4/1/09 Nan Singhasemanon
Department of Pesticide Regulation

Overview of Non-Copper AFP Biocides

This is an overview of non-copper biocides that are used in antifouling paint pesticide products. Some of these biocides have been approved for use in California. Others are at various stages of federal or CA approval.

The list of biocides that are being evaluated by the European Union under the Biocidal Products Directive (BPD) is also included. Some of the non-copper biocides on the BPD list are already in use in CA.

Biocides that have been shown to be effective for use as antifoulants are listed as potential candidates for future registration. Many of these have been approved for use in the United Kingdom, Japan, and other countries for AFP use. Note that many of these are currently registered by U.S. EPA and DPR for non-AFP use (e.g., diuron as an herbicide, ziram as a fungicide).

When looking at the number of products registered in CA, please note that the total could include one or two manufacturing-use products. Thus, the number of end-use products (e.g., AFPs that are eventually applied to hulls) are likely to be slightly smaller than the total number of products. Also, for comparative purpose, note that approximately 200 Cuprous oxide AFP products are currently registered for use in CA.

This list will be occasionally updated to incorporate new and additional information.

Currently-Registered in California w/ DPR

Zinc pyrithione (Zinc Omadine)
Chemical name: Zinc 2-pyridinethiol-1-oxide
Chemical class: metallo-organic
# of products registered as of 4/1/09: ~28
Note: Historically used as a booster biocide, but has seen shift in use as primary biocide in recent years.

Irgarol (Irgarol 1051)
Chemical name: 2-methylthio-4-tert-tutylamino-cyclopropylamino-6-(1,3,5-triazine)
Chemical class: organic (s-triazine)
# of products registered as of 4/1/09: ~62
Note: Primarily for soft-fouling pests & thus used frequently as a booster biocide.

Sea-Nine (Sea-Nine 211, DCOI)
Chemical name: 4,5-dichloro-2-n-octyl-4-isothiazolin-3-one
Chemical class: organic (isothiazolone)
# of products registered as of 4/1/09: ~6
Note: Limited products available in CA with some products limited only to commercial and military vessel uses.

Currently Being Evaluated by DPR for Registration in California

Tralopyril (Econea)
Chemical name: 2-(p-chlorophenyl)-3-cyano-4-bromo-5-trifluoromethyl pyrrole
Chemical class: organic
# of products being evaluated as of 4/1/09: ~2
Note: Has already been approved for use by U.S. EPA, and States of N.Y. & Florida.

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Currently Being Evaluated for Registration by U.S. EPA

NONE

Currently Being Evaluated by the European Union under the Biocidal Products Directive

Dichlofluanid
Chemical name: 1,1-dichloro-N-[(dimethylamino)sulfonyl]-1-fluoro-N-phenylmethane-sulfenamide
Chemical class: organic

Irgarol (see above)

Sea-Nine (see above)

Tolylfluanid
Chemical name: 1,1-dichloro-N-[(dimethylamino)sulfonyl]-1-fluoro-N-(4-methylphenyl)methanesulfenamide
Chemical class: organic

Zinc pyrithione (see above)

Zineb
Chemical name: zinc ethylene bis(dithiocarbamate)
Chemical class: metallo-organic (carbamate complex)

Could Potentially be Registered in the Future with U.S. EPA or DPR for AFP Use

Medetomidine
Chemical name: 4-[1-(2,3-dimethylphenyl)ethyl]-3*H*-imidazole
Chemical class: organic (catemine)
Note: This biocide was widely discussed as a potentially viable hard-fouling antifoulant at the 2008 International Congress on Marine Corrosion and Fouling (ICMCF) in Kobe, Japan.

TPBP
Chemical name: triphenylborane-pyridine
Chemical class: metallo-organic (organoboron)
Note: This biocide is seeing increasing use, particularly on pleasure crafts in Japan.

Chlorthalonil
Chemical name:
Chemical class: organic (aromatic halide)

Dichlofluanid (see above)

Diuron
Chemical name: N'-(3,4-dichlorophenyl)-N,N-dimethylurea
Chemical class: organic (aromatic halide)

KH101
Chemical name: pyridine triphenyl borate

Chemical class: organic (heterocyclic amine)

Maneb
Chemical name: manganese ethylenebisdithiocarbamate
Chemical class: organic (carbamate)

TCMS pyridine
Chemical name: tetrachloroisophthalonitrile
Chemical class: organic (heterocyclic amine)

TCMTB
Chemical name: 2-(thiocyanomethylthio)benzothiazole
Chemical class: organic (heterocyclic amine)

Thiram
Chemical name: bis(dimethylthiocarbamoyl) disulfide
Chemical class: organic (carbamate)

Ziram
Chemical name: zinc bis(dimethyldithio-carbamate)
Chemical class: metallo-organic (carbamate complex)

Zineb (see above)