Management of Ballast Water in Brazil  
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Abstract

Since 2001, the Brazilian Sanitary Authority has register about the referring information to the ships arrived with ballast water, in Brazil. This control happens thru the constant form in the RDC 217. This pattern form follows the model preconized by A 868 (20)-IMO Resolution. This same model of formed passed to be adopted by the Brazilian Maritime Authority in 2005, with the promulgation of NORMAN 20, norm that regulates the management of ballast water in Brazil. The present work presents the results of a study case, in which is presented a ballast water management model, basing on the exposed methods for Globallast.

Keywords: ballast water management, IMO, Brazil

1.0 Introduction

The expansion of the international trades’ borders has created the necessity of developing the maritime transport. Ships are used for the transport of all kind of loads, answering for, approximately, 80% all of the world-wide transport of loads. Many of these ships are used in oceanic trips in several routes; under some circumstances, they navigate in one direction completely or partially loaded and, not even always, they make use of the return loads. Under all circumstances, the ship must respect the operational requests that contemplate the following points: draught, stability, structural tensions, conditions of maneuver (immersion of the propeller and the rudder), and security of the vessel [1]. For guaranteeing that the ship attends to these criteria, one of the procedures used is the one that ballasts the ship.

There as situations that the ballast tanks can contain, a mixture of water from different ports and countries. International maritime enterprises estimate that, approximately, 65.000 transoceanic ships are operating, nowadays. This means that, there is a transportation of, approximately, 5 billions of m³ of ballast water for year, and, that 3.000 species of micro organisms can be transported in the ships’ ballast water [2].

In function of the problem’s magnitude caused by the ballast water, it is intended to present the art’s state in what refers itself to the legal initiatives taken in the national and international ambit, besides a study case for determining the parameters established for Globallast in Tubarão port, Brazil.
2.0 Ballast Water Management

2.1 Invasive species

The liberation of non-native species on a new environment constitutes an inoculation, but its introduction is not, necessarily, successful. The inoculation is followed by the differential survival; one observation of long time says that the majority of the individual disappears after the liberation and don’t give shape to the established populations [3]. It isn’t known how long the majority of the inoculated individuals survive. Older individuals, isolated from the non-native species that does not form reproductive populations are found, occasionally, indicating that a certain number grows until the adult phase [3]. There are several registers about non-native species that are generating damages to the local environmental and to the society.

Over more than 40 species has appeared in Great Lakes, since 1960; more than 50, in San Francisco Bay, since 1970. In the U.S.A, it was identified the zebra mussel for the first time in the 80’s, in which has proliferated itself through the rivers’ waters quickly, causing serious damages to the ecosystem, being this one derived from the ballast water [1]. The three notables introductions (that is, mussel-zebra in the U.S.A., dynoflagellates in Australia, and carnivore jellyfish in the U.S.A.), resulted in damages in order of US$ 10 millions, and had deep and wide ecological repercussions [4].

In Brazil, it is verified that an invasion of the golden mussel “L. fortunei”, proceeding from the ships’ ballast water. This is a native species from Chinese rivers and arroyos and from the Asian Southeast; and, only recently, for unknown reasons, it comes expanding its distribution around the world. From Bacia do Prata’s estuary, it has expanded quickly for the superior stretches of Paraná River’s Basin, invading, mainly, the great rivers, on a speed about 240 km/year. In 2001, its presence was reported in Itaipu’s plant, and, in 2002, it was found in the hydroelectric plants of Porto Primavera and Sérgio Motta, down Paraná River, in São Paulo. The entrance of this species in this system of rivers must have occurred through the intense navigation and transposition of boats used in the fishery. The impact of the golden mussel in Brazil has been great and has caused public health problems; clogging of tubulations, filters of hydroelectric plants and water sucking bombs; degradation of the native species; and, also, problems related to the fishery.

2.2 International efforts

IMO has been giving importance to the implications for the introductions of the exotic species and aquatic organisms, naturals of the ballast water for three decades. In 1973, the Resolution 18 from the Research of the Effects of the Ballast Water Discharge, containing the Epidemic Bacteria passed for IMO, in the International Conference of Maritime Pollution, the responsibility of elaborating control measures, drawing the attention to the transport of pathogenic species around the world inside ship’s ballast tanks. In 1990, the Marine Environment Protection Committee (MECP) formed a working group for considering researches, information and solutions proposed by IMO’s Member States and by the Non-Governmental Organization. In 2004, the committee was able to approve the International Convention for the Ballast Water Control and Management of Ships and Sediments – CALS.

Besides, IMO, together with the Global Environment Facility and the United Nations Development Program developed, in 2000, the Removal of Barriers for the Effective Implementation of Ballast Water Control and Management Measures in Developing Countries.
program. This program is known as the Global Ballast Water Management Program or, only, Globallast. This program has brought enormous benefits for the Member Countries, in which refers to the ballast water management.

2.3 Brazil

2.3.1 Bioinvasion

Although, Brazil has participated of the Globallast program, the first national regulation to deal with the ballast water problem, it was only implemented in 2005, the called NORMAM 20, that entered in vigor in October 15th of 2005. The regulation establishes that all of the ships must carry out the oceanic trade before being able of entering in a Brazilian port. The ships must use the methods approved by IMO. The NORMAM 20 establishes differentiated parameters for the operation in the Amazon region: ships derived of the internal trips must carry out two trades of ballast water. This must be done due to the local’s characteristics, which present stretches with a sufficiently fragile ecosystem and, also because, in these regions, the drained of the rivers in the sea occurs, which can generates a great environmental similarity in these regions, due to the bigger salinity of the water in these stretches. So, for the ships that enter in Amazon River, the first trade must be carried out in IMO’s patterns, and the second one in Macapá, in which the tanks’ waters must be recycled only once. The ships that enter through Pará River must make the trade from 70 miles of the coast, between Salianópolis and Mosqueiro’s Island. The ballast water report must be sent to the authorities, 24 hours before the ship’s arrival in the port. However, warship, supply boat ships, small deadweight ships and ships with segregated ballast are excluded of this regulation.

In contrast of what the studies have presented, warships can contribute, significantly, for the insertion of invasive species, as well as the boats of small deadweight. Mansur et al [5] verified that a boat of small deadweight can contribute to the proliferation of exotics species, because many microorganisms can stay fixed in the hull. Add to that, the entrance of water inside of these vessels can transport, even in small quantities, species for others localities. Offshore support ships, as well as oil platforms have an important actuation in the dispersion of exotic species, being in their hull or in the water contained in their bilges.

Hallegraeff et al [4]. inspected the ballast tanks of an American warship and founded, approximately, 100 different seaweed species, being that 22 of them are harmful. Even though, in many countries, the warships are excused of the exigency of a ballast water management plan, even knowing that it can be a great vector of contamination.

2.3.2 – Management and control

It is verified, in Brazil, that a great part of the ships with foreign or national flag that navigate in Brazilian waters, infringe IMO’s and NORMAM 20’s rules, because they do not make the oceanic trade. Besides of this problem, there is the aspect about filling in the forms delivered to the Brazilian authorities.

Leal Neto [2]. presented the main problems found on a survey carried out in the forms delivered to the Brazilian Navy, in the period between 2001 and 2002 (May). A great part of the forms were filled in incomplete and/ or incorrectly; different types of forms, different used unities (sometimes, lack of information of the unit); lack of data (arrival data, name and post of the responsible officer); different combinations of tanks in the “collection” and in the “discharge” of ballast water, unreadable copies, incomprehensive writing, incoherent data
among the different sections of the form (number of tanks and/ or tanks and/ or volumes), and confusion in the “sea height (m)” field between the profundity where occurred the ballast water trade and the height of the wave.

Caron Junior [6] has listed the main problems found during the analysis of 808 ballast water forms delivered to the maritime authorities of Itajaí Port. From the analyzed forms, only 39 contained data about the oceanic unballasting operation; 9 did not possess the origin of the ballast (coordinates), and 1 did not possess any coordinate about origin and trade. From the total of forms, 270 (33, 42%) have presented declaration that they had carried out the oceanic trade. It was used, as a validation of the procedure, in the place of trade, an analysis of the geographic coordinates contained in the report, and, it was concluded that, from the total of 270 trade declarations, 45% of the coordinates were indicating places next to the coast, close to island, inside bays and small bays, being that in one of the cases, the ship was, approximately, 450 km inland.

3 – Case study

Henrique [7] has used the procedure proposed for Globallast, for measuring the similarity between the donator and the receptor ports, in this case, Tubarão port, in Vitória (ES). This port operates, mainly, with iron ores and pellets (Terminals 1 and 2), siderurgical coal (Praia Mole Terminal - TPM), liquid granaries (Liquid Granaries Terminal - TGL) and fertilizers, sulfur and other grainaries (Diversified Products Terminal - TPD), as shown in Figures 1 and 2.

Basically, Globallast [8] propose to be identified the following parameters:

- C-1 Coefficient of frequency risk of the Inoculation Visits;
- C-2 Coefficient of Risk of the Inoculation Volume;
- C-3 Coefficient of Environmental Similarity;
- C-4 Coefficient of the Species of Risk from the Donator Port.

Besides these coefficients, two reduction factors are used:

- R-1 Correction factor of risk in function of the maximum volume for unloaded tank;
- R-2 Reduction factor of storage risk

Together with these factors, it is possible calculating the global risk coefficient, to classify the risk level, according to the ballast water origin [9].
The carried out research was based on Vale’s CADEX database, from where the data was collected of form sent by ships to the port authorities. Too many difficulties were found, since only Tubarão terminals 1 and 2 use this system. For the carrying out of this analysis in the entire port terminal, it is necessary developing a database of TPM, TPD and TGL. Knowing that, 1 and 2 piers are used only to load iron ore and pellets, and they are responsible for more than 80% of the loaded volume in the Tubarão Port, this evaluation is valid.

All the data used in this evaluation was gathered from a spreadsheet defines as a standard communication tool between the ship and the port, that includes all of the operational data necessary for the cargo loading (sequence, volume, aerial draught, loading time, trimming, among others). With the analysis ready, it was determined the set or regions that must be considered in the risk for the insertion of pathogenic agents and exotic species in Tubarão port’s region.

During 2005, all the data from the ships loaded in Tubarão’s Terminals 1 and 2 were stored in CADEX database. This documents have the objective of serving as a base for the operational evaluation and for the ship’s load plan evaluation, which is conducted together with this spreadsheet. The risk analysis was possible because, together with the information in the ship, this spread sheet contains the ship’s origin port and ballast volumes.

In Brazilian law the Port Authority and the ANVISA are responsible for the control and surveillance in all the ships that discharge ballast water in Brazilian waters. Their forms [10] are necessary for the correct analysis of ship’s ballast water management.

However, considering the available data, it is possible determine: frequency of the ship that came alongside in the terminal, ballast water volume spilled, and it’s origin. The frequency of ships that have come alongside in Tubarão terminal is presented in Table 1.
In 2005 there were 658 ships loaded in Tubarão’s terminal 1 and 2 (Source: Vale). For this analysis were available data from 533 of them.

The ballast water spilled in Tubarão port was of 24,910,000 of tons. Extrapolating this value for the 658 ships, it would be reached to 27,3 millions of tons. This movement is responsible for the load of 74 millions of tons of iron ores and pellets.

In the years of 2005, Tubarão port terminal received ships from 43 different countries, spread in 5 continents, as shown in tables 3 and 4.

### Table 1 – Table of frequency and volume ships’ ballast in relation to its size

<table>
<thead>
<tr>
<th>Size</th>
<th>Number of ships that came alongside in Tubarão</th>
<th>Total percentage of ships</th>
<th>Ballast average spilled for ships of this class (ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand Size</td>
<td>14</td>
<td>2.33%</td>
<td>10,934</td>
</tr>
<tr>
<td>Panamax</td>
<td>206</td>
<td>34.26%</td>
<td>21,106</td>
</tr>
<tr>
<td>Cape Size</td>
<td>204</td>
<td>43.33%</td>
<td>47,938</td>
</tr>
<tr>
<td>VLBC</td>
<td>117</td>
<td>19.47%</td>
<td>66,749</td>
</tr>
</tbody>
</table>

### Table 3 – Distribution of the ballast water origin countries, for number of visits
Table 4 – Distribution of ballast water origin countries for imported volume (Volume in tons)

Through these tables, it is noticed that Europe is the region in the world that sent more ballast water for Tubarão port, with 68% of the arrivals of the ships. In second place, it is Brazil, with 12% of the visits. After that, we have Asia and Australia, with 10%. The other regions contribute with the others 10%, following table 5.

Table 5 – Arrivals of the ships in Tubarão Port Terminal, divided for theglob’s regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of arrivals</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>407</td>
<td>67.72%</td>
</tr>
<tr>
<td>Brazil</td>
<td>75</td>
<td>12.48%</td>
</tr>
<tr>
<td>Asia e Oceania</td>
<td>60</td>
<td>9.90%</td>
</tr>
<tr>
<td>Middle East</td>
<td>19</td>
<td>3.18%</td>
</tr>
<tr>
<td>South and Central America</td>
<td>18</td>
<td>3.00%</td>
</tr>
<tr>
<td>Africa</td>
<td>17</td>
<td>2.83%</td>
</tr>
<tr>
<td>North America</td>
<td>5</td>
<td>0.83%</td>
</tr>
</tbody>
</table>

Basing on Vale’s database, there were determined the coefficients (C1, C2, C3, C4 and the Global Risk - RG). The biggest C1’s value was for Rotterdam port with 69 visits. Rotterdam also presented the biggest value for C2, a total volume of 4.065.621 m³ of ballast water. For C3, the Brazilian ports of Vitória and Rio de Janeiro have presented the biggest values of environmental similarity, in relation to Tubarão port, because they are in the same bioregion. The foreign port with biggest similarity was the one of Norfolk, with 91%. In relation to the C4, it was identified that Kimitsu Mizushima (Japan) and Kojeong (South Korea) ports presented the biggest risk for the receptor port. In the end, it was calculated the RG, in which Vitória and Rio de Janeiro ports have presented biggest risk values, in order of 50% or 0.5.
4.0 Conclusions

As presented in the study, Brazil doesn’t dispose, yet, of an efficient planning for controlling the bioinvasion, through the ballast water. The attitudes taken for reducing the problem are not effective, because the ship owners and men in general, do not respect the rules imposed by the Brazilian authorities.

Through the results analysis, it is possible noticing that the Brazilian Ports are the ones that have the biggest risk of introducing species, for being too close, and for having an environment very similar to Tubarão Port.

It’s important to Brazilian authorities to have the ballast water forms submission by digital archives. With this method would be possible to have on line risk analysis for all Brazilian ports, identify the best places to have the ballast change done for each common route and to define the best procedures for each port.

5.0 References


