

ANNEX C

BALLAST WATER MANAGEMENT METHODS

1. Ballast Water Change

The exchange of Ballast Water in ocean areas currently offers a means of limiting the transfer of aquatic species through water used as ballast. were identified three methods to carry out the exchange of ballast water at sea:

A. Sequential Method - ballast tanks are drained and refilled with ocean water;

B. Continuous Flow Method - ballast tanks are simultaneously filled and drained by pumping ocean water; and

C. Brazilian Dilution Method - ballast water is loaded through the top and, simultaneously, the discharge of this water through the bottom of the tank, at the same flow rate, in such a way that the water level in the ballast tank is controlled to be kept constant.

Ballast water exchange must achieve an efficiency of at least 95 percent exchange volumetric. Ships using the continuous flow or dilution method should pump three times the tank volume in order to reach the desired minimum efficiency.

2. Ballast Water Treatment Systems

Vessels with operational Ballast Water Treatment Systems (BWMS) must comply with the maximum allowable concentrations of organisms, according to the size class or group of organisms, as provided for in Regulation D-2 of the Ballast Water Convention, reproduced Next.

Table 1. Rule D-2 of the Ballast Water Convention (IMO, 2004)

Organisms/Indicators and Size Classes	Maximum number of organisms allowed in discharged water (CFU = Colony Forming Unit)
Viable organisms $\leq 50 \mu\text{m}$ in minimum dimensions	Discharge $\leq 10/\text{m}^3$
Viable organisms $\leq 10 < 50 \mu\text{m}$ in minimum dimensions	Discharge $\leq 10/\text{ml}$
<i>Vibrio cholerae</i> toxicogenic (O1 and O139)	less than 1 CFU/100 ml or less than 1 CFU per 1 gram of zooplankton samples
<i>Escherichia coli</i>	less than 250 CFU/100 ml
Intestinal Enterococci	less than 100 CFU/100 ml

References:

Fykse EM, Nilsen T, Nielsen AD, Tryland I, Delacroix S, & Blatny JM (2012). Real-time PCR and NASBA for rapid and sensitive detection of *Vibrio cholerae* in ballast water. *Marine Pollution Bulletin*, 64(2), 200-206. US Environmental Protection Agency (2010). Environmental Technology Verification Program (ETV). Generic Protocol for the Verification of Ballast Water Treatment Technology, Version 5.1. Report number EPA/600/R-10/146, United States Environmental Protection Agency, Washington, DC Welschmeyer, NA, & Maurer, B. (2012). A portable, sensitive plankton viability assay for IMO shipboard ballast water compliance testing. in *Proceedings of the Global R and D forum on Compliance Monitoring and Enforcement*. eds. A. Olgun, FT, Karokoc and F. Haa.