SB

266

SENATOR LOREN LEMAN

Northwest Anchorage

716 W 4th Ave, Ste 540, Anchorage AK 99501 258-8189 Session: State Capitol, Juneau AK 99801 465-2095

MEMO

TO: Representative Bill Hudson, Co-Chairman
Representative Beverly Masek, Co-Chairman
House Resources Committee

FROM: Senator Loren Leman, Sponsor

DATE: March 9, 2000

RE: Scheduling Senate Bill 266: Marine Anti-Fouling Paints

Please schedule at your earliest convenience a House Resources Committee hearing on SB 266, which would repeal exemptions in Alaska law for certain vessels using tributyltin (TBT) antifouling paint.

This paint has been banned from use in Alaska since 1987 on boats smaller than 4,000 gross tons; and nationwide on boats smaller than 25 meters in length and those with aluminum hulls.

The International Maritime Organization has proposed banning TBT paint, effective 2003, with all TBT-based paints to be phased out by 2008. It is clear that the maritime industry is aware of the eventual banning of TBT paints on all vessels because the U.S. Coast Guard, U.S. Navy, the Alaska Marine Highway System and barge owners have stopped using it, despite the fact that it is very effective at preventing the growth of marine organisms on boat hulls.

SENATOR LOREN LEMAN

Northwest Anchorage

716 W 4th Ave, Suite 520, Anchorage, AK 99501 (907) 258-8189
Session: State Capitol, Juneau, AK 99801 (907) 465-2095
Web Site: http://www.akrepublicans.org/Leman.htm
Email: Senator_Loren_Leman@legis.state.ak.us

SPONSOR STATEMENT
CS SB 266(RES): Antifouling Paint

According to the U.S. Environmental Protection Agency, Tributyltin (TBT) antifouling paint has been shown to cause reproductive and other adverse effects to shellfish even at very low levels of exposure. Antifouling paints are applied to boat bottoms to reduce the growth of marine organisms such as barnacles and algae. But, when research showed that the paint was affecting more than just the barnacles and algae, Congress passed the Organotin Antifouling Paint Control Act in late 1988, restricting the use of these paints to larger ships and those with aluminum hulls. The International Maritime Organization has proposed banning the use of TBT, effective 2003, with all TBT-based paints to be phased out by 2008.

The Alaska Legislature outlawed the use of TBT paints in 1987, except for:

- Vessels of the U.S. Government
- Foreign vessels in state waters fewer than 90 consecutive days
- Vessels of 4,000 gross tons or more

CS SB 266(RES) disallows application of TBT-based paint to these vessels effective 2001, putting these vessels in the same class as small boat owners who had to meet the ban in 1987.

FISCAL NOTE No. 1

STATE OF ALASKA
2000 LEGISLATIVE SESSION

Bill Version: CSSB 364(RES)
(S) Publish Date: 3-2-00

Revision Date/Time (Note if correction) _____
Dept. Affected Environmental Conservation
Title Marine Anti Fouling Paints
BRU Environmental Health
Component Laboratory Services
Sponsor Senator Lehman
Requester Senate Resources
Component No. 2065

Expenditures/Revenues (Thousands of Dollars)

Note: Amounts do not include inflation unless otherwise noted below.

OPERATING EXPENDITURES	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Personal Services						
Travel						
Contractual						
Supplies						
Equipment						
Land & Structures						
Grants & Claims						
Miscellaneous						
TOTAL OPERATING	0.0	0.0	0.0	0.0	0.0	0.0
CAPITAL EXPENDITURES	0.0	0.0	0.0	0.0	0.0	0.0
CHANGE IN REVENUES ( )	0.0	0.0	0.0	0.0	0.0	0.0

FUND SOURCE (Thousands of Dollars)

1002 Federal Receipts						
1003 GF Match						
1004 GF						
1005 GF/Program Receipts						
1037 GF/Mental Health						
Other (Specify Type)						
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0

Estimate of any current year (FY2000) cost: 0.0

POSITIONS

Full-time	0	0	0	0	0	0
Part-time	0	0	0	0	0	0
Temporary	0	0	0	0	0	0

ANALYSIS: *(Attach a separate page if necessary)*

There are no fiscal impacts to the Department

Prepared by: Mary Siroky
Phone 465-5355
Division Division of Statewide Public Service
Date/Time 2/28/00 11:49 AM
Approved by Commissioner Kurt Fredriksson for
Date 2-28-00
Agency Department of Environmental Conservation

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Shipyard Wastewater Treatment

12/6/99

The Center for Advanced Ship Repair and Maintenance (CASRM), at Old Dominion University in Norfolk, Virginia was recently awarded a contract by US EPA for $1,155,200 for work associated with Tributyltin (TBT). TBT is the most toxic compound mankind has introduced into the marine environment as a biocide in antifouling paints. Under this contract CASRM will develop water treatment technologies to remove TBT, from shipyard wastewater and operate a demonstration pilot plant to treat 500,000 gallons of shipyard washdown wastewaters.

The Director of CASRM, Dr. Tom Fox, indicated that this funding is timely since a global ban on the use of TBT is under consideration at the International Maritime Organization in London. Dr. Michael A. Champ, former EPA science advisor who helped write the U.S. Organotin Act, will serve as the technical consultant to the project. Research and technology development will be carried out at Old Dominion University and the Virginia Institute of Marine Science.

Those requiring background information would find an interesting brief paper b Dr. Michael Champ entitled "Incorporating Good Environmental Science in the Current Organotin RegulatoryDebate" invaluable. Contact Dr Champ at machamp@aol.com for an emailed copy. Over the past 30 years he has served in many roles in academia, government and industry. In the mid 1980s hewas a Senior Science Advisor at EPA and was extensively involved in the Special Review for TBT and helped write for Congress the Antifouling Paint Control Act of 1988. He has co-chaired 3 international conferences on Organotins and authored over 300 scholarly publications and 5 books related to environmental and marine sciences.

Dr Champ

THINKS NAVY & AK FERRIES USE SAME PRODUCT

ENVIRONMENTAL ISSUES: EPA Reports on Tributyltin Boat-Bottom Paint

EPA sent a report to Congress on May 30, detailing the status of environmental monitoring for tributyltin (TBT). TBT is an organometallic pesticide used in boat-bottom paint to prevent growth of fouling marine organisms. TBT antifouling paints and their adverse effects on the environment are the target of Organotin Antifouling Paint Control Act (OAPCA) of 1988 and other federal and state restrictions.

TBT has been shown to cause reproductive and other adverse effects to shellfish and other non-target aquatic organisms at very low levels. OAPCA requires that EPA and the Navy report annually on monitoring. The May 1997 report also includes the results of research into chemical and nonchemical alternatives to TBT, and EPA's evaluation of the effectiveness of laws and regulations in reducing the risks of TBT.

Both EPA and Navy data document that TBT levels in the water column are dropping. Despite this decline, EPA concluded that levels are still too high. The status of TBT in coastal and estuarine sediments, where many affected species dwell, is less certain.

The reduction of TBT concentrations in domestic waters is due to restrictions on the use of anti-fouling paints in the United States. Use is prohibited on non-aluminum hulls and vessels less than 82 feet in length. There is a limit on the release rate of TBT from paint. TBT may only be applied by persons specifically trained and certified (or to persons under their direct supervision). All TBT paint waste must be disposed in sanitary landfills and not in the water. The Navy no longer uses TBT antifouling paints. NAVY NO LONGER USES TBT

The continued hazard TBT poses is tied to remaining domestic uses, and to the use of TBT on ocean-going vessels which are painted overseas and which travel to American ports. EPA has determined that additional restrictions are need to reduce levels in water. In the May '97 report, the agency suggested to Congress that the manufacture and use of TBT anti-fouling paints be phased out in this country, to be replaced by safer alternatives. Some alternatives are currently available and others are in development. EPA is cooperating with the International Maritime Organization on a proposal for a global TBT phase-out, and is refining its TBT risk assessment for use in pursuing appropriate action under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

U.S. EPA Press Release: Friday, June 20, 1997

VIRGINIA TECH PESTICIDE PROGRAM NEWS

Virginians Participate in the 1997 National Pesticide Applicator Certification and Training Workshop

The *1997 National PAT&C Workshop* was held June 9-12 in Columbus Ohio. This biennial program is sponsored by USEPA and USDA for pesticide regulators, Cooperative Extension pesticide safety educators, and other interested parties.

Kathy Dictor (VDACS) and Brian Swingle (WI) were co-presenters of *Using Technology to Manage Certification Information* This session discussed and demonstrated the use of automated testing, electronic filing, and other tools for managing certification status data.

FROM - "Virginia Agricultural Chemical News"
MAY / JUNE, 1997

ARCO

ARCO Marine, Inc.
300 Oceangate
Long Beach, California 90802-4341
Telephone 562 590 4524

John L. Sullivan
Vice President
Engineering

February 29, 2000

Senator Loren Leman
Alaska State Senate
State Capitol, Room 115
Juneau, Alaska 99801-1182
Via Fax: (907) 465-3810

Re: SB 266

Dear Senator Leman:

This letter responds to your inquiry concerning the use of TBT based paints by ARCO Marine, Inc. We have been using U.S. EPA approved TBT antifouling paints on our existing vessels in compliance with all state and federal requirements.

In harmony with the 1999 IMO agreement on the ban of TBT based paints in the future, our three new Millennium Tankers will be coated with only tin-free materials. ARCO Marine, Inc. intends to comply with the IMO agreement for the remaining tankers in our fleet on or before the date that agreement goes into effect.

Thank you for giving us the opportunity to discuss this issue with you.

Please feel free to contact me at (562) 590-4524 if you have any additional questions.

Sincerely,

John L. Sullivan
Vice President, Engineering

ARCO Marine, Inc. is a subsidiary of Atlantic Richfield Company

Alaskan Shellfish Growers ASSOCIATION

February 21, 2000

Honorable Loren Leman
Capitol Building, Room 115
Juneau, AK 99801

Dear Senator Leman:

The Alaskan Shellfish Growers Association (ASGA) strongly endorses your legislation (Senate Bill 266) to plug up a loop hole in a state law banning the use of marine defouling paints using tributyltin (TBT).

As someone who had actively worked for the 1987 ban on TBT-based bottom paints, my initial reaction to your legislation was surprise. It turns out that we had left loop holes in the ban large enough to drive through an entire fleet of huge cruise ships.

The U.S. government no longer uses TBT-based bottom paints and Alaska huge fleet of commercial vessels have phased out the dangerous substance within a couple years of imposition of the ban. As an industry that is based upon selling the public on Alaska's unspoiled image, the cruise ship operators should be shame-faced for continuing to use a defoulant that has been proven to damage the marine environment.

TBT is designed to kill shellfish and many other marine organisms. As shellfish farmers, we don't think it's a good idea to allow vessels to use products that can kill our crops.

Please let me know if there's anything we can do to support your legislation.

Sincerely,

Rodger Painter
ASGA Vice-president

Rodger Painter, vice-president ✦ P.O. Box 20704 Juneau,AK 99802 ✦ Phone/fax: (907) 463-3600

STATE OF ALASKA

DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

OFFICE OF THE COMMISSIONER

TONY KNOWLES, GOVERNOR

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PHONE: (907) 465-3900

March 1, 2000

The Honorable Loren Leman
Alaska State Legislature
State Capitol, Room 115
Juneau, AK 99801-1182

Dear Senator ~~Leman~~ Loren:

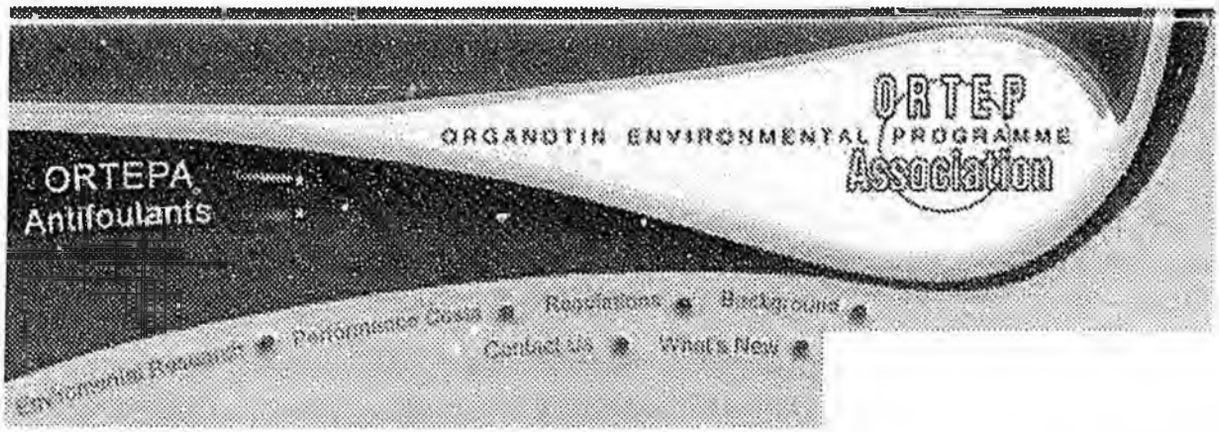
This letter is regarding the bill you sponsored, SB 266, concerning Marine Anti-Fouling Paints.

I wanted to advise you that all vessels of the Alaska Marine Highway System have anti-fouling bottom paints that are free of any type of Tributyl Tin (TBT) or any related tin compound. Tin free anti-fouling bottom paints have been in use aboard AMHS vessels for at least the last five years. The current coating system in place is approved for use on all government and public vessels of the US Navy, US Coast Guard, NOAA ships as well as MARAD vessels.

I trust that this information will be helpful to you in your efforts to protect Alaska's marine environment. Thank you for your continuing support of the Alaska Marine Highway and your coordination efforts in this legislation.

Sincerely,

Joseph L. Perkins, P.E.
Commissioner



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Commonly Asked Questions Regarding The Current Status Of Tributyltin (TBT)-Based Antifouling Paints

I. General Information

What is antifouling paint?

Antifouling paint is applied to the hulls of vessels to prevent fouling.

Fouling (the growth of organisms such as barnacles and algae) is a natural phenomenon that occurs continuously and vigorously in an aquatic environment. Fouling causes drag and slows vessel speeds, resulting in increased fuel consumption and a loss of maneuverability.

Historically TBT free-association paints were used on ship hulls to prevent fouling. TBT free-association paint is a type of antifoulant paint in which the biocide is not chemically bound and leaches freel from the paint. Since the late 1980s, TBT-self polishing copolymer (SPC) paints have replaced the free-association paints on ship hulls. Self-polishing copolymer paints, in which the TBT biocide is chemically bonded throughout the coating, allow application of thicker paint coatings and result in a slow, uniform release of the biocide. SPC paints are more effective than free-association paints at preventing fouling and reducing frictional drag, while reducing the amount of the biocide leached from the paint.

What are the benefits of using TBT-based antifouling paints vs. TBT-free paints?

•Definitions

TBT-SPC based antifouling paints provide the highest degree of reliable and consistent fouling protection. An interval of five to seven years between dry-dockings for vessels with TBT-SPC based paints is guaranteed versus a docking interval of three years for vessels using other paints, resulting in lower operating costs for ship owners and operators.

Are TBT-free products as effective or efficient for use on deep-sea vessels?

No. Although advances in technology have narrowed the performance gap between TBT and other antifouling systems for small vessels, no comparable antifouling systems are currently available for use on large, deep-sea vessels.

TBT-free systems for deep-sea vessels are still in the early stages of testing. These systems currently allow only up to three years between dry-docking, and may still require additional cleaning to remove fouling. In addition, there is little to no data on the environmental effects of TBT-free alternatives

How do TBT-based paints work to prevent fouling?

TBT-SPC based paints are applied to ship bottoms to protect them from fouling. The TBT-SPC (tin is the primary active ingredient) in the paint slowly releases into the aquatic environment to prevent attachment of aquatic organisms.

II. Environmental Safety and Regulation

Why is TBT regulated?

The first use of TBT-based antifouling paints began in the early 1970s. In the mid 1980s, researchers in France and the United Kingdom suggested that the use of TBT in antifouling paints was adversely effecting certain non-target organisms (organisms other than fouling organisms) such as some oyster and snail populations. This concern led to environmental regulations to limit the usage, and in some cases the release rate, of antifoulant paints containing TBT.

How is TBT currently regulated?

The US Congress passed the Organotin Antifouling Paint Control Act (OAPCA) in late 1988. This Act restricted use of TBT-containing paints to ships larger than 25 m in length and those with aluminum hulls. Worldwide regulations on TBT-based paints vary. Some countries have no restrictions in place on the use and release rate of TBT antifouling paints, others, including Japan, France, and several North Sea states have more stringent restrictions in place. At the same time, dockyard restrictions were implemented to control discharge.

How effective are antifouling paint regulations?

More than 10 years of research has demonstrated that TBT concentrations in water, sediment and aquatic life have been declining since regulations were put in place. These declines have been observed in the US as well as in other countries around the world. Open oceans, including international shipping lanes are largely free of TBT at biologically significant levels.

Research also has shown that current regulations are successfully limiting environmental impacts in coastal areas (e.g., marinas, harbors and shipyards). Monitoring results indicate that the distribution of TBT is restricted to the immediate proximity of the TBT source. Areas nearby a TBT source showed low or undetectable concentrations of TBT. Moreover, field studies have shown that snail and oyster populations in countries such as France and Britain have recovered substantially since regulations were put in place.

How do you define risk to the environment?

Risk occurs when the organisms that society values are affected to such a degree that their populations decline. Typically, we are concerned first about potential risks to human health. Then, we are concerned about species that we harvest (fisheries), species that we fear may become extinct (endangered species), or animals that we relate to emotionally (sea otters , dolphins, birds). There is no evidence that TBT is posing risks to any of these species or values (Green et al. 1997, Robinson et al. 1999, Cardwell et al. 1999, Keithly et al. 1999).

What has been the effect of regulations on long-term (chronic) risks to aquatic life?

TBT monitoring data from pre-1989 through 1996 at marinas, harbors, and shipyards around the world have revealed declining

chronic risks to aquatic life. Although TBT exposure remains higher in marinas, it continues to decline. In fact, concentrations in marinas show the sharpest decline among the different sites monitored. More importantly, since 1986 risks have declined to levels below that recommended by the US EPA for the protection of an aquatic community.

In addition to declining environmental TBT concentrations, the regulations for TBT use have been effective in the recovery of populations of sensitive animals, such as oysters and some marine snails. Dramatic recoveries over the past decade are evident when comparing historical monitoring sites during uncontrolled use of TBT to the same monitoring sites under current regulations.

What is known about TBT in sediments?

While available scientific data on this topic are limited, there are several important findings that should be considered:

- TBT "binds" to sediments, and
- Sediment can serve as a repository for TBT

Sediments serve as a sink (repository) for TBT due to its strong tendency to bind (sorb) to particulate matter. However, persistence in sediment does not equate to risk of adverse effects, regardless of how high the sediment concentrations are. Rather, it is indicative of a TBT source. When TBT is strongly attached (sorbed) to sediment, it is not readily available for uptake by the animals when it is eaten or breathed (i.e., it is not very bioavailable).

- Only a small fraction of sediment-bound TBT is bio-available to aquatic life, and
- TBT bound to sediments is much less likely to cause adverse effects and decomposes quickly if not bound

The TBT that is not bio-available is not in a form that can pose risk to aquatic life. TBT, when biologically available, is broken down by virtually all organisms, from bacteria to algae to invertebrates, fish, mammals, birds, and people (Bryan and Gibbs 1991; Lee 1985; 1991). It degrades in a matter of days to a few weeks, depending on temperature. Additional research is being conducted to better understand bioavailability and other factors controlling biological exposure.

- Recent studies have shown that concentrations of TBT in sediment are declining following the implementation of regulations.

Are there any risks to people eating seafood caught in areas where TBT has been measured?

According to several recent studies conducted in Europe, Asia and North America, TBT is not causing seafood to be unsafe for human consumption.

Are workers applying TBT-SPC based paints at risk?

Inhalation and skin exposures to workers have been evaluated and there have been no reports of respiratory problems or skin irritation. TBT compounds have not been demonstrated to be neurotoxic, or to represent mutagenic, teratogenic, or carcinogenic hazards to people. TBT has been in use for more than 30 years, and there is extensive information from the medical surveillance of employees i organotin production that there are no reports on cases of acute systemic poisoning or of long-term adverse effects in humans.

Is TBT the cause of death in dolphins?

Mass mortalities of dolphins occurred in several locations around the world between 1987 and 1991. No one knows the cause of these deaths although it is thought that the dolphins died of viral diseases resulting from damage to immune systems. Several causes have been postulated - brevetoxins, morbillivirus, metals, organochlorines and most recently TBT, but a cause-and-effect relationship has not been established. Further studies are required tc determine what caused the dolphin mass mortalities. Caution must be used when making statements about tissue concentrations of any chemical and how these concentrations may adversely affect an animal. The mere occurrence of a chemical in an organism means nothing by itself with respect to risk.

Does TBT accumulate in organisms?

TBT can accumulate in organisms like many other metals and organic chemicals; however, the presence of a chemical in an organism's tissue does not necessarily equate to an adverse effect. The important question is whether the accumulation has been great enough to pose risks to the organism or to other organisms that may eat it. In addition, it is important to determine if an accumulation of a substance in an organism "biomagnifies" in a foo web. A substance biomagnifies if the tissue concentration of the lower trophic level organism (i.e. oyster) increases exponentially in

the tissue of the organism (i.e. human) that eats it. Chemicals known to biomagnify in food webs include PCB's and DDT.

Virtually all aquatic animals, wildlife, and people rapidly (within a few weeks) metabolize and excrete TBT; therefore, it cannot be biomagnified. There is no evidence to suggest that TBT biomagnifies in aquatic food webs. Based upon its properties and metabolism by many organisms, TBT is unlikely to be comparable to other chemicals known to biomagnify.

Are TBT-free antifouling paints environmentally safe?

TBT-free does not necessarily mean environmentally safe. In fact, little data exist on the potential long-term risks to people, fish, birds and other aquatic creatures from the use of TBT-free paints and biocides. Understanding the full environmental impacts of these products is difficult without more comprehensive scientific research and evaluation.

Many of the new TBT-free antifouling paints require supplements of toxic biocides and/or high loadings of copper compounds to function effectively. Environmental concentration data are sparse and of limited relevance given that these biocides are not currently used on the scale they would be if an international TBT ban were imposed. Although critical data gaps exist on the chronic toxicity of alternatives to TBT and their impact on the environment, available data suggest that these biocides will, at some level, have adverse effects on the marine environment. For example, one alternative, Irgarol® 1051, has been used in antifoulant paints and already appears to be causing harm (Evans 1999). It has been detected at concentrations approaching acute toxicity thresholds along the coast of England and in the Mediterranean (Tolosa et al. 1996; Tolosa and Readman 1996; Zhou et al. 1996; Gough et al. 1994; Law et al. 1994; Readman et al. 1993). Irgarol® 1051 also occurs at concentrations high enough to damage microalgal communities off the west coast of Sweden (Dahl and Blanck 1996; Evans 1999).

III. Current Regulatory Issues

What is the current status of ongoing United Nations review of TBT regulations?

Despite the success of the current restrictions reducing TBT usage and its effects in the environment, a total ban on TBT-SPC based antifouling paints has become a current topic of political debate. The International Maritime Organization (IMO)of the United Nations is considering a proposal to further regulate the use of

TBT-based antifouling paints.

In considering the future use of TBT-SPC based antifouling paints, care should be used in making a decision that could ultimately prove more harmful to the environment and incur unnecessary costs to the worldwide shipping industry. A scientifically proven, environmentally safe alternative to TBT-SPC based paints must be established before a worldwide ban goes into effect. Sufficient time to systematically test and evaluate alternatives to TBT to ensure environmental safety must be allowed.

Until a proven-effective, environmentally sound alternative is available, implementation of worldwide IMO recommendations on restricting TBT free-association paints, lowering release rate limits, improving application techniques and sound shipyard activities, will further minimize the impact on the environment.

What will be the cost of a premature ban?

According to a recent Cost Analysis conducted by Princeton Economic Research Institute, alternative paints were calculated to be one to four times more expensive than TBT-based paints due to fuel penalties as well as higher dry-docking and paint costs. Estimated annual costs to the world fleet to switch from TBT-SPC based antifoulants to TBT-free alternatives range from $500 million to over $1 billion. A potential $1 billion loss to the worldwide shipping industry is a matter of serious economic significance that will ultimately impact consumers.

ORTEP Association - Antifoulants
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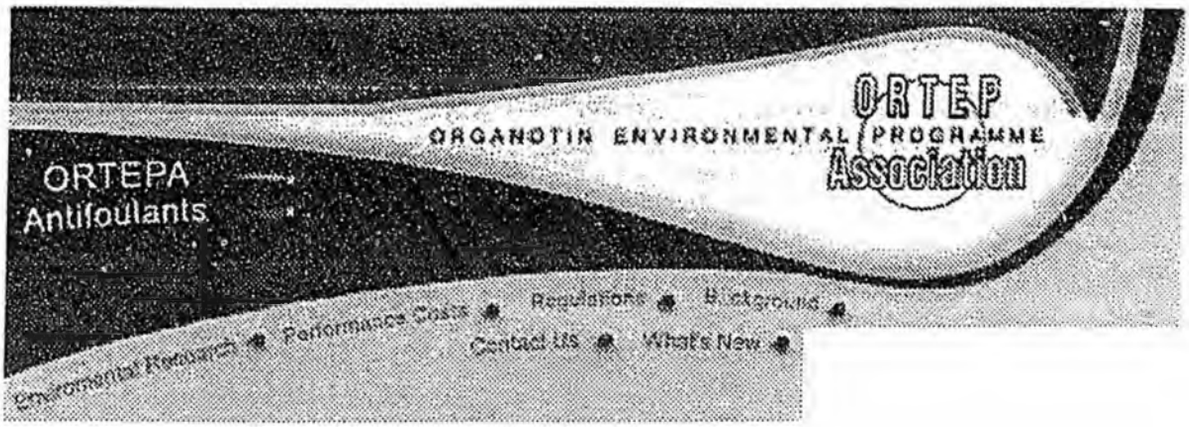

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Data Gaps in the Comparison of Tributyltin Self-Polishing Copolymer (TBT SPC) to Tin-Free Antifouling Paints

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Data Gaps in the Comparison of Tributyltin Self-Polishing Copolymer (TBT SPC) to Tin-Free Antifouling Paints

	TBT SPC	Copper Acrylates[1]	Silane Methacrylates[2]	Ion Exchange Copolymers[3]	Copper Ablatives[4]	Other Combination Technologies[5]
Extant Environmental Monitoring Data	Extensive (ongoing since 1980s)	No published data	No published data	No published data	Limited published data	No published data
Extant Aquatic Toxicity Data	Acute and chronic data available	No published data	No published data	No published data	Limited acute data available	No published data
Chronic Risk Assessment	Yes	No	No	No	No	No
Volatile Organic Compounds (VOCs)	Less than 30%	32-33%	Less than 30%	No published data	Less than 30%	No published data
Worker Exposure Study	Studies demonstrate no risks to properly equipped workers	No published data	No published data	No published data	No published data	No published data
Booster Biocide	Cu_2O (lower than 15%)	Cu_2O (40%) Cu-pyrithione (5%)	Cu_2O (40-53%) Cu/Zn pyrithione (3-6%)	No published data	Cu_2O (ca. 40%) and others (Irgarol® 1051[6], Sea-Nine® 211[7] Zn-pyrithione, etc.)	Irgarol® 1051, Sea-Nine® 211 Zn-pyrithione, etc.
Contains Leachable Chlorinated Plasticizer	No	Yes	Yes (in some formulas)	No published data	Yes	No published data
Proven Dry-Docking Interval	Data for over 60 months are available	Manufacturer reports data for 36 months are available	No published data	No published data	Data for 30-36 months are available	Manufacturer reports data for 6-15 months are available
Antifouling Performance	96% of vessels return with satisfactory performance after 60	Paint manufacturer reports 90% satisfactory performance	No published data	No published data	70-74% satisfactory performance after 30-36 months	No published data

	months	after 36 months				
Cost Comparison	Not applicable	2 to 2.5 times the cost of TBT SPC[8]	No published data	No published data	2.5 to 4 times the cost of TBT SPC[8]	No published data
Paint Shelf Life	Longer than 12 months	2-3 months (temperature dependent)	No published data	No published data	No published data	No published data
Film Integrity	Excellent film properties, no cracking or detachment	Excellent film properties, no cracking	No published data	No published data	Poor film properties, prone to cracking and detachment	No published data
Overcoating Properties	Proven satisfactory results after high pressure freshwater surface preparation	Manufacturer reports satisfactory results after high pressure freshwater surface preparation	No published data	No published data	Expensive and time consuming surface preparation, slow drying times	No published data
Leaching Properties	Excellent; very thin active zone 10-90 nm; effective under static conditions	Fair; active zone 15000-25000 nm; no available data under static conditions	No published data	No published data	Ineffective; thick, mechanically weak, insoluble, inhibits biocide release; ineffective under static conditions	No published data

Footnotes

1. Such as Intersmooth Ecoloflex and Nippon Ecoloflex SPC
2. Such as Sea Grand Prix, Takata Quantum and Nu Trim
3. Such as Exion
4. Such as Amercoat 279, Hempel's Nautic, Intersmooth Tin-Free, Antifouling Seavictor, Sigmaplane Ecol Antifouling
5. Such as E Paint, a combination of catalyzed hydrogen peroxide and zinc/copper pyrithione
6. Irgarol® 1051 is a registered trademark of Ciba Specialty Chemicals.
7. Sea-Nine® 211 is a registered trademark of Rohm and Haas Company.
8. Cost-Benefit Analysis of TBT Self-Polishing Copolymer Paints and Tin-Free Alternatives for Use on Deep-Sea Vessels, Princeton Economic Research, Inc., Parametrix Inc., 1998.

Radio National

earthbeat

with Alexandra de Blas
on Saturday 6/03/99

The Ban on Toxic Marine Anti-Fouling Paints

Summary:

In just under four years Tributyltin (TBT) an organic compound used to keep the bottom of boats clean will be banned. We look at why it's a problem and the alternative products that are likely to replace it.

Details or Transcript:

Last November the International Maritime organisation banned the use of tributyltin or TBT and organic compound that's used in anti-fouling paint on ships. The ban starts on 2003 and all TBT based paints are to be phased out by 2008. Residues of TBT have been found throughout the world particularly in shore sediments near shipping activity and it's known to effect sexual development in shell fish.

Some countries including Japan and New Zealand have already banned tributyltin paints. In Australia only vessels longer than 25 metres are allowed to use these paints in most states. The trouble is at present 70% of the world's fleet use TBT based products and four years to find an effective replacement isn't a lot of time. Janet Parker.

Janet Parker: Tributylin is a broad spectrum biocide. it was first invented for terrestrial applications but since the mid 60s it's also been used to keep boat hulls free of algae and barnacles. In open water tributylin breaks down quite quickly but in the 1980s researchers found TBT was severely contaminating many estuaries and bays.

It can cause deformities in oysters and sex changes in marine snails. Elevated levels have now been found in other marine animals such as otters, dolphins and squid. Australia's Defence Science and Technology organisation has been a leader in the testing of safer alternatives. I asked John Lewis, a senior scientist with the Aeronautical and Maritime Research Laboratory why TBT paint has been so popular.

John Lewis: Anti-fouling paints were first introduced in the middle of the last century and copper was the main biocide at that time. With even the advances over the successive century, the longest life you would get out of a copper based paint was to the order of 12 to 18

months. The tributyl tins are a broad spectrum biocide but the type of paint that they were able to develop from the compound known as a copolymer paint enabled paints to be formulated which would last for 5 or more years. These paints actually self polished in service so the performance of the paint actually improved with time and this gave considerable savings to the ship owner through both reduced docking times and also the improved performance of the ship.

Janet Parker: Now the IMO, the International Maritime Organisation has taken steps to try and introduce a ban on TBT paints. What kind of alternative methods of preventing marine fouling are available?

John Lewis: At this particular time the main alternative to tributyltin paints are still the copper based paints very similar to what we were using a century ago.

Janet Parker: And how risky is a return to those kind of paints?

John Lewis: There are concerns about the increased use of copper. In some areas there are restrictions already imposed on the use of copper based anti-fouling paints. The Baltic Sea is one area and elsewhere in the world they are looking to regulate the copper based anti-fouling paints to restrict the amount of copper released into the environment.

Generally copper is considered to be less harmful than the tributyltin because it tends to be absorbed onto humic materials and demobilised very quickly in the environment. The other costs of reverting to copper is copper is not as effective against the broad range of marine organisms so there are a number of organisms that are resistant to copper. You generally have to use a secondary biocide in those paints.

Janet Parker: It sounds like copper based paints are a very interim method to prevent marine fouling. What other opportunities have presented themselves?

John Lewis: There tends to be, you could say probably two pathways or researching into new methods of fouling control. One is to find new biocides both looking through other herbicidal compounds, or organic compounds. The other is to look at the marine organisms themselves and how, in their natural environment, they resist fouling pressure. So people are looking at extracts of different marine plants and animals. There's been some very positive and potentially useful work carried at the University of NSW on one of the local red seaweeds. Peter Steinberg and his team there have actually isolated and characterised the particular compounds which are active and are moving now to determine their effectiveness in anti-fouling paints and other coatings.

The problem with the biocidal approach is that we don't want a repeat of what happened with tributyltin so there are very stringent requirements now to actually approve any new biocidal product and there are estimates that it would cost between $6 and $10million US to actually get a new biocide approved. The other approach is to look at totally non-toxic systems and here we're looking at non-stick type coatings. And these are variously known as fouling release coatings or minimally adhesive surfaces. They actually work by minimising the strength of adhesion of different organisms to the surface. So ideally, when the vessel moves through the water that fouling growth will be

washed away.

Janet Parker: I've heard of silicone coatings, is silicone one of the main things being used to create this kind of coating?

John Lewis: Yes, it is. When the first research looked at this type of coating we went to teflon, your non-stick frypan type approach. Teflon itself has got a surface microstructure and marine organisms could actually key into the surface and they weren't as effective as was hoped but silicone has been found to create a fairly effective surface.

Janet Parker: How effective is it compared to what's being used in the past.

John Lewis: When you compare it to a biocidal coating such as the tributyltin based coatings you would probably consider that it's not effective because of its completely different approach. You'll never see any growth, or any slime growth attaching to a tributyltin coating. If a vessel painted with a silicone coating just rests alongside, marine growth will attach to it but it is easily removed so it's a different approach. It's a management approach that if the vessel is going to be alongside for long periods of time you do have to clean the growth off the surface to provide the optimum performanceconditions particularly if that vessel isn't a high speed vessel.

Janet Parker: How many ships are using silicone coating at the moment if it is a promising way forward?

John Lewis: At the present there's only been a small niche market. The high speed catamarans is one area that silicone coatings have been applied. This is because aluminium hulls and copper based anti-fouling paints just don't go together. The copper actually causes corrosion of the aluminium. High speed catamarans also have the speed to self clean. In recent times some trials on some of the cruise ships in the Carribbean have proved to be very promising and there are moves to actually introduce the silicone coatings more widely on those vessels.

Through DSTO in Australia we have actually applied these silicone coatings to the new Collins class submarines and we have built up a lot of experience in evaluating these products.

Janet Parker: So given the alternative anti-fouling products available at the moment and the stage of development there at, what do you think the shipping industry will turn to given that there's only really about four years until the ban takes place?

John Lewis: In the short term the shipping industry will turn back to copper. Now on the plus side we now have some copper based coatings where the delivery system within the coating is more effective and it looks like we will be able to get a four year life out of these coatings. In the longer term, I think it will be the fouling release coatings which are the predominant type of coating for controlling marine growth on ships.

Alexandra de Blas: John Lewis from DSTO's Aeronautical and Maritime Research Laboratory talking to Janet Parker. The

International Maritime Organisation wants to hold a diplomatic conference within the next two years to adopt a world wide agreement backing its ban on TBT paints.

Guests on this program:

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10th international Congress on Marine Corrosion and Anti-fouling
University of Melbourne
February 7-12 1999
http://www.pb.unimelb.edu.au/fho/conf

Reporter:
Janet Parker

Tuning in details
ABC Radio Tape Sales information

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ENVIRONMENTAL ISSUES: EPA Reports on Tributyltin Boat-Bottom Paint

EPA sent a report to Congress on May 30, detailing the status of environmental monitoring for tributyltin (TBT). TBT is an organometallic pesticide used in boat-bottom paint to prevent growth of fouling marine organisms. TBT antifouling paints and their adverse effects on the environment are the target of Organotin Antifouling Paint Control Act (OAPCA) of 1988 and other federal and state restrictions.

TET has been shown to cause reproductive and other adverse effects to shellfish and other non-target aquatic organisms at very low levels. OAPCA requires that EPA and the Navy report annually on monitoring. The May 1997 report also includes the results of research into chemical and nonchemical alternatives to TBT, and EPA's evaluation of the effectiveness of laws and regulations in reducing the risks of TBT.

Both EPA and Navy data document that TBT levelsin the water column are dropping. Despite this decline, EPA concluded that levels are still too high. The status of TBT in coastal and estuarine sediments, where many affected species dwell, is less certain.

The reduction of TBT concentrations in domestic waters is due to restrictions on the use of anti-fouling paints in the United States. Use is prohibited on non-aluminum hulls and vessels less than 82feet in length. There is a limit on the release rate of TBT from paint. TBT may only be applied by persons specifically trained and certified (or to persons under their direct supervision). All TBT paint waste must be disposed in sanitary landfills and not in the water. The Navy no longer uses TBT antifouling paints.

The continued hazard TBT poses is tied to remaining domestic uses, and to the use of TBT on ocean-going vessels which are painted overseas and which travel to American ports. EPA has determined that additional restrictions are need to reduce levels in water. In the May '97 report, the agency suggested to Congress that the manufacture and use of TBT anti-fouling paints be phased out in this country, to be replaced by safer alternatives. Some alternatives are currently available and others are in development. EPA is cooperating with the International Maritime Organization on a proposal for a global TBT phase-out, and is refining its TBT risk assessment for use in pursuing appropriate action under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

U.S. EPA Press Release: Friday, June 20, 1997

ANNEX 4

FORM OF INTERNATIONAL ANTI-FOULING SYSTEM CERTIFICATE

Issued under the provisions of the Convention On Controlling The Use Of Shipboard Anti-Fouling Systems That Have Adverse Effects On The Marine Environment (hereinafter referred to as "the Convention") under the authority of the Government of:

.....

(full designation of the country)

by .....

(full designation of the competent person or organization authorized under the provisions of the Convention)

Name of ship	Distinctive number or letters	Port of registry	Gross tonnage

Type of anti-fouling system being used	Date it was applied	Country in which it was applied	Name of shipyard that applied it

THIS IS TO CERTIFY:

1. That the ship has been surveyed in accordance with article 8 of the Convention; and

2. That the survey shows that the anti-fouling system on the ship complies with the applicable requirements of Annex 1 of the Convention.

This certificate is valid until ..... subject to surveys in accordance with article 8 of the Convention.

Issued at .....

(Place of issue of certificate)

.....

(Date of issue) *(Signature of duly authorized official issuing the certificate)*

(Seal or stamp of the authority, as appropriate)

ENDORSEMENT FOR ANNUAL AND INTERMEDIATE SURVEYS

THIS IS TO CERTIFY that a survey required by article 8 of the Convention found that the ship was in compliance with the relevant provisions of the Convention:

Annual survey:
Signed .....
(Signature of duly authorized official)

Place .....

Date .....

(Seal or stamp of the authority, as appropriate)

Annual survey:
Signed .....
(Signature of duly authorized official)

Place .....

Date .....

(Seal or stamp of the authority, as appropriate)

Annual survey:
Signed .....
(Signature of duly authorized official)

Place .....

Date .....

(Seal or stamp of the authority, as appropriate)

Annual survey:
Signed .....
(Signature of duly authorized official)

Place .....

Date .....

(Seal or stamp of the authority, as appropriate)

A.895(21)
Anti-fouling systems used on ships

The resolution states that the Marine Environment Protection Committee should develop a global legally-binding instrument to address the harmful effects of anti-fouling systems used on ships.

It states that the global instrument should ensure a global prohibition on the application of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2003, and a complete prohibition on the presence of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2008.

Antifouling paints are used to coat the bottoms of ships to prevent sealife such as algae and molluscs attaching themselves to the hull - thereby slowing down the ship and increasing fuel consumption. In the early days of sailing ships, lime and later arsenic was used to coat ships' hulls, until the modern chemicals industry developed effective antifouling paints using metallic compounds.

The compounds slowly "leach" into the sea water, killing barnacles and other marine life that have attached to the ship - but studies have shown that these compounds persist in the water, killing sealife, harming the environment and possibly entering the food chain. One of the most effective antifouling paints, developed in the 1960s, contains the organotin tributyltin (TBT), which has been proven to cause deformations in oysters and sex changes in whelks.

The harmful environmental effects of organotin compounds were recognized by IMO in 1990, when the Marine Environment Protection committee (MEPC) adopted a resolution which recommended that Governments adopt measures to eliminate the use of antifouling paint containing TBT on non-aluminium hulled vessels of less than 25 metres in length and eliminate the use of antifouling paints with a leaching rate of more than 4 microgrammes of TBT per day.

Alternatives to TBT paint include copper-based coatings and silicon-based paints, which make the surface of the ship slippery so that sealife will be easily washed off as the ship moves through water. Further development of alternative anti-fouling systems is being carried out. Underwater cleaning systems avoid the ship having to be put into dry dock for ridding the hull of sealife, while ultrasonic or electrolytic devices may also work to rid the ship of foulants.

The Assembly also approved the holding of a Conference in 2001 to adopt the proposed legal instrument to regulate the use of shipboard anti-fouling systems and to phase out those containing organotins such as TBT.

Description of resolution passed by IMO Assembly at their 21st session, November 15-26, 1999, taken from web site:
http://www.imo.org/imo/meetings/assembly/21/listrsumm.htm

IMO ACTION

IMO Assembly approves budget, work programme

The Assembly approved budgetary appropriations totalling £36,612,200, representing zero nominal growth over the previous biennium. The total comprises an appropriation of £18,155,000 for 2000 and £18,457,200 for 2001.

In 1998–1999, appropriations also totalled £36,612,200, comprising an appropriation of £17,946,100 for 1998 and £18,666,100 for 1999.

The Assembly elected a new Council for the next biennium and adopted a number of technical resolutions relating to the work of the Organization.

The Assembly normally meets once every two years. All 157 Member States and two Associate Members are entitled to attend, as are the inter-governmental organizations with which agreements on co-operation have been concluded and the non-governmental organizations which have consultative status with IMO.

The Assembly was attended by a total of 817 delegates. These included representatives of 138 Member States and two Associate Members, and observers from eight inter-governmental organizations and 36 non-governmental organizations.

Election of new IMO Council

The Assembly elected the following 32 States to the Council for the 2000–2001 biennium:

Category (a)

Eight States with the largest interest in providing international shipping services: China, Greece, Italy, Japan, Norway, Russian Federation, United Kingdom, United States.

Category (b)

Eight other States with the largest interest in international seaborne trade: Argentina, Brazil, Canada, France, Germany, India, Netherlands, Sweden.

Category (c)

Sixteen States not elected under (a) or (b) above which have special interests in maritime transport or navigation, and whose election to the Council will ensure the representation of all major geographic areas of the world: Australia, Bahamas, Cyprus, Egypt, Finland, Indonesia, Malta, Mexico, Morocco, Panama, Philippines, Republic of Korea, Singapore, South Africa, Spain, Turkey.

In 1998–1999, Members of the Council in categories (a) and (b) were the same, but in category (c) the Members elected for 1998–1999 were: Algeria, Australia, Cyprus, Egypt, Finland, Indonesia, Liberia, Mexico, Panama, Philippines, Poland, Republic of Korea, Singapore, South Africa, Spain, Tunisia.

The Council is the executive organ of IMO and is responsible, under the Assembly, for supervising the work of the Organization. Between sessions of the Assembly the Council performs all functions of the Assembly except that of making recommendations to Governments on maritime safety and pollution prevention.

Work programme

The Assembly approved the work programme for the next biennium, the long-term plan up to 2006 and long-term objectives for the 2000s.

Diplomatic conferences approved

The Assembly approved the holding of three diplomatic conferences in the 2000–2001 biennium to adopt new legal instruments:

- Conference to adopt a Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol). To be held in March 2000.
- Conference to adopt a legal instrument to regulate the use of shipboard anti-fouling systems, in particular to phase out those containing organotins such as tributyltin (TBT). To be held in 2001.
- Conference to adopt a new convention on liability and compensation for pollution from ships' bunkers. To be held in 2001.

Adoption of resolutions

The Assembly adopted 28 resolutions, including those submitted by the Maritime Safety Committee (MSC), IMO's senior technical body, the Marine Environment Protection Committee (MEPC) and other IMO subsidiary bodies.

Council – 83rd session: 26 November 1999

The Council's 83rd session was held on Friday 26th November.

Mr. G. A. Dubbeld of the Netherlands was re-elected Chairman of the Council for the 2000–2001 biennium and H.E. Mr. S. Oñate of Mexico was elected as Vice-Chairman.

Resolutions adopted

A.874(21) Relations with non-governmental organizations

Endorses the enjoyment of consultative status of 52 non-governmental organizations.

A.875(21) Arrears of contributions

The resolution urges Member States to make payment of any arrears at the earliest possible date. It notes that the level of contributions in 1995–1997 has not been maintained. (In 1995 and 1996, the level of contribution receipts reached 95% and 96% respectively, while for 1999 to the date of the Assembly the level of payment for contributions reached 87.6%.)

A.876(21) Presentation of accounts and audit reports

The resolution approves the accounts and audit reports for the nineteenth financial period 1996–1997 and for the first year of the twentieth financial period 1998–1999, and for IMO's participation in UNDP (United Nations Development Programme) in 1997 and 1998.

A.891(21) Recommendations on training of personnel on mobile offshore units (MOUs)

The resolution includes a recommendation on training of personnel on mobile offshore units (MOUs). The resolution covers minimum standards for familiarization and basic safety training instructions and competencies for all MOU personnel; recommendations on specialized training and qualifications of key personnel (offshore installation manager, barge supervisor, ballast control operator, maintenance supervisor); and guidance on safety and emergency response drills and exercises.

A.892(21) Unlawful practices associated with certificates of competency and endorsements

The resolution highlights the problem of fraudulent certificates of competency issued in relation to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, as amended, and encourages action by Member States to eliminate the circulation of fraudulent certificates.

The resolution follows concern about a proliferation of fraudulent certificates of competency, or authentic certificates reportedly issued on the basis of forged foreign certificates, which have been found during port State control inspections and applications for recognition of certificates.

The resolution urges Member Governments to take all possible steps to investigate cases and to prosecute, or assist in the investigation and prosecution of, those found to be involved in the processing or obtaining of fraudulent certificates or endorsements, including the holders of such certificates or endorsements.

The resolution also urges Governments who endorse certificates issued by another Party to first confirm the authenticity of the original certificate from the issuing authority and to include details of the underlying certificate on the new document.

A.893(21) Guidelines on voyage planning

The resolution includes guidelines on voyage planning and notes the view of the MSC that voyage planning is important for all ships engaged on international voyages.

The Guidelines note that the development of a plan for voyage or passage as well as the close and continuous monitoring of the vessel's progress and position during the execution of such a plan is of essential importance for the safety of life at sea, the safety and efficiency of navigation and the protection of the marine environment.

Voyage and passage planning includes: appraisal, i.e. gathering all information relevant to the contemplated voyage or passage; detailed planning of the whole voyage or passage from berth to berth, including those areas necessitating the presence of a pilot; execution of the plan; and the monitoring of the progress of the vessel in the implementation of the plan.

These components of voyage/passage planning are outlined in detail in the Guidelines.

The Guidelines update Guidance on voyage planning, which was issued as a Safety of Navigation Circular (SN/Circ.92) in 1978.

A.894(21) International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual

The resolution sets out the procedure for updating the *Manual*, which was jointly developed by IMO and the International Civil Aviation Organization (ICAO).

The resolution gives the MSC the responsibility for adopting amendments to the *IAMSAR Manual* after receiving and evaluating, through its subsidiary bodies, proposals for amendments and/or additions.

The *IAMSAR Manual*, which was published by IMO/ICAO in 1999, is designed to help States meet their obligations under the Convention on Civil Aviation, SOLAS and the SAR Convention.

The *IAMSAR Manual* replaced two manuals earlier developed by IMO: the *Merchant Ship Search and Rescue Manual (MERSAR)*, adopted by the IMO Assembly in 1971; and the *IMO Search and Rescue Manual (IMOSAR)*, adopted in 1978 by the MSC.

A.895(21) Anti-fouling systems used on ships

The resolution states that the MEPC should develop a global legally binding instrument to address the harmful effects of anti-fouling systems used on ships.

It states that the global instrument should ensure a global prohibition on the application of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2003, and a complete prohibition on the presence of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2008.

A.896(21) Provision and use of port waste reception facilities

The resolution requests the MEPC to develop guidelines on the provision and use of port waste reception facilities.

The resolution notes that while the IMO *Comprehensive Manual on Port Reception Facilities* provides guidance and technical advice, there is a need for guidelines on how best to plan the provision and utilization of port waste reception facilities that meet the needs of their users.

A.897(21) Amendments to the revised specifications for the design, operation and control of crude oil washing systems (resolution A.446 (XI) as amended by resolution A.497(XII))

The resolution includes amendments to resolution A.446(XI), as amended by resolution A.497(XII), relating to specifications for the design, operation and control of crude oil washing systems.

Crude oil washing, which was introduced into MARPOL 73/78 as part of the 1978 Protocol, involves cleaning of oil tanks using crude oil, rather than water – in other words, the cargo itself. When sprayed onto the sediments clinging to the tank walls, the oil simply dissolves them, turning them back into usable oil that can be pumped off with the rest of the cargo. There is no need for slop tanks to be used since the process leaves virtually no oily wastes.

Marine Environment Protection Committee - 42nd session: 2-6 November 1998

MEPC adopts in principle HNS protocol

The Committee adopted, in principle, a new protocol to deal with pollution incidents involving hazardous and noxious liquid substances (chemicals). The aim is to hold a conference to formally adopt the Protocol in the year 2000.

The draft **Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances, 2000** (HNS Protocol) follows the principles of the **International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC).**

The draft HNS Protocol is intended to be adopted by States already Party to the OPRC Convention. Like the OPRC Convention, it aims to provide a global framework for international co-operation in combating major incidents or threats of marine pollution. Parties to the HNS Protocol will be required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries.

The proposed protocol, when it comes into force, will ensure that ships carrying hazardous and noxious liquid substances are covered, or will be covered, by regimes similar to those already in existence for oil incidents.

In 1996, IMO adopted the **International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (HNS) by sea**, which provides for a compensation and liability regime for incidents involving these substances (it has not yet entered into force). Liability and compensation regimes for oil pollution incidents are covered by the **1992 Protocols** to the **International Convention on Civil Liability for Oil Pollution Damage, 1969** and the **International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971.**

Phase-out of organotin anti-fouling paints agreed

The Committee approved a draft Assembly resolution which includes a deadline of 2008 for the complete prohibition of organotins acting as biocides in antifouling systems on ships.

Antifouling paints are used to coat the bottoms of ships to prevent sealife such as algae and molluscs attaching themselves to the hull - thereby slowing down the ship and increasing fuel consumption. In the early days of sailing ships, lime and later arsenic was used to coat ships' hulls, until the modern chemicals industry developed effective antifouling paints using metallic compounds.

The compounds slowly "leach" into the sea water, killing barnacles and other marine life that have attached to the ship - but studies have shown that these compounds persist in the water, killing sealife, harming the environment and possibly entering the food chain. One of the most effective antifouling paints, developed in the 1960s, contains the organotin tributyltin (TBT), which has been proven to cause deformations in oysters and sex changes in whelks.

The draft resolution, which is intended to be submitted to the 21st IMO Assembly, scheduled for November 1999, states that IMO "urges the Marine Environment Protection Committee to work toward the

expeditious development of a global legally-binding instrument to address the harmful effects of anti-fouling systems used on ships" and that IMO "agrees that the global instrument to be developed by the Marine Environment Protection Committee should ensure a global prohibition on the application of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2003, and a complete prohibition on the presence of organotin compounds which act as biocides in anti-fouling systems on ships by 1 January 2008".

The resolution was drafted by a Working Group, which also began looking at the basic structure of the proposed legal instrument as well as how other, alternative anti-fouling systems should be assessed.

The Committee agreed the Working Group should continue work on these issues at the next session.

The harmful environmental effects of organotin compounds used in anti-fouling systems were recognized by IMO in 1990, when the MEPC adopted a resolution which recommended that Governments adopt measures to eliminate the use of antifouling paints containing TBT on non-aluminium hulled vessels of less than 25 metres in length and eliminate the use of antifouling paints with a leaching rate of more than 4 microgrammes of TBT per day. Some countries, such as Japan, have already banned TBTin antifouling paints for most ships.

Alternatives to TBT paint include copper-based coatings and silicon-based paints, which make the surface of the ship slippery so that sealife will be easily washed off as the ship moves through water. Further development of alternative anti-fouling systems is being carried out. Underwater cleaning systems avoid the ship having to be put into dry dock for ridding the hull of sealife, while ultrasonic or electrolytic devices may also work to rid the ship of foulants.

Harmful aquatic organisms in ballast water

An MEPC Working Group on ballast water continued work on developing draft new regulations for ballast water management.

The proposed new regulations are intended to address the environmental damage caused by the introduction of unwanted aquatic organisms in ballast water, used to stabilize vessels at sea. Globally, it is estimated that about 10 billion tonnes of ballast water is transferred each year.

The water taken on board for ballasting a vessel may contain aquatic organisms, including dormant stages of microscopic toxic aquatic plants - such as dinoflagellates, which may cause harmful algal blooms after their release. In addition, pathogens such as the bacterium vibrio cholerae (cholera), have been transported with ballast water. As ships travel faster and faster, the survival rates of species carried in ballast tanks have increased. As a result, many introductions of non-indigenous organisms in new locations have occurred, often with disastrous consequences for the local ecosystem - which may include important fish stocks or rare species.

The MEPC considered the different options for introducing the proposed regulations, and agreed to continue the debate at the next session in 1999. Options include:

- a new Annex to the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78), adopted via a Protocol to add the new Annex;
- a new Annex adopted via amendments to MARPOL 73/78, a simpler process; .
- a completely new Convention on ballast water management, under which the terms for entry into force would be determined by a Conference, instead of having to comply with existing entry into force terms established by MARPOL 73/78.

CHAPTER 37 - ORGANOTIN ANTIFOULING PAINT CONTROL

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(a) Other authorities of Administrator.
(b) State laws.

Sec. 2401. Findings; purpose

- (a) Findings
  The Congress finds the following:
  - (1) Antifouling paints containing organotin biocides are used to prevent the build-up of barnacles and other encrusting organisms on vessels.
  - (2) Laboratory and field studies show that organotin is very toxic to marine and freshwater organisms at very low levels.
  - (3) Vessels that are less than 25 meters in length and are coated with organotin antifouling paint account for a large amount of the organotin released into the aquatic environment.
  - (4) The Environmental Protection Agency has determined that concentrations of organotin currently in the waters of the United States may pose unreasonable risks to oysters, clams, fish, and other aquatic life.
- (b) Purpose
  The purpose of this chapter is to protect the aquatic environment by reducing immediately the quantities of organotin entering the waters of the United States.

Sec. 2402. Definitions

For purposes of this chapter:

- (1) The term "Administrator" means the Administrator of the Environmental Protection Agency.
- (2) The term "antifouling paint" means a coating, paint, or treatment that is applied to a vessel to control fresh water or marine fouling organisms.
- (3) The term "estuary" means a body of water having an unimpaired connection with open sea, where the sea water is measurably diluted with fresh water derived from land drainage, and such term includes the Chesapeake Bay and estuary-type areas of the Great Lakes.
- (4) The term "organotin" means any compound of tin used as a biocide in an antifouling paint.
- (5) The term "person" means any individual, and partnership, association, corporation. or organized g·oup of persons whether incorporated or not, or any government entity, including the military.
- (6) The term "qualified antifouling paint containing organotin" means an antifouling paint containing organotin that -
  - (A) is allowed to be used under the terms of the final decision referred to in section 12(c); or
  - (B) until such final decision takes effect, is certified by the Administrator under section 2405 of this title as having a release rate of not more than 4.0 micrograms per square centimeter per day.
- (7) The term "release rate" means the rate at which organotin is released from an antifouling paint over the long term, as determined by the Administrator, using -
  - (A) the American Society for Testing Materials (ASTM) standard test method which the Environmental Protection Agency required in its July 29, 1986, data call-in notice on tributyltin compounds used in antifouling paints; or
  - (B) any similar test method specified by the Administrator.
- (8) The term "retail" means the transfer of title to tangible personal property other than for resale, after manufacturing or processing.
- (9) The term "Secretary" means the Secretary of the Navy.

- (10) The term "State" means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, or any territory or possession of the United States.
- (11) The term "vessel" includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water.

Sec. 2403. Prohibition on application of organotin antifouling paints on certain vessels

- (a) Prohibition
  Subject to section 12(d), and except as provided in subsection (b) of this section, no person in any State may apply to a vessel that is less than 25 meters in length an antifouling paint containing organotin.
- (b) Exceptions
  Subsection (a) of this section shall not prohibit the application of a qualified antifouling paint containing organotin on -
  - (1) the aluminum hull of a vessel that is less than 25 meters in length; or
  - (2) the outboard motor or lower drive unit of a vessel that is less than 25 meters in length.

Sec. 2404. Prohibition of certain organotin antifouling paints and organotin additives used to make such paints

- (a) Interim prohibition of certain organotin antifouling paints
  Subject to section 12(d), no person in any State may -
  - (1) sell or deliver to, or purchase or receive from, another person an antifouling paint containing organotin; or
  - (2) apply to a vessel an antifouling paint containing organotin; unless the antifouling paint is certified by the Administrator as being a qualified antifouling paint containing organotin.
- (b) Prohibition of certain organotin additives
  Subject to section 12(d), no person in any State may sell or deliver to, or purchase or receive from, another person at retail any substance containing organotin for the purpose of adding such substance to paint to create an antifouling paint.

Sec. 2405. Certification

- (a) Initial certification
  Not later than 90 days after June 16, 1988, the Administrator shall certify each antifouling paint containing organotin that the Administrator determines has a release rate of not more than 4.0 micrograms per square centimeter per day on the basis of the information submitted to the Environmental Protection Agency before June 16, 1988, in response to its July 29, 1986, data call-in notice on tributyltin or any other data call-in notice.
- (b) Subsequent certification
  After the initial period of certification required by subsection (a) of this section, and not later than 90 days after the receipt of information with regard to an antifouling paint containing organotin submitted -
  - (1) in response to a data call-in referred to in subsection (a) of this section; or
  - (2) under any provision of law; the Administrator shall certify such paint if, on the basis of such information, the Administrator determines that such paint has a release rate of not more than 4.0 micrograms per square centimeter per day.

Sec. 2406. Monitoring and research of ecological effects

- (a) Estuarine monitoring
  The Administrator, in consultation with the Under Secretary of Commerce for Oceans and Atmosphere, shall monitor the concentrations of organotin in the water column, sediments, and aquatic organisms of representative estuaries and near-coastal waters in the United States. This monitoring program shall remain in effect until 10 years after June 16, 1988. The Administrator shall submit a report annually to the Speaker of the House of
- Representatives and to the President pro tempore of the Senate detailing the results of such monitoring program for the preceding year.
- (b) Navy home port monitoring
  The Secretary shall provide for periodic monitoring, not less than quarterly, of waters serving as the home port for any Navy vessel coated with an antifouling paint containing organotin to determine the concentration of organotin in the water column, sediments, and aquatic organisms of such waters.
- (c) Navy research of ecological effects
  The Secretary shall continue existing Navy programs evaluating the laboratory toxicity and environmental risks associated with the use of antifouling paints containing organotin.
- (d) Assistance to States
- To the extent practicable, the Administrator shall assist States in monitoring waters in such States for the presence of organotin and in analyzing samples taken during such monitoring.
- (e) Five-year repc.t
  At the end of the 5-year period beginning on June 16, 1988, the Administrator shall submit a report to the Speaker of the House of Representatives and to the President pro tempore of the Senate providing an assessment of -
  - (1) the effectiveness of existing laws and rules concerning organotin compounds in ensuring protection of human health and the environment;
  - (2) compliance with water quality criteria established pursuant to section 2408 of this title and any applicable water quality standards; and
  - (3) recommendations for additional measures to protect human health and the environment.

Sec. 2407. Alternative antifouling research

- (a) Research
  The Secretary and the Administrator shall conduct research into chemical and nonchemical alternatives to antifouling paints containing organotin.
- (b) Report
  At the end of the 4-year period beginning on June 16, 1988, the Administrator, in consultation with the Secretary, shall submit a report to the Speaker of the House of Representatives and to the President pro tempore of the Senate detailing the results of the research conducted pursuant to subsection (a) of this section.

Sec. 2408. Water quality criteria document

Not later than March 30, 1989, the Administrator shall issue a final water quality criteria document concerning organotin compounds pursuant to section 1314(a) of this title.

Sec. 2409. Penalties

- (a) Civil penalties
  - (1) Any person violating section 2403 or 2404 of this title shall be assessed a civil penalty of not more than $5,000 for each offense.
  - (2) After notice and an opportunity for a hearing, a person found by the Administrator to have violated section 2403 or 2404 of this title is liable to the United States Government for the civil penalty assessed under subsection (a) of this section. The amount of the civil penalty shall be assessed by the Administrator by written notice. In determining the amount of the penalty, the Administrator shall consider the nature, circumstances, extent, and gravity of the prohibited acts committed and, with respect to the violator, the degree of culpability, any history of prior offenses, ability to pay, and other matters that justice requires.
  - (3) The Administrator may compromise, modify, or remit, with or without consideration, a civil penalty assessed under this section until the assessment is referred to the Attorney General.
  - (4) If a person fails to pay an assessment of a civil penalty after it has become final, the Administrator may refer the matter to the Attorney General for collection in the appropriate United States district court.
- (b) Criminal penalties
  Any person knowingly violating section 2403 or 2404 of this title shall be fined not more than $25,000, or imprisoned for not more than one year, or both.

Sec. 2410. Other authorities; State laws

- (a) Other authorities of Administrator
  Nothing in this chapter shall limit or prevent the Administrator from establishing a lower permissible release rate for organotin under authorities other than this chapter.
- (b) State laws
  Nothing in this chapter shall preclude or deny any State or political subdivision thereof the right to adopt or enforce any requirement regarding antifouling paint or any other substance containing organotin.
  Compliance with the requirements of any State or political subdivision thereof respecting antifouling paint or any other substance containing organotin shall not relieve any person of the obligation to comply with the provisions of this chapter

THE EFFECT OF LEGISLATION AND REGULATION ON TRIBUTYLTIN RISK IN THE MARINE AND ESTUARINE ENVIRONMENTS OF THE UNITED STATES.

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Direct evidence of impacts from tributyltin (TBT) antifoulants was observed in oysters from France and England in the late 1970's and early 1980's, and increasing measurements of potentially harmful TBT concentrations in harbor and estuarine waters of the United State were made by the mid-1980's. Concern over these findings led individual states and the U.S. Congress to pass legislation and follow-on regulation in 1987/1988 which substantially restricted the application of this biocide to larger (>25m) vessels and low release rate coatings. This presentation addresses the impact of legislation and regulation on reducing the concentrations of TBT in the marine environment, and compares exposure levels with a broad set of effects data to evaluate the current level of environmental risk. This assessment addresses two questions: 1) has there been a significant reduction in environmental concentrations of TBT in the marine and estuarine waters of the U.S. after legislation and regulation and 2) are current levels of TBT in the receiving waters protective of marine species in the receiving environment.

Methodology. Exposure characterization was performed using TBT monitoring data for water, tissue and sediments from Navy monitoring data and three other sources (see acknowledgments) sorted by regions (San Diego Bay CA, Norfolk Region of Chesapeake Bay VA, Pearl Harbor, HI, Puget Sound WA, Narragansett Bay RI, and Galveston Bay TX), and classes of sample type (marinas, shipyards, commercial/Navy, and ecologically sensitive areas). Effects characterization was developed by creating a database of the available TBT toxicological literature. Toxicity data was selected based on careful review of each paper and selection criteria were used to select the most appropriate data. Exposure (concentration) and effects (toxicity) databases were integrated into a customized data base. The database was used to make cumulative and statistical comparisons before and after legislation to evaluate the magnitude of effect that regulations had on TBT concentrations in U.S. waters. Risk characterization was evaluated using two approaches for analysis of the exposure and effects databases; 1) making direct comparisons of the cumulative probability of exposure versus chronic and acute effects data which allow estimation of the overlap of exposure and effects; and 2) using a probabilistic approach to risk assessment. Both quantitative and qualitative risk analyses were performed using the principles of ecological risk assessment, and calculation of environmental risk criteria based on a species protection level of 95% using available LC_{50}/EC_{50} toxicity data by a logistic regression approach (Cadmus Group, 1996).

Results and Discussion. Water column concentrations, tissue burdens and sediment loading are addressed in the risk analysis. This brief summary addresses primarily water column TBT risks. Figure 1 provides a summary of TBT data shown as the cumulative probability (%) of water column concentrations for before and after legislation periods for all regions and sample types (e.g. marinas, shipyards, commercial/Navy, and ecologically sensitive areas). This figure documents a large shift of nearly 10-fold in TBT water concentrations to lower levels in averaged samples from San Diego Bay, Pear Harbor and the Norfolk region of Chesapeake Bay after the legislation and regulation took effect. Table 1. Shows mean TBT concentrations for use classifications for periods before and after legislation.

Table 1. Mean TBT Concentrations (ng/L) in Marine and Estuarine Receiving Waters Before and After Legislation for Specific Use Classes Averaged for All Regions.

BACKGROUND TBT Anti fouling

Monitoring Use Classification	Statistic	Before Legislation	After Legislation
Commercial/Navy	Mean ± std dev.	10.19 ± 13.21	2.74 ± 2.01
	Median	6.0	2.3
	n	288	149
Marinas	Mean ± std dev.	61.17 ± 120.2	5.70 ± 6.94
	Median	23.0	3.0
	n	384	130
Shipyards	Mean ± std dev.	19.32 ± 28.6	4.13 ± 2.34
	Median	7.8	3.75
	n	182	34
Ecologically Significant Areas	Mean ± std dev	4.36 ± 4.70	1.42 ± 1.21
	Median	2.8	1.0
	n	309	144

Clearly, the most significant TBT reductions were in marinas where the legislation and regulation had the most direct impact with an approximate 10-fold reduction in means. In highly impacted marinas we observed as much as a 20-fold reduction. Other areas showed 3 to 5-fold reductions. Concomitant reductions were found in bivalve tissues, but there were less definitive reductions in sediment TBT levels. In summary, our results indicate the following:

1) Federal and State legislation and regulation, which restricted TBT in the 1987/88 time period, had a highly significant impact on TBT levels in the environment by substantially reducing loading from pleasure craft and the release from antifouling paints. Water concentrations of TBT have dropped by a factor of 3 to over 10 in those harbors where before and after comparisons were made. Bivalve tissue burdens showed a similar decline. Overall mean sediment TBT concentrations decreased by approximately 3 fold in before and post legislation periods. In some specific locations TBT concentrations did not appear to have decreased over time, however.

2) Quantitative and qualitative analyses indicate that acute TBT toxicity is not a concern at current environmental marine and estuarine water concentrations which are well below predicted acutely toxic levels. Transient high TBT concentrations from such activities as drydock discharges might be acutely toxic to some sensitive species, however. No overlap of acute exposure data with water column TBT concentrations was noted (Figure 2). Some overlap of the lower chronic exposure data with water column concentrations is seen. A logistic regression analysis of chronic TBT LC_{50}/EC_{50} (concentrations which cause 50% mortality or 50% non-lethal effects) data indicated that current mean environmental TBT water concentrations would be protective of 95% of species. A chronic ecological risk criterion of 11.8 ng/L TBT, protective of 95% of species, was derived from toxicity plots of cumulative percentage of species

affected versus TBT concentration. This value is close to EPA's water quality criteria of 10 ng/L. Exceeding the LC_{50}/EC_{50} concentrations would represent a potential risk to populations that are exposed over long periods to these levels. If the lowest threshold chronic values are used with a 95% protective ecological risk criteria, the percent of species affected exceeds 5% in all categories (ranging from 9.8 to 18%), but would be protective of 82-90 % of species. It is likely that TBT levels that cause threshold chronic toxicity would not represent a level of risk that would threaten populations. Local discharges of potentially higher TBT concentration, however need to be evaluated to determine whether these may represent a regional threat to sensitive species.

3) A sediment screening value of 250 ng/L was derived from an experimental partitioning coefficient of 25,000 l/Kg and an environmental water concentration of 10 ng/L (Langston and Pope, 1995). Sediment samples found to exceed the 250 ng/g value were principally found in shipyards, commercial shipping areas and a few marinas. Between about 5% and 25% of sediment samples exceeded this value, depending on the region where they were collected. Further investigations would be needed to evaluate whether these TBT sediment loads are residual from prior use or represent levels resulting from current loading.

Conclusion. Based on the available data and information analyzed, TBT does not currently represent a broad acute risk to the marine and estuarine environment of the United States. The current level of risk would not seem to require immediate further regulatory action. There is risk, however, associated with chronic toxicity in a few species of mollusks that, in some locally impacted areas such as marinas and portions of commercial harbors or near shipyards, may represent a threat to local population viability. Although TBT does not appear to biomagnify up the food chain, it is of some concern that it is found in the tissues of marine mammals and other organisms in open ocean areas (Kannan, 1996). Persistence in sediments may act as a long-term chronic input source. It is recommended that efforts to reduce environmental TBT sources and inputs be continued.

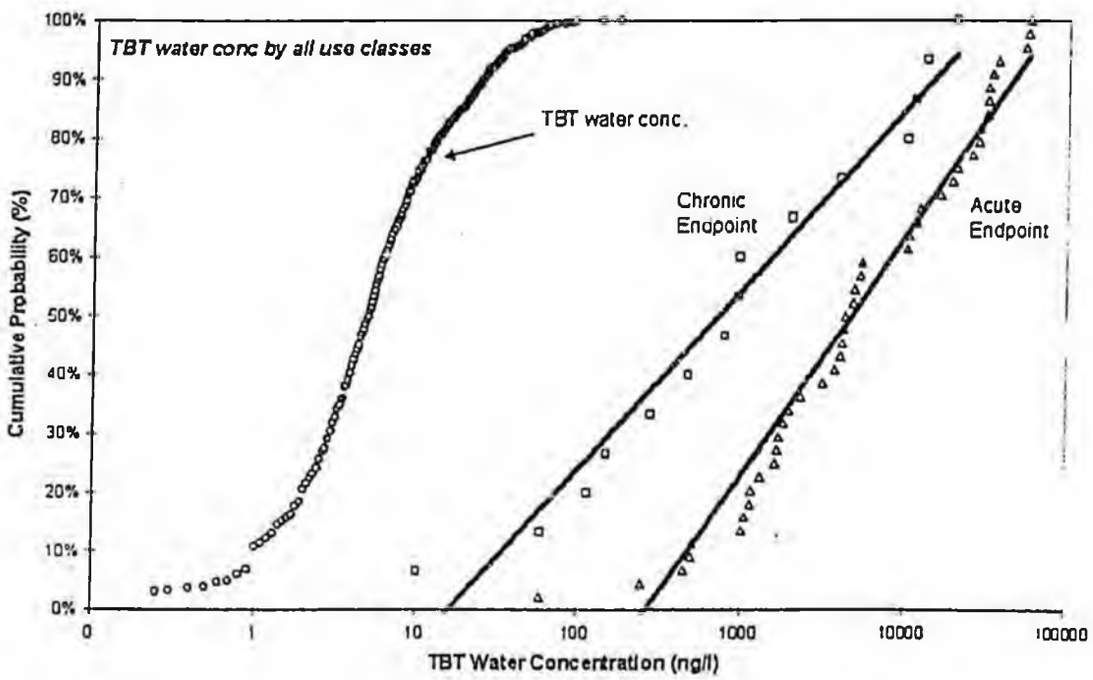

Figure 1. Cumulative % probability of water column TBT exposure in all use classes before and after legislation.

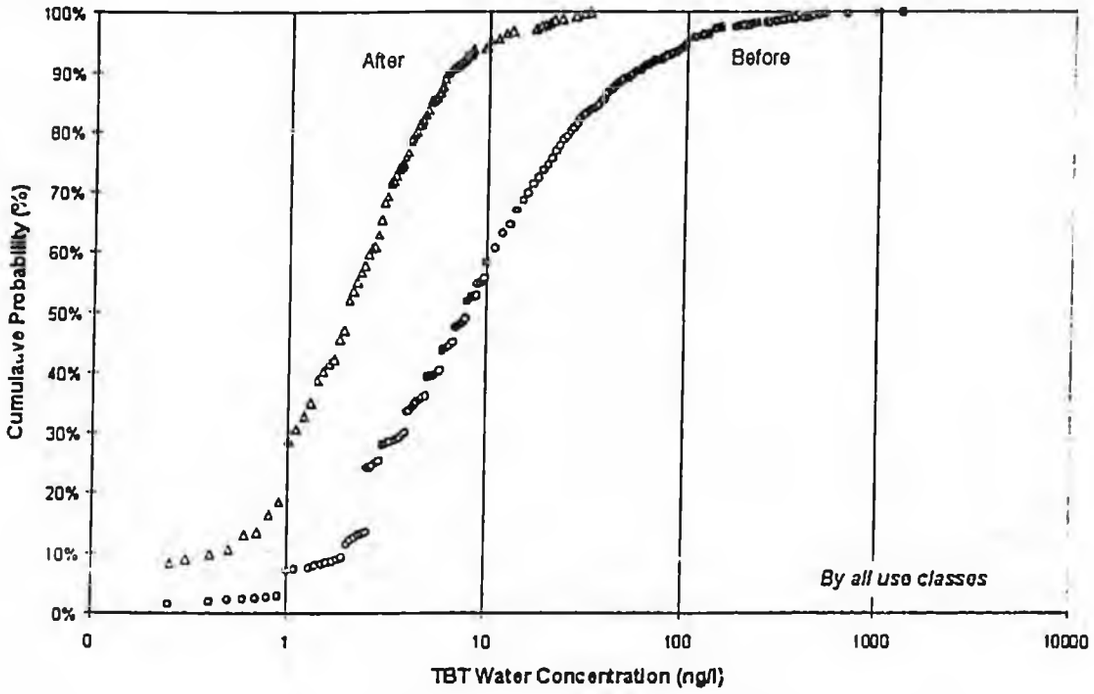

Figure 2. Cumulative % of TBT water (exposure) concentrations in all water classes and regions compared to chronic and acute LC_{50} endpoint effect levels.

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