7 µg ai/L	very highly toxic
	chronic NOEC	2.2 µg ai/L	
Aquatic plants:			
Duckweed	EC50	8.8 µg ai/L	n/a
	NOEC	4.0 µg ai/L	
Freshwater diatom	EC50	2.6 µg ai/L	n/a
Saltwater diatom	EC50	0.65 µg ai/L	n/a
Sediment toxicity:			
Freshwater amphipod	EC50 or LC50	2.1 mg/kg dry wt	n/a
Saltwater amphipod	EC50 or LC50	<1.08 mg/kg dry wt	n/a

The toxicity data for the two degradates tested are presented in Tables 5A, 6A, and 8A in Appendix A. The degradates are only slightly to practically nontoxic to aquatic organisms.

Ecological Risk Assessment and Characterization Methods

Risk assessment and characterization integrates exposure and toxicity information to evaluate the potential for adverse ecological effects. Risk quotients (RQs) are determined for each taxa or ecological group by comparing exposure estimates (Estimated Environmental Concentrations, EECs) to the available acute and chronic ecotoxicity values, where:

RQ = Exposure estimate (EEC) / Toxicity value

RQs are compared to OPP's levels of concern (LOCs). Exceedance of an LOC indicates a potential for acute or chronic adverse effects on nontarget organisms and identifies a need for regulatory action to mitigate risk. LOCs currently address the following risk presumptions:

acute:	regulatory action may be warranted to reduce or preclude acute exposure
acute, listed species:	additional regulatory action may be warranted to protect listed (i.e., endangered or threatened) species
chronic:	regulatory action may be needed to reduce or preclude chronic exposure

The LOCs for the various risk presumptions are listed below for terrestrial and aquatic animals and plants:

	Aquatic Animals	Terrestrial Animals	Plants
Acute:	0.5	0.5	1
Acute, listed species:	0.05	0.1	1
Chronic:	1	1	n/a

The following toxicity endpoints are used as inputs to the RQ method for expressing risk:

Aquatic Animals

Acute:	Lowest tested EC50 or LC50 for freshwater fish and invertebrates and estuarine/marine fish and invertebrates
Chronic:	Lowest NOEC for freshwater fish and invertebrates and estuarine/marine fish and invertebrates (early life-stage or full life-cycle tests)

Terrestrial Animals

Avian acute:	Lowest LD50 (single oral dose) and LC50 (subacute dietary)
Avian chronic:	Lowest NOEC (21-week avian reproduction test)
Mammalian acute:	Lowest LD50 from single oral dose test.

Mammalian chronic:	Lowest NOEC for two-generation reproduction test

Plants

Terrestrial:	Lowest EC25 values from both seedling emergence and vegetative vigor for both monocots and dicots
Terrestrial listed:	Lowest EC05 or NOEC for both seedling emergence and vegetative vigor for both monocots and dicots
Aquatic vascular and algae:	Lowest EC50
Aquatic vascular listed:	NOEC or EC05

When available, toxicity measures or other appropriate information from non-guideline studies or from the open literature also may be used to characterize risk.

OPP generally uses computer simulation models to estimate exposure of aquatic organisms to an active ingredient. These models estimate EECs in surface waters and sediment using product-label information (e.g., treatment site, application rate, application method,) and available environmental-fate data to determine how fast the pesticide breaks down and its expected movement in the environment. The model used in the current risk assessment is described in more detail in the **Aquatic Exposure Assessment** section.

For aquatic organisms, the following EECs are used to calculate the RQ for each taxa:

Fish

Acute:	Instantaneous
Chronic:	60-day average

Invertebrates

Acute:	Instantaneous
Chronic:	21-day average

Plants

Acute:	Instantaneous
Chronic:	Not applicable

Environmental Fate Summary

The following environmental fate summary is from the AD/RASSB's *Environmental Fate Science Chapter on Zinc Pyrithione (Zinc Omadine®) For Reregistration Eligibility Document (RED)*[3]:

[3] Environmental Fate Science Chapter on Zinc Pyrithione (Zinc Omadine®) For Reregistration

Zinc Pyrithione (Zinc Omadine®) appears hydrolytically stable in abiotic, buffered and simulated water systems. Photolytically, however, it rapidly degrades with a half life of 13 minutes in buffered aqueous medium and 17 minutes in simulated sea water.

There are multiple degradation pathways for zinc pyrithione. Under aerobic conditions, zinc pyrithione degradation half life is 0.6 hours in aqueous system and 0.89 days in sediment. Similarly zinc pyrithione shows a tendency of degrading anaerobically in water within 0.5 hours and in about 19 hours in sediments.

Zinc pyrithione shows a moderately strong tendency to bind with soils and sediments: With salt water soil and sediment its K_ds are 50 and 99 respectively. Tendency to bind with freshwater soils and sediments are less strong and observed K_ds are 11 and 48 respectively. There may be a short-lived water/sediment partitioning issue. There could be an acute adverse impact on benthic aquatic organisms. However, since it degrades fairly quickly in freshwater and saltwater soils and sediments (half lives 0.89 days to 19 hours), the acute adverse impact may be very short-lived. It is not likely to persist in water and microbial soils and sediments.

Reported Octanol/Water Partition coefficient K_{OW} is < 1000, and therefore zinc pyrithione is not likely to bioaccumulate in aquatic organisms.

Aquatic Exposure Assessment

EECs in the water column and sediment are estimated using MAM-PEC (v. 2.0)[4,5]. The MAM-PEC model was developed by the Institute of Environmental Studies/IVM and Delft Hydraulics for the European Paint Makers Association to predict environmental concentrations of antifoulant paints/coatings in various marine environments (e.g., marinas, harbors, surrounding waters). The model accounts for a variety of emission factors (e.g., leaching rate, watercraft numbers and sizes, residence times, watercraft-hull underwater surface areas), compound-related properties and processes (e.g., Kd, Kow, Koc, volatilization, speciation, hydrolysis, photolysis, biodegradation), and environmental properties and processes (e.g. currents, tides, salinity, DOC, suspended matter load, port dimensions). The default scenarios in MAM-PEC allow the user to alter input values for the specific locality being assessed if data are available. For example, the

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Eligibility Document (RED), April 14, 2004, A. Najm Shamim, Regulatory Management Branch II, Antimicrobials Division

[4] van Hattum B., A.C Baart, and J.G. Boon. 2002. Computer model to generate predicted environmental concentrations (PECs) for antifouling products in the marine environment - 2nd ed. accompanying the release of Mam-Pec version 1.4, IVM Report (E-02/04), Institute for Environmental Studies, Vrije Universiteit, Amsterdam, Netherlands.

[5] OECD. 2005. Emission Scenario Document on Antifouling Products. OECD Environmental Health and Safety Publications, OECD Series on Emission Scenario Documents No. 13, ENV/JM/MONO(2005)8, Organisation for Economic Co-operation and Development, 166 pp.

dimensions of the default marina (see below) can be altered for the known dimensions of a specific marina, or to predict aquatic EECs for marinas of different sizes. The number and sizes of watercraft also can be changed, as well as the percentage of craft treated if actual usage information is obtained. With a few modifications (e. g., latitude, water temperature, salinity and tidal factors), RASSB is using the default scenarios provided by MAM-PEC that were also used in RASSB's 2008 assessment for copper pyrithione[6]. These scenarios can be further refined when additional information on the dimensions and physical and chemical properties of U. S. coastal and inland marinas and harbors become available.

The estimated leaching rate of zinc pyrithione from painted hulls was determined from leaching studies conducted by the registrant and submitted to and reviewed by RASSB. Leaching data are available for 13 paint formulations[7]. The highest leaching rate was from International Copper-free White Paint, with a maximum average leach rate of 14.3 µg/cm^2/day. Three other formulations had leaching rates that exceeded 10 µg/cm^2/day. The formulation with the lowest leaching rate (4.5 µg/cm^2/day) was Ecoflex BEA469/G044 Paint. MAM-PEC was run using the highest and lowest rates. For each leaching rate, maximum and average EECs are predicted for the water column and over time (1 to 10 years) in sediment, both within the marina or harbor and in the surrounding waters. For each scenario, in the absence of any usage information, it is assumed that 100% of the craft are treated. If usage information becomes available, the scenarios can be refined to reflect that information. The EECs generated by MAM-PEC are used for both acute and chronic exposure.

MAM-PEC Scenarios

The inland (freshwater) and coastal (saltwater) marina and harbor scenarios used in this assessment (and the copper pyrithione assessment) are briefly described below. Details of the specific runs, including all input values and predicted water-column and sediment EECs are provided in Appendix B. Further descriptions of the MAM-PEC model default scenarios are provided in the OECD (2005) *Emission Scenario Document on Antifouling Products*.

Inland Marina

MAM-PEC scenario: default estuarine harbor (no tidal factors, minimal salinity)
Dimensions: 400 x 400 m, 3.5 m deep
No. craft at berth: 299 (10-5 m in length)
Underwater area of individual craft: 22.5 m^2
See Appendix B for additional specifications on this scenario

[6] Ecological Hazards and Risk Assessment for Copper Pyrithione, November 18, 2008, W. Erickson, AD/RASSB

[7] Environmental Fate Science Chapter on Zinc Pyrithione (Zinc Omadine®) and Proposed Bridging to Copper Pyrithione, October 14, 2008, J. Breithaupt, AD/RASSB

Inland Small Marina

MAM-PEC scenario: modified default Swiss marina scenario from OECD (2005)
Dimensions: 100 x 100 m, 2 m deep
No. craft at berth: 75 ($\leq$10 m in length)
Underwater area of individual craft: 10 m^2
See Appendix B for additional specifications on this scenario

Coastal Marina

MAM-PEC scenario: default marina
Dimensions: 400 x 400 m, 3.5 m deep
No. craft at berth: 299 (10-50 m in length)
Underwater area of individual craft: 22.5 m^2
See Appendix B for additional specifications on this scenario

Coastal Harbor

MAM-PEC scenario: default estuarine harbor
Dimensions: 1000 x 5000 m, 15 m deep
No. craft at berth: 24 (50-100 m to 250-300 m in length)
Underwater area of individual craft: 450 to 14,814 m^2
See Appendix B for additional specifications on this scenario

MAM-PEC EECs

MAM-PEC predicted EECs in the water column are presented in Table 2 for the inland scenarios and in Table 3 for the coastal scenarios. Table 4 presents the MAM-PEC predicted maximum sediment concentrations after one year in the marina or harbor and in the surrounding waters. Average predicted sediment concentrations did not change after two, five, and 10 years (see Appendix B). These predictions are further discussed in the **Aquatic Risk Assessment** section entitled **Invertebrates Exposed to Contaminated Sediments, Acute**.

Table 2. MAM-PEC Predicted Water-column EECs for Inland Marinas and Surrounding Waters

Leaching rate (µg/cm²/day)	Marina or Harbor EEC (µg/L)		Surrounding-water EEC (µg/L)	
	max.	avg.	max.	avg.
Inland Marina:				
14.3	0.639	0.421	0.037	0.002
4.5	0.201	0.132	0.012	<0.001

Inland Small Marina:				
14.3	10.8	6.83	0.433	0.041
4.5	3.41	2.15	0.136	0.014

Table 3. MAM-PEC Predicted Water-column EECs for Coastal Marinas and Harbors and Surrounding Waters

Leaching rate (µg/cm^2/day)	Marina or Harbor EEC (µg/L)		Surrounding-water EEC (µg/L)	
	max.	avg.	max.	avg.
Coastal Marina:				
14.3	0.639	0.421	0.037	0.002
4.5	0.201	0.132	0.012	<0.001
Coastal Harbor:				
14.3	0.157	0.077	0.025	0.005
4.5	0.049	0.024	0.008	0.002

Table 4. MAM-PEC Predicted Maximum Sediment Concentrations for Inland and Coastal Marinas and Harbors

Environment	Leaching rate (µg/cm^2/day)	Max. concentration (µg/g dry wt) after 1 year	
		marina or harbor	surrounding waters
Inland Marina	14.3	1.92E-07	1.12E-08
	4.5	6.03E-08	3.54E-09
Inland Small Marina	14.3	3.25 E-06	1.30E-07
	4.5	1.02 E-06	4.09E-08
Coastal Marina	14.3	9.58E-07	5.62E-08
	4.5	3.02E-07	1.77E-08
Coastal Harbor	14.3	2.35E-07	3.74E-08
	4.5	7.40E-08	1.18E-08

Aquatic Risk Assessment

Freshwater Fish and Invertebrates Exposed in the Water Column, Acute

RQs based on acute toxicity to the most sensitive freshwater fish species (fathead minnow) and invertebrate species (waterflea) exceed the acute LOC for listed (e.g., threatened and endangered) species in the inland marina scenarios, even when RQs are based on average EECs (Tables 5 and 6). Nonlisted fish also are at risk from high exposure in small marinas. The LOC also is exceeded for listed fish and aquatic invertebrates in the waters surrounding small inland marinas.

Table 5. Acute Risk Quotients for Freshwater Fish and Invertebrates Exposed in the Water Column of an Inland Marina (400 x 400 m, 3.5 m deep) and Surrounding Waters

Site/ Taxa	Leaching rate ($\mu g/cm^2/day$)	EEC (µg ai/L)		LC50/EC50 (µg ai/L)	Acute RQ	
		max.	avg		max.	avg
Inland Marina:						
Fish	14.3	0.639	0.421	2.6	**0.25***	**0.16***
	4.5	0.201	0.132		**0.08***	**0.05***
Invertebrates	14.3	0.639	0.421	8.2	**0.08***	0.05
	4.5	0.201	0.132		0.02	0.02
Surrounding waters:						
Fish	14.3	0.037	0.002	2.6	0.01	<0.01
	4.5	0.012	<0.001		<0.01	<0.01
Invertebrates	14.3	0.037	0.002	8.2	0.01	<0.01
	4.5	0.012	<0.001		<0.01	<0.01

***** exceeds the LOC for listed species (RQ $\geq$0.05)

Table 6. Acute Risk Quotients for Freshwater Fish and Invertebrates Exposed in the Water Column of an Inland Small Marina (100 x 100 m, 2 m deep)

Site/ Taxa	Leaching rate (µg/cm²/day)	EEC (µg ai/L)		LC50/EC50 (µg ai/L)	Acute RQ	
		max.	avg		max.	avg
Inland Small Marina:						
Fish	14.3	10.8	6.83	2.6	**4.1****	**2.6****
	4.5	3.41	2.15		**1.3****	**0.8****
Invertebrates	14.3	10.8	6.83	8.2	**1.3****	**0.8****
	4.5	3.41	2.15		**0.4***	**0.3***
Surrounding waters:						
Fish	14.3	0.433	0.041	2.6	**0.2***	0.02
	4.5	0.136	0.014		**0.05***	<0.01
Invertebrates	14.3	0.433	0.041	8.2	**0.05***	<0.01
	4.5	0.136	0.014		0.02	<0.01

** exceeds the LOC for listed (RQ $\geq$0.05) and non-listed (RQ $\geq$0.5) species
* exceeds the LOC for listed species

Estuarine/marine Fish and Invertebrates Exposed in the Water Column, Acute

RQs based on acute toxicity to the sheepshead minnow and mysid shrimp and maximum and average EECs in the water column exceed the acute LOC only for listed invertebrates in the coastal marina scenario (Table 7). No LOC is exceeded for the harbor scenario, even at predicted maximum exposure (Table 8), or in the waters surrounding the marina.

Table 7. Acute Risk Quotients for Saltwater Fish and Invertebrates Exposed in the Water Column of a Coastal Marina and Surrounding Waters

Site/ Taxa	Leaching rate (µg/cm²/day)	EEC (µg ai/L)		LC50 (µg ai/L)	Acute RQ	
		max.	avg		max.	avg
Coastal Marina:						
Fish	14.3	0.639	0.421	400	<0.01	<0.01
	4.5	0.201	0.132		<0.01	<0.01
Invertebrates	14.3	0.639	0.421	4.7	**0.14***	**0.09***

Site/ Taxa	Leaching rate (µg/cm²/day)	EEC (µg ai/L)		LC50 (µg ai/L)	Acute RQ	
		max.	avg		max.	avg
	4.5	0.201	0.132		0.04	0.03
Surrounding waters:						
Fish	14.3	0.037	0.002	400	<0.01	<0.01
	4.5	0.012	<0.001		<0.01	<0.01
Invertebrates	14.3	0.037	0.002	4.7	<0.01	<0.01
	4.5	0.012	<0.001		<0.01	<0.01

*****exceeds the LOC for listed species (RQ ≥0.05)

Table 8. Acute Risk Quotients for Saltwater Fish and Invertebrates Exposed in the Water Column of a Coastal Harbor and Surrounding Waters

Site/ Taxa	Leaching rate (µg/cm²/day)	EEC (µg ai/L)		LC50 (µg ai/L)	Acute RQ	
		max.	avg		max.	avg
Coastal Harbor:						
Fish	14.3	0.157	0.077	400	<0.01	<0.01
	4.5	0.049	0.024		<0.01	<0.01
Invertebrates	14.3	0.157	0.077	4.7	0.03	0.02
	4.5	0.049	0.024		0.01	<0.01
Surrounding waters:						
Fish	14.3	0.025	0.005	400	<0.01	<0.01
	4.5	0.008	0.002		<0.01	<0.01
Invertebrates	14.3	0.025	0.005	4.7	<0.01	<0.01
	4.5	0.008	0.002		<0.01	<0.01

Aquatic Organisms Exposed in the Water Column, Chronic

The chronic LOC is exceeded for listed and nonlisted freshwater fish and invertebrates inhabiting small inland marinas, even for average leaching EECs from the lowest leaching rate

(Table 10). Minimal chronic risk exists for larger inland marinas (Table 9) or for coastal marinas and harbors (Tables 11, 12).

Table 9. Chronic Risk Quotients for Freshwater Fish and Invertebrates Exposed in the Water Column of an Inland Marina (400 x 400 m, 3.5 m deep) and Surrounding Waters

Site/ Taxa	Leaching rate (µg/cm^2/day)	EEC (µg ai/L)		NOEC (µg ai/L)	Chronic RQ	
		max.	avg		max.	avg
Inland Marina:						
Fish	14.3	0.639	0.421	1.2	0.5	0.4
	4.5	0.201	0.132		0.2	0.1
Invertebrates	14.3	0.639	0.421	2.7	0.2	0.2
	4.5	0.201	0.132		<0.1	<0.1
Surrounding waters:						
Fish	14.3	0.037	0.002	1.2	<0.1	<0.1
	4.5	0.012	<0.001		<0.1	<0.1
Invertebrates	14.3	0.037	0.002	2.7	<0.1	<0.1
	4.5	0.012	<0.001		<0.1	<0.1

Table 10. Chronic Risk Quotients for Freshwater Fish and Invertebrates Exposed in the Water Column of an Inland Small Marina (100 x 100 m, 2 m deep)

Site/ Taxa	Leaching rate (µg/cm^2/day)	EEC (µg ai/L)		NOEC (µg ai/L)	Chronic RQ	
		max.	avg		max.	avg
Inland Small Marina:						
Fish	14.3	10.8	6.83	1.2	**9.0***	**5.7***
	4.5	3.41	2.15		**2.8***	**1.8***
Invertebrates	14.3	10.8	6.83	2.7	**4.0***	**2.5***
	4.5	3.41	2.15		**1.3***	0.8

Surrounding waters:						
Fish	14.3	0.433	0.041	1.2	0.4	<0.1
	4.5	0.136	0.014		0.1	<0.1
Invertebrates	14.3	0.433	0.041	2.7	0.2	<0.1
	4.5	0.136	0.014		<0.1	<0.1

***** exceeds the chronic LOC (RQ ≥1) for listed and nonlisted species

Table 11. Chronic Risk Quotients for Saltwater Invertebrates Exposed in the Water Column of a Coastal Marina and Surrounding Waters

Site/ Taxa	**Leaching rate ($\mu g/cm^2/day$)**	**EEC (µg ai/L)**		**NOEC (µg ai/L)**	**Chronic RQ**	
		max.	**avg**		**max.**	**avg**
Coastal Marina:						
Invertebrates	14.3	0.639	0.421	2.2	0.3	0.2
	4.5	0.201	0.132		<0.1	<0.1
Surrounding waters:						
Invertebrates	14.3	0.037	0.002	2.2	<0.1	<0.1
	4.5	0.012	<0.001		<0.1	<0.1

Table 12. Chronic Risk Quotients for Saltwater Fish and Invertebrates Exposed in the Water Column of a Coastal Harbor and Surrounding Waters

Site/ Taxa	**Leaching rate ($\mu g/cm^2/day$)**	**EEC (µg ai/L)**		**NOEC (µg ai/L)**	**Chronic RQ**	
		max.	**avg**		**max.**	**avg**
Coastal Harbor:						
Invertebrates	14.3	0.157	0.077	2.2	<0.1	<0.1
	4.5	0.049	0.024		<0.1	<0.1

Surrounding waters:						
Invertebrates	14.3	0.025	0.005	2.2	<0.1	<0.1
	4.5	0.008	0.002		<0.1	<0.1

Invertebrates Exposed to Contaminated Sediments, Acute

Minimal risk is presumed for benthic organisms exposed to ZnPt in sediments of marinas or harbors. RQs based on the highest maximum sediment concentrations are orders of magnitude below the LOC (Table 13). RQs based on average EECs and lower leaching rates would be even lower than those tabulated for the highest exposure scenarios. Some uncertainty exists for saltwater invertebrates, because a definitive toxicity value was not established. However, because the exposure values are exceedingly low, it seems highly unlikely that establishing the toxicity to saltwater invertebrates would lead to any exceedance of the LOC.

Table 13. Acute Risk Quotients for Freshwater and Saltwater Invertebrates Exposed to Contaminated Sediment in Inland and Coastal Marinas

Site/ Taxa	**Leaching rate (µg/cm^2/day)**	**Max. EEC (µg/g dry wt)**	**Toxicity (µg/g dry wt)**	**Max. Acute RQ**
Inland Small Marina:				
Freshwater amphipod	14.3	0.00000013	2100	<<1
Coastal Marina:				
Saltwater amphipod	14.3	0.00000006	<1080	not determined

It needs to be noted that MAM-PEC predicted sediment concentrations after 2, 5, and 10 years are the same as those predicted after one year. Those predictions are based solely on the initial exposure at Day 0 and do not consider any subsequent copper pyrithione input into the aquatic environment. In fact, existing watercraft would be retreated, new craft may be treated, and other treated craft may be entering marinas. Therefore, sediment concentrations might actually increase over time, not remain constant, and this adds some uncertainty to the exposure and risk assessment.

Aquatic Plants

RQs for nonlisted species are presented in Table 14 for both freshwater and saltwater aquatic plants, based on the various exposure scenarios and the toxicity to duckweed (vascular sp.) and the most sensitive non-vascular species (algae or diatom). The LOC is exceeded for vascular and non-vascular species in small inland marinas. The LOC for listed vascular species also is exceeded for small inland marinas (Table 15).

Table 14. Risk Quotients for Nonlisted Aquatic Plant Species (vascular and non-vascular) Exposed in the Water Column of Inland and Coastal Marinas and Harbors

Site/ Taxa	Leaching rate (µg/cm²/day)	EEC (µg ai/L)		EC50 (µg ai/L)	RQ	
		max.	avg		max.	avg
Inland Marina:						
Vascular spp.	14.3	0.639	0.421	8.8	<0.1	<0.1
Non-vascular spp.		0.639	0.421	2.6	0.2	0.2
Inland Small Marina:						
Vascular spp.	14.3	10.8	6.83	8.8	**1.2***	0.8
	4.5	3.41	2.15		0.4	0.2
Non-vascular spp.	14.3	10.8	6.83	2.6	**4.1***	**2.6***
	4.5	3.41	2.15		**1.3***	0.8
Coastal Marina:						
Vascular spp.	14.3	0.639	0.421	8.8	<0.1	<0.1
Non-vascular spp.	14.3	0.639	0.421	0.65	0.9	0.6
Coastal Harbor:						
Vascular spp.	14.3	0.157	0.077	8.8	<0.1	<0.1
Non-vascular spp.		0.157	0.077	0.65	0.2	0.1

* exceeds the LOC (RQ $\geq$1) for nonlisted species

Table 15. Risk Quotients for Listed Vascular Aquatic Plant Species Exposed in the Water Column of Inland and Coastal Marinas and Harbors

Site/ Taxa	Leaching rate (μg/cm²/day)	EEC (μg ai/L)		NOEC (μg ai/L)	RQ	
		max.	avg		max.	avg
Inland Marina:						
Vascular spp.	14.3	0.639	0.421	4.0	0.2	0.1
	4.5	0.201	0.132		<0.1	<0.1
Inland Small Marina:						
Vascular spp.	14.3	10.8	6.83	4.0	**2.7***	**1.7***
	4.5	3.41	2.15		<0.1	<0.1
Coastal Marina:						
Vascular spp.	14.3	0.639	0.421	4.0	0.2	0.1
	4.5	0.201	0.132		<0.1	<0.1
Coastal Harbor:						
Vascular spp.	14.3	0.157	0.077	4.0	<0.1	<0.1
	4.5	0.049	0.024		<0.1	<0.1

* exceeds the LOC (RQ $\geq$1) for listed species

Aquatic Risk Characterization

Based on the risk quotient methodology and the Agency's Levels of Concern, ZnPt use as an antifoulant coating to boat hulls poses acute and chronic risks to freshwater fish and invertebrates exposed to leachate in the water column. Vascular and non-vascular aquatic plants also are at risk in small freshwater marinas. Although the LOC also is exceeded for listed saltwater invertebrates, there currently are no federally listed species. EECs were not modeled for the degradates, but the available toxicity data indicate that they are only slightly to practically nontoxic and likely to pose minimal acute and chronic risks. MAM-PEC predicted concentrations in sediment are much too low to be hazardous to benthic invertebrates.

Environmental exposure modeling was not conducted for the indoor uses (materials preservative) of ZnPt. Exposure to terrestrial and aquatic organisms is expected to be minimal from the indoor uses. Therefore, an ecological risk assessment was not conducted for those uses.

Exposure Uncertainties: For the antifoulant screening assessment, RASSB relyies on the MAM-PEC European scenarios, with minor modifications (e.g., temperature, pH) for expected U. S. conditions. The MAM-PEC scenarios consider many measured variables for European settings, including hydrological and environmental factors, compartment sizes (e.g., marinas, harbors), and watercraft sizes and numbers in marinas and harbors. For example, the default marina scenario in MAM-PEC is based on an actual French Mediterranean marina in the Golfe Juan (Van Hattum et al. 2002). The extent to which these European conditions approximate those of U. S. marinas and harbors is unknown and needs to be determined. The risk assessment could be refined if such information on U. S. coastal and inland marinas and harbors were available. Such relevant information would include environmental and hydrological conditions, typical dimensions (and range of dimensions) of freshwater and coastal marinas and harbors, number and sizes of watercraft, antifoulant usage, geographical variations in these factors, and others. Potential risks also are largely dependent on the extent of exposure to the leachate. Leaching rates vary among the 13 paint formulations for which data are available, and many uncertainties exist in the exposure assessment.

Toxicity Uncertainties: The risk presumptions in this assessment are based solely on the ZnPt component of the antifoulant paints. RASSB only assesses risks from individual active ingredients, but several products containing ZnPt (3.04-4.78% ai) also contain cuprous oxide (34.34-45.48% ai), cuprous thiocyanate (16.95% ai), or econea (3.90% ai) as an additional antifoulant ingredient. Leaching of those active ingredients may exacerbate the risks posed solely by ZnPt. Cuprous oxide, for example, also is highly toxic to aquatic organisms, and combined exposure to these two active ingredients will likely results in more severe acute and chronic affects than if the product consisted solely of ZnPt. A more refined risk assessment would consider the exposure and risk from the simultaneous exposure of aquatic organisms to both active ingredients found in the various paints.

Several studies in the open literature demonstrate synergistic effects when ZnPt occurs in the presence of copper. Mochida et al. (2006) determined the acute toxicity of zinc pyrithione and copper to red sea bream (*Pagrus major*) and toy shrimp (*Heptacarpus futilirostris*). Because the two compounds are often used together in antifoulant paints (copper is usually the main ingredient in the formulated product, with ZnPt added as a booster), they also tested mixtures of the two compounds. They found that the toxicity of ZnPt is enhanced when copper is present, with mixtures being more toxic than predicted by the toxicities of the individual compounds. For the shrimp, 96-h LC50s were 120 µg/L for ZnPt and 113 µg/L for copper when each was tested alone. The 96-h LC50 for mixtures was 4.6 µg/L ZnPt and 28.2 µg/L copper. Based on the individual LC50s, only about 16% mortality should occur for that mixture. For the bream, 96-h LC50s were 98.2 µg/L for ZnPt and 84.4 µg/L for copper when tested alone. When tested together, the average 96-h LC50 for mixtures was 24µg/L ZnPt and 64.3 µg/L copper. Based on the individual LC50s, theoretical mortality for the mixture was 44.2%. The authors concluded that "The enhancement of toxicity in thee mixture was inferred to be caused by conversion of ZnPT to the more toxic CuPT in the presence of Cu."

Bao et al. (2008) also found a strong synergistic effect when examining the toxicity of ZnPt alone and in combination with copper to three marine organisms. They suggest this may be due to tranchelation of ZnPt in the presence of copper. For the marine diatom, *Thalassiosira* *pseudonana*, the 96-h growth rate was about 47% that of the control when exposed to 2 µg/L ZnPt. When exposed to 2 µg/L ZnPt combined with 10 µg/L Cu, growth decreased to only 11% that of the control. A similar pattern was noted for polychaete larvae (*Hydroides elegans*) and an amphipod (*Elasmopus rapax*). They conclude that ecological risk assessments based solely on toxicity of ZnPt are probably inadequate when copper is available even at low concentrations.

When examining the toxicity of mixtures of antifouling biocides on the brine shrimp (*Artemia salina*), Koutsaftis and Aoyama (2007) reported "strictly synergistic effects" of CuPt:ZnPt mixtures (4:1, 3:2, 1:1, 2:3). Because transchelation of ZnPt may result in the coexistence of ZnPt and CuPt in the marine environment, and synergistic effects from the mixtures, they emphasize the need for tests on mixtures and not simply on the single chemicals.

Other Uncertainties: RASSB notes that the EECs in this assessment are based only on the in-service use of ZnPt leaching from watercraft hulls in the water. Emission to the environment also can occur at application of the antifoulant paint to the hull and at removal of paint from the hull (OECD 2005). The product label states that removed paint chips must be kept out of the water, it is likely that some will enter the aquatic environment in some situations. Such additional exposure may add to risk, but the extent of that exposure is uncertain at this time and is not addressed in the risk assessment.

Photodegradation: Pyrithione compounds, because they rapidly photodegrade into less toxic degradates, have been suggested to pose considerably less risk to aquatic organisms than do some other current or formerly registered antifoulants (e.g., TBT). While pyrithione photodegradation does occur rapidly in the presence of sunlight, photodegradation may be much less pronounced or minimal under conditions of low light attenuation, such as beneath watercraft, docks, and mooring structures or in the murky waters typical of many marinas. Bellas et al. (2005) examined the toxicity of ZnPt to sea urchin (*Paracentrotus lividus*) and mussel (*Mytilus edulis*). Toxic effects on larval growth of sea urchin were detected at concentrations as low as 0.16 µg ai/L. The authors calculated RQs based on predicted environmental concentrations reported by Madsen et al. (2000 as cited in Bellas et al. 2005) in a pleasure-craft harbor in Europe. When photodegradation was ignored, RQs = 15 for mussels and 106 for urchins. However, even when photodegradation was considered, RQs = 4.9 for mussels and 35 for urchins. The authors conclude, based on their assertion that an RQ >1 presumes risk, that ZnPt predicted concentrations in marinas pose a threat to mussel and urchin early stages regardless of whether photodegradation is a factor or not.

Terrestrial Risk Characterization

Birds and mammals are presumed to have little exposure to ZnPt from its use as an antifoulant coating on boat hulls or from any indoor uses. Possible routes of exposure to antifoulant leachate include dermal uptake by swimming and wading birds in harbors and consumption of fish and invertebrates containing ZnPt residues. Based on the available data, RASSB assumes that ZnPt is not likely to bioconcentrate in aquatic organisms (bioconcentration factor <1). For this reason, and because ZnPt is not highly toxic to birds or mammals and predicted water concentrations are exceedingly low (parts per trillion), ingestion of prey items exposed to ZnPt is not likely to pose much risk to birds or wild mammals. Possible adverse affects from dermal exposure are unknown.

Endangered Species Considerations

Section 7 of the Endangered Species Act (ESA), 16 U.S.C. Section 1536(a)(2), requires that federal agencies consult with the National Marine Fisheries Service (NMFS) for marine and andronomus listed species, or with the United States Fish and Wildlife Services (FWS) for listed wildlife and freshwater organisms, if proposing an "action" that may affect listed species or their designated habitat. Each federal agency is required under the Act to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. To jeopardize the continued existence of a listed species is to "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species." 50 C.F.R. §402.02.

To comply with subsection (a)(2) of the ESA, EPA's Office of Pesticide Programs has established procedures to evaluate whether a proposed registration action may directly or indirectly appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of any listed species (U.S. EPA 2004). If any of the Listed Species LOC Criteria are exceeded for either direct or indirect effects in the Agency's screening-level risk assessment, the Agency identifies any listed or candidate species that may occur spatially and temporally in the footprint of the proposed use. Further biological assessment is undertaken to refine the risk. The extent to which any species may be at risk determines the need to develop a more comprehensive consultation package as required by the ESA.

For currently registered uses of ZnPt other antifoulant paints, the Agency assumes there will be minimal environmental exposure, and only a minimal toxicity data set is required (Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs U.S. Environmental Protection Agency - Endangered and Threatened Species Effects Determinations, 1/23/04, Appendix A, Section IIB, p 81). Uses in these categories do not undergo a full screening-level risk assessment and are considered to fall under a no effect determination.

The assessment for ZnPt antifoulant paint uses indicates that there is a potential for exposure of listed freshwater and saltwater organisms, and a more refined assessment is warranted for direct, indirect, and habitat effects. The refined assessment will involve clear delineation of the action area associated with proposed use of ZnPt and best available information on the temporal and spatial co-location of listed species with respect to the action area. This analysis has not been conducted for this assessment. An endangered species effect determination will not be made at this time.

References

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Appendix A: Data Requirements and Available Guideline Ecotoxicity Data for Zinc Pyrithione

The toxicity endpoints used in OPP's hazards and risk assessments are obtained from guideline toxicity studies conducted for wildlife, aquatic organisms, and plants (40 CFR §158). Guideline studies are required to provide acute and reproductive/chronic measures of effect for one or more test species in several taxonomic groups. Some studies are only required on a case-by-case basis, depending on factors such as use patterns, environmental fate characteristics, or toxicity to organisms in other taxa. The available toxicity endpoints and data requirements for ZnPt are presented below. Toxicity data for two degradates (pyrithione sulfonic acid and pyridine sulfonic acid) also are available for some aquatic species.

Toxicity to Terrestrial Animals

Birds, Acute and Dietary

The Agency requires one acute-oral study to establish the toxicity of ZnPt (technical grade active ingredient, TGAI) to birds. The preferred test species is either the mallard (*Anas platyrhynchos*) or the northern bobwhite (*Colinus virginianus*). Avian dietary toxicity studies (northern bobwhite and mallard) are conditionally required for antimicrobial pesticides used as antifoulant paints and coatings. The available acute-oral and dietary studies indicate that ZnPt is moderately to practically nontoxic to birds (Table 1A). The guidelines for avian acute-oral toxicity (OPPTS 850.2100) and avian dietary toxicity (OPPTS 850.2200) are satisfied.

Table 1A. Acute-oral (LD50) and Dietary (LC50) Toxicity of Zinc Pyrithione to Birds

Test Species	Test material (% ai)	Toxicity Endpoint (95% CI)	Toxicity Category	Study Status	MRID No.
Northern bobwhite	ZnPt (96)	LD50 = 60 mg ai/kg bw (44-81)	moderately toxic	core	438646-11
		LC50 = 1063 ppm ai (789-1412)	slightly toxic	core	438646-10
Mallard	ZnPt (96)	LC50 >5000 ppm ai	practically nontoxic	core	438646-12

Mammals, Acute

The available mammalian acute toxicity data indicate that ZnPt is slightly to moderately toxic to small mammals on an acute-oral basis (lab. rat LD50s = 630 mg ai/kg bw, males, and 460 mg ai/kg bw, females). The human toxicology chapter for zinc pyrithione contains more information on a variety of mammalian toxicity studies submitted in support of the human-health assessment.

Toxicity to Aquatic Organisms

Freshwater Fish, Acute

Studies are required with the TGAI to establish the acute toxicity of ZnPt to freshwater fish. The preferred test species are the rainbow trout (*Oncorhynchus mykiss*), a coldwater fish, and the bluegill (*Lepomis macrochirus*), a sunfish. The guideline for freshwater-fish acute toxicity (OPPTS 850.1075) is satisfied.

Table 2A. Acute Toxicity of ZnPt to Freshwater Fish Exposed in the Water Column

Test Species	Test material (% ai)	96-h LC50 (µg ai/L) (95% CI)	Toxicity Category	Study Status	MRID No.
Rainbow trout	ZnPt (97.8)	3.6 (3.0-4.3)	very highly toxic	core	438646-13
Fathead minnow	ZnPt (97.8)	2.6 (2.1-3.2)	very highly toxic	core	438646-06

Freshwater Invertebrates, Acute

A study with the TGAI is required to establish the acute toxicity of ZnPt to freshwater invertebrates. The preferred test species is the water flea, *Daphnia magna*. The data categorize ZnPt as being very highly toxic to freshwater invertebrates (Table 3A). The guideline requirement (OPPTS 850.1010) is satisfied.

Table 3A. Acute Toxicity of ZnPt to Freshwater Invertebrates Exposed in the Water Column

Test Species	Test material (% ai)	48-h EC50 (µg ai/L) (95% CI)	Toxicity Category	Study Status	MRID No.
Waterflea	ZnPt (97.8)	8.2 (5.2-25.8)	very highly toxic	core	438646-04

Estuarine/Marine Fish and Invertebrates, Acute

Acute toxicity data for the TGAI with estuarine/marine fish and two invertebrate species are required for antifoulant coatings and paints, because of their direct release via leaching into the estuarine/marine environment. The preferred fish test species is sheepshead minnow (*Cyprinodon variegatus*) and preferred invertebrate species are the mysid shrimp (*Mysidopsis* *bahia*) and Eastern oyster (*Crassostrea virginica*). The available data categorize ZnPt as being highly toxic to saltwater fish and very highly toxic to saltwater invertebrates (Table 4A). The guideline requirements for estuarine/marine fish and invertebrate acute toxicity testing (OPPTS 850.1075, 850.1025, and 850.1035) are satisfied.

Table 4A. Acute Toxicity of ZnPt to Estuarine/Marine Fish and Invertebrates Exposed in the Water Column

Test Species	Test material (% ai)	96-h LC50 (µg ai/L) (95% CI)	Toxicity Category	Study Status	MRID No.
Sheepshead minnow	ZnPt (97.8)	400 (200-590)	highly toxic	core	438646-05
Mysid shrimp	ZnPt (97.8)	4.7 (4.0-5.5)	very highly toxic	core	438646-07
Eastern oyster	ZnPt (97.8)	22.0 (18.9-27.3)	very highly toxic	core	438646-08

Degradates, Acute Toxicity to Fish and Aquatic Invertebrates

Some acute toxicity data are available for two ZnPt degradates (pyridine sulfonic acid and pyrithione sulfonic acid). The data are sufficient to categorize both degradates as being only slightly toxic to practically nontoxic to freshwater and saltwater fish and invertebrates (Table 5A).

Table 5A. Acute Toxicity of Two ZnPt Degradates to Fish and Aquatic Invertebrates Exposed in the Water Column

Test Species	Test material (% ai)	LC50 or EC50 (µg ai/L) (95% CI)	Toxicity Category	Study Status	MRID No.
Rainbow trout	pyridine sulfonic acid (98)	57,100 (48,300-69,800)	slightly toxic	core	438646-27
	pyrithione sulfonic acid (98.5)	92,300 (73,600-124,000)	slightly toxic	core	438646-16
	pyridine sulfonic acid (98)	68,500 (55,200-85,000)	slightly toxic	core	438646-21

	pyrithione sulfonic acid (98.5)	58,800 (48,700-71,000)	slightly toxic	core	438646-18
Waterflea	pyridine sulfonic acid (98)	>122,000	practically nontoxic	core	438646-22
	pyrithione sulfonic acid (98.5)	>127,000	practically nontoxic	core	438646-19
Sheepshead minnow	pyridine sulfonic acid (98)	>127,000	practically nontoxic	core	438646-23
	pyrithione sulfonic acid (98.5)	>137,000	practically nontoxic	core	438646-17
Mysid shrimp	pyridine sulfonic acid (98)	71,000 (62,800-81,100)	slightly toxic	core	438646-26
	pyrithione sulfonic acid (98.5)	70,300 (61,600-81,600)	slightly toxic	core	438646-20
Eastern oyster	pyridine sulfonic acid (98)	85.600 (73,300-102,500)	slightly toxic	core	438646-24
	pyrithione sulfonic acid (98.5)	96,200 (89,313-104,560)	slightly toxic	core	438646-15

Aquatic Organisms, Chronic

Chronic testing of fish and aquatic invertebrates is required for ZnPt, because it is discharged via leaching directly into the aquatic environment. The preferred test species are the fish and invertebrate species most sensitive in the acute studies. The available data for ZnPt report adverse affects on survival, growth, and reproduction occur at concentrations from about 2 to 9 µg ai/L (Table 6A). No adverse affects of the degradate were reported at concentrations of 10 µg ai/L or lower. The guideline requirements (OPPTS 850.1400, 850.1300/1350) are satisfied.

Table 6A. Chronic Toxicity of ZnPt and a Degradate to Freshwater Fish and Invertebrates Exposed in the Water Column

Test Species	Test material (% ai)	NOEC/LOEC (µg ai/L)	Endpoints affected	Study Status	MRID No.
Fathead minnow	ZnPt (98.2)	1.2 / 2.8	hatching, growth, sublethal effects	core	452041-02

	pyridine-2-sulfonic acid (98.2)	NOEC = 10	none (highest concentration tested)	core	452041-02
Waterflea	ZnPt (98.2)	2.7 / 5.8	reproduction, growth	core	445354-01
Mysid shrimp	ZnPt (98.2)	2.2 / 4.2 4.2 / 9.1	growth reproduction	core	449111-01

Aquatic Plants

Aquatic plant growth testing (TGAI or TEP) is required for ZnPt because of its discharge via leaching into the aquatic environment. Test species include duckweed (*Lemna gibba*), a vascular plant, and four non-vascular species: (1) freshwater green alga, *Selenastrum capricornutum*, (2) marine diatom, *Skeletonema costatum*, (3) freshwater diatom, *Navicula pelliculosa*, and (4) bluegreen cyanobacteria, *Anabaena flos-aquae.* The available aquatic plant data indicate that the marine diatom is the most sensitive species (Table 7A). The guideline requirement for aquatic plant growth testing (OPPTS 850.5400) is satisfied.

Table 7A. Toxicity of ZnPt to Aquatic Plants

Test Species	Test material (% ai)	EC50 (µg ai/L)	NOEC (µg ai/L)	Study Status	MRID No.
Duckweed	ZnPt (97.8)	8.8	4.0	core	452041-04
Freshwater green alga	ZnPt (97.8)	28.0	7.8	core	438646-09
Blue-green alga	ZnPt (98.3)	7.1	3.8	core	455649-01
Marine diatom	ZnPt (98.2)	0.65	0.46	core	462503-05
Freshwater diatom	ZnPt (98.3)	2.6	2.4	core	455650-01

Freshwater green alga also were tested with two degradates. Both degradates are considerably less toxic to green alga than is ZnPt (Table 8A). However, there are data in the literature indicating that two photodegradates (2-mercaptopyridine-N-oxide and 2.2'-dithio-bis-pyridin-N-oxide) are about as toxic to the marine diatom (*S. costatum*) as is ZnPt (Onduka et al. 2007). In that study, the 72-h EC50 was 1.6 µg ai/L for ZnPt and 1.1 µg ai/L for 2-mercaptopyridine-N-oxide and 3.4 µg ai/L for 2.2'-dithio-bis-pyridin-N-oxide.

Table 8A. Toxicity of Two Pyrithione Degradates to Aquatic Plants

Test Species	Test material (% ai)	EC50 (µg ai/L)	NOEC (µg ai/L)	Study Status	MRID No.
Freshwater green alga	pyridine sulfonic acid (98)	28,900	5460	core	438646-25
	pyrithione sulfonic acid (98.5)	28,200	11,800	core	438646-14

Terrestrial (Semi-aquatic) Plants

A seedling-emerge test with rice (*Oryza sativa*) is required for all pesticides having antifoulant paint and coating uses. The study available for ZnPt determined an EC25 of 172 mg ai/kg (Table 9A). The guideline requirement (OPPTS 850.4225) is satisfied.

Table 9A. Toxicity of ZnPt to Semi-aquatic Terrestrial Plants

Test Species	Test	Test material (% ai)	EC25 (mg ai/kg)	NOEC (mg ai/kg)	Study Status	MRID No.
Rice	seedling emergence	ZnPt (98.3)	172	100	core	462503-01

Sediment Toxicity

Acute, whole-sediment tests with freshwater and saltwater invertebrates are required for antifoulant paints and coatings. Two studies were conducted with ZnPt (Table 10A). However, the study testing a marine amphipod did not establish an EC50 and thus is not adequate to calculate an RQ. The guideline requirement for a freshwater test (OPPTS 850.1735) is satisfied. However, because an EC50 or LC50 was not determined for the marine amphipod, the guideline requirement (OPPTS 850.1740) is not satisfied for a whole-sediment acute toxicity test with a saltwater invertebrate.

Table 10A. Acute Sediment Toxicity of ZnPt to Freshwater and Estuarine/Marine Invertebrates

Test Species	% ai	10-d EC50/LC50 (mg/kg dry sediment)	Study Status	MRID No.
Freshwater amphipod (*Hyalella azteca*)	ZnPt (98.2)	2.1	core	462503-03
Marine amphipod (*Leptocheirus plumulosus*)	ZnPt (98.2)	<1.08	supplemental	462503-04

Appendix B: Zinc Pyrithione MAM-PEC Runs for U. S. Inland and Coastal Marinas and Harbors and Surrounding Waters

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

EPA United States Environmental Protection Agency Office of Pesticide Programs

3/18/2009

MEMORANDUM

SUBJECT: **Estimated Environmental Concentrations (EECs) for Antifoulant use of Zinc Pyrithion**

From: **Siroos Mostaghimi, Ph.D., Senior Scientist**
Risk Assessment and Science Support Branch (RASSB)
Antimicrobials Division (7510P)

To: **Norm Cook, Chief**
Risk Assessment and Science Support Branch (RASSB)
Antimicrobials Division (7510P)

Chemical Name: Zinc-2-pyridinethiol-1-oxide

Chemical No.: 088002

DP No.:362201

Attached please find the Estimated Environmental Concentrations (EECs) for antifoulant use of Zinc Pyrithion. The MAM-PEC (Version 2) model was used to estimate the concentrations of Zinc Pyrithion in water and sediments from application of antifoulant paints applied on ships and other water recreational vehicles.

Background:

The Arch Chemicals, Inc. has submitted an application for registration for a manufacturing use product containing Zinc Omadine (Zinc pyrithion), for use in formulating antifoulant paints. This report provides Estimated Environmental Concentrations (EECs) for the Zinc pyrithion antifoulant use.

MAM-PEC is used as an assessment tool for antifoulant risk assessments in Europe. MAM-PEC was developed by the Institute of Environmental Studies/IVM and Delft Hydraulics for the European Paint Makers Association (CEPE) for conducting risk assessments for antifouling agents. The model provides prediction of environmental concentrations of antifouling products in six generalized "typical" marine environments (commercial harbor, estuarine harbor, marina, marina poorly flushed, open sea, and shipping lane). The version 2 of MAMPEC was used for this report.

EECs are generated using MAMPEC for the two leaching rates (4.5 μg/cm^2/day, and 14.3 μg/cm^2/day. These leaching rates were chosen from several leaching rate studies available for Zn-Pyrithion. They represent a low and high in the spectrum reported as maximum leaching rates for Zn-Pyrithion.

Several MAMPEC scenarios were chosen for these runs which are briefly described below.

The estimated environmental concentrations (EECs) could be used for ecological and dietary (if necessary) risk assessment based on the availability of toxicity data.

Summary of the Results:

Scenario 1- Inland Marina

Input

Environment	: Default marina 1-Fresh water-InLand
Compound	: Zinc Omadine (EPA)
Emission	: Default Marina 100% Zn-Omadine-Fresh Water LR 4.5 and 14.3 μg /cm^2/day
Load	: 3.03E+02:g/d and 9.62E+02:g/d, respectively.

A summary of the results for MAMPEC model runs for Inland Marina for two leaching rates (4.5 μg /cm^2/day and 14.3 μg /cm^2/day) are presented in Table 1 and 2. Total and dissolved concentrations in water as well as concentrations of Zinc Pyrithion in sediments after one year are shown. The detailed input and output of the MAMPEC model run are shown in Appendix A.

Table 1. Estimated Environmental Concentrations of Zn-Pyrithion in an inland marina--The leaching rate is 4.5 µg /cm^2/day

	Total concentration (µg /l)	Dissolved (µg /l	Suspended matter (µg /g dw)	Sediment after one year (µg /g) dw
Maximum concentration	2.01E-01	2.00E-01	1.44E-02	6.03E-08
95% confidence	1.94E-01	1.93E-01	1.38E-02	5.81E-08
Average concentration	1.32E-01	1.32E-01	9.47E-03	3.97E-08
Median concentration	1.31E-01	1.31E-01	9.40E-03	3.94E-08
Minimum concentration	2.79E-02	2.78E-02	2.00E-03	8.38E-09

Table 2. Estimated Environmental Concentrations of Zn-Pyrithion in an inland Marina The leaching rate is 14.3 µg /cm^2/day

	Total concentration (µg /l)	Dissolved (µg /l	Suspended matter (µg /g dw)	Sediment after one year (µg /g) dw
Maximum concentration	6.39E-01	6.37E-01	4.57E-02	1.92E-07
95% confidence	6.15E-01	6.13E-01	4.40E-02	1.85E-07
Average concentration	4.21E-01	4.19E-01	3.01E-02	1.26E-07
Median concentration	4.17E-01	4.16E-01	2.99E-02	1.25E-07
Minimum concentration	8.88E-02	8.85E-02	6.35E-03	2.66E-08

Scenario 2- Inland Small Marina

Input

Environment : Default marina-Swiss marina 1
Compound : Zinc Omadine (EPA)
Emission : Default Marina 100% Zn-Omadine-Fresh Water 4.5 and 14.3 µg /cm^2/day leaching rates
Load : 3.03E+02:g/d and 9.62E+02:g/d, respectively.

A summary of the results for this MAMPEC model runs are presented in Table 3 and 4. Total and dissolved concentrations in water as well as concentrations of Zinc Pyrithion in sediment after one year are shown. The detailed input and output of the MAMPEC model run are shown in Appendix B.

Table 3 . Estimated Environmental Concentrations of Zn-Pyrithion in a Small Inland Marina-The leaching rate is 4.5 µg /cm^2/day

	Total concentration (µg /l)	Dissolved (µg /l)	Suspended matter (µg /g dw)	Sediment after one year (µg /g) dw
Maximum concentration	3.41E+00	3.40E+00	2.44E-01	1.02E-06
95% confidence	3.41E+00	3.40E+00	2.44E-01	1.02E-06
Average concentration	2.15E+00	2.14E+00	1.54E-01	6.45E-07
Median concentration	2.00E+00	1.99E+00	1.43E-01	6.01E-07
Minimum concentration	6.96E-01	6.94E-01	4.98E-02	2.09E-07

Table 4. Estimated Environmental Concentrations of Zn-Pyrithion in a Small Inland Marina- The leaching rate is 14.3 µg /cm^2/day

	Total concentration (µg /l)	Dissolved (µg /l	Suspended matter (µg /g dw)	Sediment after one year (µg /g) dw
Maximum concentration	1.08E+01	1.08E+01	7.74E-01	3.25E-06
95% confidence	1.08E+01	1.08E+01	7.74E-01	3.25E-06
Average concentration	6.83E+00	6.81E+00	4.89E-01	2.05E-06
Median concentration	6.36E+00	6.34E+00	4.55E-01	1.91E-06
Minimum concentration	2.21E+00	2.21E+00	1.58E-01	6.64E-07

Scenario 3- Coastal Marina

Environment : Default marina for salt water
Compound : Zinc Omadine (EPA)
Emission : Default Marina 100% Zn-Omadine1 for 4.5 and 14.3 µg /cm^2/day
Load : 3.03E+02:g/d and 9.62E+02:g/d, respectively.

A summary of the results for this MAMPEC model runs are presented in Table 5 and 6. Total and dissolved concentrations in water as well as concentrations of Zinc Pyrithion in sediment after one year are shown. The detailed input and output of the MAMPEC model run are shown in Appendix C.

Table. 5. Estimated Environmental Concentrations of Zn-Pyrithion in a Coastal Marina. The Leaching rate used is 4.5 µg /cm^2/day.

	Total concentration (µg /l)	Dissolved (µg /L)	Suspended matter (µg /g dw)	Sediment after one year (µg /g) dw
Maximum concentration	2.01E-01	2.00E-01	1.44E-02	3.02E-07
95% confidence	1.94E-01	1.93E-01	1.38E-02	2.90E-07
Average concentration	1.32E-01	1.32E-01	9.47E-03	1.99E-07
Median concentration	1.31E-01	1.31E-01	9.40E-03	1.97E-07
Minimum concentration	2.79E-02	2.78E-02	2.00E-03	4.19E-08

Table 6. Estimated Environmental Concentrations of Zn-Pyrithion in a Coastal Marina. The leaching rate used is 14.3 µg /cm^2/day

	Total concentration (µg /l)	Dissolved (µg /L)	Suspended matter (µg /g dw)	Sediment after one year (µg /g) dw
Maximum concentration	6.39E-01	6.37E-01	4.57E-02	9.58E-07
95% confidence	6.15E-01	6.13E-01	4.40E-02	9.23E-07
Average concentration	4.21E-01	4.19E-01	3.01E-02	6.31E-07
Median concentration	4.17E-01	4.16E-01	2.99E-02	6.26E-07
Minimum concentration	8.88E-02	8.85E-02	6.35E-03	1.33E-07

Scenario 4 - Costal Harbor

Environment : Default estuarine harbour 1
Compound : Zinc Omadine (EPA)
Emission : Default Estuarine Harbour-5, 4.5 and 14.3 µg /cm^2/day leaching rates
Load : 4.35E+03:g/d and 1.38E+04:g/d, respectively.

A summary of the results for this MAMPEC model runs are presented in Table 7 and 8. Total and dissolved concentrations in water as well as concentrations of Zinc Pyrithion in sediment after one year are shown. The detailed input and output of the MAMPEC model run are shown in Appendix D.

Table. 7. Estimated Environmental Concentrations of Zn-Pyrithion in a Costal Harbor. The Leaching rate used was 4.5 µg /cm^2/day.

	Total concentration (µg /l)	Dissolved (µg /L)	Suspended matter (µg /g dw)	Sediment after one year (µg /g) dw
Maximum concentration	4.93E-02	4.92E-02	3.53E-03	7.40E-08
95% confidence	4.54E-02	4.52E-02	3.24E-03	6.81E-08
Average concentration	2.41E-02	2.40E-02	1.72E-03	3.62E-08
Median concentration	1.83E-02	1.82E-02	1.31E-03	2.74E-08
Minimum concentration	3.48E-03	3.47E-03	2.49E-04	5.22E-09

Table 8. Estimated Environmental Concentrations of Zn-Pyrithion in a Costal Harbor. The leaching rate used was 14.3 µg /cm^2/day

	Total concentration (µg /l)	Dissolved (µg /L)	Suspended matter (µg /g dw)	Sediment after one year (µg /g) dw
Maximum concentration	1.57E-01	1.56E-01	1.12E-02	2.35E-07
95% confidence	1.44E-01	1.44E-01	1.03E-02	2.16E-07
Average concentration	7.66E-02	7.63E-02	5.48E-03	1.15E-07
Median concentration	5.80E-02	5.79E-02	4.15E-03	8.71E-08
Minimum concentration	1.11E-02	1.10E-02	7.91E-04	1.66E-08

These EECs estimated from the above scenarios could be used for ecological risk assessment of both fresh and salt water.

References:

Baart, T, Boon, J, and B. Van Hattum. 2008. User Manual-Quick Guide. MAM-PEC Version 2. European Commission, CEPEWL, IRM.

USEPA. 2007. Environmental Fate Science Chapter on Zinc Pyrithione (Zinc Omadine®) and Proposed Bridging to Copper Pyrithione. Memo from James Breithaupt to Marshall Swindle. October 14, 2008

File: C:\Myfiles\2009 Reports\Zinc-Pyrithion/ Estimated Environmental Concentrations (EECs) for Zinc Pyrithion

CC: RASSB Chemical File
Siroos Mostaghimi /RASSB

Appendix A

Inputs, parameters and out put results from the MAMPEC Model run for Scenario 1

MAMPEC - Result Sheet

Run	: Default marina 1-Fresh water-InLand Zinc Inland Marina Fresh water LR 4.5
Version	: MamPec 2.0
Run date	: 3/16/2009 10:37:22 AM
Memo	:

Input

Environment	: Default marina 1-Fresh water-InLand
Compound	: Zinc Omadine (EPA)
Emission	: Default Marina 100% Zn-Omadine-Fresh Water LR 4.5
Load	: 3.03E+02:g/d

Results

Total concentration in water

Maximum concentration	: 2.01E-01	:ug/l
95 % concentration	: 1.94E-01	:ug/l
Average concentration	: 1.32E-01	:ug/l
Median concentration	: 1.31E-01	:ug/l
Minimum concentration	: 2.79E-02	:ug/l

Dissolved concentration in water

Maximum concentration	: 2.00E-01	:ug/l
95 % concentration	: 1.93E-01	:ug/l
Average concentration	: 1.32E-01	:ug/l
Median concentration	: 1.31E-01	:ug/l
Minimum concentration	: 2.78E-02	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 1.44E-02	:ug/g dw
95 % concentration	: 1.38E-02	:ug/g dw
Average concentration	: 9.47E-03	:ug/g dw
Median concentration	: 9.40E-03	:ug/g dw
Minimum concentration	: 2.00E-03	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 6.03E-08	:ug/g dw
95 % concentration	: 5.81E-08	:ug/g dw
Average concentration	: 3.97E-08	:ug/g dw
Median concentration	: 3.94E-08	:ug/g dw
Minimum concentration	: 8.38E-09	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 6.03E-08	:ug/g dw
95 % concentration	: 5.81E-08	:ug/g dw
Average concentration	: 3.97E-08	:ug/g dw
Median concentration	: 3.94E-08	:ug/g dw
Minimum concentration	: 8.38E-09	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 6.03E-08	:ug/g dw
95 % concentration	: 5.81E-08	:ug/g dw
Average concentration	: 3.97E-08	:ug/g dw
Median concentration	: 3.94E-08	:ug/g dw
Minimum concentration	: 8.38E-09	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 6.03E-08	:ug/g dw
95 % concentration	: 5.81E-08	:ug/g dw
Average concentration	: 3.97E-08	:ug/g dw
Median concentration	: 3.94E-08	:ug/g dw
Minimum concentration	: 8.38E-09	:ug/g dw

Results in surrounding waters

Total concentration in water

Maximum concentration	: 1.20E-02	:ug/l
95 % concentration	: 1.04E-02	:ug/l
Average concentration	: 6.46E-04	:ug/l
Median concentration	: 5.36E-03	:ug/l
Minimum concentration	: 4.56E-03	:ug/l

Dissolved concentration in water

Maximum concentration	: 1.17E-02	:ug/l
95 % concentration	: 1.03E-02	:ug/l
Average concentration	: 6.44E-04	:ug/l
Median concentration	: 5.34E-03	:ug/l
Minimum concentration	: 4.54E-03	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 8.43E-04	:ug/g dw
95 % concentration	: 7.42E-04	:ug/g dw
Average concentration	: 4.62E-05	:ug/g dw
Median concentration	: 3.84E-04	:ug/g dw
Minimum concentration	: 3.26E-04	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 3.54E-09	:ug/g dw
95 % concentration	: 3.11E-09	:ug/g dw
Average concentration	: 1.94E-10	:ug/g dw
Median concentration	: 1.61E-09	:ug/g dw
Minimum concentration	: 1.37E-09	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 3.54E-09	:ug/g dw
95 % concentration	: 3.11E-09	:ug/g dw
Average concentration	: 1.94E-10	:ug/g dw
Median concentration	: 1.61E-09	:ug/g dw

Minimum concentration	: 1.37E-09	:ug/g dw

<u>Contaminant concentration in sediment after 5 years of use</u>

Maximum concentration	: 3.54E-09	:ug/g dw
95 % concentration	: 3.11E-09	:ug/g dw
Average concentration	: 1.94E-10	:ug/g dw
Median concentration	: 1.61E-09	:ug/g dw
Minimum concentration	: 1.37E-09	:ug/g dw

<u>Contaminant concentration in sediment after 10 years of use</u>

Maximum concentration	: 3.54E-09	:ug/g dw
95 % concentration	: 3.11E-09	:ug/g dw
Average concentration	: 1.94E-10	:ug/g dw
Median concentration	: 1.61E-09	:ug/g dw
Minimum concentration	: 1.37E-09	:ug/g dw

MAMPEC - Input data sheet

Compound

Name	:	Zinc-pyrithione	
Description	:	Zinc Omadine (EPA)	
Molecular mass	:	317.7 :g/Mol	
Vapor pressure	:	1.00E-06	:Pa
Solubility	:	6.30E+00	:g/m3
Octanol-water coefficient	:	9.00E-01	:(-) Log (Kow)
Kd	:	0.00E+00	:m3/kg
Koc	:	3.40E+00	:(-) Log(Koc), Koc expressed as l/kg OrganicCarbon
Henry's coefficient	:	6.60E-05	:Pa.m3/mol
Melting temperature	:	267.0	:oC
pKa	:	0.0	:(-)
in water			
Biological degradation rate	:	1.76E-01	:1/d
Hydrolytic degradation rate	:	3.82E-02	:1/d
Photolytic degradation rate	:	9.20E-01	:1/d
in sediment			
Biological degradation rate	:	6.30E-01	:1/d
Hydrolytic degradation rate	:	8.13E+00	:1/d
Photolytic degradation rate	:	0.00E+00	:1/d
Advanced Photodegradation calculation	:	False	
Reference	:		

Environment

Description	: Default marina 1-Fresh water-InLand	
Silt concentration	: 35.0	:g/m3
Particular organic carbon conc	: 1.0	:g Organic Carbon/m3
Dissolved organic carbon conc	: 2.0	:g/m3
Temperature	: 25.0	:oC
Salinity	: 5.00E+00	:s.e.
Depth well-mixed sediment top layer	: 1.00E-01	: m
Sediment density	: 1.000E+03	:kg/m3
Fraction organic carbon in sediment	: 3.00E-02	:-/-

Nett sedimentation velocity	: 1.00E-01	:m/d
pH	: 6.5	:(-)
Chlorophyll	: 3.00	:ug/l
Latitude	: 50.00 degrees NH	
Background concentrations	: 0.00E+00	:ug/l
Average windspeed	: 0.00	:m/s
Fraction wind perpendicular to harbour	: 0.00	:-/-
Daily maximum non tidal water level change	: 0.00	:m
Length of river, not part of harbor (x1)	: 400	:m
Width of harbor (y1)	: 400	:m
Length of harbor (x2)	: 400	:m
Width of river (y2)	: 400	:m
Depth of harbor	: 3.5	:m
Length of open harbour mouth (x3)	: 100	:m
Flow	: 1	:m/s
Flow of flushing into harbor	: 0	:m3/s
Tidal height	: 1	:m
Density difference	: 0.1	:kg/m3
Density difference flushing	: 0	:kg/m3
Tidal period	: 12.41	:h
Exchange surface	: 350	:m2
Depth at harbour mouth	: 3.5	:m
Height underwater dam at mouth	: 0	:m
Width underwater dam at mouth	: 0	:m
Length selected area	: 0	:m
Width selected area	: 0	:m
Depth selected area	: 0	:m
Flow	: 0	:m/s
Exchange volume in 1 tidal period	: 243420	:m3
Reference	:	

Emission

Description	: Default Marina 100% Zn-Omadine-Fresh Water LR 4.5	
Load	: 302.7375	:g/d
Loading due to moving ships	: 0	:g/d
Loading due to ships at berth	: 302.7375	:g/d
Leaching rate ships at berth	: 4.5	:ug/cm2/d
Leaching rate ships at berth	: 4.5	:ug/cm2/d
Number of ships at berth (Class 1)	: 0	
Number of ships at berth (Class 2)	: 299	
Number of ships at berth (Class 3)	: 0	
Number of ships at berth (Class 4)	: 0	
Number of ships at berth (Class 5)	: 0	
Number of ships at berth (Class 6)	: 0	
Number of ships at berth (Class 7)	: 0	
Number of ships at berth (Class 8)	: 0	
Number of ships at berth (Class 9	: 0	
Number of ships at berth (Class 10)	: 0	
Number of moving ships (Class 1)	: 0	
Number of moving ships (Class 2)	: 0	
Number of moving ships (Class 3)	: 0	
Number of moving ships (Class 4)	: 0	
Number of moving ships (Class 5)	: 0	
Number of moving ships (Class 6)	: 0	

Number of moving ships (Class 7)	: 0	
Number of moving ships (Class 8)	: 0	
Number of moving ships (Class 9)	: 0	
Number of moving ships (Class 10)	: 0	
Application factor (Class 1)	: 100	:%
Application factor (Class 2)	: 100	:%
Application factor (Class 3)	: 100	:%
Application factor (Class 4)	: 100	:%
Application factor (Class 5)	: 100	:%
Application factor (Class 6)	: 20	:%
Application factor (Class 7)	: 20	:%
Application factor (Class 8)	: 20	:%
Application factor (Class 9)	: 20	:%
Application factor (Class 10)	: 20	:%
Underwater ship area (Class 1)	: 20	:m2
Underwater ship area (Class 2)	: 22.5	:m2
Underwater ship area (Class 3)	: 450	:m2
Underwater ship area (Class 4)	: 3061	:m2
Underwater ship area (Class 5)	: 5999	:m2
Underwater ship area (Class 6)	: 9917	:m2
Underwater ship area (Class 7)	: 14814	:m2
Underwater ship area (Class 8)	: 22645	:m2
Underwater ship area (Class 9)	: 27547	:m2
Underwater ship area (Class 10)	: 39668	:m2
Ship Length (Class 1)	: 0-10	:m
Ship Length (Class 2)	: 10-50	:m
Ship Length (Class 3)	: 50-100	:m
Ship Length (Class 4)	: 100-150	:m
Ship Length (Class 5)	: 150-200	:m
Ship Length (Class 6)	: 200-250	:m
Ship Length (Class 7)	: 250-300	:m
Ship Length (Class 8)	: 300-350	:m
Ship Length (Class 9)	: 350-400	:m
Ship Length (Class 10)	: > 400	:m
Reference	: all assumptions are like the inland marina scenario except LR=4.5	

MAMPEC - Result Sheet

Run	: Inland Marina-Fresh water-LR 14.3
Version	: MamPec 2.0
Run date	: 3/16/2009 10:29:48 AM
Memo	:

Input

Environment	: Default marina 1-Fresh water-InLand
Compound	: Zinc Omadine (EPA)
Emission	: Default Marina 100% Zn-Omadine-Fresh Water 14.3
Load	: 9.62E+02:g/d

Results

Total concentration in water

Maximum concentration	: 6.39E-01	:ug/l
95 % concentration	: 6.15E-01	:ug/l
Average concentration	: 4.21E-01	:ug/l
Median concentration	: 4.17E-01	:ug/l
Minimum concentration	: 8.88E-02	:ug/l

Dissolved concentration in water

Maximum concentration	: 6.37E-01	:ug/l
95 % concentration	: 6.13E-01	:ug/l
Average concentration	: 4.19E-01	:ug/l
Median concentration	: 4.16E-01	:ug/l
Minimum concentration	: 8.85E-02	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 4.57E-02	:ug/g dw
95 % concentration	: 4.40E-02	:ug/g dw
Average concentration	: 3.01E-02	:ug/g dw
Median concentration	: 2.99E-02	:ug/g dw
Minimum concentration	: 6.35E-03	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 1.92E-07	:ug/g dw
95 % concentration	: 1.85E-07	:ug/g dw
Average concentration	: 1.26E-07	:ug/g dw
Median concentration	: 1.25E-07	:ug/g dw
Minimum concentration	: 2.66E-08	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 1.92E-07	:ug/g dw
95 % concentration	: 1.85E-07	:ug/g dw
Average concentration	: 1.26E-07	:ug/g dw
Median concentration	: 1.25E-07	:ug/g dw
Minimum concentration	: 2.66E-08	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 1.92E-07	:ug/g dw
95 % concentration	: 1.85E-07	:ug/g dw
Average concentration	: 1.26E-07	:ug/g dw
Median concentration	: 1.25E-07	:ug/g dw
Minimum concentration	: 2.66E-08	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 1.92E-07	:ug/g dw
95 % concentration	: 1.85E-07	:ug/g dw
Average concentration	: 1.26E-07	:ug/g dw
Median concentration	: 1.25E-07	:ug/g dw
Minimum concentration	: 2.66E-08	:ug/g dw

Results in surrounding waters

Total concentration in water

Maximum concentration	: 3.70E-02	:ug/l
95 % concentration	: 3.29E-02	:ug/l
Average concentration	: 2.05E-03	:ug/l
Median concentration	: 1.70E-02	:ug/l
Minimum concentration	: 1.45E-02	:ug/l

Dissolved concentration in water

Maximum concentration	: 3.73E-02	:ug/l
95 % concentration	: 3.28E-02	:ug/l
Average concentration	: 2.05E-03	:ug/l
Median concentration	: 1.70E-02	:ug/l
Minimum concentration	: 1.44E-02	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 2.68E-03	:ug/g dw
95 % concentration	: 2.36E-03	:ug/g dw
Average concentration	: 1.47E-04	:ug/g dw
Median concentration	: 1.22E-03	:ug/g dw
Minimum concentration	: 1.04E-03	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 1.12E-08	:ug/g dw
95 % concentration	: 9.89E-09	:ug/g dw
Average concentration	: 6.16E-10	:ug/g dw
Median concentration	: 5.11E-09	:ug/g dw
Minimum concentration	: 4.35E-09	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 1.12E-08	:ug/g dw
95 % concentration	: 9.89E-09	:ug/g dw
Average concentration	: 6.16E-10	:ug/g dw
Median concentration	: 5.11E-09	:ug/g dw
Minimum concentration	: 4.35E-09	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 1.12E-08	:ug/g dw
95 % concentration	: 9.89E-09	:ug/g dw
Average concentration	: 6.16E-10	:ug/g dw
Median concentration	: 5.11E-09	:ug/g dw
Minimum concentration	: 4.35E-09	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 1.12E-08	:ug/g dw
95 % concentration	: 9.89E-09	:ug/g dw
Average concentration	: 6.16E-10	:ug/g dw
Median concentration	: 5.11E-09	:ug/g dw
Minimum concentration	: 4.35E-09	:ug/g dw

MAMPEC - Input data sheet

Compound

Name	:	Zinc-pyrithione	
Description	:	Zinc Omadine (EPA)	
Molecular mass	:	317.7	:g/Mol
Vapor pressure	:	1.00E-06	:Pa
Solubility	:	6.30E+00	:g/m3
Octanol-water coefficient	:	9.00E-01	:(-) Log (Kow)
Kd	:	0.00E+00	:m3/kg
Koc	:	3.40E+00	:(-) Log(Koc), Koc expressed as l/kg OrganicCarbon
Henry's coefficient	:	6.60E-05	:Pa.m3/mol
Melting temperature	:	267.0	:oC
pKa	:	0.0	:(-)
in water			
Biological degradation rate	:	1.76E-01	:1/d
Hydrolytic degradation rate	:	3.82E-02	:1/d
Photolytic degradation rate	:	9.20E-01	:1/d
in sediment			
Biological degradation rate	:	6.30E-01	:1/d
Hydrolytic degradation rate	:	8.13E+00	:1/d
Photolytic degradation rate	:	0.00E+00	:1/d
Advanced Photodegradation calculation	:	False	
Reference	:		

Environment

Description	: Default marina 1-Fresh water-InLand	
Silt concentration	: 35.0	:g/m3
Particular organic carbon conc	: 1.0	:g Organic Carbon/m3
Dissolved organic carbon conc	: 2.0	:g/m3
Temperature	: 25.0	:oC
Salinity	: 5.00E+00	:s.e.
Depth well-mixed sediment top layer	: 1.00E-01	: m
Sediment density	: 1.000E+03	:kg/m3
Fraction organic carbon in sediment	: 3.00E-02	:-/-
Nett sedimentation velocity	: 1.00E-01	:m/d

pH	: 6.5	:(-)
Chlorophyll	: 3.00	:ug/l
Latitude	: 50.00 degrees NH	
Background concentrations	: 0.00E+00	:ug/l
Average windspeed	: 0.00	:m/s
Fraction wind perpendicular to harbour	: 0.00	:-/-
Daily maximum non tidal water level change	: 0.00	:m
Length of river, not part of harbor (x1)	: 400	:m
Width of harbor (y1)	: 400	:m
Length of harbor (x2)	: 400	:m
Width of river (y2)	: 400	:m
Depth of harbor	: 3.5	:m
Length of open harbour mouth (x3)	: 100	:m
Flow	: 1	:m/s
Flow of flushing into harbor	: 0	:m3/s
Tidal height	: 1	:m
Density difference	: 0.1	:kg/m3
Density difference flushing	: 0	:kg/m3
Tidal period	: 12.41	:h
Exchange surface	: 350	:m2
Depth at harbour mouth	: 3.5	:m
Height underwater dam at mouth	: 0	:m
Width underwater dam at mouth	: 0	:m
Length selected area	: 0	:m
Width selected area	: 0	:m
Depth selected area	: 0	:m
Flow	: 0	:m/s
Exchange volume in 1 tidal period	: 243420	:m3
Reference	:	

Emission

Description	: Default Marina 100% Zn-Omadine-Fresh Water 14.3	
Load	: 962.0325	:g/d
Loading due to moving ships	: 0	:g/d
Loading due to ships at berth	: 962.0325	:g/d
Leaching rate ships at berth	: 14.3	:ug/cm2/d
Leaching rate ships at berth	: 14.3	:ug/cm2/d
Number of ships at berth (Class 1)	: 0	
Number of ships at berth (Class 2)	: 299	
Number of ships at berth (Class 3)	: 0	
Number of ships at berth (Class 4)	: 0	
Number of ships at berth (Class 5)	: 0	
Number of ships at berth (Class 6)	: 0	
Number of ships at berth (Class 7)	: 0	
Number of ships at berth (Class 8)	: 0	
Number of ships at berth (Class 9	: 0	
Number of ships at berth (Class 10)	: 0	
Number of moving ships (Class 1)	: 0	
Number of moving ships (Class 2)	: 0	
Number of moving ships (Class 3)	: 0	
Number of moving ships (Class 4)	: 0	
Number of moving ships (Class 5)	: 0	
Number of moving ships (Class 6)	: 0	
Number of moving ships (Class 7)	: 0	

Number of moving ships (Class 8)	: 0	
Number of moving ships (Class 9)	: 0	
Number of moving ships (Class 10)	: 0	
Application factor (Class 1)	: 100	:%
Application factor (Class 2)	: 100	:%
Application factor (Class 3)	: 100	:%
Application factor (Class 4)	: 100	:%
Application factor (Class 5)	: 100	:%
Application factor (Class 6)	: 20	:%
Application factor (Class 7)	: 20	:%
Application factor (Class 8)	: 20	:%
Application factor (Class 9)	: 20	:%
Application factor (Class 10)	: 20	:%
Underwater ship area (Class 1)	: 20	:m2
Underwater ship area (Class 2)	: 22.5	:m2
Underwater ship area (Class 3)	: 450	:m2
Underwater ship area (Class 4)	: 3061	:m2
Underwater ship area (Class 5)	: 5999	:m2
Underwater ship area (Class 6)	: 9917	:m2
Underwater ship area (Class 7)	: 14814	:m2
Underwater ship area (Class 8)	: 22645	:m2
Underwater ship area (Class 9)	: 27547	:m2
Underwater ship area (Class 10)	: 39668	:m2
Ship Length (Class 1)	: 0-10	:m
Ship Length (Class 2)	: 10-50	:m
Ship Length (Class 3)	: 50-100	:m
Ship Length (Class 4)	: 100-150	:m
Ship Length (Class 5)	: 150-200	:m
Ship Length (Class 6)	: 200-250	:m
Ship Length (Class 7)	: 250-300	:m
Ship Length (Class 8)	: 300-350	:m
Ship Length (Class 9)	: 350-400	:m
Ship Length (Class 10)	: > 400	:m
Reference	: all assumptions are like the inland marina scenario except LR=14.3	

Appendix B

Inputs, parameters and out put results from the MAMPEC Model run for Scenario 2

MAMPEC - Result Sheet

Run	: Scenario2-Inland Small Marina-LR 4.5
Version	: MamPec 2.0
Run date	: 3/16/2009 11:25:48 AM
Memo	:

Input

Environment	: Default marina-Swiss marina 1
Compound	: Zinc Omadine (EPA)
Emission	: Default Marina 100% Zn-Omadine-Fresh Water 4.5
Load	: 3.03E+02:g/d

Results

Total concentration in water

Maximum concentration	: 3.41E+00	:ug/l
95 % concentration	: 3.41E+00	:ug/l
Average concentration	: 2.15E+00	:ug/l
Median concentration	: 2.00E+00	:ug/l
Minimum concentration	: 6.96E-01	:ug/l

Dissolved concentration in water

Maximum concentration	: 3.40E+00	:ug/l
95 % concentration	: 3.40E+00	:ug/l
Average concentration	: 2.14E+00	:ug/l
Median concentration	: 1.99E+00	:ug/l
Minimum concentration	: 6.94E-01	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 2.44E-01	:ug/g dw
95 % concentration	: 2.44E-01	:ug/g dw
Average concentration	: 1.54E-01	:ug/g dw
Median concentration	: 1.43E-01	:ug/g dw
Minimum concentration	: 4.98E-02	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 1.02E-06	:ug/g dw
95 % concentration	: 1.02E-06	:ug/g dw
Average concentration	: 6.45E-07	:ug/g dw
Median concentration	: 6.01E-07	:ug/g dw
Minimum concentration	: 2.09E-07	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 1.02E-06	:ug/g dw
95 % concentration	: 1.02E-06	:ug/g dw
Average concentration	: 6.45E-07	:ug/g dw
Median concentration	: 6.01E-07	:ug/g dw
Minimum concentration	: 2.09E-07	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 1.02E-06	:ug/g dw
95 % concentration	: 1.02E-06	:ug/g dw
Average concentration	: 6.45E-07	:ug/g dw
Median concentration	: 6.01E-07	:ug/g dw
Minimum concentration	: 2.09E-07	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 1.02E-06	:ug/g dw
95 % concentration	: 1.02E-06	:ug/g dw
Average concentration	: 6.45E-07	:ug/g dw
Median concentration	: 6.01E-07	:ug/g dw
Minimum concentration	: 2.09E-07	:ug/g dw

Results in surrounding waters

Total concentration in water

Maximum concentration	: 1.36E-01	:ug/l
95 % concentration	: 1.33E-01	:ug/l
Average concentration	: 1.28E-02	:ug/l
Median concentration	: 7.97E-02	:ug/l
Minimum concentration	: 5.85E-02	:ug/l

Dissolved concentration in water

Maximum concentration	: 1.36E-01	:ug/l
95 % concentration	: 1.32E-01	:ug/l
Average concentration	: 1.28E-02	:ug/l
Median concentration	: 7.94E-02	:ug/l
Minimum concentration	: 5.83E-02	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 9.74E-03	:ug/g dw
95 % concentration	: 9.48E-03	:ug/g dw
Average concentration	: 9.18E-04	:ug/g dw
Median concentration	: 5.70E-03	:ug/g dw
Minimum concentration	: 4.18E-03	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 4.09E-08	:ug/g dw
95 % concentration	: 3.98E-08	:ug/g dw
Average concentration	: 3.85E-09	:ug/g dw
Median concentration	: 2.39E-08	:ug/g dw
Minimum concentration	: 1.75E-08	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 4.09E-08	:ug/g dw
95 % concentration	: 3.98E-08	:ug/g dw
Average concentration	: 3.85E-09	:ug/g dw
Median concentration	: 2.39E-08	:ug/g dw
Minimum concentration	: 1.75E-08	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 4.09E-08	:ug/g dw
95 % concentration	: 3.98E-08	:ug/g dw
Average concentration	: 3.85E-09	:ug/g dw
Median concentration	: 2.39E-08	:ug/g dw
Minimum concentration	: 1.75E-08	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 4.09E-08	:ug/g dw
95 % concentration	: 3.98E-08	:ug/g dw
Average concentration	: 3.85E-09	:ug/g dw
Median concentration	: 2.39E-08	:ug/g dw
Minimum concentration	: 1.75E-08	:ug/g dw

MAMPEC - Input data sheet

Compound

Name	:	Zinc-pyrithione	
Description	:	Zinc Omadine (EPA)	
Molecular mass	:	317.7 :g/Mol	
Vapor pressure	:	1.00E-06	:Pa
Solubility	:	6.30E+00	:g/m3
Octanol-water coefficient	:	9.00E-01	:(-) Log (Kow)
Kd	:	0.00E+00	:m3/kg
Koc	:	3.40E+00	:(-) Log(Koc), Koc expressed as l/kg OrganicCarbon
Henry's coefficient	:	6.60E-05	:Pa.m3/mol
Melting temperature	:	267.0	:oC
pKa	:	0.0	:(-)
in water			
Biological degradation rate	:	1.76E-01	:1/d
Hydrolytic degradation rate	:	3.82E-02	:1/d
Photolytic degradation rate	:	9.20E-01	:1/d
in sediment			
Biological degradation rate	:	6.30E-01	:1/d
Hydrolytic degradation rate	:	8.13E+00	:1/d
Photolytic degradation rate	:	0.00E+00	:1/d
Advanced Photodegradation calculation	:	False	
Reference	:		

Environment

Description	: Default marina-Swiss marina 1	
Silt concentration	: 35.0	:g/m3
Particular organic carbon conc	: 1.0	:g Organic Carbon/m3
Dissolved organic carbon conc	: 2.0	:g/m3
Temperature	: 25.0	:oC
Salinity	: 5.00E+00	:s.e.
Depth well-mixed sediment top layer	: 1.00E-01	: m
Sediment density	: 1.000E+03	:kg/m3
Fraction organic carbon in sediment	: 3.00E-02	:-/-
Nett sedimentation velocity	: 1.00E-01	:m/d
pH	: 6.5	:(-)

Chlorophyll	: 3.00	:ug/l
Latitude	: 50.00 degrees NH	
Background concentrations	: 0.00E+00	:ug/l
Average windspeed	: 0.00	:m/s
Fraction wind perpendicular to harbour	: 0.00	:-/-
Daily maximum non tidal water level change	: 0.00	:m
Length of river, not part of harbor (x1)	: 100	:m
Width of harbor (y1)	: 100	:m
Length of harbor (x2)	: 100	:m
Width of river (y2)	: 100	:m
Depth of harbor	: 2	:m
Length of open harbour mouth (x3)	: 30	:m
Flow	: 0.1	:m/s
Flow of flushing into harbor	: 0	:m3/s
Tidal height	: 1	:m
Density difference	: 0.1	:kg/m3
Density difference flushing	: 0	:kg/m3
Tidal period	: 12.41	:h
Exchange surface	: 60	:m2
Depth at harbour mouth	: 2	:m
Height underwater dam at mouth	: 0	:m
Width underwater dam at mouth	: 0	:m
Length selected area	: 0	:m
Width selected area	: 0	:m
Depth selected area	: 0	:m
Flow	: 0	:m/s
Exchange volume in 1 tidal period	: 15383 :m3	
Reference	: This is a Swiss Marina scenario taken from OECD 2005 report	

Emission

Description	: Default Marina 100% Zn-Omadine-Fresh Water 4.5	
Load	: 302.7375	:g/d
Loading due to moving ships	: 0	:g/d
Loading due to ships at berth	: 302.7375	:g/d
Leaching rate ships at berth	: 4.5	:ug/cm2/d
Leaching rate ships at berth	: 4.5	:ug/cm2/d
Number of ships at berth (Class 1)	: 0	
Number of ships at berth (Class 2)	: 299	
Number of ships at berth (Class 3)	: 0	
Number of ships at berth (Class 4)	: 0	
Number of ships at berth (Class 5)	: 0	
Number of ships at berth (Class 6)	: 0	
Number of ships at berth (Class 7)	: 0	
Number of ships at berth (Class 8)	: 0	
Number of ships at berth (Class 9	: 0	
Number of ships at berth (Class 10)	: 0	
Number of moving ships (Class 1)	: 0	
Number of moving ships (Class 2)	: 0	
Number of moving ships (Class 3)	: 0	
Number of moving ships (Class 4)	: 0	
Number of moving ships (Class 5)	: 0	
Number of moving ships (Class 6)	: 0	
Number of moving ships (Class 7)	: 0	
Number of moving ships (Class 8)	: 0	

Number of moving ships (Class 9)	: 0	
Number of moving ships (Class 10)	: 0	
Application factor (Class 1)	: 100	:%
Application factor (Class 2)	: 100	:%
Application factor (Class 3)	: 100	:%
Application factor (Class 4)	: 100	:%
Application factor (Class 5)	: 100	:%
Application factor (Class 6)	: 20	:%
Application factor (Class 7)	: 20	:%
Application factor (Class 8)	: 20	:%
Application factor (Class 9)	: 20	:%
Application factor (Class 10)	: 20	:%
Underwater ship area (Class 1)	: 20	:m2
Underwater ship area (Class 2)	: 22.5	:m2
Underwater ship area (Class 3)	: 450	:m2
Underwater ship area (Class 4)	: 3061	:m2
Underwater ship area (Class 5)	: 5999	:m2
Underwater ship area (Class 6)	: 9917	:m2
Underwater ship area (Class 7)	: 14814	:m2
Underwater ship area (Class 8)	: 22645	:m2
Underwater ship area (Class 9)	: 27547	:m2
Underwater ship area (Class 10)	: 39668	:m2
Ship Length (Class 1)	: 0-10	:m
Ship Length (Class 2)	: 10-50	:m
Ship Length (Class 3)	: 50-100	:m
Ship Length (Class 4)	: 100-150	:m
Ship Length (Class 5)	: 150-200	:m
Ship Length (Class 6)	: 200-250	:m
Ship Length (Class 7)	: 250-300	:m
Ship Length (Class 8)	: 300-350	:m
Ship Length (Class 9)	: 350-400	:m
Ship Length (Class 10)	: > 400	:m
Reference	: all assumptions are like the inland marina scenario except LR=4.5	

MAMPEC - Result Sheet

Run : Scenario 2-Inland Small Marina-LR 14.3

Version	: MamPec 2.0	
Run date	: 3/16/2009 11:23:45 AM	
Memo	:	

Input

Environment	: Default marina-Swiss marina 1
Compound	: Zinc Omadine (EPA)
Emission	: Default Marina 100% Zn-Omadine-Fresh Water 14.3
Load	: 9.62E+02:g/d

Results

Total concentration in water

Maximum concentration	: 1.08E+01	:ug/l
95 % concentration	: 1.08E+01	:ug/l
Average concentration	: 6.83E+00	:ug/l
Median concentration	: 6.36E+00	:ug/l
Minimum concentration	: 2.21E+00	:ug/l

Dissolved concentration in water

Maximum concentration	: 1.08E+01	:ug/l
95 % concentration	: 1.08E+01	:ug/l
Average concentration	: 6.81E+00	:ug/l
Median concentration	: 6.34E+00	:ug/l
Minimum concentration	: 2.21E+00	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 7.74E-01	:ug/g dw
95 % concentration	: 7.74E-01	:ug/g dw
Average concentration	: 4.89E-01	:ug/g dw
Median concentration	: 4.55E-01	:ug/g dw
Minimum concentration	: 1.58E-01	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 3.25E-06	:ug/g dw
95 % concentration	: 3.25E-06	:ug/g dw
Average concentration	: 2.05E-06	:ug/g dw
Median concentration	: 1.91E-06	:ug/g dw
Minimum concentration	: 6.64E-07	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 3.25E-06	:ug/g dw
95 % concentration	: 3.25E-06	:ug/g dw
Average concentration	: 2.05E-06	:ug/g dw
Median concentration	: 1.91E-06	:ug/g dw
Minimum concentration	: 6.64E-07	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 3.25E-06	:ug/g dw

95 % concentration	: 3.25E-06	:ug/g dw
Average concentration	: 2.05E-06	:ug/g dw
Median concentration	: 1.91E-06	:ug/g dw
Minimum concentration	: 6.64E-07	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 3.25E-06	:ug/g dw
95 % concentration	: 3.25E-06	:ug/g dw
Average concentration	: 2.05E-06	:ug/g dw
Median concentration	: 1.91E-06	:ug/g dw
Minimum concentration	: 6.64E-07	:ug/g dw

Results in surrounding waters

Total concentration in water

Maximum concentration	: 4.33E-01	:ug/l
95 % concentration	: 4.21E-01	:ug/l
Average concentration	: 4.08E-02	:ug/l
Median concentration	: 2.53E-01	:ug/l
Minimum concentration	: 1.86E-01	:ug/l

Dissolved concentration in water

Maximum concentration	: 4.31E-01	:ug/l
95 % concentration	: 4.20E-01	:ug/l
Average concentration	: 4.07E-02	:ug/l
Median concentration	: 2.52E-01	:ug/l
Minimum concentration	: 1.85E-01	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 3.10E-02	:ug/g dw
95 % concentration	: 3.01E-02	:ug/g dw
Average concentration	: 2.92E-03	:ug/g dw
Median concentration	: 1.81E-02	:ug/g dw
Minimum concentration	: 1.33E-02	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 1.30E-07	:ug/g dw
95 % concentration	: 1.26E-07	:ug/g dw
Average concentration	: 1.22E-08	:ug/g dw
Median concentration	: 7.60E-08	:ug/g dw
Minimum concentration	: 5.58E-08	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 1.30E-07	:ug/g dw
95 % concentration	: 1.26E-07	:ug/g dw
Average concentration	: 1.22E-08	:ug/g dw
Median concentration	: 7.60E-08	:ug/g dw
Minimum concentration	: 5.58E-08	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 1.30E-07	:ug/g dw
95 % concentration	: 1.26E-07	:ug/g dw
Average concentration	: 1.22E-08	:ug/g dw
Median concentration	: 7.60E-08	:ug/g dw
Minimum concentration	: 5.58E-08	:ug/g dw

<u>Contaminant concentration in sediment after 10 years of use</u>

Maximum concentration	: 1.30E-07	:ug/g dw
95 % concentration	: 1.26E-07	:ug/g dw
Average concentration	: 1.22E-08	:ug/g dw
Median concentration	: 7.60E-08	:ug/g dw
Minimum concentration	: 5.58E-08	:ug/g dw

MAMPEC - Input data sheet

Compound

Name	:	Zinc-pyrithione	
Description	:	Zinc Omadine (EPA)	
Molecular mass	:	317.7 :g/Mol	
Vapor pressure	:	1.00E-06	:Pa
Solubility	:	6.30E+00	:g/m3
Octanol-water coefficient	:	9.00E-01	:(-) Log (Kow)
Kd	:	0.00E+00	:m3/kg
Koc	:	3.40E+00	:(-) Log(Koc), Koc expressed as l/kg OrganicCarbon
Henry's coefficient	:	6.60E-05	:Pa.m3/mol
Melting temperature	:	267.0	:oC
pKa	:	0.0	:(-)
in water			
Biological degradation rate	:	1.76E-01	:1/d
Hydrolytic degradation rate	:	3.82E-02	:1/d
Photolytic degradation rate	:	9.20E-01	:1/d
in sediment			
Biological degradation rate	:	6.30E-01	:1/d
Hydrolytic degradation rate	:	8.13E+00	:1/d
Photolytic degradation rate	:	0.00E+00	:1/d
Advanced Photodegradation calculation	:	False	
Reference	:		

Environment

Description	: Default marina-Swiss marina 1	
Silt concentration	: 35.0	:g/m3
Particular organic carbon conc	: 1.0	:g Organic Carbon/m3
Dissolved organic carbon conc	: 2.0	:g/m3
Temperature	: 25.0	:oC
Salinity	: 5.00E+00	:s.e.
Depth well-mixed sediment top layer	: 1.00E-01	: m
Sediment density	: 1.000E+03	:kg/m3
Fraction organic carbon in sediment	: 3.00E-02	:-/-
Nett sedimentation velocity	: 1.00E-01	:m/d
pH	: 6.5	:(-)
Chlorophyll	: 3.00	:ug/l

Latitude	: 50.00	degrees NH
Background concentrations	: 0.00E+00	:ug/l
Average windspeed	: 0.00	:m/s
Fraction wind perpendicular to harbour	: 0.00	:-/-
Daily maximum non tidal water level change	: 0.00	:m
Length of river, not part of harbor (x1)	: 100	:m
Width of harbor (y1)	: 100	:m
Length of harbor (x2)	: 100	:m
Width of river (y2)	: 100	:m
Depth of harbor	: 2	:m
Length of open harbour mouth (x3)	: 30	:m
Flow	: 0.1	:m/s
Flow of flushing into harbor	: 0	:m3/s
Tidal height	: 1	:m
Density difference	: 0.1	:kg/m3
Density difference flushing	: 0	:kg/m3
Tidal period	: 12.41	:h
Exchange surface	: 60	:m2
Depth at harbour mouth	: 2	:m
Height underwater dam at mouth	: 0	:m
Width underwater dam at mouth	: 0	:m
Length selected area	: 0	:m
Width selected area	: 0	:m
Depth selected area	: 0	:m
Flow	: 0	:m/s
Exchange volume in 1 tidal period	: 15383	:m3
Reference	: This is a Swiss Marina scenario taken from OECD 2005 report	

Emission

Description	: Default Marina 100% Zn-Omadine-Fresh Water 14.3	
Load	: 962.0325	:g/d
Loading due to moving ships	: 0	:g/d
Loading due to ships at berth	: 962.0325	:g/d
Leaching rate ships at berth	: 14.3	:ug/cm2/d
Leaching rate ships at berth	: 14.3	:ug/cm2/d
Number of ships at berth (Class 1)	: 0	
Number of ships at berth (Class 2)	: 299	
Number of ships at berth (Class 3)	: 0	
Number of ships at berth (Class 4)	: 0	
Number of ships at berth (Class 5)	: 0	
Number of ships at berth (Class 6)	: 0	
Number of ships at berth (Class 7)	: 0	
Number of ships at berth (Class 8)	: 0	
Number of ships at berth (Class 9	: 0	
Number of ships at berth (Class 10)	: 0	
Number of moving ships (Class 1)	: 0	
Number of moving ships (Class 2)	: 0	
Number of moving ships (Class 3)	: 0	
Number of moving ships (Class 4)	: 0	
Number of moving ships (Class 5)	: 0	
Number of moving ships (Class 6)	: 0	
Number of moving ships (Class 7)	: 0	
Number of moving ships (Class 8)	: 0	
Number of moving ships (Class 9)	: 0	

Number of moving ships (Class 10)	: 0	
Application factor (Class 1)	: 100	:%
Application factor (Class 2)	: 100	:%
Application factor (Class 3)	: 100	:%
Application factor (Class 4)	: 100	:%
Application factor (Class 5)	: 100	:%
Application factor (Class 6)	: 20	:%
Application factor (Class 7)	: 20	:%
Application factor (Class 8)	: 20	:%
Application factor (Class 9)	: 20	:%
Application factor (Class 10)	: 20	:%
Underwater ship area (Class 1)	: 20	:m2
Underwater ship area (Class 2)	: 22.5	:m2
Underwater ship area (Class 3)	: 450	:m2
Underwater ship area (Class 4)	: 3061	:m2
Underwater ship area (Class 5)	: 5999	:m2
Underwater ship area (Class 6)	: 9917	:m2
Underwater ship area (Class 7)	: 14814	:m2
Underwater ship area (Class 8)	: 22645	:m2
Underwater ship area (Class 9)	: 27547	:m2
Underwater ship area (Class 10)	: 39668	:m2
Ship Length (Class 1)	: 0-10	:m
Ship Length (Class 2)	: 10-50	:m
Ship Length (Class 3)	: 50-100	:m
Ship Length (Class 4)	: 100-150	:m
Ship Length (Class 5)	: 150-200	:m
Ship Length (Class 6)	: 200-250	:m
Ship Length (Class 7)	: 250-300	:m
Ship Length (Class 8)	: 300-350	:m
Ship Length (Class 9)	: 350-400	:m
Ship Length (Class 10)	: > 400	:m
Reference	: all assumptions are like the inland mania scenario except LR=14.3	

Appendix C

Inputs, parameters and out put results from the MAMPEC Model run for Scenario 3

MAMPEC - Result Sheet

Run	: Scenario3-Coastal marina-LR-4.5
Version	: MamPec 2.0
Run date	: 3/16/2009 11:39:46 AM

Memo	:

Input

Environment	: Default marina for salt water
Compound	: Zinc Omadine (EPA)
Emission	: Default Marina 100% Zn-Omadine1
Load	: 3.03E+02:g/d

Results

Total concentration in water

Maximum concentration	: 2.01E-01	:ug/l
95 % concentration	: 1.94E-01	:ug/l
Average concentration	: 1.32E-01	:ug/l
Median concentration	: 1.31E-01	:ug/l
Minimum concentration	: 2.79E-02	:ug/l

Dissolved concentration in water

Maximum concentration	: 2.00E-01	:ug/l
95 % concentration	: 1.93E-01	:ug/l
Average concentration	: 1.32E-01	:ug/l
Median concentration	: 1.31E-01	:ug/l
Minimum concentration	: 2.78E-02	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 1.44E-02	:ug/g dw
95 % concentration	: 1.38E-02	:ug/g dw
Average concentration	: 9.47E-03	:ug/g dw
Median concentration	: 9.40E-03	:ug/g dw
Minimum concentration	: 2.00E-03	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 3.02E-07	:ug/g dw
95 % concentration	: 2.90E-07	:ug/g dw
Average concentration	: 1.99E-07	:ug/g dw
Median concentration	: 1.97E-07	:ug/g dw
Minimum concentration	: 4.19E-08	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 3.02E-07	:ug/g dw
95 % concentration	: 2.90E-07	:ug/g dw
Average concentration	: 1.99E-07	:ug/g dw
Median concentration	: 1.97E-07	:ug/g dw
Minimum concentration	: 4.19E-08	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 3.02E-07	:ug/g dw
95 % concentration	: 2.90E-07	:ug/g dw
Average concentration	: 1.99E-07	:ug/g dw

Median concentration	: 1.97E-07	:ug/g dw
Minimum concentration	: 4.19E-08	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 3.02E-07	:ug/g dw
95 % concentration	: 2.90E-07	:ug/g dw
Average concentration	: 1.99E-07	:ug/g dw
Median concentration	: 1.97E-07	:ug/g dw
Minimum concentration	: 4.19E-08	:ug/g dw

Results in surrounding waters

Total concentration in water

Maximum concentration	: 1.20E-02	:ug/l
95 % concentration	: 1.04E-02	:ug/l
Average concentration	: 6.46E-04	:ug/l
Median concentration	: 5.36E-03	:ug/l
Minimum concentration	: 4.56E-03	:ug/l

Dissolved concentration in water

Maximum concentration	: 1.17E-02	:ug/l
95 % concentration	: 1.03E-02	:ug/l
Average concentration	: 6.44E-04	:ug/l
Median concentration	: 5.34E-03	:ug/l
Minimum concentration	: 4.54E-03	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 8.43E-04	:ug/g dw
95 % concentration	: 7.41E-04	:ug/g dw
Average concentration	: 4.62E-05	:ug/g dw
Median concentration	: 3.83E-04	:ug/g dw
Minimum concentration	: 3.26E-04	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 1.77E-08	:ug/g dw
95 % concentration	: 1.56E-08	:ug/g dw
Average concentration	: 9.70E-10	:ug/g dw
Median concentration	: 8.04E-09	:ug/g dw
Minimum concentration	: 6.84E-09	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 1.77E-08	:ug/g dw
95 % concentration	: 1.56E-08	:ug/g dw
Average concentration	: 9.70E-10	:ug/g dw
Median concentration	: 8.04E-09	:ug/g dw
Minimum concentration	: 6.84E-09	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 1.77E-08	:ug/g dw

95 % concentration	: 1.56E-08	:ug/g dw
Average concentration	: 9.70E-10	:ug/g dw
Median concentration	: 8.04E-09	:ug/g dw
Minimum concentration	: 6.84E-09	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 1.77E-08	:ug/g dw
95 % concentration	: 1.56E-08	:ug/g dw
Average concentration	: 9.70E-10	:ug/g dw
Median concentration	: 8.04E-09	:ug/g dw
Minimum concentration	: 6.84E-09	:ug/g dw

MAMPEC - Input data sheet

Compound

Name	:	Zinc-pyrithione	
Description	:	Zinc Omadine (EPA)	
Molecular mass	:	317.7	:g/Mol
Vapor pressure	:	1.00E-06	:Pa
Solubility	:	6.30E+00	:g/m3
Octanol-water coefficient	:	9.00E-01	:(-) Log (Kow)
Kd	:	0.00E+00	:m3/kg
Koc	:	3.40E+00	:(-) Log(Koc), Koc expressed as l/kg OrganicCarbon
Henry's coefficient	:	6.60E-05	:Pa.m3/mol
Melting temperature	:	267.0	:oC
pKa	:	0.0	:(-)
in water			
Biological degradation rate	:	1.76E-01	:1/d
Hydrolytic degradation rate	:	3.82E-02	:1/d
Photolytic degradation rate	:	9.20E-01	:1/d
in sediment			
Biological degradation rate	:	6.30E-01	:1/d
Hydrolytic degradation rate	:	8.13E+00	:1/d
Photolytic degradation rate	:	0.00E+00	:1/d
Advanced Photodegradation calculation	:	False	
Reference	:		

Environment

Description	: Default marina for salt water	
Silt concentration	: 35.0	:g/m3
Particular organic carbon conc	: 1.0	:g Organic Carbon/m3
Dissolved organic carbon conc	: 2.0	:g/m3
Temperature	: 25.0	:oC
Salinity	: 3.40E+01	:s.e.
Depth well-mixed sediment top layer	: 1.00E-01	: m
Sediment density	: 1.000E+03	:kg/m3
Fraction organic carbon in sediment	: 3.00E-02	:-/-
Nett sedimentation velocity	: 5.00E-01	:m/d
pH	: 8.0	:(-)
Chlorophyll	: 3.00	:ug/l
Latitude	: 50.00 degrees NH	
Background concentrations	: 0.00E+00	:ug/l

Average windspeed	: 0.00	:m/s
Fraction wind perpendicular to harbour	: 0.00	:-/-
Daily maximum non tidal water level change	: 0.00	:m
Length of river, not part of harbor (x1)	: 400	:m
Width of harbor (y1)	: 400	:m
Length of harbor (x2)	: 400	:m
Width of river (y2)	: 400	:m
Depth of harbor	: 3.5	:m
Length of open harbour mouth (x3)	: 100	:m
Flow	: 1	:m/s
Flow of flushing into harbor	: 0	:m3/s
Tidal height	: 1	:m
Density difference	: 0.1	:kg/m3
Density difference flushing	: 0	:kg/m3
Tidal period	: 12.41	:h
Exchange surface	: 350	:m2
Depth at harbour mouth	: 3.5	:m
Height underwater dam at mouth	: 0	:m
Width underwater dam at mouth	: 0	:m
Length selected area	: 0	:m
Width selected area	: 0	:m
Depth selected area	: 0	:m
Flow	: 0	:m/s
Exchange volume in 1 tidal period	: 243420	:m3
Reference	:	

Emission

Description	: Default Marina 100% Zn-Omadine1	
Load	: 302.7375	:g/d
Loading due to moving ships	: 0	:g/d
Loading due to ships at berth	: 302.7375	:g/d
Leaching rate ships at berth	: 4.5	:ug/cm2/d
Leaching rate ships at berth	: 4.5	:ug/cm2/d
Number of ships at berth (Class 1)	: 0	
Number of ships at berth (Class 2)	: 299	
Number of ships at berth (Class 3)	: 0	
Number of ships at berth (Class 4)	: 0	
Number of ships at berth (Class 5)	: 0	
Number of ships at berth (Class 6)	: 0	
Number of ships at berth (Class 7)	: 0	
Number of ships at berth (Class 8)	: 0	
Number of ships at berth (Class 9	: 0	
Number of ships at berth (Class 10)	: 0	
Number of moving ships (Class 1)	: 0	
Number of moving ships (Class 2)	: 0	
Number of moving ships (Class 3)	: 0	
Number of moving ships (Class 4)	: 0	
Number of moving ships (Class 5)	: 0	
Number of moving ships (Class 6)	: 0	
Number of moving ships (Class 7)	: 0	
Number of moving ships (Class 8)	: 0	
Number of moving ships (Class 9)	: 0	
Number of moving ships (Class 10)	: 0	
Application factor (Class 1)	: 100	:%
Application factor (Class 2)	: 100	:%

Application factor (Class 3)	: 100	:%
Application factor (Class 4)	: 100	:%
Application factor (Class 5)	: 100	:%
Application factor (Class 6)	: 20	:%
Application factor (Class 7)	: 20	:%
Application factor (Class 8)	: 20	:%
Application factor (Class 9)	: 20	:%
Application factor (Class 10)	: 20	:%
Underwater ship area (Class 1)	: 20	:m2
Underwater ship area (Class 2)	: 22.5	:m2
Underwater ship area (Class 3)	: 450	:m2
Underwater ship area (Class 4)	: 3061	:m2
Underwater ship area (Class 5)	: 5999	:m2
Underwater ship area (Class 6)	: 9917	:m2
Underwater ship area (Class 7)	: 14814	:m2
Underwater ship area (Class 8)	: 22645	:m2
Underwater ship area (Class 9)	: 27547	:m2
Underwater ship area (Class 10)	: 39668	:m2
Ship Length (Class 1)	: 0-10	:m
Ship Length (Class 2)	: 10-50	:m
Ship Length (Class 3)	: 50-100	:m
Ship Length (Class 4)	: 100-150	:m
Ship Length (Class 5)	: 150-200	:m
Ship Length (Class 6)	: 200-250	:m
Ship Length (Class 7)	: 250-300	:m
Ship Length (Class 8)	: 300-350	:m
Ship Length (Class 9)	: 350-400	:m
Ship Length (Class 10)	: > 400	:m
Reference	: Coastal Martina-LR=4.5	

MAMPEC - Result Sheet

Run	: Scenario 3-Coastal Marina-LR-14.3
Version	: MamPec 2.0
Run date	: 3/16/2009 11:37:48 AM
Memo	:

Input

Environment	: Default marina for salt water
Compound	: Zinc Omadine (EPA)
Emission	: Default Marina 100% Zn-Omadine
Load	: 9.62E+02:g/d

Results

Total concentration in water

Maximum concentration	: 6.39E-01	:ug/l
95 % concentration	: 6.15E-01	:ug/l
Average concentration	: 4.21E-01	:ug/l
Median concentration	: 4.17E-01	:ug/l
Minimum concentration	: 8.88E-02	:ug/l

Dissolved concentration in water

Maximum concentration	: 6.37E-01	:ug/l
95 % concentration	: 6.13E-01	:ug/l
Average concentration	: 4.19E-01	:ug/l
Median concentration	: 4.16E-01	:ug/l
Minimum concentration	: 8.85E-02	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 4.57E-02	:ug/g dw
95 % concentration	: 4.40E-02	:ug/g dw
Average concentration	: 3.01E-02	:ug/g dw
Median concentration	: 2.99E-02	:ug/g dw
Minimum concentration	: 6.35E-03	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 9.58E-07	:ug/g dw
95 % concentration	: 9.23E-07	:ug/g dw
Average concentration	: 6.31E-07	:ug/g dw
Median concentration	: 6.26E-07	:ug/g dw
Minimum concentration	: 1.33E-07	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 9.58E-07	:ug/g dw
95 % concentration	: 9.23E-07	:ug/g dw
Average concentration	: 6.31E-07	:ug/g dw
Median concentration	: 6.26E-07	:ug/g dw
Minimum concentration	: 1.33E-07	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 9.58E-07	:ug/g dw
95 % concentration	: 9.23E-07	:ug/g dw
Average concentration	: 6.31E-07	:ug/g dw
Median concentration	: 6.26E-07	:ug/g dw

Minimum concentration	: 1.33E-07	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 9.58E-07	:ug/g dw
95 % concentration	: 9.23E-07	:ug/g dw
Average concentration	: 6.31E-07	:ug/g dw
Median concentration	: 6.26E-07	:ug/g dw
Minimum concentration	: 1.33E-07	:ug/g dw

Results in surrounding waters

Total concentration in water

Maximum concentration	: 3.70E-02	:ug/l
95 % concentration	: 3.29E-02	:ug/l
Average concentration	: 2.05E-03	:ug/l
Median concentration	: 1.70E-02	:ug/l
Minimum concentration	: 1.45E-02	:ug/l

Dissolved concentration in water

Maximum concentration	: 3.73E-02	:ug/l
95 % concentration	: 3.28E-02	:ug/l
Average concentration	: 2.05E-03	:ug/l
Median concentration	: 1.70E-02	:ug/l
Minimum concentration	: 1.44E-02	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 2.68E-03	:ug/g dw
95 % concentration	: 2.36E-03	:ug/g dw
Average concentration	: 1.47E-04	:ug/g dw
Median concentration	: 1.22E-03	:ug/g dw
Minimum concentration	: 1.04E-03	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 5.62E-08	:ug/g dw
95 % concentration	: 4.94E-08	:ug/g dw
Average concentration	: 3.08E-09	:ug/g dw
Median concentration	: 2.56E-08	:ug/g dw
Minimum concentration	: 2.17E-08	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 5.62E-08	:ug/g dw
95 % concentration	: 4.94E-08	:ug/g dw
Average concentration	: 3.08E-09	:ug/g dw
Median concentration	: 2.56E-08	:ug/g dw
Minimum concentration	: 2.17E-08	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 5.62E-08	:ug/g dw
95 % concentration	: 4.94E-08	:ug/g dw

Average concentration	: 3.08E-09	:ug/g dw
Median concentration	: 2.56E-08	:ug/g dw
Minimum concentration	: 2.17E-08	:ug/g dw

<u>Contaminant concentration in sediment after 10 years of use</u>

Maximum concentration	: 5.62E-08	:ug/g dw
95 % concentration	: 4.94E-08	:ug/g dw
Average concentration	: 3.08E-09	:ug/g dw
Median concentration	: 2.56E-08	:ug/g dw
Minimum concentration	: 2.17E-08	:ug/g dw

MAMPEC - Input data sheet

Compound

Name	:	Zinc-pyrithione	
Description	:	Zinc Omadine (EPA)	
Molecular mass	:	317.7	:g/Mol
Vapor pressure	:	1.00E-06	:Pa
Solubility	:	6.30E+00	:g/m3
Octanol-water coefficient	:	9.00E-01	:(-) Log (Kow)
Kd	:	0.00E+00	:m3/kg
Koc	:	3.40E+00	:(-) Log(Koc), Koc expressed as l/kg OrganicCarbon
Henry's coefficient	:	6.60E-05	:Pa.m3/mol
Melting temperature	:	267.0	:oC
pKa	:	0.0	:(-)
in water			
Biological degradation rate	:	1.76E-01	:1/d
Hydrolytic degradation rate	:	3.82E-02	:1/d
Photolytic degradation rate	:	9.20E-01	:1/d
in sediment			
Biological degradation rate	:	6.30E-01	:1/d
Hydrolytic degradation rate	:	8.13E+00	:1/d
Photolytic degradation rate	:	0.00E+00	:1/d
Advanced Photodegradation calculation	:	False	
Reference	:		

Environment

Description	: Default marina for salt water	
Silt concentration	: 35.0	:g/m3
Particular organic carbon conc	: 1.0	:g Organic Carbon/m3
Dissolved organic carbon conc	: 2.0	:g/m3
Temperature	: 25.0	:oC
Salinity	: 3.40E+01	:s.e.
Depth well-mixed sediment top layer	: 1.00E-01	: m
Sediment density	: 1.000E+03	:kg/m3
Fraction organic carbon in sediment	: 3.00E-02	:-/-
Nett sedimentation velocity	: 5.00E-01	:m/d
pH	: 8.0	:(-)
Chlorophyll	: 3.00	:ug/l
Latitude	: 50.00 degrees NH	
Background concentrations	: 0.00E+00	:ug/l
Average windspeed	: 0.00	:m/s

Fraction wind perpendicular to harbour	: 0.00	:-/-
Daily maximum non tidal water level change	: 0.00	:m
Length of river, not part of harbor (x1)	: 400	:m
Width of harbor (y1)	: 400	:m
Length of harbor (x2)	: 400	:m
Width of river (y2)	: 400	:m
Depth of harbor	: 3.5	:m
Length of open harbour mouth (x3)	: 100	:m
Flow	: 1	:m/s
Flow of flushing into harbor	: 0	:m3/s
Tidal height	: 1	:m
Density difference	: 0.1	:kg/m3
Density difference flushing	: 0	:kg/m3
Tidal period	: 12.41	:h
Exchange surface	: 350	:m2
Depth at harbour mouth	: 3.5	:m
Height underwater dam at mouth	: 0	:m
Width underwater dam at mouth	: 0	:m
Length selected area	: 0	:m
Width selected area	: 0	:m
Depth selected area	: 0	:m
Flow	: 0	:m/s
Exchange volume in 1 tidal period	: 243420	:m3
Reference	:	

Emission

Description	: Default Marina 100% Zn-Omadine	
Load	: 962.0325	:g/d
Loading due to moving ships	: 0	:g/d
Loading due to ships at berth	: 962.0325	:g/d
Leaching rate ships at berth	: 14.3	:ug/cm2/d
Leaching rate ships at berth	: 14.3	:ug/cm2/d
Number of ships at berth (Class 1)	: 0	
Number of ships at berth (Class 2)	: 299	
Number of ships at berth (Class 3)	: 0	
Number of ships at berth (Class 4)	: 0	
Number of ships at berth (Class 5)	: 0	
Number of ships at berth (Class 6)	: 0	
Number of ships at berth (Class 7)	: 0	
Number of ships at berth (Class 8)	: 0	
Number of ships at berth (Class 9	: 0	
Number of ships at berth (Class 10)	: 0	
Number of moving ships (Class 1)	: 0	
Number of moving ships (Class 2)	: 0	
Number of moving ships (Class 3)	: 0	
Number of moving ships (Class 4)	: 0	
Number of moving ships (Class 5)	: 0	
Number of moving ships (Class 6)	: 0	
Number of moving ships (Class 7)	: 0	
Number of moving ships (Class 8)	: 0	
Number of moving ships (Class 9)	: 0	
Number of moving ships (Class 10)	: 0	
Application factor (Class 1)	: 100	:%
Application factor (Class 2)	: 100	:%
Application factor (Class 3)	: 100	:%

Application factor (Class 4)	: 100	:%
Application factor (Class 5)	: 100	:%
Application factor (Class 6)	: 20	:%
Application factor (Class 7)	: 20	:%
Application factor (Class 8)	: 20	:%
Application factor (Class 9)	: 20	:%
Application factor (Class 10)	: 20	:%
Underwater ship area (Class 1)	: 20	:m2
Underwater ship area (Class 2)	: 22.5	:m2
Underwater ship area (Class 3)	: 450	:m2
Underwater ship area (Class 4)	: 3061	:m2
Underwater ship area (Class 5)	: 5999	:m2
Underwater ship area (Class 6)	: 9917	:m2
Underwater ship area (Class 7)	: 14814	:m2
Underwater ship area (Class 8)	: 22645	:m2
Underwater ship area (Class 9)	: 27547	:m2
Underwater ship area (Class 10)	: 39668	:m2
Ship Length (Class 1)	: 0-10	:m
Ship Length (Class 2)	: 10-50	:m
Ship Length (Class 3)	: 50-100	:m
Ship Length (Class 4)	: 100-150	:m
Ship Length (Class 5)	: 150-200	:m
Ship Length (Class 6)	: 200-250	:m
Ship Length (Class 7)	: 250-300	:m
Ship Length (Class 8)	: 300-350	:m
Ship Length (Class 9)	: 350-400	:m
Ship Length (Class 10)	: > 400	:m
Reference	: Coastal Martina-LR=14.3	

Appendix D

Inputs, parameters and out put results from the MAMPEC Model run for Scenario 4

MAMPEC - Result Sheet

Run	: Scenario 4-Coastal Harbor-LR-4.5
Version	: MamPec 2.0
Run date	: 3/16/2009 12:54:42 PM
Memo	: Coastal Harbor-LR=4.5

Input

Environment	: Default estuarine harbour 1
Compound	: Zinc Omadine (EPA)
Emission	: Default Estuarine Harbour-5
Load	: 4.35E+03:g/d

Results

<u>Total concentration in water</u>

Maximum concentration	: 4.93E-02	:ug/l
95 % concentration	: 4.54E-02	:ug/l
Average concentration	: 2.41E-02	:ug/l
Median concentration	: 1.83E-02	:ug/l
Minimum concentration	: 3.48E-03	:ug/l

<u>Dissolved concentration in water</u>

Maximum concentration	: 4.92E-02	:ug/l
95 % concentration	: 4.52E-02	:ug/l
Average concentration	: 2.40E-02	:ug/l
Median concentration	: 1.82E-02	:ug/l
Minimum concentration	: 3.47E-03	:ug/l

<u>Contaminant concentration on suspended solids</u>

Maximum concentration	: 3.53E-03	:ug/g dw
95 % concentration	: 3.24E-03	:ug/g dw
Average concentration	: 1.72E-03	:ug/g dw
Median concentration	: 1.31E-03	:ug/g dw
Minimum concentration	: 2.49E-04	:ug/g dw

<u>Contaminant concentration in sediment after 1 year of use</u>

Maximum concentration	: 7.40E-08	:ug/g dw
95 % concentration	: 6.81E-08	:ug/g dw
Average concentration	: 3.62E-08	:ug/g dw
Median concentration	: 2.74E-08	:ug/g dw
Minimum concentration	: 5.22E-09	:ug/g dw

<u>Contaminant concentration in sediment after 2 years of use</u>

Maximum concentration	: 7.40E-08	:ug/g dw
95 % concentration	: 6.81E-08	:ug/g dw
Average concentration	: 3.62E-08	:ug/g dw
Median concentration	: 2.74E-08	:ug/g dw
Minimum concentration	: 5.22E-09	:ug/g dw

<u>Contaminant concentration in sediment after 5 years of use</u>

Maximum concentration	: 7.40E-08	:ug/g dw
95 % concentration	: 6.81E-08	:ug/g dw
Average concentration	: 3.62E-08	:ug/g dw
Median concentration	: 2.74E-08	:ug/g dw
Minimum concentration	: 5.22E-09	:ug/g dw

Contaminant concentration in sediment after 10 years of use

Maximum concentration	: 7.40E-08	:ug/g dw
95 % concentration	: 6.81E-08	:ug/g dw
Average concentration	: 3.62E-08	:ug/g dw
Median concentration	: 2.74E-08	:ug/g dw
Minimum concentration	: 5.22E-09	:ug/g dw

Results in surrounding waters

Total concentration in water

Maximum concentration	: 8.00E-03	:ug/l
95 % concentration	: 6.65E-03	:ug/l
Average concentration	: 1.62E-03	:ug/l
Median concentration	: 3.40E-03	:ug/l
Minimum concentration	: 1.83E-03	:ug/l

Dissolved concentration in water

Maximum concentration	: 7.81E-03	:ug/l
95 % concentration	: 6.63E-03	:ug/l
Average concentration	: 1.62E-03	:ug/l
Median concentration	: 3.39E-03	:ug/l
Minimum concentration	: 1.83E-03	:ug/l

Contaminant concentration on suspended solids

Maximum concentration	: 5.61E-04	:ug/g dw
95 % concentration	: 4.76E-04	:ug/g dw
Average concentration	: 1.16E-04	:ug/g dw
Median concentration	: 2.43E-04	:ug/g dw
Minimum concentration	: 1.31E-04	:ug/g dw

Contaminant concentration in sediment after 1 year of use

Maximum concentration	: 1.18E-08	:ug/g dw
95 % concentration	: 9.97E-09	:ug/g dw
Average concentration	: 2.44E-09	:ug/g dw
Median concentration	: 5.10E-09	:ug/g dw
Minimum concentration	: 2.75E-09	:ug/g dw

Contaminant concentration in sediment after 2 years of use

Maximum concentration	: 1.18E-08	:ug/g dw
95 % concentration	: 9.97E-09	:ug/g dw
Average concentration	: 2.44E-09	:ug/g dw
Median concentration	: 5.10E-09	:ug/g dw
Minimum concentration	: 2.75E-09	:ug/g dw

Contaminant concentration in sediment after 5 years of use

Maximum concentration	: 1.18E-08	:ug/g dw
95 % concentration	: 9.97E-09	:ug/g dw
Average concentration	: 2.44E-09	:ug/g dw

Median concentration	: 5.10E-09	:ug/g dw
Minimum concentration	: 2.75E-09	:ug/g dw

<u>Contaminant concentration in sediment after 10 years of use</u>

Maximum concentration	: 1.18E-08	:ug/g dw
95 % concentration	: 9.97E-09	:ug/g dw
Average concentration	: 2.44E-09	:ug/g dw
Median concentration	: 5.10E-09	:ug/g dw
Minimum concentration	: 2.75E-09	:ug/g dw

MAMPEC - Input data sheet

Compound

Name	:	Zinc-pyrithione	
Description	:	Zinc Omadine (EPA)	
Molecular mass	:	317.7 :g/Mol	
Vapor pressure	:	1.00E-06	:Pa
Solubility	:	6.30E+00	:g/m3
Octanol-water coefficient	:	9.00E-01	:(-) Log (Kow)
Kd	:	0.00E+00	:m3/kg
Koc	:	3.40E+00	:(-) Log(Koc), Koc expressed as l/kg OrganicCarbon
Henry's coefficient	:	6.60E-05	:Pa.m3/mol
Melting temperature	:	267.0	:oC
pKa	:	0.0	:(-)
in water			
Biological degradation rate	:	1.76E-01	:1/d
Hydrolytic degradation rate	:	3.82E-02	:1/d
Photolytic degradation rate	:	9.20E-01	:1/d
in sediment			
Biological degradation rate	:	6.30E-01	:1/d
Hydrolytic degradation rate	:	8.13E+00	:1/d
Photolytic degradation rate	:	0.00E+00	:1/d
Advanced Photodegradation calculation	:	False	
Reference	:		

Environment

Description	: Default estuarine harbour 1	
Silt concentration	: 35.0	:g/m3
Particular organic carbon conc	: 1.0	:g Organic Carbon/m3
Dissolved organic carbon conc	: 2.0	:g/m3
Temperature	: 25.0	:oC
Salinity	: 3.40E+01	:s.e.
Depth well-mixed sediment top layer	: 2.00E-01	: m
Sediment density	: 1.000E+03	:kg/m3
Fraction organic carbon in sediment	: 3.00E-02	:-/-
Nett sedimentation velocity	: 1.00E+00	:m/d
pH	: 7.5	:(-)
Chlorophyll	: 3.00	:ug/l
Latitude	: 50.00 degrees NH	
Background concentrations	: 0.00E+00	:ug/l
Average windspeed	: 0.00	:m/s
Fraction wind perpendicular to harbour	: 0.00	:-/-

Daily maximum non tidal water level change	: 0.00	:m
Length of river, not part of harbor (x1)	: 1000	:m
Width of harbor (y1)	: 1000	:m
Length of harbor (x2)	: 5000	:m
Width of river (y2)	: 500	:m
Depth of harbor	: 15	:m
Length of open harbour mouth (x3)	: 2500	:m
Flow	: 1	:m/s
Flow of flushing into harbor	: 0	:m3/s
Tidal height	: 1.5	:m
Density difference	: 0.4	:kg/m3
Density difference flushing	: 0	:kg/m3
Tidal period	: 12.41	:h
Exchange surface	: 37500	:m2
Depth at harbour mouth	: 15	:m
Height underwater dam at mouth	: 0	:m
Width underwater dam at mouth	: 0	:m
Length selected area	: 0	:m
Width selected area	: 0	:m
Depth selected area	: 0	:m
Flow	: 0	:m/s
Exchange volume in 1 tidal period	: 60262000	:m3
Reference	:	

Emission

Description	: Default Estuarine Harbour-5	
Load	: 4351.5945	:g/d
Loading due to moving ships	: 310.8195	:g/d
Loading due to ships at berth	: 4040.775	:g/d
Leaching rate ships at berth	: 4.5	:ug/cm2/d
Leaching rate ships at berth	: 4.5	:ug/cm2/d
Number of ships at berth (Class 1)	: 0	
Number of ships at berth (Class 2)	: 0	
Number of ships at berth (Class 3)	: 11	
Number of ships at berth (Class 4)	: 5	
Number of ships at berth (Class 5)	: 5	
Number of ships at berth (Class 6)	: 1	
Number of ships at berth (Class 7)	: 2	
Number of ships at berth (Class 8)	: 0	
Number of ships at berth (Class 9	: 0	
Number of ships at berth (Class 10)	: 0	
Number of moving ships (Class 1)	: 0	
Number of moving ships (Class 2)	: 0	
Number of moving ships (Class 3)	: 1.8	
Number of moving ships (Class 4)	: 0.4	
Number of moving ships (Class 5)	: 0.4	
Number of moving ships (Class 6)	: 0.1	
Number of moving ships (Class 7)	: 0.1	
Number of moving ships (Class 8)	: 0	
Number of moving ships (Class 9)	: 0	
Number of moving ships (Class 10)	: 0	
Application factor (Class 1)	: 0	:%
Application factor (Class 2)	: 100	:%
Application factor (Class 3)	: 100	:%
Application factor (Class 4)	: 100	:%

Application factor (Class 5)	: 100	:%
Application factor (Class 6)	: 100	:%
Application factor (Class 7)	: 100	:%
Application factor (Class 8)	: 100	:%
Application factor (Class 9)	: 100	:%
Application factor (Class 10)	: 100	:%
Underwater ship area (Class 1)	: 20	:m2
Underwater ship area (Class 2)	: 120	:m2
Underwater ship area (Class 3)	: 450	:m2
Underwater ship area (Class 4)	: 3061	:m2
Underwater ship area (Class 5)	: 5999	:m2
Underwater ship area (Class 6)	: 9917	:m2
Underwater ship area (Class 7)	: 14814	:m2
Underwater ship area (Class 8)	: 22645	:m2
Underwater ship area (Class 9)	: 27547	:m2
Underwater ship area (Class 10)	: 39668	:m2
Ship Length (Class 1)	: 0-10	:m
Ship Length (Class 2)	: 10-50	:m
Ship Length (Class 3)	: 50-100	:m
Ship Length (Class 4)	: 100-150	:m
Ship Length (Class 5)	: 150-200	:m
Ship Length (Class 6)	: 200-250	:m
Ship Length (Class 7)	: 250-300	:m
Ship Length (Class 8)	: 300-350	:m
Ship Length (Class 9)	: 350-400	:m
Ship Length (Class 10)	: > 400	:m
Reference	:	

MAMPEC - Result Sheet

Run	: Scenario 4-Coastal Harbor-LR-14.3
Version	: MamPec 2.0
Run date	: 3/16/2009 12:51:59 PM
Memo	: Coastal Harbor-LR=14.3

Input

Environment	: Default estuarine harbour 1
Compound	: Zinc Omadine (EPA)
Emission	: Default Estuarine Harbour-4
Load	: 1.38E+04:g/d

Results

Total concentration in water

Maximum concentration	: 1.57E-01	:ug/l
95 % concentration	: 1.44E-01	:ug/l
Average concentration	: 7.66E-02	:ug/l
Median concentration	: 5.80E-02	:ug/l
Minimum concentration	: 1.11E-02	:ug/l

Dissolved concentration in water

Maximum concentration	: 1.56E-01	:ug/l
95 % concentration	: 1.44E-01	:ug/l

Average concentration	: 7.63E-02	:ug/l
Median concentration	: 5.79E-02	:ug/l
Minimum concentration	: 1.10E-02	:ug/l

<u>Contaminant concentration on suspended solids</u>

Maximum concentration	: 1.12E-02	:ug/g dw
95 % concentration	: 1.03E-02	:ug/g dw
Average concentration	: 5.48E-03	:ug/g dw
Median concentration	: 4.15E-03	:ug/g dw
Minimum concentration	: 7.91E-04	:ug/g dw

<u>Contaminant concentration in sediment after 1 year of use</u>

Maximum concentration	: 2.35E-07	:ug/g dw
95 % concentration	: 2.16E-07	:ug/g dw
Average concentration	: 1.15E-07	:ug/g dw
Median concentration	: 8.71E-08	:ug/g dw
Minimum concentration	: 1.66E-08	:ug/g dw

<u>Contaminant concentration in sediment after 2 years of use</u>

Maximum concentration	: 2.35E-07	:ug/g dw
95 % concentration	: 2.16E-07	:ug/g dw
Average concentration	: 1.15E-07	:ug/g dw
Median concentration	: 8.71E-08	:ug/g dw
Minimum concentration	: 1.66E-08	:ug/g dw

<u>Contaminant concentration in sediment after 5 years of use</u>

Maximum concentration	: 2.35E-07	:ug/g dw
95 % concentration	: 2.16E-07	:ug/g dw
Average concentration	: 1.15E-07	:ug/g dw
Median concentration	: 8.71E-08	:ug/g dw
Minimum concentration	: 1.66E-08	:ug/g dw

<u>Contaminant concentration in sediment after 10 years of use</u>

Maximum concentration	: 2.35E-07	:ug/g dw
95 % concentration	: 2.16E-07	:ug/g dw
Average concentration	: 1.15E-07	:ug/g dw
Median concentration	: 8.71E-08	:ug/g dw
Minimum concentration	: 1.66E-08	:ug/g dw

Results in surrounding waters

<u>Total concentration in water</u>

Maximum concentration	: 2.50E-02	:ug/l
95 % concentration	: 2.11E-02	:ug/l
Average concentration	: 5.16E-03	:ug/l
Median concentration	: 1.08E-02	:ug/l
Minimum concentration	: 5.83E-03	:ug/l

<u>Dissolved concentration in water</u>

Maximum concentration	: 2.48E-02	:ug/l
95 % concentration	: 2.11E-02	:ug/l
Average concentration	: 5.14E-03	:ug/l
Median concentration	: 1.08E-02	:ug/l
Minimum concentration	: 5.81E-03	:ug/l

<u>Contaminant concentration on suspended solids</u>

Maximum concentration	: 1.78E-03	:ug/g dw
95 % concentration	: 1.51E-03	:ug/g dw
Average concentration	: 3.69E-04	:ug/g dw
Median concentration	: 7.72E-04	:ug/g dw
Minimum concentration	: 4.17E-04	:ug/g dw

<u>Contaminant concentration in sediment after 1 year of use</u>

Maximum concentration	: 3.74E-08	:ug/g dw
95 % concentration	: 3.17E-08	:ug/g dw
Average concentration	: 7.74E-09	:ug/g dw
Median concentration	: 1.62E-08	:ug/g dw
Minimum concentration	: 8.74E-09	:ug/g dw

<u>Contaminant concentration in sediment after 2 years of use</u>

Maximum concentration	: 3.74E-08	:ug/g dw
95 % concentration	: 3.17E-08	:ug/g dw
Average concentration	: 7.74E-09	:ug/g dw
Median concentration	: 1.62E-08	:ug/g dw
Minimum concentration	: 8.74E-09	:ug/g dw

<u>Contaminant concentration in sediment after 5 years of use</u>

Maximum concentration	: 3.74E-08	:ug/g dw
95 % concentration	: 3.17E-08	:ug/g dw
Average concentration	: 7.74E-09	:ug/g dw
Median concentration	: 1.62E-08	:ug/g dw
Minimum concentration	: 8.74E-09	:ug/g dw

<u>Contaminant concentration in sediment after 10 years of use</u>

Maximum concentration	: 3.74E-08	:ug/g dw
95 % concentration	: 3.17E-08	:ug/g dw
Average concentration	: 7.74E-09	:ug/g dw
Median concentration	: 1.62E-08	:ug/g dw
Minimum concentration	: 8.74E-09	:ug/g dw

MAMPEC - Input data sheet

Compound

Name	:	Zinc-pyrithione	
Description	:	Zinc Omadine (EPA)	
Molecular mass	:	317.7	:g/Mol
Vapor pressure	:	1.00E-06	:Pa

Solubility	: 6.30E+00	:g/m3
Octanol-water coefficient	: 9.00E-01	:(-) Log (Kow)
Kd	: 0.00E+00	:m3/kg
Koc	: 3.40E+00	:(-) Log(Koc), Koc expressed as l/kg OrganicCarbon
Henry's coefficient	: 6.60E-05	:Pa.m3/mol
Melting temperature	: 267.0	:oC
pKa	: 0.0	:(-)
in water		
Biological degradation rate	: 1.76E-01	:1/d
Hydrolytic degradation rate	: 3.82E-02	:1/d
Photolytic degradation rate	: 9.20E-01	:1/d
in sediment		
Biological degradation rate	: 6.30E-01	:1/d
Hydrolytic degradation rate	: 8.13E+00	:1/d
Photolytic degradation rate	: 0.00E+00	:1/d
Advanced Photodegradation calculation	: False	
Reference	:	

Environment

Description	: Default estuarine harbour 1	
Silt concentration	: 35.0	:g/m3
Particular organic carbon conc	: 1.0	:g Organic Carbon/m3
Dissolved organic carbon conc	: 2.0	:g/m3
Temperature	: 25.0	:oC
Salinity	: 3.40E+01	:s.e.
Depth well-mixed sediment top layer	: 2.00E-01	: m
Sediment density	: 1.000E+03	:kg/m3
Fraction organic carbon in sediment	: 3.00E-02	:-/-
Nett sedimentation velocity	: 1.00E+00	:m/d
pH	: 7.5	:(-)
Chlorophyll	: 3.00	:ug/l
Latitude	: 50.00 degrees NH	
Background concentrations	: 0.00E+00	:ug/l
Average windspeed	: 0.00	:m/s
Fraction wind perpendicular to harbour	: 0.00	:-/-
Daily maximum non tidal water level change	: 0.00	:m
Length of river, not part of harbor (x1)	: 1000	:m
Width of harbor (y1)	: 1000	:m
Length of harbor (x2)	: 5000	:m
Width of river (y2)	: 500	:m
Depth of harbor	: 15	:m
Length of open harbour mouth (x3)	: 2500	:m
Flow	: 1	:m/s
Flow of flushing into harbor	: 0	:m3/s
Tidal height	: 1.5	:m
Density difference	: 0.4	:kg/m3
Density difference flushing	: 0	:kg/m3
Tidal period	: 12.41	:h
Exchange surface	: 37500	:m2
Depth at harbour mouth	: 15	:m
Height underwater dam at mouth	: 0	:m
Width underwater dam at mouth	: 0	:m
Length selected area	: 0	:m
Width selected area	: 0	:m
Depth selected area	: 0	:m

Flow	: 0	:m/s
Exchange volume in 1 tidal period	: 60262000	:m3
Reference	:	

Emission

Description	: Default Estuarine Harbour-4	
Load	: 13828.4003	:g/d
Loading due to moving ships	: 987.7153	:g/d
Loading due to ships at berth	: 12840.685	:g/d
Leaching rate ships at berth	: 14.3	:ug/cm2/d
Leaching rate ships at berth	: 14.3	:ug/cm2/d
Number of ships at berth (Class 1)	: 0	
Number of ships at berth (Class 2)	: 0	
Number of ships at berth (Class 3)	: 11	
Number of ships at berth (Class 4)	: 5	
Number of ships at berth (Class 5)	: 5	
Number of ships at berth (Class 6)	: 1	
Number of ships at berth (Class 7)	: 2	
Number of ships at berth (Class 8)	: 0	
Number of ships at berth (Class 9	: 0	
Number of ships at berth (Class 10)	: 0	
Number of moving ships (Class 1)	: 0	
Number of moving ships (Class 2)	: 0	
Number of moving ships (Class 3)	: 1.8	
Number of moving ships (Class 4)	: 0.4	
Number of moving ships (Class 5)	: 0.4	
Number of moving ships (Class 6)	: 0.1	
Number of moving ships (Class 7)	: 0.1	
Number of moving ships (Class 8)	: 0	
Number of moving ships (Class 9)	: 0	
Number of moving ships (Class 10)	: 0	
Application factor (Class 1)	: 0	:%
Application factor (Class 2)	: 100	:%
Application factor (Class 3)	: 100	:%
Application factor (Class 4)	: 100	:%
Application factor (Class 5)	: 100	:%
Application factor (Class 6)	: 100	:%
Application factor (Class 7)	: 100	:%
Application factor (Class 8)	: 100	:%
Application factor (Class 9)	: 100	:%
Application factor (Class 10)	: 100	:%
Underwater ship area (Class 1)	: 20	:m2
Underwater ship area (Class 2)	: 120	:m2
Underwater ship area (Class 3)	: 450	:m2
Underwater ship area (Class 4)	: 3061	:m2
Underwater ship area (Class 5)	: 5999	:m2
Underwater ship area (Class 6)	: 9917	:m2
Underwater ship area (Class 7)	: 14814	:m2
Underwater ship area (Class 8)	: 22645	:m2
Underwater ship area (Class 9)	: 27547	:m2
Underwater ship area (Class 10)	: 39668	:m2
Ship Length (Class 1)	: 0-10	:m
Ship Length (Class 2)	: 10-50	:m
Ship Length (Class 3)	: 50-100	:m
Ship Length (Class 4)	: 100-150	:m

Ship Length (Class 5)	: 150-200	:m
Ship Length (Class 6)	: 200-250	:m
Ship Length (Class 7)	: 250-300	:m
Ship Length (Class 8)	: 300-350	:m
Ship Length (Class 9)	: 350-400	:m
Ship Length (Class 10)	: > 400	:m
Reference	:	

Sign-off Date : 03/25/09
DP Barcode No. : D362199