MAHARASHTRA ACADEMY OF NAVAL EDUCATION AND TRAINING

PRESENTS

A PAPER ON "GREEN TECHNOLOGY FOR MARINE POLLUTION CONTROL" (BALLAST WATER MANAGEMENT)

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CONTENT:-

INTRODUCTION:-

In today's world there are certain hot topics often discussed, Pollution and global warming being the major one. World pollution is quite fast growing problem. This paper deals with the causes of pollution at sea, and the detailed discussion on the pollution due to ballast water and its control method via a new technology called **VENTURI OXYGEN STRIPPING (VOS)** system.

It is said that the sea can no longer be the dustbin to the world. This sentence can let us know the condition of today's oceans.

Ship pollution is the pollution of air and water by shipping**.** It is a problem that has been accelerating as trade has become increasingly globalized, posing an increasing threat to the world's oceans and waterways. It is expected that, shipping traffic in the whole world is projected to double by 2020. Because of increased traffic in ocean and ports, pollution from ships also directly affects coastal areas. The pollution produced affects biodiversity, climate, food, and human health.

In many instances vessels due to a variety of reasons intentionally discharge illegal wastes which in turn become cause of a marine pollution.

Causes of pollution at sea:-

There are various causes of pollution at sea as mentioned below--

1) Oil spills

2) Pollution due to exhaust emission

3) Pollution due to vessel waste

4) Pollution on ports

But most of the time ignored and which contains vital potential of pollution is Ballast Water Pollution.

Ballast water Pollution:-

"Ballast Water" means water with its suspended matter taken on board a ship to control trim, list, draught, stability or stresses of the ship.

Ships take on ballast water for stability when they're not carrying cargo. They discharge ballast when they load cargo, expelling tons of water and anything else—from pathogenic microbes to molluscs and fish—that's in it.

HOW BALLAST WATER CAN CAUSE POLLUTION:-

Ballast water discharged by ships can have a negative impact on the marine environment. Cruise ships, large tankers, and bulk cargo carriers use a huge amount of ballast water, which is often taken on in the coastal waters in one region and discharged at the next port of call, wherever more cargo is loaded. Ballast water discharge typically contains a variety of biological materials, including plants, animals, viruses, and bacteria. These materials often include non-native, nuisance, exotic species that can cause extensive ecological and economic damage to aquatic ecosystems.

When a larger vessel, such as a container ship or an oil tanker unloads cargo, seawater is pumped into compartments in the hull. Similarly, when a larger vessel is being loaded it discharges seawater from these compartments. Nevertheless, the discharge of ballast water only accounts for a small percentage of oil pollution in the marine environment.

Ships are also responsible for transporting harmful organisms in their ballast water. *Mnemiopsis leidyi*, a species of comb jellyfish that inhabits estuaries from the United States to the Valdes peninsula in Argentina along the Atlantic coast, has caused notable damage in the Black Sea. **It was first introduced in 1982, and thought to have been transported to the Black Sea in a ship's ballast water. The population of the jellyfish shot up exponentially and, by 1988, it was wreaking havoc upon the local fishing industry.** Recently the jellyfish have been discovered in the Caspian Sea. Invasive species can take over once occupied areas and facilitate the spread of new diseases, introduce new genetic material, alter landscapes and jeopardize the ability of native species to obtain food. "On land and in the sea, invasive species are responsible for about 137 billion dollars in lost revenue and management costs in the U.S. each year."

The invasive freshwater zebra mussels, native to the Black, Caspian and Azov seas, were probably transported to the Great Lakes via ballast water from a transoceanic vessel

In addition to introducing non native species into new environments, ballast discharge from ships can spread human pathogens and other harmful diseases and toxins potentially causing health issues for humans and marine life. *Marine pollution have the potential to be toxic to marine plants, animals, and microorganisms causing alterations such as changes in growth, disruption of hormone cycles, birth defects, suppression of the immune system, and disorders resulting in cancer, tumours, and genetic abnormalities or even death. They may also have the opposite effect upon some marine life stimulating growth and providing a source of food. Sources of seafood can become contaminated and unhealthy for consumption. Shellfish and drinking water can be contaminated when the ship discharges its ballast water.*

Ship Ballast Water Affecting Human Life:-

Some species introduced to new places in ballast water contaminate filter feeding shellfish, making them toxic and inedible. Consumption of these contaminated shellfish by humans can cause severe health problems and even death. Moreover, harmful microorganisms of various types can become more virulent as a result of contact with other organisms in ballast water.

Apart from introducing invasive species, ballast water from ships is responsible for sea water pollution. The ship ballast tanks are often rusted from inside which ultimately leads to contamination of the sea water taken in as ballast. Sometimes leakage of bilge or from an oil line can also lead to discharge of oil and other impurities into the ballast water making it impure. If oil is discharged with the ballast water it can cause severe harm to marine plants and animals and also to human life in coastal regions

A form of cholera, *Vibrio cholerae*, previously reported only in Bangladesh apparently arrived via ballast water in Peru in 1991, killing more than 10,000 people over the following three years.

To mitigate the growing risk of invasive aquatic species, pending international regulations came into picture. *In 1997, the member countries of the IMO adopted voluntary ballast water management guidelines to minimize the risk of spreading aquatic nuisance species. The guidelines recommend that vessels exchange ballast water collected in coastal waters with mid-ocean water, which contains fewer organisms that can survive in coastal environments*. In February 2004, the

member countries of the IMO adopted a binding international agreement for mandatory ballast water management, which mandates a ballast water discharge standard (to be achieved through shipboard treatment) and will replace the previous voluntary guidelines. Globally-trading ships have to install ballast water treatment systems (BWTS) to eliminate the problem of ballast water-transported organisms from one ecosystem to another.

Specifically, the International Maritime Organization (IMO) adopted the Ballast Water Management Convention requiring mandatory installation and use of ballast water treatment systems (BWTS) starting in 2012. This Convention is currently in the process of being ratified by the IMO Member Nations, many of which are also developing national regulations to enforce this pending new international regulation.

BALLAST WATER MANAGEMENT:-

"Ballast Water Management" means mechanical, physical, chemical, and biological processes, either singularly or in combination, to remove or avoid the uptake or discharge of Harmful Aquatic Organisms and Pathogens within Ballast Water and Sediments.

Ballast water management (BWM) for vessels includes all measures that aim to prevent unwanted aquatic nuisance species from being transported between ports in the ballast. Seaports in which ships exchange ballast water daily are at severe risk of invasions.

To simplify the requirement of the control of ballast water problem, a "ballast water management plan" was introduced which was to be used and implemented on board sailing vessels entering international waters

Contents of Ballast Water Management Plan:-
The ballast water management plan includes the following:

- International rules and regulations for different port state controls all over the world.
- Location of ports providing shore discharge facility of sediments and ballast water.

- Duties of the personnel on board for carrying out ballast operation.
- Operational procedure along with the method to be used for ballasting.
- The locations at different coastal water for ballast exchange should be mentioned in the plan.
- Sampling point and treatment method should be given in the ballast water management plan.

Advantage of ballast water management plan:

With the help of a proper ballast management plan and some additional information, operational delays can be avoided which will help to save time and money.

Reporting for requirements of different post state authority is simplified. And the most important of all is that a safe ballast exchange can be carried out anywhere in the world

Management and control requirements for ships

Ships of 400 gross tonnes and above are required to have on board and implement a Ballast Water Management Plan approved by the Administration. The Ballast Water Management Plan is specific to each ship and includes a detailed description of the actions to be taken to implement the Ballast Water Management requirements and supplemental Ballast Water Management practices. Ships must have a Ballast Water Record Book to record when ballast water is taken on board, circulated or treated for Ballast Water Management purposes, 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.

The specific requirements for ballast water management are as follows:

- Ships constructed before 2009 with a ballast water capacity of between 1,500 and 5,000 cubic metres must conduct ballast water management that at least meets the ballast water exchange standards or the ballast water performance standard until 2014, after which time they must at least meet the ballast water performance standard.
- Ships constructed before 2009 with a ballast water capacity of less than 1,500 or greater than 5,000 cubic metres must conduct ballast water management that at least meets the ballast water exchange standards or the ballast water performance standard until 2016, after which time they must at least meet the ballast water performance standard.
- Ships constructed in or after 2009 with ballast water capacity of less than 5,000 cubic metres must conduct ballast water management that at least meets the ballast water performance standard.
- Ships constructed in or after 2009 but before 2012 with a ballast water capacity of 5,000 cubic metres or more must conduct ballast water management that at least meets the ballast water performance standard.
- Ships constructed in or after 2012 with ballast water capacity of 5,000 cubic metres or more must conduct ballast water management that at least meets the ballast water performance standard.

Other methods of ballast water management may also be accepted as per approved in principle by the IMO's Marine Environment Protection Committee (MEPC).

Ballast Water Exchange Standard

Ships performing ballast water exchange must do so with an efficiency of 95 per cent volumetric exchange of ballast water. For ships exchanging ballast water by the pumping-through method, pumping through three times the volume of each ballast water tank will be considered to meet the standard described. Pumping through less than three times the volume may be accepted provided the ship can demonstrate that at least 95 per cent volumetric exchange is met.

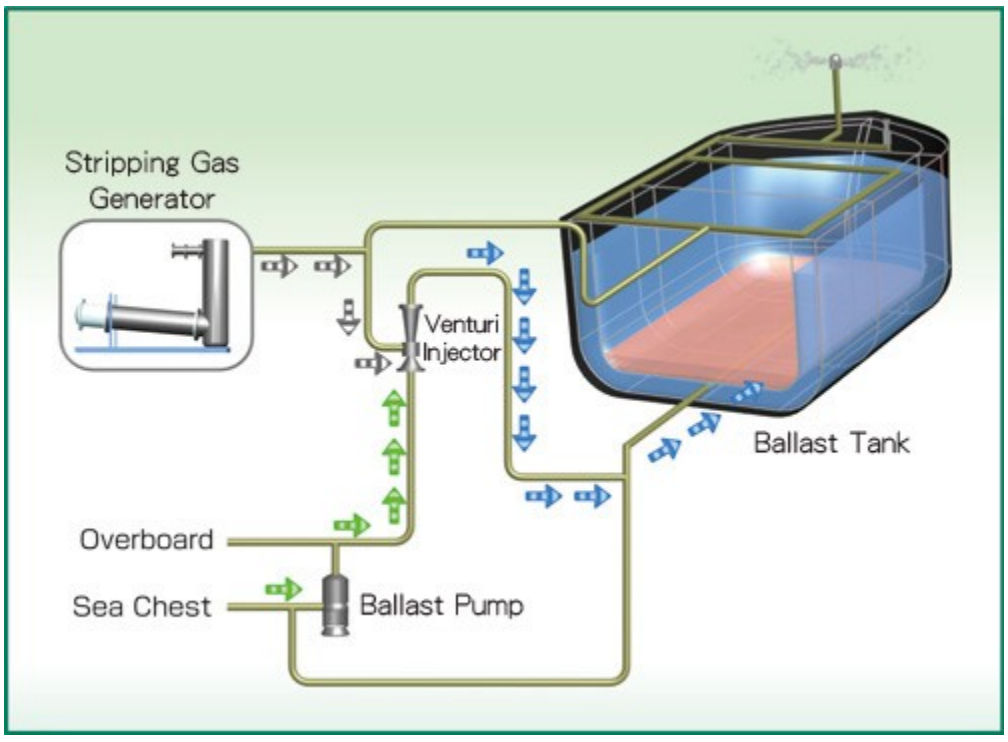
CONTROL OF MARINE POLLUTION CAUSED BY BALLAST WATER:-

To compensate this globally increasing threat following new methods can be adopted:--

VOS (Venturi Oxygen Stripping) system:-

VOS (Venturi Oxygen Stripping) system is a safe, compact, cost-effective deoxygenating method to treat ballast water. The VOS system is the first to meet IMO D-2 standards as well as the first to be certified to the IMO G-8 Guideline. VOS system not only eliminates the transfer of aquatic microorganisms, but also significantly reduces ballast tank corrosion.

How the system works:-



This system works on the principle of removing the dissolved oxygen from the ballast water, creating a low-oxygen environment where aquatic organisms neither can nor survive. In less than one minute this system is capable of removing more than 85% of the dissolved oxygen from the ballast water by mixing very low-oxygen inert gas with natural water as it is drawn into the ships ballast tanks. In a process similar to evaporation, the inert gas strips the water off its dissolved oxygen.

In natural water aquatic organism survives due to the small amount of oxygen dissolved in sea water. The VOS system mixes the natural sea water (which is with good amount of oxygen) with the low oxygen gases. These gases strip the dissolved oxygen out of water.

The source of this oxygen stripping gas is an efficient high temperature component called *STRIPPING GAS GENERATOR* .which is shown below --

FIG: A STRIPPING GAS GENERATOR

The VOS system starts with this component. After the gas generator is turned on, the gas oxygen level is low enough. The gas then directed to **venture injectors.** A signal relay then turns on the ballast pump. As ballast water passes through the venture injectors, the gas is mixed into the water. This low oxygen gas bubbles passes through the ballast water and such condition is created by the virtue of which the organisms cannot survive.

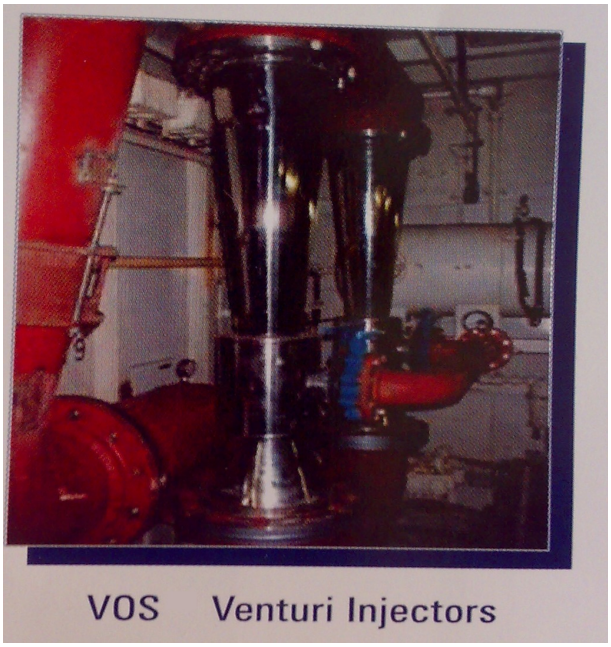


FIG:- VENTURE INJECTOR

Another most important advantage of this system is that it minimizes the rate of corrosion of ships ballast tanks.
To restore a ships ballast tank from poor to good condition is expensive, costing millions of dollars. By preventing corrosion, VOS system may maintain a good ballast tank rating for the life of a vessel.

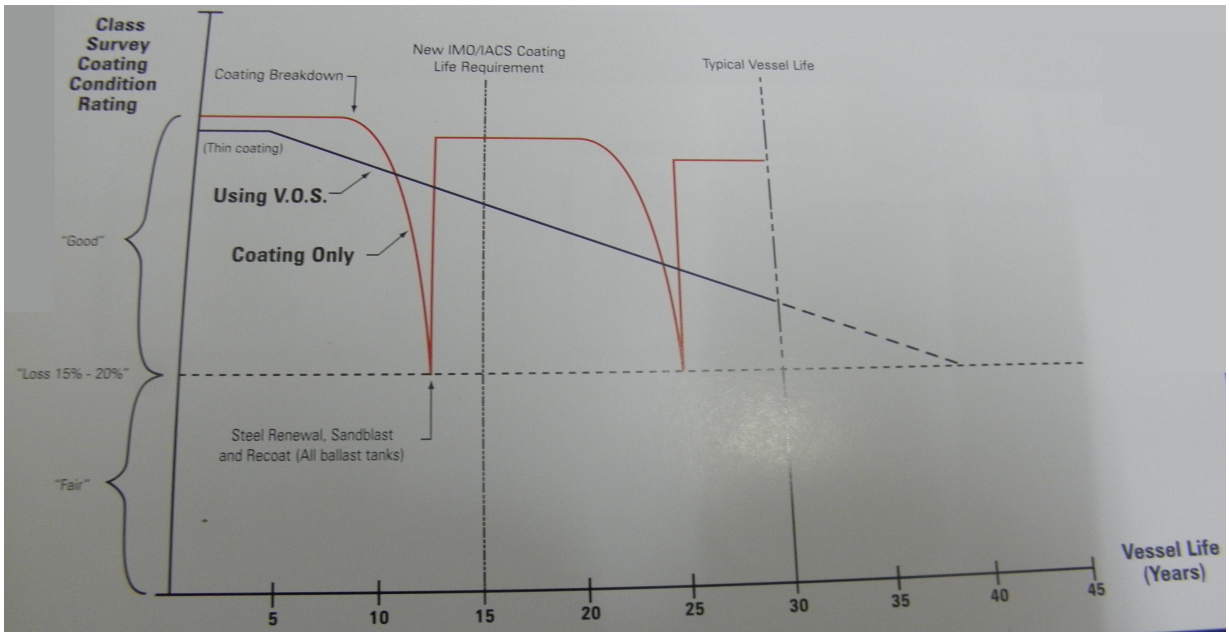
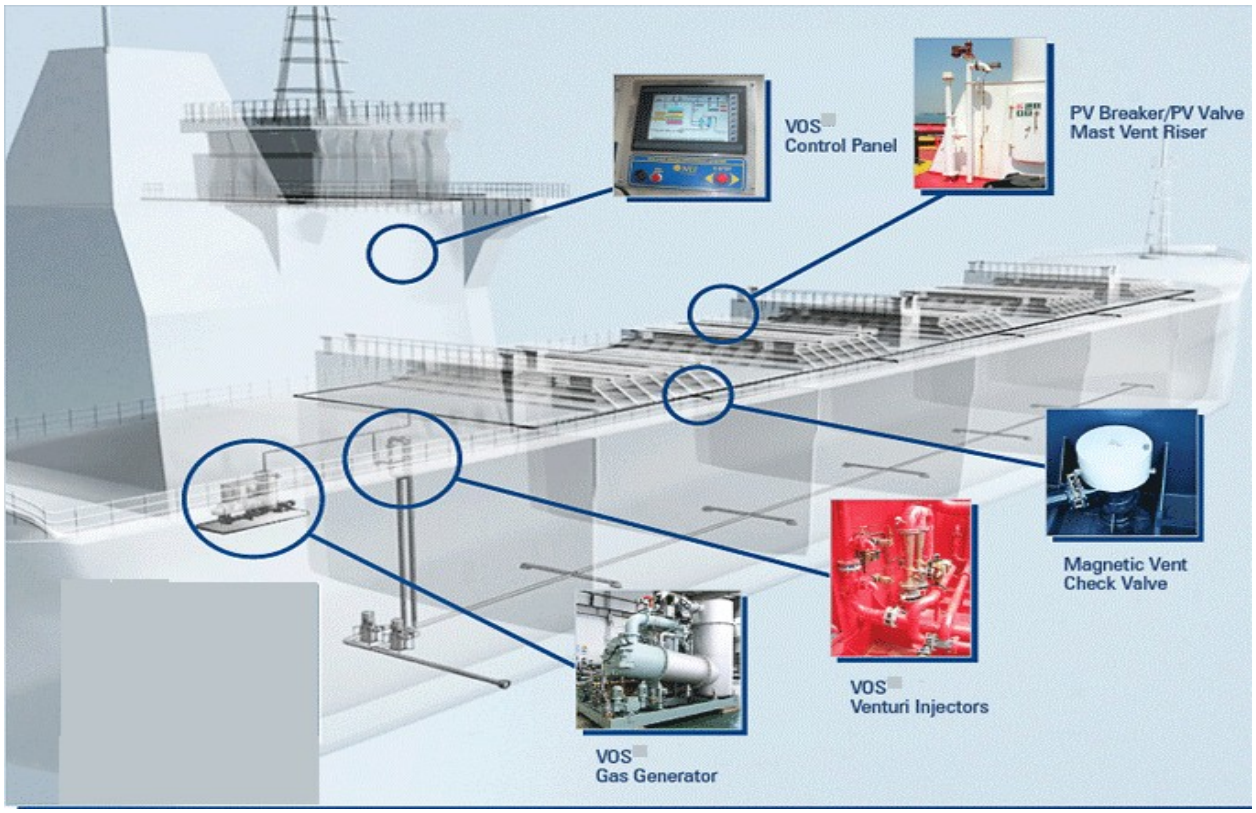


Fig: a graph showing VOS system is good over other methods for protecting ballast tanks

The general layout of components of VOS system onboard:-



Ships fitted with VOS system:-

Recently in Aug. 2011 Bohai Shipbuilding Heavy Industry has ordered for two Venturi Oxygen Stripping (VOS) Ballast Water Treatment Systems (BWTS) to be installed aboard two 320,000 DWT VLCCs being built for Sovcomflot.

Bohai is a subsidiary of the China Shipbuilding Industry Corporation (CSIC) and Sovcomflot is the largest commercial shipping group in Russia.

CONCLUSION:-

CALM AND COOL SEA WE CAN ONLY HOPE FOR BUT THE CLEAN SEA IS OUR RESPONSIBILITY. Even though there are traceable extents of pollution caused by the shipping industry, there are conventions and regulations laid down by international bodies and governments in order to control and minimize it. Hence, shipping is considered as the safest, cleanest and most environment friendly mode of transportation used today.

However, even this level of pollution is not acceptable. We have to start looking not just from a business point of perspective but rather from nature's point of view. Our aim should be to attain a zero level of pollution in the future.

This can be achieved ultimately if all the shipping bodies, management and the shipping personnel come hand in hand in realizing the seriousness of the issue.

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