Antifouling biocide contamination in the coastal water and sediments of Hokkaido

(北海道沿岸域における代替船底防汚物質の汚染調査)

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Background

After IMO (International Maritime Organization) has prohibited the usage of organotin compounds as an antifouling agent all over the world, antifouling biocides Irgarol 1051 and diuron have been widely used as an alternative antifouling agent. However, it was reported that these compounds and their metabolites were persistent in the aquatic environment and highly toxic to marine organisms. Some European countries such as UK and Denmark have already banned using these substances as antifouling biocides. Besides the prohibition of Irgarol 1051 was proposed at IMO recently. To discuss their regulation, current situation in the coastal water should be investigated. Since Irgarol 1051 and diuron have been frequently used in Japan and no data of Irgarol 1051 and diuron concentration in Hokkaido was reported, concentration of Irgarol 1051 and diuron were analyzed in the coastal water and sediments of main ports in Hokkaido.

Methodology

Surface seawater samples were taken from the seven ports (Mori, Muroran, Tomakomai, Tokachi, Kushiro, Nemuro, Abashiri), while surface sediments were obtained from the six ports except for Tomakomai. Seawater was extracted twice by dichloromethane. Sediment was extracted three times by dichloromethane after centrifugation with acetonitrile. Analytes were quantified using LC-ESI- MS.

Result and discussion

Irgarol 1051 was detected in seawater from the six ports except for Nemuro and Abashiri, and in sediment from the all ports. Maximum concentration (2.6 μg/L) exceeded EQS (Environmental Quality Standard; 24 ng/L) value of Netherland and UK which have prohibited the use of Irgarol 1051. M1 (metabolite of Irgarol 1051) was detected in seawater from Mori, Tomakomai and Nemuro and in sediment from the all six ports. M1 concentration (6.6 μg/L) was much higher than the parent compound, although M1 is more toxic than Irgarol 1051. Diuron was detected in seawater from Muroran and Hanasaki and in sediment from Mori and Muroran. Concentration of diuron (1.4 μg/L) was under EQS value (4.3 μg/L). 3,4-DCA (metabolite of diuron) was not detected in seawater and in sediment in the all ports. In previous data in Japan, concentration of Irgarol 1051, M1, diuron were 0.3, 1.9 and 4.6 μg/L, respectively. Irgarol 1051 and M1 in this study exceeded previous ones. Therefore, there is a probability that these compounds are used for ships in the Hokkaido ports more than any other area or have been accumulated year by year. This study indicates that continuous analysis of alternative antifouling agents is required.