



This document is part of Appendix A, and includes Hull Coating Leachate: Marine Pollution Control Device for the "Phase I Final Rule and Technical Development Document of Uniform National Discharge Standards (UNDS)," published in April 1999. The reference number is EPA-842-R-99-001.

Phase I Final Rule and Technical Development Document of Uniform National Discharge Standards (UNDS)

Hull Coating Leachate: Marine Pollution Control Device

April 1999

HULL COATING LEACHATE MARINE POLLUTION CONTROL DEVICE (MPCD) ANALYSIS

Several alternatives were investigated to determine if any reasonable and practicable MPCDs exist or could be developed for controlling discharges from hull coatings. An MPCD is defined as any equipment or management practice, for installation or use onboard a vessel, designed to receive, retain, treat, control, or eliminate a discharge incidental to the normal operation of a vessel. Phase I of UNDS requires several factors to be considered when determining which discharges should be controlled by MPCDs. These include the practicability, operational impact, and cost of an MPCD. During Phase I of UNDS, an MPCD option was deemed reasonable and practicable even if the analysis showed it was reasonable and practicable only for a limited number of vessels or vessel classes, or only on new construction vessels. Therefore, every possible MPCD alternative was not evaluated. A more detailed evaluation of MPCD alternatives will be conducted during Phase II of UNDS when determining the performance requirements for MPCDs. This Phase II analysis will not be limited to the MPCDs described below and may consider additional MPCD options.

MPCD Options

Hull coating leachate refers to the transfer by diffusion or ablation of coating constituents from the underwater portion of a vessel's hull into the water. The anticorrosive (AC) and antifouling (AF) coating system minimizes adhesion and propagation of marine fouling organisms on the hull surface which increase drag, and prevents costly structural damage to the hull (metal or material loss) which would otherwise result from long-term exposure to seawater. Without effective antifouling coatings, ships' hulls would have to be cleaned or dry docked and repainted much more frequently; thereby expending time, money, and manpower, while compromising operational readiness.

To determine the practicability of mitigating the potentially adverse environmental effects of hull coating leachate, three potential MPCD options were investigated. The purpose of these MPCDs would be to reduce or eliminate the release of antifouling agents, specifically copper and tributyltin, from antifouling hull coatings. The MPCD options were selected based on initial screenings of alternate materials, equipment, pollution prevention options, and management practices. They are listed below with brief descriptions of each:

Option 1: Use Less Toxic Fouling Release Coatings - This option would require that hulls be coated with less toxic paints that may initially foul, but readily release fouling organisms when the vessel reaches a target speed.

Option 2: Control the Maximum Allowable AF Release Rate - This option would set limits on the maximum allowable release rate of copper from fouling resistant coatings to a level known to effectively control fouling but not cause an excess of copper to be released.

Option 3: Limit or Eliminate Use of Tributyltin (TBT) Paints - The goal of this option is to further reduce or eliminate the use of TBT paints on Armed Forces vessels.

MPCD Analysis Results

Table 1 shows the results of the MPCD analysis. It contains information on the elements of practicability, effect on operational and warfighting capabilities, cost, environmental effectiveness, and a final determination for each option. Based on these findings, Option 2 – establishing the maximum release rate of copper in AF coatings, and Option 3 – further restricting the application of TBT paints on vessels of the Armed Forces, offer the best combination of these elements and are each considered to represent a reasonable and practicable MPCD.

Table 1. MPCD Option Analysis and Determination

MPCD Option	Practicability	Effect on Operational & Warfighting Capabilities	Cost	Environmental Effectiveness	Determination
<p>Option 1. Use Less Toxic Fouling Release Coatings</p>	<p>Since 1993, the Navy has been investigating non-polluting antifouling hull coatings and, as part of this program, silicone-based coatings are being tested on Navy ships. When the tests are completed, the coating must demonstrate a five to twelve year service life, ease of self and mechanical cleaning, good adhesion to various hull substrates, and overall durability. The coating may not be suitable for low speed ships.</p>	<p>If the new coating does not perform on Navy ships as well as the current coatings, marine fouling will increase, detrimentally affecting the ship's acoustic signature, vessel speed, endurance, maneuverability, and fuel consumption.</p>	<p>Costs for this option include research and development costs and an estimated four-fold increase in paint costs. If the self-cleaning coating is not as effective at bio-fouling prevention as current hull coating technologies, maintenance costs will increase and fuel costs could increase by 15%.¹ If the self-cleaning coating is effective, maintenance costs will decrease. Disposal costs will decrease because hazardous waste is no longer generated.</p>	<p>Use of less toxic coatings would significantly reduce the amount of copper and zinc discharged from antifouling hull paints.</p>	<p>Using less toxic fouling release coatings would reduce toxic discharge levels, but may not effectively prevent hull fouling which would adversely affect ship capabilities and increase fuel and maintenance costs. The technology has not yet been proven aboard vessels of the armed forces.</p>
<p>Option 2. Control the Maximum Allowable AF Release Rate</p>	<p>This option could be implemented by establishing a maximum copper release rate that is near the release rate of the lowest acceptable release rate. The Navy has tested ablative copper paints containing 28-32% cuprous oxide, as opposed to the standard 40-50%.² These trial formulations of AF coatings did not prevent fouling. Setting the release rate below what is determined to be effective</p>	<p>Ship capabilities will not be affected if limits are set near current copper release rates. If the maximum copper release rate is set below what is effective in preventing hull fouling then noise emissions will increase, affecting acoustic signature; maximum speed will decrease; and the frequency of hull cleanings will increase, affecting ship mobility and availability.</p>	<p>In order to accurately define minimum copper release rates, it would cost an estimated \$300K to \$500K. If hull fouling is not adequately prevented, there will be an increase in fuel and maintenance costs.</p>	<p>This option would prevent future increases in ambient water concentrations of copper from hull coatings, and would potentially reduce copper discharge quantities.</p>	<p>Establishing a maximum copper release rate: 1) can be implemented, 2) would be inexpensive to institute, and 3) would prevent future increases in copper loadings. This MPCD warrants further consideration in Phase II.</p>

MPCD Option	Practicability	Effect on Operational & Warfighting Capabilities	Cost	Environmental Effectiveness	Determination
Option 2 (continued)	would be impractical because of the potential for excess fouling and increased rates of hull cleaning.				
Option 3. Limit or Eliminate Use of TBT Paints	The Armed Forces have been phasing out the use of TBT paints since 1988, and replacing them with copper- or silicone-based coatings. Copper-based AF paints accelerate corrosion of aluminum substrates. Newer silicone-based coatings are only effective when the vessel reaches a minimum effective speed, which some Navy and USGS vessels are unable to attain. Exceptions could be provided for critical use vessels.	No AF alternative as effective as TBT self-polishing copolymer paint has been found so, without the use of TBT, underwater hull fouling is expected to increase causing a negative impact on acoustic signature, maximum ship speed, hull cleaning frequency, and ship readiness.	Assuming TBT paint is replaced by silicone-based easy release coatings, material costs could increase by \$91K for all remaining small boats, fuel costs will increase, and maintenance costs may increase if ships have to be recoated more frequently, yet disposal costs will decrease since TBT is a hazardous waste.	Prohibiting the use of TBT as an antifouling hull coating for non-critical Navy and USCG small boats will be effective in reducing TBT loadings. Approximately 80% of the estimated 11 kg (24 lbs) of TBT released annually by the Armed Forces could be eliminated. If replaced by copper-based AF coatings, total copper loading from hull coatings will increase slightly.	Further restricting the use of TBT paints is: 1) reasonable to implement, 2) not cost prohibitive, and 3) will significantly reduce TBT loadings in the environment. Therefore, this MPCD option warrants further consideration.

REFERENCES

- ¹ Naval Ships' Technical Manual S9086-CQ-STM-010 R3 Chapter 081, Waterborne Underwater Hull Cleaning of Navy Ships. 4 August 1997. Page 1-1.
- ² EPA and the Secretary of the Navy. "Congressional Report on Alternatives to Organotin Antifoulants and Alternative Antifoulant Research." December 1996. Pages 8, 29.