Sediments in the ship's ballast water tank

Vlado Valkovic and Jasmina Obhodas

Institute Ruder Boskovic, Bijenicka c.54, Zagreb, Croatia

Phone: +385-1-456-0101

E-mail: valkovic@irb.hr

Invasive aquatic species present a major threat to the marine ecosystems, and shipping has been identified as a major pathway for introducing species to new environments. The problem increased as trade and traffic volume expanded over the last few decades, and in particular with the introduction of steel hulls, allowing vessels to use water instead of solid materials as ballast. The effects of the introduction of new species have been devastating in many areas of the world. Quantitative data show the rate of bio-invasions is continuing to increase at an alarming rate. The Ballast Water Management (BWM) Convention, adopted in 2004, aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments.

International Convention for the Control and Management of Ships' Ballast Water and Sediments will entry into force on 8 September 2017.

Under the Convention, all ships in international traffic are required to manage their ballast water and sediments to a certain standard, according to a ship-specific ballast water management plan. All ships will also have to carry a ballast water record book and an international ballast water management certificate.

"Sediments" means matter settled out of ballast water within a ship. Regulation B-5 Sediment Management for Ships states that all ships shall remove and dispose of sediments from spaces designated to carry ballast water in accordance with the provisions of the ship's Ballast Water Management plan. New ships (described in regulation B-3.3 to B-3.5) should, without compromising safety or operational efficiency, be designed and constructed with a view to minimize the uptake and undesirable entrapment of sediments, facilitate removal of sediments, and provide safe access to allow for sediment removal and sampling, taking into account guidelines developed by IMO.

In addition, under Article 5 entitled "Sediment Reception Facilities" Parties undertake to ensure that ports and terminals where cleaning or repair of ballast tanks occurs, have adequate reception facilities for the reception of sediments.

Regulation D-2 of the Ballast Water Convention sets the standard that ballast water treatment systems must meet (allowable concentrations of plankton, toxicogenic vibrio cholera, escherichia coli and intestinal enterococci). Treatment systems must be tested and approved in accordance with the relevant IMO Guidelines.

There are two generic types of process technology used in ballast water treatment: (i) solid-liquid separation and (ii) disinfection. Solid-liquid separation is simply the separation of suspended solid material, including the larger suspended micro-organisms, from the ballast water, either by sedimentation (allowing the solids to settle out by virtue of their own weight) or by surface filtration. They include following processes: filtration, the use of hydrocyclone and coagulation.

Disinfection removes and/or inactivates micro-organisms using one or more of the following methods: (i) Chemical inactivation of the micro-organisms through either: (a) oxidising biocides – general disinfectants which act by destroying organic structures, such as cell membranes, or nucleic acids; or (b) non-oxidizing biocides – these interfere with reproductive, neural, or metabolic functions of the organisms. (ii) Physicochemical inactivation of the micro-organisms through processes such as UV light, heat or cavitation. (iii) Asphyxiation of the micro-organisms through deoxygenation.

Chemical disinfection (oxidizing biocides) processes include chlorination, electrochlorination, ozonation, the use of chlorine dioxide, peracetic acid and hydrogen peroxide. Physical disinfection includes the use of ultraviolet (UV) irradiation, deoxygenation, cavitation and heat.

Presence of sediments in ballast waters imposes the limits on applicability of these methods. For example, systems with UV irradiation cannot eliminate all organisms present in ballast waters because of inability to deliver a stable lethal dose to ballast waters of variable quality. The presence of sediments drastically reduces the effectiveness of UV irradiation because the sediment particles protect small organisms from exposure to irradiation.

Several systems for treatment of ballast waters use combination of two or three techniques, filtration being usually first and/or last step. We advocate the use of radiation treatment by using electron accelerator, preferably in an on-shore installation.