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HOW CAN REDUCE THE TRANSFER OF HARMFUL AQUATIC ORGANISMS AND PATHOGENS BY BALLAST WATER IN THE ROPME SEA AREA

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ABSTRACT

ROPME SEA Area (Persian Gulf and Oman Sea) is one of the most strategic area of the world and Protection of the sensitive marine ecosystem of this area against pollution from sea-based sources, especially oil activities and ballast water discharges by oil tankers and bulk carrier ships, is very importance for the region and the world.

This article addresses the problems that can arise for the marine environment by non-native species and Pathogenic virus carried by ship's ballast water and sediments in ROPME SEA Area.

The quantity of ballast water and transportation of Alien species increased in mentioned area soon as possible in less time due to increase in number of ships, amount of water carried by ships and increase in speed of ships. So, we will investigate methods of management, control, and reduce transmission of non-native species in ballast water by control and activities that need to be done by the ship's crew and officers of ports. At the end of the article there are Suggestions for countries to better manage of ballast water of ships and prevent the entry of invasive species in the ROPME SEA Area.

Keywords: ROPME SEA Area, marine environment, Non-native species, Ships Ballast water management, Reception Facility

INTRODUCTION

ROPME SEA Area (RSA) is considered as one of the major areas of global energy and more than 62 percent of the world oil and energy reserves provided in it.

Annually, more than 50, 000 ships are sailing in the Persian Gulf and Oman Sea to transfer millions tones of oil, gas and another cargo from ports of countries in this area to countries of Europe, Africa, South and South East of Asia and South American by the Atlantic Ocean, the Mediterranean Sea, the Red Sea and Indian Ocean and conversely.

When Ships are empty or only partially load, they additional weight necessary.

Therefore they use ballast water to get a suitable weight, draft, stability and maneuverability and maintain safety and avoid rolling and reduce tresses.

Ballast water is loaded in one port or sea area and discharged to load cargo in another port.

During the last decades, ballast water discharges have increased in the most of the major ports in Persian Gulf and Oman Sea and it is estimated more than 100 million tones of ballast water is transferred throughout them annually by ships.

Ships have been considered as a major factor for transfer of unwanted species in coastal area that could cause serious problems to the economy, ecology and human health. These non-native species may cause diseases and damage the life of native species or may effect to native species and disappear race of species living in the local maritime areas. In some case may both species live together and produce hybrids through hybridizing.

On the other hand, there is variety of habitats and biodiversity in Persian Gulf and Oman Sea and now more than two thousand and five hundred species of plants and animals are living in RAS area.

Recently, the quantity of ballast water increased in mentioned area due to increase in number of ships, increase in amount of water carried by ships and increase in speed of ships. So, the amount of ballast water will be transfer as soon as possible in less time.

Therefore if an appropriate action plan is not taken in management of discharge of ballast water with considerable amount of harmful aquatic organisms and Pathogens by the RSA and not establish reception facilities in Ports, the Persian Gulf & Oman Sea's marine environment will be threatened in the very near future.

Transportation of Alien species & Pathogenic virus and affect on marine environment:

Ballast water and sediments can transport Alien species and Pathogenic virus from polluted water to another areas and it can be harmful to human health and has negative impact on the economy and ecology of marine environment. Natural toxins produced by introduction of new species represent harm to the seafood resources as well as marine environment. Human health will be affect through seafood that has been consumed by people and cause many diseases. Another issue in human health difficulties by ballast water is fresh water, where the marine area had negatively affected by ship's ballast water and people consume that water as drinking water. In comparison, nobody died due to oil spill, but ballast water may cause ill or dead. Although, the effect of ballast water may cause or dead, but it has not been considered such as oil spill problem (Bhaskar & Pederson, 1996).

This negative impact of ballast water has very high expenses for coastal states. They have to pay million of dollar to repair their environment where has been damaged by non-native species. The non-Native species can damage the agriculture, fishing, industry and forestry. This damage influences the environment and food link of native species. Usually, these species combat for food and place. Sometime they kill native species and replace them or use them as food. In some case may both species live together and produce hybrids. Non-native species can pollute the beaches and tourism places. The cost of mentioned losses is very high and it's irreparable. The cost of cleanup, parties training, research and migration of people from affected area will be added to other expenses.

Unfortunately, most of these distortions are harmful and irreparable that cannot be compensated. This process can reduce the quantity of native species and alter their environment. The mentioned processes may overthrown native species and increase their vulnerability (Raymakers, 2002; and Bhaskar & Pederson, 1996)

Significant examples of these invasions are zebra mussel in North American Great Lake and toxic dinoflagellates in Australian's southern coastal water (Haley, 1999; and Maritime Safety and Environment, 2001). They changed scalar chain life in area due to gaining food for themselves.

How can minimize the transfer of invasive species?

In order to minimize the migration of non-native species, IMO acted as legal marine body to prevent the invasion of non-native species and established Ballast Water Management program and endorsed a guideline on 27 September 1997and after that "International Convention for the control and Management of Ships Ballast water and Sediments" was adopted on 13 February 2004 to help coastal states.

In the ROPME Sea Area, the ROPME Council identified ballast water exchange areas on April 2008 and Marine Environment Protection Committee (MEPC) on 2 February 2009, recognized the need for establishment of mandatory ballast water management requirements to address the issue of harmful aquatic organisms and pathogens in ballast water and sediments of ships.

Ballast water management guideline, guides how to manage ballast water for any types of ship. In this case the safety of specific ship has to be considered that has been mentioned in ballast water management plan. Ship's ballast water plan consist record of all operations and any method of treatment has to be well organized. These procedures help port state and other authorities to evaluate whether the procedure had been followed properly or not.

In past two decades the number of species transferred by ballast water increased suddenly around the world due to increased of world trading. Therefore, IMO adopted a guideline by resolution A.868 (20) to manage ship's ballast water and sediment discharges. The resolution adopted on 27 September 1997 to help shipmaster for prevention of harmful aquatic organisms transfer. The guideline states the procedures of ballast water exchange, port state assessment, reporting, training and technologies of treatment, but it was not mandatory. All detail has been mentioned in this guideline; therefore, it was an effective research and test to find the best option for organism's prevention. Guideline helps the member states and ship-owners to follow its provisions to prevent invasion of harmful organisms (IMO, 2003).

As well as, the "International Convention for the control and Management of Ships Ballast water and Sediments" was adopted on 13 February 2004. This convention concerns the technical standard and equipment for the control and management of ship's ballast water and sediments. Most of the conventions are concerned to ship, but this convention involves both ships and ports. Ports have to establish reception facilities and ships have to cope with the provisions of the convention. This convention has developed the management and guideline provisions and it seems to prevent the migration of harmful aquatic organisms partially. The convention considered ballast water exchange and procedure of reporting, planning, managing and controlling of ballast water by ships and ports (IMO, 2004).

Although International Convention for the control and Management of Ships Ballast water and Sediments" was adopted on

2004, but by the beginning of 2016, 49 countries with 34.79 percent of global shipping tonnage, have been accepted the Convention, but has not yet entered into force conditions due to complexity of the applying of the convention.

Convention will enter into force 12 months after the date 30 countries with 35% of the world's merchant shipping, they will be binding.

In ROPME Sea Area, because of the sensitivity of the ecosystem of Persian Gulf and Oman sea to marine bio-invasions and the very large volume of ballast water being discharged into the sea, ROPME Council in April 2008 decided to identify ballast water exchange areas outside the RSA as a matter of priority to efficiently address the issue of harmful aquatic organisms in ships ballast water and sediments.

In addition the marine environment protection committee in 59th session 2 February 2009, recognized the need for the establishment of the mandatory ballast water management requirements to address the issue of harmful aquatic organisms and pathogens in ballast water and sediments of ships in line with the ROPME Council decisions in identifying ballast water management as the most appropriate way to improve the regional marine environment.

The convention involves both ships and ports. Therefore ships and ports should have a ballast water management plan and procedures for the management and control of ships' ballast water and sediments to reduce effect of non-native species on marine environment.

Control and activities that need to be done by the ships

Ships can manage and control of ballast water and sediments to reduce effect of non-native species on marine environment by exchanging of ballast water in open sea or treating the ballast water on board ships.

Ballast water exchange: Ballast water exchange occurs when a ship has loaded ballast water. During the voyage and almost in mid-ocean can discharge the coastal ballast water and replaces by new water. This has been considered as the best way of preventing the migration of non-native species, but it is not effective on its own. Ballast water management recommended that the model plan have to be prepared such as cargo plan before any voyage. It seems that the model plan for ballast water varies with the type of ships. Ballast water exchange considered as a reasonable way of preventing non-native species to transfer via ballast water process (IMO, 1996).There for all ships that carry ballast water, Should have a ballast water management plan and procedures for the management and control of ships' ballast water and sediments.

The plan will help to ships staff how to carry out ballast water and exchange.

Each ship have different plan in this case. Exchange of ballast water is common way in different area. All ships also have to carry a ballast water record book to record when ballast water is taken on board; circulated or treated and discharged into the sea. It should also record when ballast water is discharged to a reception facility and accidental or other exceptional discharges of Ballast Water. Also an international ballast water management certificate most be on board ships.

In the ROPME SEA Area, vessels arriving from outside the Persian Gulf & Oman Sea should undertake ballast water exchange in water over 200 nautical miles from the nearest land in depth at least 200 meters. If this is not possible because of safety of ships in that area, it can be done in areas more than 50 N/M from nearest land in water at least 200 meters depth. If this is not achievable, then the ship shall provide the respective authority with the reason why she has not done so.

Ballast water treatment: ballast water treatment, is the technology of treating the ballast water physically or chemically to prevent introduction of species inside tanks or after release into new environment. Technology of ballast water treatment used to kill or inactive the rest of species in ballast tanks.

- Physical ballast water treatment:

In physical ballast water treatment different methods such as screening or straining, gravity process, filtration, thermal process and radiation will be used.

1- Screening or straining method:

In this process solid will be removed from water by screening equipment. The size of slot differs from 0.05 mm to 100 mm then can prevent different size of solids to enter through pipes of ballast tanks. The size of organisms remaining varies between 0.01 mm to more than one meter that small organisms will remain in water entering into ballast water tank. This technology has got easy operational system and the equipment is easy to handle. Therefore, this technology can be considered as one option of treatment method, but this method cannot remove small organisms (Bureau of Resource Science, 1993).

2- Gravity process method:

This process includes sedimentation, flotation and centrifugation and needs time for settling the particles of solids. In this case almost large particles can be removed easily but it cannot remove very small particles easily. In this process, differential of gravity works as a base of treatment technology. This technology needs large area to process the ballast water and may be high in expense; therefore, it is not economical for ships to have this technology, but shore base facility can work here in better condition (Bureau of Resource Science, 1993).

3- Filtration method:

In this method, the water has to pass through very small holes to prevent suspended particles entering into pipelines that lead water into ballast tanks. Types of holes can be different in size and also varies between 0.2 mm to 0.25 mm. One kind of filtration known as “granular” that has been used over a century is a good way of ballast water treatment. In this process most of harmful aquatic organisms will be removed. Big size of filtration equipment and its high cost will make this technology impracticable. The equipment may damage during the treatment process (Bureau of Resource Science, 1993; National Research Council, 1996).

4- Thermal method:

Another type of physical ballast water treatment is known as thermal process. In this process, changing the temperature of ballast water will kill most of the species. Heating of 30-40 degrees can kill some kind of species, but many other species will survive by this temperature. Adequate temperature for killing all species will is 60c. To achieve this amount of that bulk carrier of 140,000 tones (45,000 tones of ballast water) needs to generate 90 Mega Watt of generation power. (Bureau of Resource Science, 1993; National Research Council, 1996

5- Radiation method:

Another method of physical ballast water treatment is known as radiation process. In this process, ballast water can be treated by means of electromagnetic radiation to disinfect the water inside the ballast tanks. Different wavelength band known as ultra violet, gamma rays and microwave used in this procedure. In this process water will pass through a tube to expose the wave of gamma, ultra violet or microwave to kill the organisms. This technique can be used, as pre-treatment method to kill small species such as bacteria. This process is useful after filtration treatment (Bureau of Resource Science, 1993).

- **Chemical ballast water treatment:**

In chemical ballast water treatment different methods such as biocides, chlorine, ozone and pH adjustment can be used.

1- Biocides method:

One type of chemical ballast water treatment is biocides. Biocides are chemicals to prevent the growth of organisms and kill them inside ballast tanks. This procedure has been used before by adding oxidize chemicals to the water inside the tanks. The biocides are harm to ship's crew and sometime to the environment. They cannot kill all of the organisms inside the tank. These biocides may corrode the ship tanks. These technologies are more costly for ship owners and it doesn't seem practical. This method can be effective and useful for ballast water reception facilities on land base system (Bureau of Resource Science, 1993; National Research Council, 1996).

2- Chlorine method:

Chlorine is a common type of chemical ballast water treatment, which can be used in powder or liquid form. The cost of this chemical is less than other mentioned types of chemicals, but it may be hazardous to the environment. Totally this type of treatment has fewer advantages than its disadvantages (Bureau of Resource Science, 1993; National Research Council, 1996).

3- Ozone method:

Other type of chemical ballast water treatment is ozone process. Ozone is more effective than chlorine, but the cost of its equipment is too high and it is not economical to be used (Bureau of Resource Science, 1993).

4- pH adjustment method:

Another type of chemical ballast water treatment is known as pH adjustment process. In this process most of the organisms are sensitive to the range of PH. If the range of PH changes for some time, many organisms will be destroyed. This type of technology may damage the ship's tanks and harm to new environment. Therefore it is not useful.

In the ROPME SEA Area, ballast water treatment by physically or chemically on board ships or in ports to prevent introduction of species inside tanks or after release into new environment is not mandatory.

Control and activities that need to be done at ports:

The ports shall take all measures necessary to control, reduce and prevent of entrance the non-native species in marine environment under their monitoring or control. With appropriate management of loading and discharge of ship's ballast water and sediments in the ports and dry docks by maritime authorities, transfer of invasive spices will be minimal.

This is necessary that member states of ROPME Sea Area prepare their national strategy on ballast water management.

Ballast Water, transfers many kinds of species to new environment, which is harmful to new place. Many coastal areas around the world have been invaded by harmful aquatic organisms through ballast water process. Therefore the ports need to have management plan to manage ballast water from the ships entering the ports.

To minimize the entrance and invasion of harmful aquatic and pathogens, and prevent of marine pollution, many considerations need to be taken into account by coastal states in RAPME Sea Area as follow:

Peer base line study - Reception Facilities, Survey, Ballast water treatment, Research and monitoring, Certification and Inspection, Working group, Risk analysis technique, Risk Assessment Project, Holding a Regional Conference with Member States, Development of Ballast Water Management procedures for flag state ships, Air monitoring, Ships inspection and Training. Some of these considerations will be mentioned below.

Reception Facilities:

1- Ballast Water Reception Facility

In special situation such as emergency cases, a ballast water reception facility (BWRF) should be capable of receiving from ships so as not to create a risk to the environment, human health, property and resources arising from the release to the environment of harmful aquatic organisms and pathogens. A facility should provide equipment such as pipelines, manifolds, reducers and other resources to enable, as far as practicable all ship's wishing to discharge ballast water in a port to use the facility.

2- Sediment Reception Facility

This is necessary all dry docks and Shipyards where repairing or cleaning the ballast tanks, to be equipped with Sediment reception facilities (SRFs) units to receive the sediments and prevent discharge to sea. Some organisms can transfer and cause marine pollution by sediments inside the ballast tanks if this sediments discharge to marine areas.

Most probably all port must be ready ballast water facilities units to receive ballast water and sediment from ships in 2017, when all ships must have installed ballast water treatment systems at 2017.

Risk Analysis and Assessment:

Each port in RSA should be carryout risk analysis and risk assessment for ships entering to those ports to manage the transfer and introduction of harmful aquatic organisms and pathogens in ships' Ballast Water.

There are three major elements for the Risk Analysis: Risk identification, Risk assessment and Risk management.

Ballast Water Risk Assessment is important activity in the ports and for this evaluation uses the results of the port biological survey.

The invasive species in ship ballast water will be different and depend on time and place of to get ballast water.

There are different methods of assessing the risk of species in ballast water and this assessment can be down on species-specific and environmental similarity species.

The assessment will be aligned with four proposed principles of risk-based resource management: (i) society accepts that low risk scenarios exist; (ii) risk assessment is capable of identifying low risk species (iii) risk mitigation strategies exist; and

(iv) mitigation costs are less than the cost of performing risk assessment. Species-specific ballast water risk assessment is best suited to situations where the assessment can be restricted to a limited set of harmful species on journeys within bioregions where ballast water is a small component of natural genetic exchange. Environmental similarity risk assessment is appropriate for journeys that start and end in locations which have very little or no natural genetic exchange. All risk assessment shall be recorded in the Ballast Water Record Book.

Training:

All marine personnel in charge of ballast water and sediment reception facility including the treatment and disposal of ballast water and sediment should have received adequate training. Training should include but not be limited to:

- Principles of the B/W Convention
- Risks analyze to the marine environment and human health
- Safety of ships and any operational constraints
- Sufficient knowledge of the equipment involved on board ships and in terminals.
- Communication interface between ship and port

CONCLUSION AND RECOMMENDATIONS

- It is necessary for the ship to use ballast water for stability, maneuverability and safety reason when she is empty or partially loaded.

- As the research in this paper shows, ballast water transfers many kinds of species to new environment, which is harmful to new place. Many coastal areas invaded by harmful aquatic organisms through ballast water process.

- Organizations interesting in this matter and government suffered this problem researched and tested methods of prevention.

- From past two decade, discussion of ballast water problem started in IMO extremely and discussion concludes a guideline (27 September 1997), ballast water Convention (13 February 2004) and in the ROPME SEA AREA, ballast water exchange areas (April 2008) and ballast water management (2 February 2009) to help the coastal states, ship masters and ship owners for methods of preventing the migration of non-native species.

-There are several methods that help to minimizing aquatic pathogens such as ballast water exchange, ballast water treatment physically or chemically and ballast water reception facility. But ballast water exchange is accepted by ship- masters and ship- owners because of low cost and high speed of operation.

- To better management of ballast water of ships and prevent the entry of invasive species, all countries in the region of RAPME Sea Area to join the Ballast Water management Convention.

- Preparation of ballast water management plan for the ports of the RSA's countries

- Implementation of all provisions of the convention of B/W by the countries in the RAPME Sea Area.

- Preparation a national strategy for states in Persian Gulf & Oman Sea.

- Research and monitoring and transfer of technologies

- Regional study and scientific & Technical Research and Monitoring by states of RSA individually or jointly to promote and facilitate scientific and technical research on ballast water management; and monitor the effects of ballast water in marine waters under their jurisdiction.

- SWOP (Strengths, Weaknesses, Opportunities, Threats) study on the implementation of the Ballast Water Management Plan by the regional country of RSA.

- Preparation of bilateral or multilateral agreement to implement the Ballast Water Management.

- All shipbuilding and dray ducks to be equipped with Sediment Reception Facility.

- Environmental, Biological and risk assessment studies in major ports of RAPME Sea Area.

-Equipping major ports with facilities for ships inspection monitoring, sampling and laboratory for identify species and pathogens in ship's ballast water.

- Training courses and a regional conference for experts, taskforce and those involved with Ballast Water Management Convention in ROPME states.

- Promotion of culture and knowledge of the coastal area's people for dangers of invasive species.

-Compliance Monitoring and enforcement of ballast water management by the countries of RSA.

- Preparation of ballast water management plan in the ports of the countries of the RSA.

- Cooperation with national organizations to manage and monitor the implementation of the Ballast Water Convention and protection of the marine environment.

- Exchange of knowledge and taskforce in form of a collective labor agreement between RSA's states.

- I think the ballast water exchange in open sea; reporting, managing and all provisions cannot prevent the invaders efficiently in RSA, because many species may remain on side tanks and sediments. Therefore, it is suggested the provisions of Ballast water Convention has to follow by one or two types of treatment technologies to prevent organisms to invade the new marine environment.

- Development of Ballast Water Management procedures for flag state ships.

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