BALLAST W

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■■ The world-wide threat from the introduction of non-indigenous species to coastlines or closed and thus very fragile bio-systems, has been well recognised and established by scientists.

A number of states and individual ports have taken the initiative of imposing strict voluntary regulations on their coastal areas, which will soon become mandatory, before any International legislation is passed.

From the technical point of view, the IMO Resolution A.868(20), Appendix 2, provides a rough basis for the technical issues and restrictions involved in the process.

As is customary with most regulations in shipping, the burden for dealing with a problem is placed on the shoulders of ship management, while the port authorities reserve the policing role for themselves.

According to IMO there are three recognised ballast water management methods.

1. Exchange at sea
2. Treatment
3. Isolation

With respect to the exchange at sea method, which for the time being is the most cost- effective and practically applicable to most existing ships, IMO recognises only two methods.

1. Sequential
2. Flow-through (overflow)

In this article I mainly target the new building container ships under design, with respect to the means available for minimising the influences of the newly introduced ballast exchange practices to the ship's normal operation and creating a trouble-free and user- friendly system.

The effectiveness of the ballast water exchange method for minimising the transfer of malicious species to alien waters has been studied by several readers.

Papers such as "The analysis of flow-through ballast water exchange" by G. Armstrong, A. Rose and A. Holdø, in March 1999 at IMarE, and "An investigation of ballast water management methods with particular emphasis on the risk of the sequential method" by Lefteris Karaminas of LR in June 2000, provide thorough scientific analysis and practical guidance.

It is assumed that with perfect mixing, the ballast exchange method can succeed in removing 95 per cent of the original ballast water. A problem usually imposed is that many organisms, with higher density than water, tend to settle as sediment at the bottom of the tanks. In order to improve the efficiency of the process in this respect, the ballast tank internal structure and the associated piping should be so designed as to ensure that the highest degree of mixing can be achieved, the stagnant areas reduced and high water velocities achieved in order to lift the bottom sediment into the outgoing water stream as far as possible.

We can now elaborate on the individual characteristics of each method.

SEQUENTIAL METHOD

This method dictates that water in a ballast tank should be exchanged several times with water from the open ocean in order to ensure that the ship arrives at the destination port with ballast water containing species from the ocean or neighbouring areas rather than from very distant and alien waters of the port she departed.

This procedure of ballasting and de-ballasting has the great advantage of not requiring any modification to the ship's existing equipment. However, its implementation gives rise to a number of practical problems:

- The operation is laborious and requires continual attendance from a responsible officer during the whole process. Nowadays, with the personnel on board the ships already reduced in number, such a method constitutes a further burden to the crew's workload, which is already quite significant.
- The sequence of the operation should be such that the sea condition, bending moments and shear forces, under the ship's current loading condition, will not endanger the strength of the structure.
- IMO document MEPC 44/4 regulation 15.1 (c)iii refers to "... favourable sea and swell conditions...". This self-explanatory comment limits the operational envelope of the method in some narrow segments of most ocean routes.
- Apart from the ship's overall longitudinal strength, there are concerns with respect to the additional dynamic loads due to ballast inertia and sloshing. Further, these dynamic cycles impose extra fatigue loads on the structure, and in some draft conditions the propeller immersion affects the ship's manoeuvrability, and even the visibility line may exceed the IMO limits during the operation.
- The design of the steel structure inside the ballast tanks restricts the disposition of sediments in hidden corners, especially at the fore parts of the tanks, due to the fact that the ballast exchange is done through a single bell mouth suction located at the aft corner of the tank.

Despite the many disadvantages of the sequential method, its greatest strength lies in the fact that it remains the only feasible and cost-effective solution for water ballast management on board existing ships with immediate effect.

OVERFLOW METHOD

Through the continuous overflow of a ballast tank, seawater is exchanged regularly during a ship's passage.

This method ensures that many of the dangers associated with the sequential system are skipped or become of lesser importance.

For most of the time the ballast water tanks are full, in order to reduce the free surface effects, and they remain full during the whole process. This fact is enough to negate the navigational and structural strength risks related to the sequential method.

On the other hand, the existing non-return overflow ventilation heads on deck have not been designed for continuous flow. In addition, in the case of a malfunctioning valve, the overpressure inside the tank becomes a real and present danger, especially when considering the diminishing local strength of an old ship.

Operational and maintenance-wise having a flooded main deck is

WATER Management methods

Environmentally & user-friendly by birth

definitely not the best environment for the deck outfittings, let alone the people working on deck.

This condition is becoming even more serious on some new container ships. This is particularly so where the WBT (water ballast tank) ventilation outlets are located on the torsion box of the transverse bulkheads on the upper deck, close to the cargo hold ventilation duct outlets, the reefer container sockets, and in fact on the top of the cargo-hold hatch coamings.

Hence, the overflow method is not recommended if the ballast piping system has not been designed to be operated in this way.

COMMON WATER BALLAST OVERFLOW SYSTEM

This is not a very widely known system, although it combines the benefits of both the sequential and flow-through methods, without some of the undesirable aspects inherited by both. To the knowledge of the writer, this system has been employed in the past on some high-quality north European designs and recently in the Korean shipyards, upon the owner's request.

Some of the merits of the common overflow system are:

• **Operational flexibility.** As long as the WBTs are treated in full condition, there is no change to the longitudinal strength, stability or any other navigational feature of the ship. This also applies irrespective of the weather conditions.

• **Simple/trouble-free system.** There are no additional moving parts (except in damaged condition). This aspect gives the operator a great degree of confidence. A chief officer only arranges that the proper valves (as usual) switch on the ballast pump. He then forgets about the process, and returns only after some time to switch off the pump. The ballast exchange takes place as many times as one desires, and maybe nobody on board will notice anything.

• **Outfittings.** The plethora of big ventilation heads on the upper deck are becoming obsolete. This aspect has been very welcomed by the designers. It reduces the number of outfittings on the already congested main decks, and saves strength from the otherwise inevitable upper deck plate penetrations.

Some of the disadvantages also inherent to the system are :

• **Initial capital cost.** The system has an initial capital cost, due to the extra piping installed. This cost is in the region of USD 20 to 70 thousand, depending on the size of the ship ranging from small feeder vessels to large post-panamax ones. There is also a small reduction to the deadweight, which ranges from 10MT to 40MT.

• **Structural reinforcements.** The ship's structure should be reinforced to compensate for the material loss due to the passage of the two (PORT and STARBOARD) main overflow pipelines. The ballast tanks should also be reinforced to withstand the additional pressure imposed by the head losses of the water travelling towards the fore or aft overboard outlets.

Such a design should elaborate on the pressure losses of the additional piping under different ballast exchange condition and flows, taking into account combinations of tanks used, pump capacities and vessel draught conditions.

The tanks most likely to suffer from the increased pressure are the centre double bottom tanks. One way to get over this, in cases where it becomes a major obstacle especially on standard designs, is to arrange for a locking mechanism. This permits only a certain combination of tanks and pumps to be operated each time, and/or additional flexibility by installing ballast pumps of different capacities. The latter solution minimises the flow rate and consequently the pressure at the bottom of the tank.

• **Damage stability.** Another matter that requires very close attention from the designer of the system, is for the ship to retain her damage stability characteristics even though the ballast tanks are interconnected through a common system. The main common overflow lines running along the whole length of the ship from both sides should be arranged above the damage water line, and also prevent the uncontrollable flow of water from one tank to another, regardless of the damage condition. To satisfy the class damage stability requirements, depending on the specific design, a number of isolating valves may be installed across the piping to be used only when there are collisions or any other situations that endanger the ship's stability.

• **Operational.** The design should be such that the ballast water outflow does not obstruct the ship's normal operational procedures. The overboard ballast outlets should be constructed well away from the accommodation ladders, and the pier should be out of reach of the ballast water discharge in case the de-ballasting operation takes place in the port during the cargo operation.

The guideline of such design concepts is that the systems that aim to protect life, property and the environment in the maritime industry should be designed in a user- friendly way.

Furthermore, the design should be simple and able to withstand the harsh marine environment.

Such modifications are difficult to implement on existing ships. However, with the correct design during the construction phase, new buildings attain a high degree of safety which is easier to implement.

The port state controls, who police and monitor the implementation of these regulations, should bear in mind that in today's shipping industry, false log book entries are not the actions of lazy or criminal seamen. These are actions of frustrated people, squeezed in the corner by the law makers on the one side and the charterers/managers/owners on the other side, where their only way of surviving is by breaking the rules.