EFFECTS OF ORGANIC BORON ANTIFOULANTS ON OYSTER EMBRYO

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1.Introduction

Organotin(Ot) compounds that were used for many years as antifouling biocides have become a problem due to their toxicity and accumulation characteristics. In September 2008, Ot compounds were prohibited from being used worldwide.

From 1997, the production of paints that contain TBT compounds was prohibited in Japan, and so alternatives to Ot antifoulants have been used since then. We have evaluated the toxicity of alternative Ot antifoulants (e.g., TPBP and TPBOA) and the degradation products from TPBP and TPBOA using oysters that inhabit a large area of Hiroshima Bay.

2.Materials and Methods

2.1 Reagents and materials

Triphenylborane pyridine (TPBP) and triphenylborane octadecylamine (TPBOA)were used as the antifoulants in our study. Diphenylborane hydroxide (DPB), phenyl-borane dihydroxide (MPB), biphenyl, pridine, phenol, benzene, and boric acid were used as the degradation products from TPBP or TPBOA.

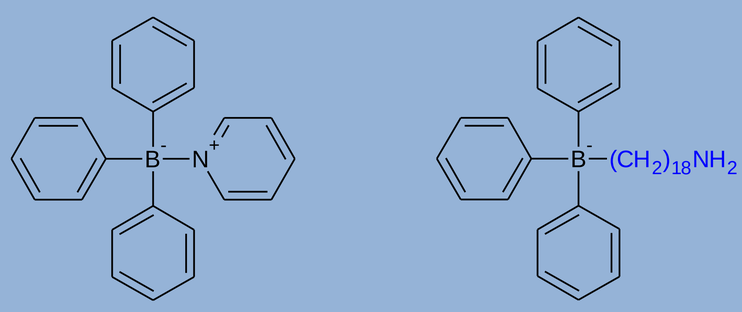

Fig.1 Structers of TPBP and TPBOA

2.2 The oyster toxicity test

Dilute solutions (1000mg/l) were prepared by dissolving the standard materials in dimethyl sulfoxide (DMSO) and then forming standard solutions (0.1-1000μg/l) by diluting these solutions with artificial seawater.

A volume of 10ml of standard solution was placed into 6-hole microplate. Three wells with the same concentration were prepared. A mature egg was added to each well, along with a volume of 25μl of artificial seawater, which included about 200 mature eggs. The sperm was diluted with artificial seawater 1000 times and a volume of 100μl of seawater was added to each well. After periods of 2h and 24h, each well was observed under the microscope and the development stages of 200 eggs were identified. At the same time, the oyster eggs were photographed.

After the experiments had ended, LC10, LC50, EC10,and EC50 values were calculated.

3.Result and Discussion

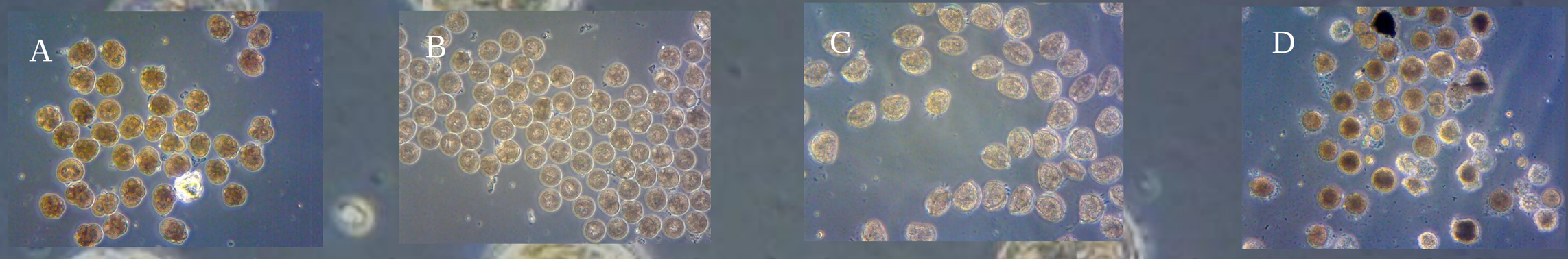

Fig.2 Effects of TPBP and TPBOA on oyster embryo development. (A) Control after 2h; (B) TPBP 10ppb, 2h; (C) Control after 24; (D) TPBOA 100ppb, 24h

3.1 LC10,LC50

We calculated the LC10 and LC50 values of each compound from the survival rate of the fertilized oyster eggs after an exposure time of 2 and 24 h using the data from the Ecotox-Statics software package. The results are shown in Table1.

Table1 Lethal effects of antifouling compounds to oyster embryo

	2h		24h	
	LC10	LC50	LC10	LC50
TPBP	1.1(1.0-1.1)	7.5(6.7-8.5)	0.58(0.55-0.60)	6.3(5.4-7.4)
TPBOA	2.7(2.6-2.8)	23(20-26)	2.2(2.1-2.8)	10(9.5-12)
DPB	>1000	>1000	>1000	>1000
MPB	>1000	>1000	>1000	>1000
Biphenyl	>1000	>1000	>1000	>1000
Phenol	>1000	>1000	>1000	>1000
Pyridine	>1000	>1000	>1000	>1000
Benzene	>1000	>1000	>1000	>1000
Boric acid	>1000	>1000	>1000	>1000
TBT*	2.7(2.6-2.9)	14(13-16)	0.69(0.64-0.70)	3.3(2.9-3.7)
TPT*	4.1(3.9-4.3)	13(12-14)	1.4(1.4-1.5)	2.5(2.4-2.7)

LC50 : 50% lethal concentration(μg/l) ( ) : 95% confidence interval
LC10 : 10% lethal concentration(μg/l) * : previous research data

3.2 Influence on deformity

The EC10 and EC50 values of TPBP were 0.30 and 2.5 μg/l, respectively.

4. Conclusions

The results showed that the toxicity of the degradation products was very low, and the toxicity of TPBP and TPBOA was almost the same as that of TBT and TPT.

Acknowledgements

The TPBP, DPB, and MPB test compounds were kindly donated by the Hokko Chemical Co. Ltd., Japan, and the TPBOA was provided by the Benny-Toyama Co. Ltd., Japan with much appreciation. This work was partly supported by a Grant-in-Aid for Scientific Research (Monbukagakusyo B20310019) and the Mitsui & Co. Ltd., Environmental Fund (2007)