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FEATURES OF TECHNICAL IMPLEMENTATION OF THE CONCEPTS OF BALLAST-FREE SHIPS

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Oceanic plants and creatures are known to be endangered by human actions. Oceanic life forms are also threatened by various activities of the shipping industry, which is a constraint on the existence and development of organisms [1]. An urgent problem that has become even more serious is invasive marine species. These species live in certain parts of the ocean, where rocks and winds act as natural barriers and prevent them from penetrating and expanding their negative growth. But due to the constant movement of vessels, they get into different ocean areas through the ballast waters of ships [2]. This complicates the problem on a huge scale. According to statistics, these problem organisms are part of a quartet of ocean pollutants, which also includes:

1) ocean pollution caused by land-based activities;
2) extensive use of ocean resources;
3) unnecessary changes to the ocean environment and ecosystem.

In connection with the entry into force of the International Maritime Organization (IMO) "International Convention for the Control and Management of Ships' Ballast Water and Precipitation" (adopted on 13 February 2004, entered into force on 8 September 2017), the topic of free-ballast vessels is regulated under very strict requirements for ballast water treatment [3, 4].

The creation of vessels with an alternative non-ballast solution means that they are no longer bound by ballast water treatment standards. Exemptions from pumps, pipes and valves associated with ballast tanks can reduce maintenance costs, free up electricity normally required for ballasting, and make ballast water treatment systems unnecessary, making them the cheapest way to comply with IMO rules.

One of the well-known project of a ballastless vessel is the University of Michigan project, in which the ship's ballast tanks are replaced by a longitudinal structural ballast line, through which a constant flow of local seawater is created, which reduces the potential danger of contaminated water (Fig. 1, 2).

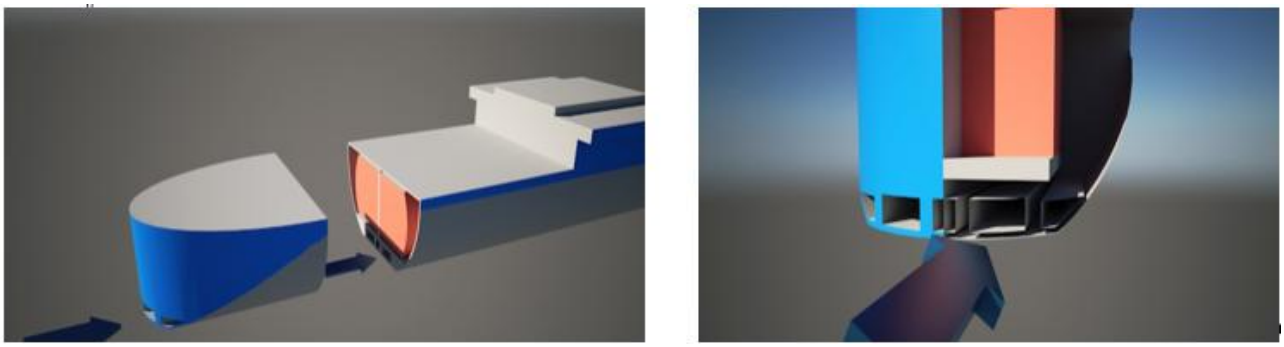

Fig. 1. Tunnels for the flow of ballast water in the hull

When the vessel moves in the area of the bow is forming of high pressure, and in the area of the stern is forming an area of low pressure. This pressure difference is used to create a flow of water through the tunnels, without the use of pumps. Although this slightly increases the resistance of the vessel, the flow to the upper half of the propeller provides a stable flow of water that attacks the propeller, increasing its efficiency and compensating to some extent for the increase in resistance.

A number of projects have also been developed that do not completely abandon the use of ballast water, but reduce its quantity to a minimum (low-ballast).

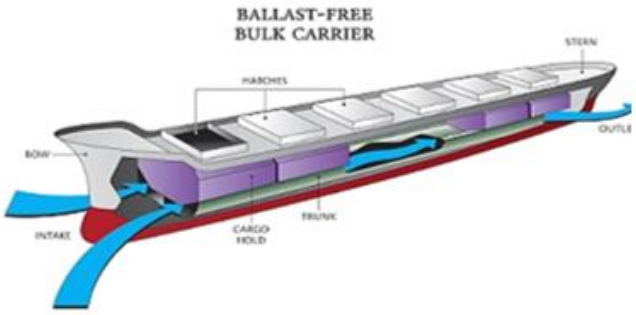

Fig. 2. Bulk with ballastless system of sea water flow through tunnels. "Electric Blue"

Fig. 3. Project of a modern ballastless container vessel

Another project worth mentioning-is the Rolls-Royce Marine's Electric Blue feeder container project with modular components that can be replaced or upgraded to adapt to changing needs, which is a significant step towards building ships without ballast water (Fig. 3).

Conclusions

In the implementation of the ballastless vessels' concept, it is important that in addition to the costs associated with regulatory benefits, ballastless vessels can have an extended service life without the risk of corrosion caused by the accumulation of sediment in ballast tanks. Elimination of this problem will also reduce inspection and cleaning time, making life easier for crew members. The vessel's ability to hold course will also improve, and movement without heavy ballast tanks will reduce impacts during collisions in severe weather. Therefore, the creation of a vessel that does not carry ballast will prevent the transportation of microorganisms without the installation of expensive cleaning equipment, such as filters, installation of ultraviolet radiation, the use of chemical biocidal additives and other solutions.

Among the disadvantages we note the following:

1) loss of load capacity due to the limitation of the volume of ballast water, as it is difficult to maintain the load capacity and the same volume of ballast water;

2) loss of strength of the vessel − complete processing of the double bottom will be required;

3) increasing the flow rate of ballast water at the point of discharge, i.e., increasing the resistance, as shown experimentally.

Despite all the costs and some shortcomings, we will get much more − clean seas, oceans and progress that may open our eyes to new ideas and discoveries.

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