

Antifouling pesticides in the coastal waters of Southern California

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ABSTRACT

Antifouling biocides are used to prevent settlement and growth of organisms on the submerged surfaces of boats and ships. Organotin, particularly tributyltin (TBT) were the most widely used compounds in antifouling paints until the 1990s. After the United Nation's International Maritime Organization passed legislation banning the use of harmful organotins (Konstantinou and Albanis, 2004), organic booster biocides were introduced as alternatives to organotin compounds in antifouling products. The antifouling agent Irgarol 1051 and other multi-use pesticides: diuron, chlorothalonil, dichlofluanid and TCMTB (2-(thiocyanatomethylthio)-1,3-benzothiazole) are among the most frequently used antifouling biocide ingredients in many countries (Thomas, 2001). Irgarol 1051 (2-methylthio-4-tert-butylamino-6-cyclopropylamino-s-triazine) is a triazine-based herbicide manufactured by Ciba Giegy Corp. Like other s-triazine herbicides, it is a photosystem-II inhibitor (Hall et al., 1999) and is highly toxic to non-target plant species at low ng/L concentrations (Konstantinou and Albanis, 2004). Irgarol degrades in seawater with half-life of about 100 days (Konstantinou and Albanis, 2004), resulting in the major degradation product 2-methylthio-4-tert-butylamino-6-amino-s-triazine, also known as M1 or GS26575 (Okamura, 2002). Some studies have shown that M1 has a similar (Hall et al., 1999) or longer half-life in seawater (Okamura et al., 2000) compared to the parent compound. The herbicide diuron is also used in antifouling paints, and these products contain diuron at concentrations ranging from 4% to 7%. Diuron is more persistent than Irgarol in seawater and more toxic to fish (Okamura et al., 2002). Irgarol and M1 have been widely detected in estuarine and coastal waters of European countries as well as in Japan and the USA. Although monitoring of Irgarol has been extensive worldwide (Konstantinou and Albanis, 2004), studies conducted in the USA only reported Irgarol concentrations in US waters along eastern coastal areas of South Florida (Gardinali et al., 2002, 2004; Zamora-Ley et al., 2006), Chesapeake Bay (Hall et al., 2004), North and South Carolina, Georgia and Florida (Hall et al., 2005). This paper presents data on the occurrence of Irgarol in the surface waters of several marinas around San Diego, CA. To our knowledge, this is first study reporting Irgarol concentrations in western areas of the US, particularly in Southern California.

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