

Prohibition of Organotins in Antifouling Paints

*S Sonak, R Morabito, N B Bhosle, A Mukherjee, Gipperth L,
S Rajagopal, R R Chaudhuri, A Giriyan, P Pangam*



The Energy and Resources Institute
Western Regional Centre, Goa

Introduction

What are Organotin Compounds?

Organotin compounds are compounds containing at least one covalent Sn-C bond. They are classified as mono-, di-, tri- or tetraorganotin compounds.

Uses of organotin

- ❖ Polyvinyl chloride plastics (PVC) stabilizers
- ❖ Industrial Catalysts
- ❖ Glass coatings
- ❖ Insecticides, Pesticides and fungicides.
- ❖ Biocides in antifouling paints in large shipping

Accumulation and impact of organotins in marine environment

- ❖ Cause Imposex
- ❖ Inhibition of cytochrome P4 501 in Fish
- ❖ Hematological and pathomorphological alterations in rainbow trout
- ❖ Diabetogenic effects in hamsters
- ❖ Deaths of dolphins by suppressing their immune system
- ❖ Can be teratogen to mammals during organogenesis (Gestations)

TBT as a biocide

- ❖ Extremely effective in keeping hulls of ships smooth and clean
- ❖ Broad spectrum activity
- ❖ Cost effective

Environmental impacts of TBT

- ❖ Collapse of oyster fishery in France
- ❖ Decline of *Dogwhelk* population due to imposex in UK
- ❖ Bioaccumulation in the food chain from bacteria and algae to seals and dolphins

TBT Regulations

- 📄 First regulated in France, in 1982
- 📄 Followed by UK in 1985
- 📄 In 1988 problem of environmental impacts of TBT was brought to the notice of MEPC of IMO
- 📄 In 1990 IMO's Marine Environment Protection Committee (MEPC) passed a resolution recommending to eliminate use of antifouling paint containing TBT on ship hulls < 25 mts in length

Contd...

☰ In 1999 IMO adopted a resolution that called for 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 by 1 January 2008.

☰ Conference held on Oct 2001 successfully adopted the new **International Convention on the Control of Harmful Anti-fouling Systems on Ships.**

☰ IMO- AFS convention opened for signature on 1st Feb 2002

AFS Convention

Convention will come into force 12 months after 25 countries representing 25% of the world's merchant shipping tonnage have ratified it

Application of organotin compounds, which act as biocides in antifouling systems on ships, is prohibited from 1 January 2003, and a complete prohibition will come into effect by 1 January 2008

By 1 January 2008 ships either

- Shall not bear such compounds on their hulls or external parts or surfaces; or
- Shall bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant antifouling systems.

Current status

For AFS convention 2001, number of contracting states are 16 with 17.27 % of world tonnage,

Convention signed by following states:

Antigua and Barbuda, Bulgaria, Denmark, Japan, Latvia, Nigeria, Norway, Poland, Romania, Spain, Sweden, Cyprus, Greece, Luxembourg, Saint kitts and Nevis, and Tavalu

Alternative antifouling strategy

Non-coating methods

Cleaning

- Manual
- Robotics
- Water jetting, etc

Electro-chemical

- Electrolysis

Others

- Vibration

Coating methods

Foul release

- Silicones, Fluro-polymer etc

Biocidal antifouling

- Organic (Diuron, Zineb)
- Inorganic (Copper oxides, Zinc, etc)
- Natural antifoulants

Research gap

- ❖ No alternative with global approval available to replace TBT
- ❖ Inadequate research on tin free paints
- ❖ A reliable inspection system for TBT application on ship hull
- ❖ Non-availability of criteria for evaluating TBT
- ❖ Research for the use of natural antifoulant need to be accelerated for field applications on commercial scale
- ❖ Foul release coatings are more environmental friendly but are expensive

Concerns regards TBT ban

- ❖ Increased introduction of alien species in tropical waters
- ❖ Increase in fouling organism on ship hulls.
- ❖ Increase in emission of greenhouse gases and VOCs
- ❖ Shift of local pollution problem to global pollution

Future directions for research

- ❖ Safer and efficient alternative to TBT
- ❖ Guidelines for inspection of TBT on ship hulls
- ❖ Strict regulations to check shifting of environmental impacts to less regulated countries
- ❖ Reliable indicators for determining environmental impacts of TBT and other antifouling strategies