BALLAST WATER MANAGEMENT

 

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□ SYNOPSIS:-

This paper aims at discussing the various aspects related with ballast water i.e. causes, effects and it's efficient tackling methods. Ballast water has always acted as an effective vehicle for the transportation of non-indigenous marine invasive species, and thus this paper is intended at exploring the latest trends and developments in efficiently managing ballast water loading and discharging with regards to the present shipping sector. The paper also provides a sneak-peek into ballast free ship concept.

□ INTRODUCTION:-

Since the days of sail, ships have carried ballast, originally in the form of rocks, to balance the ship correctly. Often cargo ships would take on ballast when empty of cargo and remove the ballast when cargo was loaded. Modern ships, especially bulk carriers and tankers, continue this practice, except now sea water is used instead of rocks.

Most marine organisms have planktonic egg or larval stages and it is possible for these to be drawn into a ship's ballast tanks when ballast water is taken on. When the ballast water is eventually discharged, often at a port in another country, any organisms discharged with the ballast may survive and even establish viable populations.

All oceangoing ship use ballast water to maintain its stability, balance and structural strength. Ballast water and its associated management related issues have for long been a food for thought.

Over the last few decades the shipping sector has seen a tremendous growth in terms of globalization and consequently, this problem of marine ballast water management has also grown into a major global concern.

As per the American Association of Port Authorities, more than 99% of US overseas trade (by weight) is regulated via ships. Thus, whenever any oceangoing vessel transits at a given country's port, it potentially makes that marine environment vulnerable to various non-indigenous species, which are primarily foreign to that environmental setup. Through a number of transmission methods, various types of plant life, insects, animals and almost anything that can pass through marine ballast pump (microbes, bacteria, cysts and larvae of various species) get introduced into the unprepared environments and have caused environmental as well as economic harm.

□ BALLAST WATER:-

Ships take in a certain amount of water for stability and trim before a voyage. Once the ship arrives at its destination it may release this ballast water into the new bay. Ballast stabilizes ships in the water and is a necessary feature of commercial shipping. Ballast is primarily composed of water and is full of sediments, pebbles and thousands of living species. International shipping industries are responsible for the majority of these alien species invading foreign waters. Over 3,000 marine species travel around the world in ships' ballast water on a daily basis.

□ INVASIVE SPECIES:-

The species carried in ballast water are called exotic species, alien species, invasive species, or non-indigenous species, all meaning a member, or members of a group or population, of a species that enters an aquatic ecosystem outside of its historic or native range. Invasions of exotic marine animals and plants into coastal waters are not new. Wooden ships transported innumerable species both in them (as boring organisms) and on them (as fouling communities).

In the last quarter of the 19th century, commercial oysters began to be moved around the world in huge numbers. With them came an untold number of epizoic and endozoic species, as well as entire estuarine communities in the mud and seaweed packed with these oysters. The world's oceans began to be biologically homogenized centuries ago. Yet, despite the successful movement of hundreds of species over these decades, the speed of modern ships and the volume of ballast water now carried are two of several factors that may be in the process of successfully overwhelming these earlier centuries of transport in terms of the number of successful invasions. Invasive species have recently been discovered because of their detrimental economic impact in the Great Lakes causing billions of dollars of damage. Other means of exotic species introduction include the aquarium trade, military, recreational marine vessels, research institutions, seafood commodity distribution.

The problem faced due to the invasive species is that they feed on native species, thus eliminating a vital part of the native food chain. Economic and environmental damage occur when non-indigenous species are introduced.

There are two basic approaches to dealing with invasive species:

1. Stop them from coming in `the first place, or

2. Eliminate organisms that have invaded.

Getting rid of established non-indigenous species is practically impossible. Even preventing them from causing damage is very difficult and expensive. Stopping invasions before they occur is the only long term practical and economical solution. To stop invasions, live organisms must not be discharged from ballast tanks. This can be achieved by:

- not taking organisms into ballast tanks;
- killing organisms during the voyage; or
- not discharging organisms when ballast water is released.

Unfortunately, no method of ballast water treatment can today completely eliminate the risk of introducing exotic species. The goal of managing ballast water must be to minimize the risk. More research is needed on methods that might prevent introductions of unwanted species.

GROWING CONCERNS REGARDING BALLAST WATER:-

The release of ballast water may introduce non-native organisms into the port of discharge. These introduced species are often referred to as exotic, nuisance, alien, or non-indigenous species. Typically, few organisms are able to survive in new surroundings because temperature, food, and salinity are less than optimal; however, the few that do survive and establish a population have the potential to cause ecological and economic harm. When a species enters a new ecosystem, often there are no natural predators. As per, Jamie Clark, Director US Fish & Wildlife Service said recently "invasive species tend to be adaptive, aggressive and resilient, once they are established we are unlikely to ever completely eradicate them". In many cases, organisms have been able to flourish in their new surroundings to the detriment of indigenous species. Historically, fouling on ship's hulls accounted for most introduced species in ports, and it still remains a major threat, accounting for pests such as the Japanese kelp, Undaria. Over the last few decades, there appears to have been a shift so that a greater number of species are arriving in untreated ballast water. Greater attention to the problem has shown many more invasions than was originally thought. Ballast water dumped from a single ship can contain hundreds of species of phytoplankton, zooplankton, larval fish and invertebrates.

Although the effects of many introductions remain largely unmeasured, it is clear that some invaders have human-health consequences and significant economic and ecological impacts. Introductions such as the zebra mussel in the North American Great Lakes and toxic dinoflagellates in Australia's southern coastal waters are both examples of introduced species that have reproduced at exponential rates in a new environment causing human health problems, environmental damage and economic loss.

Globally, it is estimated that about 10 billion tonnes of ballast water is taken on board ships and dumped each year. Countries such as Australia, Brazil, Canada, South Africa and the U.S. that export large amounts of minerals or crops are particularly exposed as a large bulk carrier can discharge up to 80,000 tonnes of water ballast into port waters on each trip. The water taken on board for ballasting a vessel may contain dormant stages of microscopic toxic aquatic plants such as dinoflagellates, which may cause harmful algal blooms after their release. Pathogens such as the cholera bacteria, have been transported with ballast water. Many varieties of fish, plants, and other animals have all been found in ballast water. Higher rates of species transfer have been attributed to:

- an increase in ship numbers;
- an increase in the amount of ballast carried per ship;
- an increase in the amount of water being transported;
- an increase in ship speeds with shorter voyage times and higher survival rates.

All these factors create a greater opportunity for the introduction of non-indigenous organisms in new locations. This can lead to disastrous consequences for regional ecosystems that include commercial fish or crustacean stocks or rare and endangered species.

BALLAST WATER MANAGEMENT:-

In response to the threats posed by invasive marine species, the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992, in its Agenda 21 called on the International Maritime Organization (IMO) and other international bodies to take action to address the transfer of harmful organisms by ships.

Article 196 of the United Nations’ Law of the Sea convention states that "States shall take all measures necessary to prevent, reduce and control.....the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto."

Ballast water management essentially concerns with the loading and discharging of the ballast water of a ship in manner such that the marine environment at the port of stay is least affected by the introduction of non-indigenous species.

Recent past has been testimonial to the nuisances created by the introduction of foreign species in the form of phytoplankton, zooplankton and various other aquatic micro-organisms by vessels transiting at the various international ports the world wide over. This fact has been best illustrated by the infestation of the port waters by a special kind of marine species known as the **ZEBRA MUSSEL** at the ports of the Great Lakes.

The introduction of such non-indigenous species is not only growing problem in developed countries rather the developing countries are also facing a similar situation. This problem associated with ballast water adversely affects both the marine ecosystem as well as the economy of a country which is heavily depended on sea transportation (Singapore).

The International Maritime Organization (IMO) has recognized its members increasing concern about the introduction of unwanted aquatic organisms and pathogens transferred through the discharge of ships' ballast water. In 1993 the IMO Assembly adopted resolution A.774 (18) which contains guidelines for combating the problem. The Marine Environment Protection Council (MEPC) is examining a number of options including a new annex to the International Convention for the Prevention of Pollution from Ships (1973) through the MARPOL 73/78 regulations.

The International Maritime Organization (I.M.O.) specialized body, Marine Environment Protection Committee (M.E.P.C.) has held various international conventions with regards to ballast water management and some of the key conventions and their salient points are as follows:-

1. **1997 CONVENTION :**

- ☐ Adoption of voluntary ballast water management guidelines to minimize the risk of spreading aquatic nuisance species.
- ☐ Guidelines recommended that vessels exchange ballast water collected in the coastal waters with mid ocean water, which contains fewer organisms which can adapt to the coastal environments.

2. **2004 CONVENTION :**

- ☐ The member countries of the IMO adopted a binding international agreement for mandatory ballast water management
- ☐ Agreement mandates a ballast water discharge standard, which is to be achieved by a suitable shipboard treatment plan.

With the 2004 convention being widely ratified by majority of the participating members, a 10 year long wait is finally coming to an end with the development of an approved international regulatory framework for ballast water management.

One of the primary reasons for the abandoning the voluntary guidelines of the 1997 convention was that though exchange process at mid-ocean would be highly effective, yet the micro-organisms present in the exchanged ballast water would pose an immediate threat to the existent marine ecosystem at the next port as, though these aquatic species may adapt to the new ecosystem, yet they would dominate their presence in that ecosystem during their life cycle, thereby compromising on the existent species and hence disrupting the natural cycle of the ecosystem. This in turn may have drastic consequences on the economy of that region.

□ 2004 IMO CONVENTION:-

1. Background :

In February 2004 the IMO has organised the **INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIP'S BALLAST WATER AND SEDIMENTS.**
The purpose of the Convention is to prevent, minimize and ultimately eliminate the risk of introduction of harmful aquatic organisms and Pathogens which use the ballast water as a hub.
Ballast Water Management includes exchange of ballast water and ballast water treatment. – For the later technical solutions by mechanical, physical, chemical or biological processes are possible, either singularly or in combination.

2. Applications :

The BALLAST WATER Convention is applicable to new and existing vessels that are designed to carry ballast water.
The Convention will enter into force 12 month after ratification by 30 States, representing 35% of the world merchant shipping tonnage.
The status of ratification in October 2009 is 18 States, representing 15.4 % of world GT.
In order to show compliance with the requirements of the Convention each vessel shall have on board a valid Certificate, a Ballast Water Management Plan and a Ballast Water Record Book.
The application date for new and existing vessels is dependent on the construction date and the capacity of ballast water. It is noted that the matrix comprises data from the BALLAST WATERM Convention subject to the ratification of the Convention.

3. Standards for Ballast Water Management :

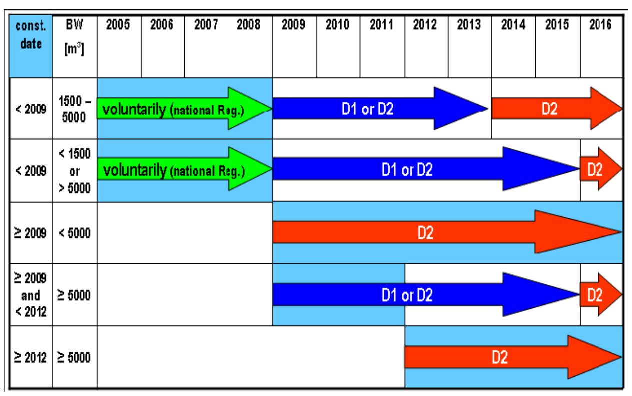
Two standards for the "purity of managed ballast water" are stipulated:

D-1 : Exchange Standard – efficiency of
at least 95 % volumetric exchange (*sequential method*)
or
Pumping-through three times the volume of a tank (*flow-through method, dilution method*)

D-2 : Performance Standard – less than
10 viable organisms per cubic meter greater than 50µm
and

Less than 10 viable organisms per millilitre smaller than 50µm and greater than 10µm
and
Limited number of indicator microbes (bacteria)

Ballast Water exchange (D1) can be utilised by the sequential method where tanks are first emptied and then filled again, or be the flow-through method or dilution method whereby tanks are overfilled by pumping in additional water. The exchange procedure shall be carried out in an “open ocean condition” at least 200 nautical miles from the nearest land and in waters at least 200 metres in depth.



Due to limited biological efficiency the Exchange Standard (D-1) is to be regarded as an interim measure.

Compliance with the Performance Standard (D-2) seems to be achievable only by use of a Ballast Water treatment system. In general treatment systems that comply with the standard D-2 shall be approved by the Administration.

4. **Ballast Water Treatment :**

Commonly the following technologies for Ballast Water Treatment are applied, either singularly or in combination are as follows:

☐ **Filtration**

Sediment and particles removal by disc and screen filters
– Parallel assembly of many filter units
– Filtration grade down to 100 / 50 / 20 µm

☐ **De-oxygenation**
– Removal of dissolved oxygen in Ballast Water and replacement by inactive gases

☐ **Cyclonic separation**

–Separation of solid particles due to centrifugal forces
– Acceleration of the water by internal flow direction inside the facility

☐ **UV radiation**

–Inactivation of organisms and pathogens by breaking the cell membrane
– Low pressure drop in water system

☐ **Cavitation**

–Slit plates or venture pipes generate cavitation bubbles
– High local energy due to implosion of bubbles inactivate organisms

☐ **Electrolysis**

– Electronically ionization by means of electrical current
– Generation of Chlorine/Chlorine Dioxide as disinfection

☐ **Chemical additives**

- Direct adding of chemical additives to the BALLAST WATER that have disinfectory actions.
- Applicable for big volumes

☐ **Gas super saturation**

– Controlled atmosphere in tanks is needed to avoid re-oxygenation.

Every treatment system is to be type approved by the Flag State Administration. Further, in case the system makes use of an “active substance”, (active substances means any substance or organism that has a general or specific action on or against harmful aquatic organisms or pathogens) an additional approval procedure is to be followed, whereby the approval is granted by IMO exclusively.

In July 2005 IMO agreed on Guidelines stipulating standardized procedures for type approval of BALLAST WATER treatment systems (MEPC Res.125 (53) – G8) and approval of active substances (MEPC Res.126 (53) – G9). In total 14 Guidelines will accompany the Convention.
Upon October 2009 in total 6 systems have successfully run through the type approval process and have already obtained full certification. For another 10 to 15 systems the approval process is underway.

On request GL provides a comprehensive list of BALLAST WATERT manufacturers which are available for the market.

5. **National and regional requirements for Ballast Water Management**

Several countries and regions have taken a unilateral approach and set into force national requirements for Ballast Water Management.
Based on these regulations several countries already now require Ballast Water Exchange with similar or identical requirements to the D-1 standard before discharging water in their ports.
Approximately 25 different requirements exist worldwide.
Amongst them are the United States (special requirements for California, Washington State and others), Australia, Brazil, New Zealand and recently Norway and the region of the Persian Gulf. Vessels trading in those areas are advised to obtain information prior to reaching such regions.

☐ PRESENT DAY BALLAST WATER MANAGEMENT:-

With a view to the above described Ballast Water Management requirement ships nowadays are principally designed having in mind

For Ballast Water Exchange:

- Piping/pumping system
- Sufficient tank structure to

compensate additional pressures (as appropriate)
- Type, arrangement and location of overflow arrangements with a view to minimize possible pressure components

For Ballast Water Treatment:
- Reserve space (e.g. in the engine room) to arrange the treatment system
- Possible additional pressure of the ballast pumps to cover the pressure losses of the ballast water treatment plant.
- The capability of the ballast system to enable a monitored and flow controlled by-passing of the treatment plant in case of plant failure.
- Additional power supply as demanded from the treatment systems.

☐ PROBLEMATIC SPECIES AND THEIR IMPACT:-

The marine term for the non-indigenous species travelling from one ecosystem into the other is **INVASIVE SPECIES.**

Modern day shipping has seen a wide variety of these aquatic invasive species posing potential threat to the existing marine ecosystems.

There are hundreds of organisms carried in ballast water that cause problematic ecological effects outside of their natural range. Few of them as listed by the IMO are as follows:

- ☐ Cholera **[Vibrio cholerae]** (various strains)
- ☐ Cladoceran Water Flea **[Cercopagis pengoi]**
- ☐ Mitten Crab **[Eriocheir sinensis]**
- ☐ Toxic algae (red/brown/green tides) (various species)
- ☐ Round Goby **[Neogobius melanostomus]**
- ☐ North American Comb Jelly **[Mnemiopsis leidyi]**
- ☐ North Pacific Seastar **[Asterias amurensis]**
- ☐ Zebra Mussel **[Dreissena polymorpha]**
- ☐ Asian Kelp **[Undaria pinnatifida]**
- ☐ European Green Crab **[Carcinus maenas]**

Introduction of exotic species have been known to damage the stock of commercial fisheries. The following examples of invasion species have been introduced by ballast water:

1. Six countries near the Black Sea have been affected by the Atlantic comb jelly. It has eliminated the zooplankton in the Black Sea which has exhausted the region's anchovy fishery.

2. Shellfish in Tasmania have been wiped out by North Pacific sea stars.

3. Toxic red tides have closed clam and mussel farms and fisheries. Both of these invasive species were introduced by ballast water.

4. It has been estimated that $44 million in annual fisheries revenues in Oregon and Washington State are vulnerable to the purple varnish clam and the green crab.

5. The European zebra mussel was introduced into the Great Lakes in the 1980's and caused billions of dollars of damage. The zebra mussel clogged the water systems for cities, and factories and power plants. Fouling boat hulls and maritime structures and sinking navigational buoys, and accumulating on recreational beaches, fouling them with sharp-edged mussel shells and rotting mussel flesh.

These are just a few of the unwanted organisms disturbing the sanctity of the port water ecosystems the world over.

The economic consequences of invasive species are only just starting to be quantified. More and more countries are realizing that exotic species are displacing native species to the detriment of local industry. In Tasmania, Northern Pacific seastars have eaten out many commercial shellfish and fish species; several are now on the endangered list. Loss of jobs, exports and lower investment are direct consequences of this invasion. Zebra mussels in North America create clean up and maintenance bills of nearly $US 1 billion dollars a year.

Countries like Peru have seen the growth and assimilation of Vibrio cholerae in their port water bodies. This invasive species were until late found majorly in the Bangladeshi waters and upon its arrival in Peru, it has claimed more than 10,000 lives so far.

The United States has so far been constantly tormented by the growth of the Zebra Mussel. The Zebra Mussel, native to the Caspian and Black Seas arrived in Lake St. Clair in the ballast water of a transatlantic freighter in 1988 and within 10 years spread to all of the five neighboring Great Lakes.

Ballast water discharges are believed to be the leading source of invasive species in marine waters the world over, thus posing public health and environmental risks, as well as significant economic cost to industries such as water and power utilities, commercial and recreational fisheries, agriculture, and tourism. Studies suggest that the economic cost just from introduction of pest mollusks (zebra mussels, the Asian clam, and others) to U.S. aquatic ecosystems is more than $6 billion per year.

A recent red tide outbreak in New Zealand was so severe that people breathing the sea air became ill. Ballast water can also transport cholera around the world. In 1991 the South American cholera epidemic was a result of the bacterium discovered in oysters and fish

BALLAST WATER MANAGEMENT TECHNIQUES AND METHODS:-

This process reduces the density of coastal organisms in ballast tanks that may be able to invade a recipient port, replacing them with oceanic organisms with a lower probability of survival in near shore waters. Reballasting at sea, as recommended by the IMO guidelines, currently provides the best-available measure to reduce the risk of transfer of harmful aquatic organisms, but is subject to serious ship-safety limits. Even when it can be fully implemented, this technique is less than 100% effective in removing organisms from ballast water.

There have been several techniques in practice in the recent past for effective management of ballast water. Ballast water exchange involves replacing coastal water with open-ocean water during a voyage.

Other methods currently being projected for use in the near future are:

SEDIMENTOR

A. Ballast Water Treatment System (Filtration & Disinfection);

B. Seakleen (Natural Biocide).

Certain features of Seakleen as observed aboard the “Seabulk Mariner” in 2006 are:

☐ Cost Effective —10 to 20 cents per tonne10 to 20 cents per tonne.
☐ Highly soluble in fresh and salt water
☐ Not corrosive to Piping or Ballast tanks - Unlike Oxidizing Biocides.
☐ Delivered in safe powder form — Can be stored on board and easily managed by the crew.

☐ Low affinity for particulate matter and sediment.

1. **HYDE MARINE BALLAST WATER TREATMENT PLAN:-**

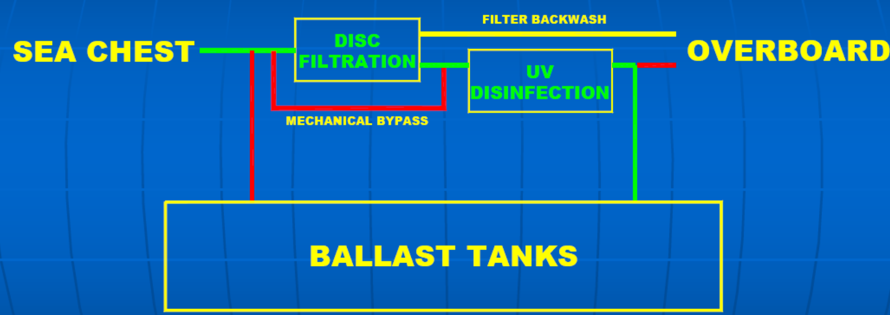
Hyde marine, one of the pioneers in ballast water treatment systems has come up with two unique Ballast Water Treatment technologies.

DISK FILTER

The Hyde Marine Ballast Water Treatment has been illustrated as follows:

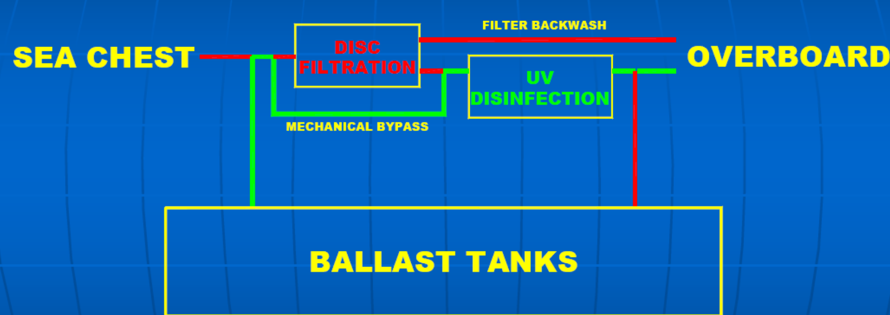
Hyde Marine BWT System

BALLAST MODE



Hyde Marine BWT System

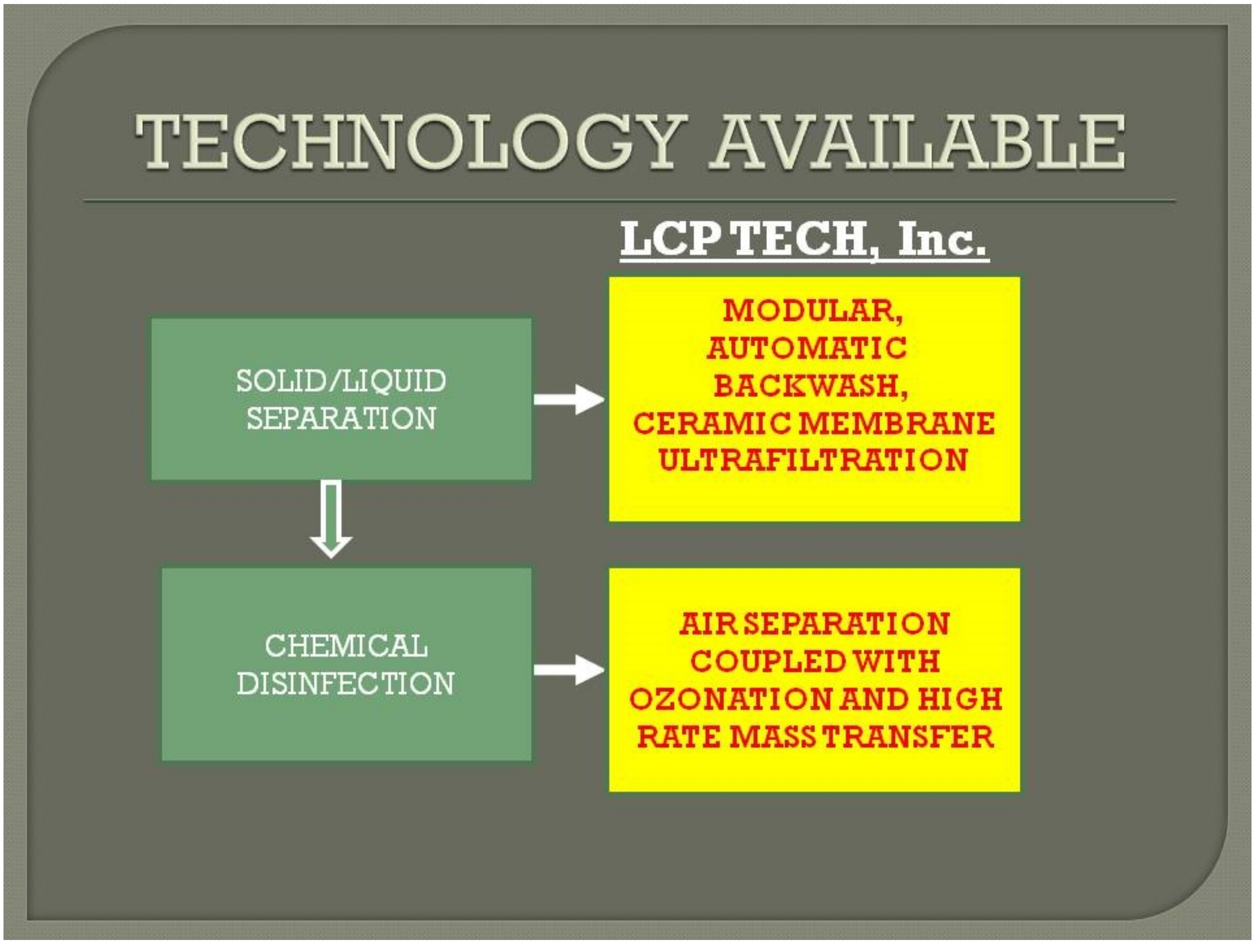
DE-BALLAST MODE



GREAT LAKES BALLAST WATER CONFERENCE
September 27, 2006 Cleveland OH

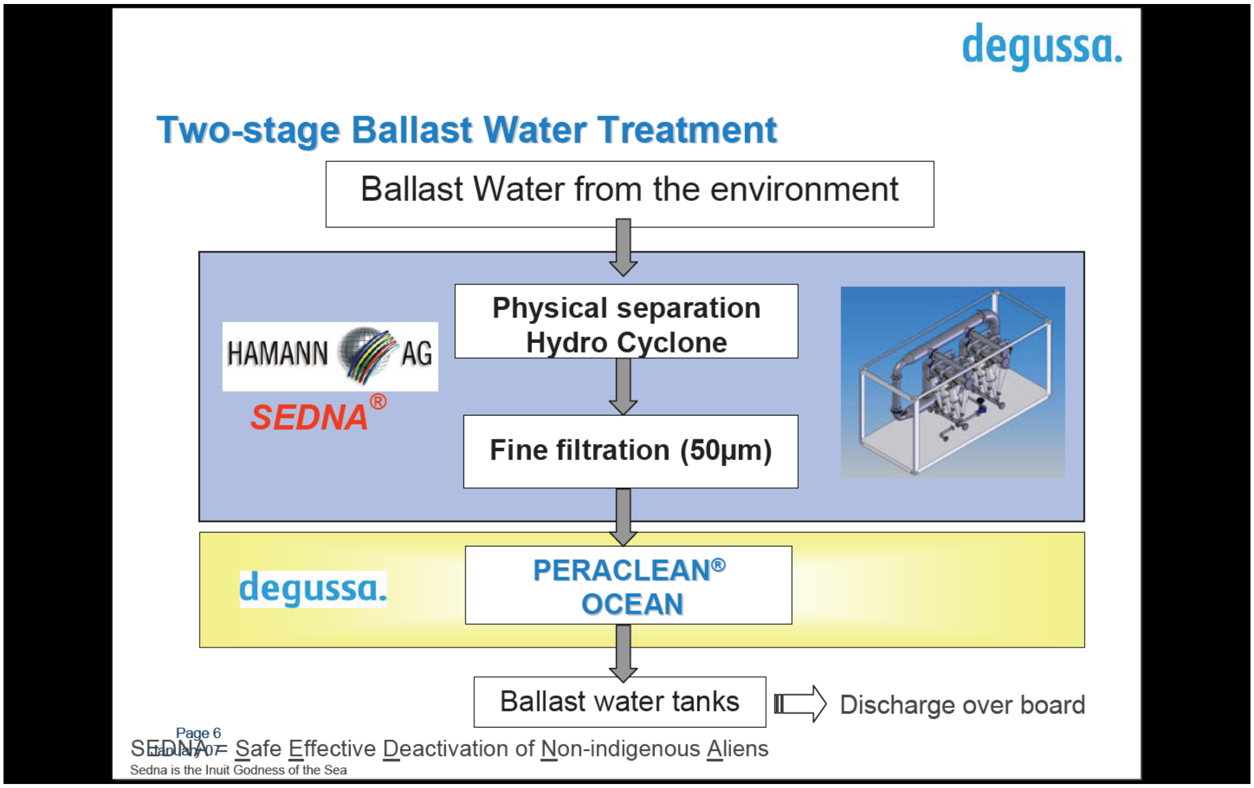
2. LCP TECH, Inc. BALLAST WATER TREATMENT PLAN :-

LCP Tech Inc has a cost effective treatment system that can separate the oil and other contaminants and at the same time can sterilize the water to prevent non-native aquatic organisms from being discharged.



3. PARCLEAN OCEAN BALLAST WATER TREATMENT PLAN :-

Parclean Ocean has proposed the use of a 2 stage Ballast Water treatment plan:



At a field research held at the Parc aquarium at Quebec City in Canada, the technology was put to test to determine it's efficacy under cold working conditions as well as to determine the use of catalase to eliminate residual toxicity, and the results obtained were in tandem with the resarch objectives as high efficacy was observed for fresh and salt water (retention time 72 hrs) and for riverwater, catalase removed the residual peroxide completely.

The system is presently under consideration by th International Maritime Organisation.

4. ATLAS-DANMARK BALLAST WATER TREATMENT PLAN :-

The IMO Ballast Water Convention has set up the following standard for the quality of the water – the Ballast Water Quality Standard – discharged from any vessels:

- Less than 10 viable organisms per m^3 of greater than or equal to 50 μm in minimum dimension
- Less than 10 viable organisms per ml. of less than 50 μm in minimum dimension and of larger than or equal to 10 μm in minimum dimension
- Less than the following concentrations of indicator microbes (but not limited to these microbes), as a human health standard:

- Toxicogenic Vibrio Cholerae (serotypes O1 and O139) with less than 1 Colony Forming Unit (cfu) per 100 ml or less than 1 cfu per 1 g (wet weight) zooplankton samples
- Escherichia Coli (E. Coli) less than 250 cfu per 100 ml.
- Intestinal Enterococci less than 100 cfu per 100 ml.

It should be noted, that Vibrio Cholerae is fatal as explained previously and, Escherichia Coli (E. Coli) causes serious stomach infections and that Enterococci is a strong indicator of general hygienic problems.

Atlas-Danmark Ballast Water Treatment System**,** have following advantages:

- Easy to install, as retrofit on existing vessels as well as on new buildings
- Requires a minimum of space
- Will meet any capacities required
- Can be operated by Natural Flow of the Ballast Water to Ballast Tanks as well as using ballast pumps, pumping to Ballast Tanks
- No special and harmful chemical used
- Use of a disinfection agent, which requires no dangerous chemicals to produce and which poses no risk of leaking during distribution to the ballast water system
- The disinfection agent is during the disinfection process itself, which will ensure that the environment and the crew are not endangered.
- The cost of power use and chemicals used is kept low and the installation of the system is fairly simple for a feasible solution
- Monitoring system is available for controlling the condition of the Ballast Water during the voyage and of the Ballast Water discharged, to secure that the vessel observes the MEPC directive and the Procedure of the Ballast Water Management System. The System consists of the following components:

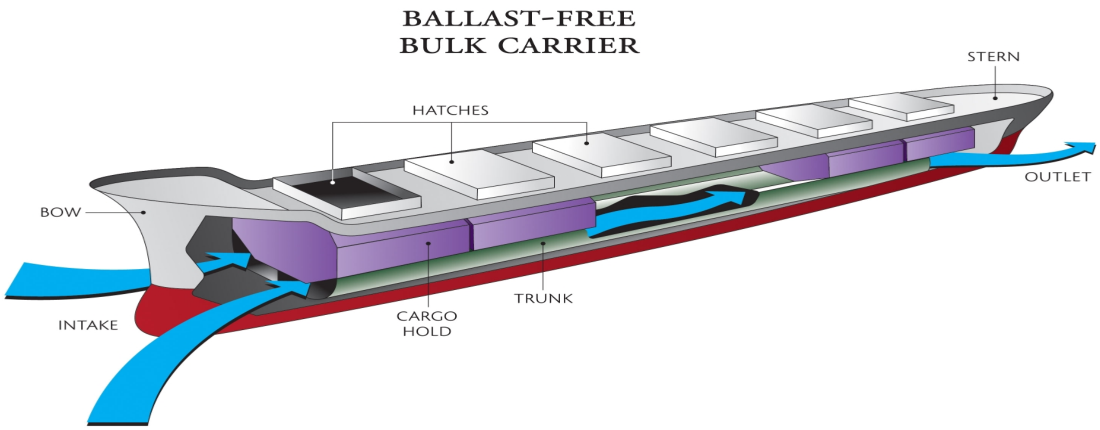
1. Pallet tank.
2. Activated Water Panel(AWP) with Activated Water System(AWS).
3. Anolyte and Catolyte.
4. Dosing pump.
5. Monitoring System (For measuring Redox potential).

□ BALLAST FREE SHIPS – THE WAY AHEAD:-

As an alternative to ballast treatment systems, a new ship-concept that will essentially eliminate the trans-oceanic transport of non-invasive aquatic species(NIS) through ballast water has been proposed by researchers at the University of Michigan. The Ballast-Free Ship concept involves a new paradigm that approaches ballast operation as the reduction of buoyancy, rather than the addition of weight to get the vessel to its required ballast drafts.

In the Ballast-Free Ship concept the traditional ballast tanks are replaced by longitudinal trunks that run from bow to stern below the ballast waterline. Pairs of these trunks are flooded in the ballast condition and are left open to the sea. This can be viewed at reducing the buoyancy of the vessel rather than adding weight as occurring in traditional ballasting. There would be three trunks per side on a Seaway-size bulk carrier.

The natural pressure distribution that develops around a hull at speed produces a positive relative pressure at the bow and a negative pressure at the stern. This pressure differential is used to drive a slow flow through the trunks so that they always contain "local water." The trunks and openings are sized so that the water in these trunks is swept out every hour or two to meet the environmental objective, but not increase the resistance of the ship significantly in the ballast condition. This prevents the ballast water transfer of NIS across the globe. In order to place sufficient volume in the ballast trunks to reach a safe storm ballast draft, the inner bottom must be raised and the hull must be made deeper to provide an equivalent bale capacity for the ship. Thus, the concept is really only practical for new construction. In the Ballast-Free Ship Concept there is a slow flow through trunks extending the length of the ship below the ballast waterline.



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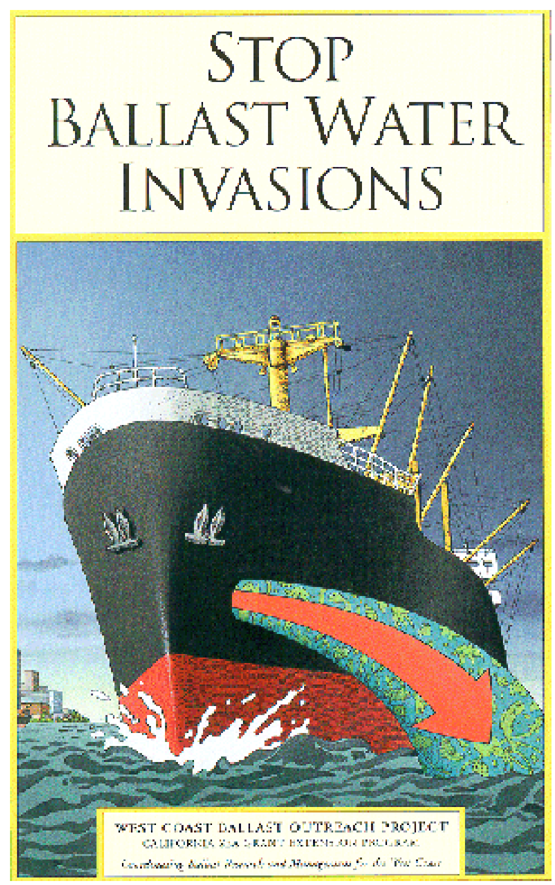
8. Hyde Marine.
9. Lcp Tech. Inc.
10. Atlas-Danmark.
11. Parclean Ocean.



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