

BALLAST WATER TREATMENT METHODS

Fact Sheet 6

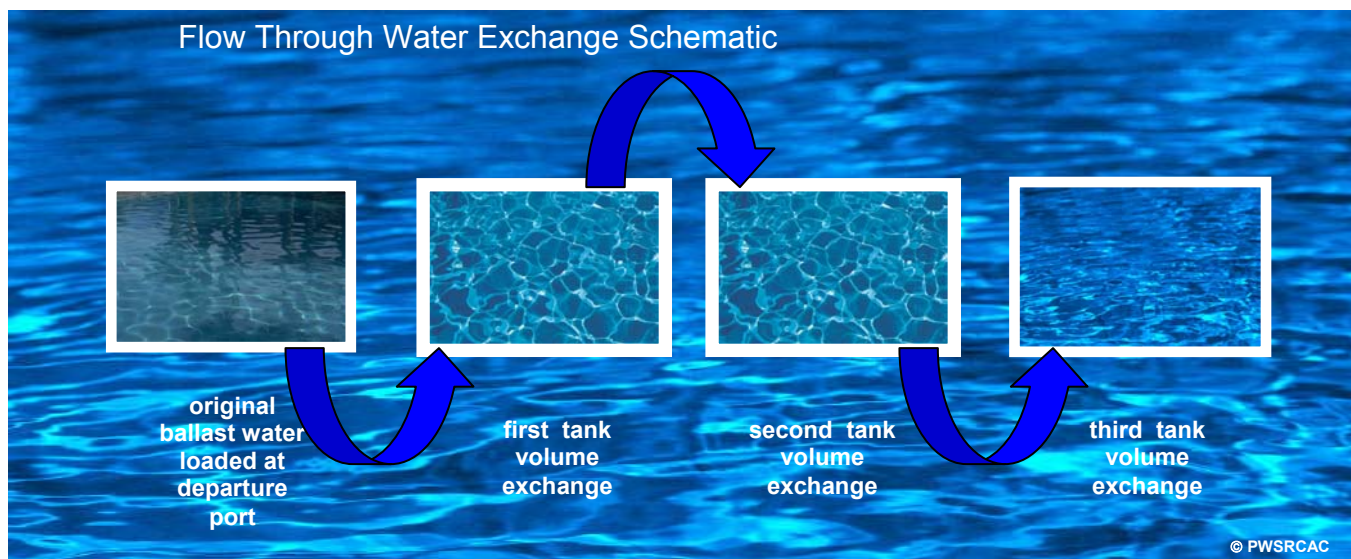
Ballast Water Exchange *Flow-Through Method*

Purpose

Ballast water exchange is an operational method used to remove nonindigenous species (NIS) from ballast tanks by replacing seawater taken on in port and nearshore areas with deep, open ocean seawater. The goal is to remove NIS laden seawater with deep, open ocean water which is void of NIS capable of survival in the port where the ballast water is discharged. Deballasting in open ocean poses little NIS contamination risk to the deeper ocean water because inland coastal organisms cannot survive when discharged in deep water. Ballast water collected from deep, open ocean areas is not contaminated with coastal NIS and poses much less risk of transporting species likely to survive in a nearshore, coastal habitat.

Technology Description

There are two main types of ballast water exchange: sequential and flow-through. Flow-through ballast water exchange involves pumping open ocean water into a full ballast tank for a length of time sufficient to flush the ballast water tank. Tanks are typically flushed with a quantity of water equivalent to three times the tank volume. Assuming perfect mixing, a three-tank volume flush will theoretically achieve 95% replacement of the original ballast water volume. The goal of the flow-through method is to dilute the original in-port and near-shore ballast water with high volumes of deep, open-ocean ballast water, leaving a very small percentage of NIS remaining in the tank. Although the flow-through method is not as effective in NIS removal as sequential exchange,¹ this method is safer since it is completed with full ballast tanks. Flow-through ballast water exchange does not alter the stability, stress, and ship attitude, and can be accomplished in a wider range of weather conditions.



Technology Advantages

Currently, ballast water exchange is viewed as the only proven, currently available, effective treatment to reduce the risk of NIS for a wide range of vessels. Many large vessels, such as crude oil tankers are currently equipped and trained to conduct ballast water exchange, since it is required when conducting international trade. As a result, ballast water exchange is a technically feasible and cost effective approach for tankers. However, for some vessels implementation of ballast water exchange may involve modest impacts on operations and a minimal capital investment for retrofit.

¹ Sequential ballast water exchange involves completely emptying segregated ballast tanks (individually or in sequence) and then refilling them with open ocean water.

Technology Challenges

Ballast water exchange does not effectively remove sediment that has settled to the bottom of the tank that may be harboring NIS. While the flow-through ballast water exchange technique is estimated to “theoretically” achieve 95% efficiency, there are numerous partitions, bulkheads and baffles that impede mixing. Incoming water typically takes the shortest and most expedient pathway to the outlet, resulting in a less efficient exchange. There is also some evidence that NIS are unlikely to be evenly distributed through the tank, thus organism removal does not always directly correlate with exchange efficiency. Researchers have observed a natural tendency for organisms to avoid high flow and turbulent zones, seeking protection in low flow rate zones (tank corners and bottoms) and in or near the sediment zone on the tank bottom. Displacement efficiency is vessel design dependent. The design of the ship’s ballast tanks, safety requirements of the ship, sea conditions, quantity of water pumped, and the pumping system all factor into the ballast water exchange efficiency. Use of ballast water exchange will not necessarily reduce the risk of translocating undesirable organisms if the exchange water is compatible with the receiving water. Thus, it is critical that the exchange be made in deep ocean water. The need to obtain deep ocean water for the exchange may result in some additional cost for the vessel voyage if obtaining deep water requires the vessel to transit a less efficient route than would normally be required.

Cost

Ballast exchange costs are relatively low and involve development of ballast water management plans as well as increased pumping and fuel costs. Most crude oil tankers already have ballast water management plans in place.

United States Regulatory Requirements

Principal regulations controlling the management of ballast water in the United States are Coast Guard rules administered under the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) and the National Invasive Species Act of 1996 (NISA). Effective July 1, 1999, the Coast Guard promulgated a NISA regulation promoting voluntary ballast water exchange guidelines and mandatory ballast water reporting. The guidelines recommend vessels entering US waters with ballast water from outside the 200-mile exclusive economic zone (EEZ) conduct open water ballast exchange in waters of at least 2,000 meters depth before deballasting in port. Mandatory reporting requirements apply to all vessels entering the EEZ with ballast on board. For each vessel, a ballast water report form must be submitted to the US Coast Guard, in care of the Smithsonian Environmental Research Center and includes information on the vessel, route, and ballasting volumes. The information is available to the public in a searchable database at <http://invasions.si.edu/cgi/>. Since May 1996, oil tankers that export crude oil from the Trans-Alaska Pipeline outside the US are required to conduct mandatory ballast exchange on their return voyage (US Code of Federal Regulations 15 CFR 754.2(iii) A). NISA specifically exempts oil tankers from mandatory ballast water exchange when engaged in “coastwise” trade (Subtitle B, Section 1101 (c) (2) (L)). Thus, Alaska tankers sailing to domestic ports are not currently required to exchange their ballast.

Flow-Through Method: Rating as a Viable NIS Treatment Method²

| NIS Treatment Rating System For PWS | Rating for Flow-Through Method | Rating Description |
|--|---------------------------------------|--|
| Safety | *** | No incremental safety risk |
| Environmental | *** | Technology removes NIS and has no negative impact on the environment |
| Efficacy | ** | Technology is effective, but may not be effective for all NIS of concern |
| Cost | *** | Technology is well established and proven cost effective |
| Practicality | *** | Little or no impact on current operations, common technology |

Rating is based on a three star system; three stars is the highest rating, one star is the lowest rating.

Status of Technology for Port Valdez & Alaska Crude Oil Tanker Trade

In its peak, less than 5% of the total crude oil shipped from Valdez is transported to foreign ports. Ballast water exchange is required for this international trade. Currently, no crude oil is being shipped to foreign ports, although it could be again in the future. The vast majority of Alaskan tankers (~95%) sail to domestic ports, which are also invaded with exotic species. Alaska tankers sailing to domestic ports have never been required to exchange their segregated ballast.

² See PWSRCAC “Technology Viability Rating System” FACT SHEET for an explanation of the rating system.