

Science for Environment Policy

Toxic by-products of ballast water treatment evaluated

A new study has evaluated disinfection by-products (DBPs) formed during the treatment of ballast water. As some of the DBPs produced are hazardous, the study concludes that more information is needed to ensure DBPs from treatment methods do not harm human health or aquatic environments.

Ships hold ballast water in tanks to provide stability at sea. Frequently, water is taken at one port and discharged at another, allowing plants, animals, viruses and bacteria contained in the water to be transported to new environments. Some species introduced this way can become invasive, causing local environmental, human health and economic damage in their new habitat.

In 2004, the International Maritime Organisation (IMO) adopted the 'International Convention for the Control and Management of Ships' Ballast Water and Sediments'¹ to reduce the global spread of invasive species via ballast water. It requires ballast water to be treated before discharge.

Most of the approved procedures for treating ballast water disinfect the water using strong oxidising agents, such as chlorine or ozone. Other ballast water management systems (BWMS) disinfect water using ultraviolet (UV) radiation. However, disinfection produces by-products, some of which are known to be toxic. Other DBPs, or their impact on the marine environment, are less understood.

Partly funded by the EU², this study carried out a preliminary survey of BWMS using oxidative or UV-based systems that have been submitted to the IMO for approval. The study identified all reported DBPs formed during ballast water treatment that could affect the safety of a ship (from shipboard installations of BWMS), human health or aquatic environments.

The most frequently reported DBPs formed during the oxidative treatment of ballast water were trihalomethanes, haloacetic acids and bromate. The most common type of BWMS were different chlorination systems, which generated variable levels of DBPs. Compared with seawater, chlorination treatment of brackish water (less salty than seawater) generated the highest levels of DBPs, particularly trihalomethanes. Haloacetic acids were not reported as frequently as trihalomethanes. Bromate was also reported less often. Its concentrations in discharged water after chlorination ranged from 2.6-46 µg/L (micrograms per litre), but levels were higher after ozonation (50-70 µg/L).

Reporting of individual DBPs formed during disinfection of marine waters suggest that the bulk of trihalomethanes and haloacetic acids were brominated varieties. The majority of trihalomethanes was tribromomethane, with smaller amounts of dibromochloromethane. Of the haloacetic acids generated, dibromoacetic acid was found in the largest amount, followed by smaller quantities of bromoacetic acid and mixed bromochloro derivatives.

For UV-based BWMS, little information on potential DBPs was reported, but nitrite levels in brackish water were found to be slightly elevated. In addition, small increases in concentrations of hydrogen peroxide, halogenated methanes and acetic acids were reported. Although human exposure to ballast water is likely to be limited, there are a number of concerns. These include carcinogenic classifications for some DBPs, such as brominated acetic acids, the cumulative effects of DBPs, and the lack of risk assessment of emerging DBPs, which are potentially toxic. In particular, their potential toxic effects on wildlife are not well known.



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1. See: [www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-control-and-management-of-ships-ballast-water-and-sediments-\(bwm\).aspx](http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-control-and-management-of-ships-ballast-water-and-sediments-(bwm).aspx)

2. The North Sea Region Programme is partly funded for the period 2007-2013 through the European Regional Development Fund (ERDF). See: www.northsearegion.eu/ivb/home/