This document includes the Aluminum Hulls in the EPA "Draft Characterization Report for Hull Coating Leachate" published in August 2003. The reference number is:

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Characterization Report
Hull Coating Leachate

Aluminum Hulls, Baseline Discharge, Copper Release Rates, Foul-Release Coatings, and Advanced Antifouling Coatings.

August 2003

4.0 ALUMINUM HULLS

The Aluminum Hulls vessel group includes numerous classes of smaller vessels used by the Armed Forces. Vessels with aluminum hulls include boats and craft ranging from less than 20 feet long to 192 feet long. This vessel group includes approximately 403 vessels, which comprises 13% of all Armed Forces vessels that produce the hull coating leachate discharge. The total underwater hull wetted area for this vessel group is 1.3×10^5 ft^2, which is 0.46% of the total underwater hull wetted area for all Armed forces vessels that contribute to this discharge.

The 47-ft Motor Lifeboat (MLB 47) class was selected as the representative vessel class for this vessel grouping because it contains 71 vessels, which is over a quarter of the total number of vessels in the Aluminum Hulls vessel group. In addition, the MLB 47 class was selected because this is one of the larger classes of Armed Forces vessels with an aluminum hull.

Vessels in the Aluminum Hulls vessel group primarily use foul-release and advanced antifouling coatings that do not contain copper to avoid deposition corrosion that could occur if copper-containing coatings are applied to an aluminum hull. As such, analyses based on copper-containing coatings are not conducted for the aluminum vessel class.

4.1 BASELINE DISCHARGE

Vessels in this vessel group use both foul-release coating and advanced antifouling coatings. Approximately 10% of the vessels in this group currently use foul-release coatings, while the remaining 90% currently use advanced antifouling coatings (Dust, 2003). To facilitate calculations and analyses, the baseline discharge from this vessel group is estimated to result from 10% of the aluminum underwater hull wetted area being coated with International Intersleek 425 and 90% of the area being coated with E Paint Company *E Paint SN-1*.

4.1.1 Characterization Data

Studies conducted by the Navy and information supplied by coating manufacturers were used to characterize these coatings and the resulting discharges.

4.1.1.1 Physical Parameters

The MLB 47 class was selected to represent this group of vessels because it contains over a quarter of the number of vessels and is one of the largest vessels in the Aluminum Hulls vessel group. Each vessel is 47 feet long and has an underwater hull wetted area of 440 ft^2. MLB 47 class vessels are in U.S. ports for an average of 305 days per year and in operation within 12 nm of U.S. shoreline approximately 30 days per year. It is estimated that these vessels are out of the water an average of 30 days per year.

Additional physical parameters are not necessary for the hull coating leachate discharge, because discharge modeling is not conducted to support the environmental effects analysis.

4.1.1.2 Constituent Data, Classical Data, and Other Descriptors

Chemical Data

<u>Composition of Coatings</u>

The constituents for International Intersleek 425 and *E Paint SN-1* are presented in Tables 4-1 and 4-2, respectively.

Table 4-1. Constituents for International Intersleek 425

Constituent[a]	Approximate Coating Weight % from MSDS[a]
Ethyl benzene	11
Titanium dioxide	11
Xylenes (o-, m-, and p- isomers)	11

[a]Source: International Intersleek 425 MSDS (International, 2002c).
- The MSDS reported a weight percentage range. The constituent weight percentage presented is the maximum value.
- The MSDS did not report information regarding the balance of constituents. The remaining percentage of coating constituents may include silicon, resins, oils, pigments, and fillers.

Table 4-2. Constituents for E Paint Company *E Paint SN-1*

Constituent[a]	Approximate Coating Weight % from MSDS[a]
Zinc oxide	36
Ethyl benzene	21
Sea-Nine211® (4,5-dichloro-2-n-octyl-4-isothiazolin-3-one)	3.0
Xylene	1.9
Toluene	1.2

[a]Source: E Paint Company MSDS for *E Paint SN-1* (E Paint, 2002).
- The MSDS did not report information regarding the balance of constituents. The remaining percentage of coating constituents may include silicon, resins, oils, pigments, and fillers.

<u>Constituent Release Rates</u>

Foul-release coatings do not release any biocides as discussed in Section 2.3.1.2. The release rates of any other constituents in foul-release coatings are estimated to be negligible.

E Paint Company supplied the release rate for Sea-Nine211® (EPA, 2001), and the remaining coating constituent release rates were estimated from analysis discussed in Section 2.4.1.2. Table 4-3 presents the release rates for the constituents in *E Paint SN-1*.

Table 4-3. Release Rates for E Paint Company *E Paint SN-1*

Constituent	Release Rate [µg/cm^2)/day]
Sea-Nine211® (4,5-dichloro-2-n-octyl-4-isothiazolin-3-one)	1.8 [b]
Zinc oxide	17
Ethyl benzene[a]	0.0
Xylene[a]	0.0
Toluene[a]	0.0

[a]-VOCs are estimated to not be present in the cured coating.
[b]- Average leaching rate measured by ASTM Standard Test Method D 5108-90.

As presented in Section 2.4.1.2, the biocide Sea-Nine211® has a short half-life (i.e., less than one hour) in the marine environment (Rohm and Haas, 2003). Due to this short half-life, no studies were available to estimate concentrations in the water of Sea-Nine211® at varying distances from the hull. Concentrations for Sea-Nine211® were estimated assuming the constituents dilutes without degradation. This assumption may result in an over-estimate of concentrations because Sea-Nine211® has a short half-life.

Using the copper information presented in Section 2.1.1.2 and the known Sea-Nine211® release rate, concentrations at 1 cm and 35m were estimated using the following formula:

$$\textit{Sea-Nine211® Concentration at X m} = \left(\frac{\textit{Copper Conc. at Xm}}{\textit{Copper Static Release Rate}}\right) \times \textit{SeaNine}211\,\textit{Release Rate}$$

The 35 m value was estimated with the removal of background concentration levels. The concentrations estimated for Sea-Nine211® are presented in Table 4-4.

Table 4-4. Estimated Sea-Nine211® Concentrations

Distance	Concentration with Removal of Background Level (µg/l)
1 cm (End-of-Pipe)	1.0
35 m (Edge of Mixing Zone)	6.5×10^{-3}

Because it is assumed that zinc is released through the ablative process, total zinc concentrations were also calculated using the same approach. The concentrations estimated for total zinc are presented in Table 4-5.

Table 4-5. Estimated Total Zinc Concentrations

Distance	Concentration with Removal of Background Level (µg/l)
1 cm (End-of-Pipe)	10
35 m (Edge of Mixing Zone)	6.3×10^{-2}

Field Information

Field information was not collected as part of the UNDS program for foul-release or advanced antifouling coatings.

Descriptive Information

Descriptive information is not available for foul-release or advanced antifouling coatings. As previously stated, hull coating leachate is not discharge from a pipe but slowly released from the entire underwater hull of a vessel. The release of foul-release coating constituents is estimated to be negligible. In addition, advanced antifouling coating constituent concentrations at the 35m edge of the mixing zone are also negligible. Therefore, it is deduced that these coatings do not produce an effect on color, floating materials, odor, settleable materials, taste, or turbidity/colloidal matter in receiving waters.

4.1.1.3 Discharge Generation Rates for Mass Loadings

The release rates of constituents from International Intersleek 425 are estimated to be negligible. Therefore, generation rates for foul-release coatings are assumed to be zero.

As discussed in Section 2.4, *E Paint SN-1* releases a biocide called Sea-Nine211®. Tables 4-6 and 4-7 present the estimated baseline discharge generation rate for Sea-Nine211® and total zinc based on a 90% usage (i.e., 64 vessels coated with *E Paint SN-1* produce discharge of Sea-Nine211® and total zinc) for the MLB 47 vessel class. A full listing of vessel classes and characteristics for calculating generation rates and mass loadings are included in Appendix D.

Table 4-6. MLB 47 Vessel Class Estimated Generation Rates for Sea-Nine211® for the Baseline Discharge

Class	Number of Vessels	Days In Port	Days Operating w/in 12 nm	Days Underway (12+ nm)	Daily generation rate per vessel (kg Sea-Nine 211/day)			Annual generation rate per class (kg Sea-Nine 211/year)		
					In Port	Underway (0-12 nm)	Underway (12+ nm)	In Port	Underway (0-12 nm)	Underway (12+ nm)
MLB 47	64	305	30	0	7.4×10^{-4}	7.4×10^{-4}	0	14	1.4	0

Note: This analysis does not account for a vessel's time in drydock.

Table 4-7. MLB 47 Vessel Class Estimated Generation Rates for Total Zinc for the Baseline Discharge

Class	Number of Vessels	Days In Port	Days Operating w/in 12 nm	Days Underway (12+ nm)	Daily generation rate per vessel (kg Zn/day)			Annual generation rate per class (kg Zn/year)		
					In Port	Underway (0-12 nm)	Underway (12+ nm)	In Port	Underway (0-12 nm)	Underway (12+ nm)
MLB 47	64	305	30	0	7.0×10^{-3}	7.0×10^{-3}	0	1.4×10^{2}	13	0

Note: This analysis does not account for a vessel's time in drydock.

4.1.2 Uncertainty Information

It is estimated that 90% of aluminum-hulled vessels use advanced antifouling coatings, while the other 10% use foul-release coatings. The high use of advanced antifouling coatings is indicative of USCG findings that foul-release coatings are too vulnerable to damage to be cost effective as compared with the advanced antifouling coatings. As a result, there is uncertainty associated with the number of vessels coated with foul-release and with advanced antifouling coatings.

Foul-release coatings are not designed to release constituents and do not contain biocides. No studies have been conducted identifying or quantifying constituents released from foul-release coatings.

While the E Paint Company claims that only Sea-Nine211® is released from *E Paint SN-1*, no data exist to support this claim. A registration letter from EPA provides the release rate for Sea-Nine211® but does not mention zinc. A representative of the company stated that zinc was a pigment encased in the resin and not released to the environment (E Paint, 2003a). EPA does consider zinc oxide to be a biocide in this formulation (citation needed from EPA). The latest product data sheet on *E Paint SN-1* classifies the coating type as a copper and tin-free ablative matrix vehicle (E Paint, 2003b). Panels coated with the product are observed to wear or ablate in Navy tests suggesting the product does have ablative characteristics. There is uncertainty regarding the release rate of zinc from the *E Paint SN-1*. This analysis relies on the assumption that zinc is released at a rate proportional, by weight, to the release rate of Sea-Nine211®.

Seawater concentrations for Sea-Nine211® at varying distances from the hull were estimated assuming the constituents dilutes without degradation. This assumption introduces uncertainty because the Sea-Nine211® is known to have a short half-life in the marine environment. Therefore, this analysis used the conservative assumption that the Sea-Nine211® did not degrade in the marine environment.

Seawater concentrations for zinc at varying distances from the hull were estimated based on the assumption that zinc is released from the coating through the ablative process. Because the company claims that zinc is not released, the use of the ablative analysis introduces uncertainty. However, test panels coated with *E Paint SN-1* showed wear similar to ablative coatings and are the basis for the conservative assumption that the product is ablative (Lawrence, 2003).

4.2 ESTABLISH A MAXIMUM ALLOWABLE COPPER RELEASE RATE FOR ANTIFOULING COATINGS

No Armed Forces coating policy allows use of copper ablative coatings on aluminum vessels and the use of the copper ablative coatings on aluminum hulls is not recommended by vessel manufacturers (Navy, 2001a; USCG, 2001). Copper ablative coatings are not allowed on aluminum hulls because copper from the coating can deposit on the aluminum hull at scratches or defects and cause accelerated hull corrosion (Jones, 1992; Lamtec, 2001). Based on these broad prohibitions, the MPCD option to "Establish a Maximum Allowable Copper Release Rate for Antifouling Coatings" is not feasible for this vessel group; and therefore, no characterization was conducted (EPA and Navy, 2003d).

4.3 FOUL-RELEASE COATINGS

This option group does not vary among vessel groups. As stated in Section 2.3.1.2, International Intersleek 425 does not use biocides to control fouling, and the release of constituents is estimated to be negligible. Additional characterization is not necessary for this MPCD option group in this vessel group, because the physical parameters of the vessel group do not change from the baseline discharge, which is presented in Section 4.1.1.1.

4.4 ADVANCED ANTIFOULING COATINGS

The advanced antifouling coatings MPCD option group does not vary among vessel groups. The advanced antifouling coating, *E Paint SN-1*, is used as the basis for all analyses.

4.4.1 Characterization Data

Characterization of advanced antifouling coatings and the resulting discharge is presented in the following sections. Information supplied by the E Paint Company is the basis for all assumptions.

4.4.1.1 Physical Parameters

The physical parameters of the vessel group do not change among MPCD option groups. The MLB 47 class physical parameters are presented in Section 4.1.1.1.

4.4.1.2 Constituent Data, Classical Data, and Other Descriptors

Chemical data, field information, and descriptive information for the advanced antifouling coatings are presented in Section 2.4.1.2.

4.4.1.3 Discharge Generation Rates for Mass Loading

To estimate generation rates, all 71 vessels of the MLB 47 class were considered. The release rate supplied by E Paint Company for Sea-Nine211® was used for all calculations. Tables 4-8 and 4-9 present the estimated generation rates Sea-Nine211® and total zinc for the MLB 47 vessel class if all of the hulls were coated with *E Paint SN-1*. A full listing of vessel classes and characteristics for calculating generation rates and mass loadings is included in Appendix D.

Table 4-8. MLB 47 Vessel Class Estimated Generation Rates for Sea-Nine211® for the Advanced Antifouling Coatings MPCD Option Group

Class	Number of Vessels	Days In Port	Days Operating w/in 12 nm	Days Underway (12+ nm)	Daily generation rate per vessel (kg Sea-Nine 211/day)			Annual generation rate per class (kg Sea-Nine 211/year)		
					In Port	Underway (0-12 nm)	Underway (12+ nm)	In Port	Underway (0-12 nm)	Underway (12+ nm)
MLB 47	71	305	30	0	7.4×10^{-4}	7.4×10^{-4}	0	16	1.6	0

Note: This analysis does not account for a vessel's time in drydock.

Table 4-9. MLB 47 Vessel Class Estimated Generation Rates for Total Zinc for the Advanced Antifouling Coatings MPCD Option Group

Class	Number of Vessels	Days In Port	Days Operating w/in 12 nm	Days Underway (12+ nm)	Daily generation rate per vessel (kg Zn/day)			Annual generation rate per class (kg Zn/year)		
					In Port	Underway (0-12 nm)	Underway (12+ nm)	In Port	Underway (0-12 nm)	Underway (12+ nm)
MLB 47	71	305	30	0	7.0×10^{-3}	7.0×10^{-3}	0	1.5×10^{2}	15	0

Note: This analysis does not account for a vessel's time in drydock.

4.4.2 Uncertainty Information

The uncertainty information for this vessel group and MPCD option group is the same as the Steel, Composite, and Other Non-Aluminum Rigid Hulls vessel group and advanced coatings option group. Refer to section 2.4.2 for uncertainty information.