International Convention for The Prevention of Pollution from Ships, 1973/78 (MARPOL)

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Annex IV - Prevention of Pollution by Sewage from Ships
Definitions

**Sewage** means:
1. drainage and other wastes from any form of toilets and urinals
2. drainage from medical premises (dispensary, sick bay, etc.) via wash basins, wash tubs and scuppers located in such premises
3. drainage from spaces containing living animals
4. other waste waters when mixed with the drainages defined above.

**Holding tank** means a tank used for the collection and storage of sewage.

**From the nearest land** - means from the baseline from which the territorial sea of the territory in question is established in accordance with international law.

Prevention of Pollution by Sewage from Ships

**Application**
- Ships engaged in international voyages:
  - New ships of \( \text{GT} \geq 400 \)
  - New ships \( \text{GT} < 400 \) which are certified to carry more than 15 persons
Sewage Systems

Every ship which shall be equipped with one of the following sewage systems:

- A sewage treatment plant
- A sewage comminuting and disinfecting system fitted with facilities for the temporary storage of sewage when the ship is less than 3 nautical miles from the nearest land
- A holding tank of the capacity for the retention of all sewage, having regard to the operation of the ship, the number of persons on board and other relevant factors.

Chemical Sewage Treatment Plants (1)

- Consists of a big storage tank which collects, treats and stores the sewage for discharging it to the sea or to a shore receiving facility.
- The sewage is first collected in a tank and the liquid content is reduced. This can be done by flushing water from wash basins and bathroom drains directly into the sea.
- The liquid from any other sources is treated chemically to get rid of the color and smell and then it is reused as flushing water in toilets. The chemicals that are used assist in the process of breaking the solid constituents and also in sterilization.
Chemical Sewage Treatment Plants (2)

- A mechanical instrument known as comminutor is used to help breaking down of the solid particles to smaller ones. The liquid sewage remains at the top and the solid particles settle down, which are then discharged to a sewage tank.
- The liquid sewage is chemically treated and is used for toilet flushing purposes. The sewage from the sewage tank is discharged to the shore collecting facilities.
- It is important to supply adequate quantity of chemical dosages to prevent odor and corrosion due to high level of alkalinity.

Biological Sewage Treatment Plants (1)

- Uses bacteria to facilitate the process of breaking down of solid constituents.
- It generates an oxygen rich atmosphere that aerobic bacteria utilizes to multiply and disintegrate the sewage waste to convert it into sludge (aeration process).
- The whole plant is divided into three compartments:
  - Aeration compartment
  - Settling compartment
  - Chlorine treatment compartment.
Biological Sewage Treatment Plants (2)

- Sewage enters the sewage treatment plant first through the aeration compartment. Aerobic bacteria digest the sewage waste and reduce it to small particles. A continuous supply of atmospheric oxygen is provided to increase the rate of digestion process.
- The disintegrated solid waste is then transferred to the settling compartment where the solid constituents settle down under the effect of gravity.
- The liquid at the top is then passed to the chlorine treatment compartment. In this compartment the liquid water is treated with chlorine and other chemicals to kill any surviving bacteria. Once done the water is then discharged into the sea.
- The process of chlorination is facilitated with the help of chlorine tablets. The sludge that settles down in the settling compartment is removed and stored in a storage tank to later discharge it to shore facilities or decontrolled areas.

Discharge of Sewage

- The discharge of sewage into the sea is prohibited, except when:
  1. The ship is discharging
     - comminuted and disinfected sewage at a distance > 3 nautical miles from the nearest land, or
     - sewage which is not comminuted or disinfected at a distance > 12 nautical miles from the nearest land,
     provided that in any case, the sewage shall not be discharged instantaneously but at a moderate rate when the ship is en route and proceeding at \( V \geq 4 \) knots
  2. The ship has in operation an approved sewage treatment plant and additionally, the effluent shall not produce visible floating solids nor cause discoloration of the surrounding water.
Standard Discharge Connections

- To enable pipes connections between the reception facilities and the ship, both lines shall be fitted with a standard discharge connection in accordance with the following table:

<table>
<thead>
<tr>
<th>Description</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside diameter</td>
<td>210 mm</td>
</tr>
<tr>
<td>Inner diameter</td>
<td>According to pipe outside diameter</td>
</tr>
<tr>
<td>Bolt circle diameter</td>
<td>110 mm</td>
</tr>
<tr>
<td>Slots in flange</td>
<td>4 holes 19 mm in diameter equidistantly placed on a bolt circle of the above diameter, slotted to the flange periphery. The slot width to be 1.8 mm</td>
</tr>
<tr>
<td>Flange thickness</td>
<td>15 mm</td>
</tr>
<tr>
<td>Bolts and nuts</td>
<td>8 each of 9 mm in diameter and of suitable length</td>
</tr>
</tbody>
</table>

- For ships having a Depth ≤ 5 m, the inner diameter may be 38 mm
- In alternative, ships in dedicated trades, i.e. passenger ferries, the ship's discharge pipeline may be fitted with quick connection couplings.

M.Ventura MARPOL 11

Annex V - Prevention of Pollution by Garbage from Ships
Definitions

- **Garbage** - means all kinds of victual, domestic and operational waste excluding fresh fish and parts thereof, generated during the normal operation of the ship and liable to be disposed of continuously or periodically.

- **Special Area** - means a sea area where for recognized technical reasons in relation to its oceanographical and ecological condition and to the particular character of its traffic the adoption of special mandatory methods for the prevention of sea pollution by garbage is required.

Prevention of Pollution by Garbage from Ships

Application

- Unless expressly provided otherwise, the provisions of this Annex shall apply to all ships.
Garbage Outside Special Areas (1)

- **The disposal into the sea of all plastics**, including but not limited to synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products which may contain toxic or heavy metal residues, is **prohibited**.

- The disposal into the sea of the following garbage shall be made as far as practicable from the nearest land but is prohibited if the distance from the nearest land is less than:
  1. **25 nautical miles** for dunnage, lining and packing materials which will float
  2. **12 nautical miles** for **food wastes** and all other garbage including paper products, rags, glass, metal, bottles, crockery and similar refuse

Garbage Outside Special Areas (2)

- **The disposal into the sea of garbage specified in subparagraph (ii) may be permitted when:**
  - it has passed through a comminuter or grinder and
  - is made as far as practicable from the nearest land but in any case is prohibited if the distance from the nearest land is < 3 nautical miles.
  - Comminuted or ground garbage shall be capable of passing through a screen with openings <= 25 mm

- When the garbage is **mixed with other discharges** having different disposal or discharge requirements the more stringent requirements shall apply.
Garbage Processing Equipment (1)

- **Comminuter** - is an oversized garbage disposal that reduces food scraps to a finely chopped residual, which is rinsed out of the unit with a steady stream of water. The effluent is a slurry of water and food bits.

- **Compactors** - make garbage easier to store, to transfer to port reception facilities and to dispose of at sea when discharge limitations permit.

Garbage Processing Equipment (2)

- **Shredder** - ideal for most waste materials such as various food waste including bones, paper and cardboard, tins and soda cans, PE soda bottles, other PE materials etc.
Special Requirements for Disposal of Garbage

• The disposal of any materials regulated by this Annex is **prohibited** from:
  - fixed or floating **platforms** engaged in the exploration, exploitation and associated offshore processing of sea-bed mineral resources
  - all other ships when alongside or within 500 m of such platforms

• The disposal into the sea of **food wastes** is permitted when:
  - They have been passed through a comminuter or grinder
  - They are located more than 12 nautical miles from land

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Garbage Disposal in Special Areas

• Disposal into the sea of the following is **prohibited**:
  i. **all plastics**, including but not limited to synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products which may contain toxic or heavy metal residues; and
  ii. all other garbage, including paper products, rags, glass, metal, bottles, crockery, dunnage, lining and packing materials

• Disposal into the sea of **food wastes** shall be made as far as practicable from land, at least > 12 nautical miles from the nearest land

• Disposal into the **Wider Caribbean Region** of food wastes comminuted or grinded is **acceptable** at distances > 3 nautical miles from the nearest land.
Special Areas

For the purpose of this Annex, the special areas are:

• the Mediterranean Sea area
• the Baltic Sea area
• the Black Sea area
• the Red Sea area
• the "Gulfs area"
• the North Sea area
• the Antarctic area
• the Wider Caribbean Region, including the Gulf of Mexico and
  the Caribbean Sea

Summary of Garbage Disposal Regulations

<table>
<thead>
<tr>
<th>Garbage Type</th>
<th>***All ships except platforms</th>
<th>**In special areas</th>
<th>***Offshore platforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastics - includes synthetic ropes and fishing nets and plastic garbage bags</td>
<td>Disposal prohibited</td>
<td>Disposal prohibited</td>
<td>Disposal prohibited</td>
</tr>
<tr>
<td>Floating dunnage, lining and packing materials</td>
<td>&gt;25 miles offshore</td>
<td>Disposal prohibited</td>
<td>Disposal prohibited</td>
</tr>
<tr>
<td>Paper, rags, glass, metal, bottles, crockery and similar refuse</td>
<td>&gt;12 miles</td>
<td>Disposal prohibited</td>
<td>Disposal prohibited</td>
</tr>
<tr>
<td>All other garbage including paper, rags, glass, etc. comminuted or ground</td>
<td>&gt;3 miles</td>
<td>Disposal prohibited</td>
<td>Disposal prohibited</td>
</tr>
<tr>
<td>Food waste not comminuted or ground</td>
<td>&gt;12 miles</td>
<td>&gt;12 miles</td>
<td>Disposal prohibited</td>
</tr>
<tr>
<td>*Food waste comminuted or ground</td>
<td>&gt;3 miles</td>
<td>&gt;12 miles</td>
<td>&gt;12 miles</td>
</tr>
<tr>
<td>Mixed refuse types</td>
<td>****</td>
<td>****</td>
<td>****</td>
</tr>
</tbody>
</table>
NOTES:

* Comminuted or ground garbage must be able to pass through a screen with mesh size no larger than 25 mm.

** Garbage disposal regulations for special areas shall take effect in accordance with regulation 5(4)(b) of Annex V.

*** Offshore platforms and associated ships include all fixed or floating platforms engaged in exploration or exploitation of sea-bed mineral resources, and all ships alongside or within 500 m of such platforms.

**** When garbage is mixed with other harmful substances having different disposal or discharge requirements, the more stringent disposal requirements shall apply.

Note: The Baltic Sea Special Area Disposal Regulations took effect on 1 October 1989
### Compaction Options on Board

<table>
<thead>
<tr>
<th>Typical examples</th>
<th>Compaction characteristics</th>
<th>Onboard storage space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal, food and beverage containers, glass, small wood pieces</td>
<td>Special handling by vessel personnel before compaction</td>
<td>Rate of alteration</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>Very rapid</td>
</tr>
<tr>
<td>Comminuted plastics, fiber and paper board</td>
<td>Rigid - reduced material to size for feed, minimal manual labor</td>
<td>Rapid</td>
</tr>
<tr>
<td>Small metal drums, uncommminuted cargo packing, large pieces of wood</td>
<td>Moderate - longer manual labor time required to size material for feed</td>
<td>Slow</td>
</tr>
<tr>
<td>Uncommminuted plastics</td>
<td>Major - very long manual labor time to size material for feed; usually impractical</td>
<td>Very slow</td>
</tr>
<tr>
<td>Bulky metal cargo containers, thick metal items</td>
<td>Impractical for shipboard compaction; not feasible</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

### Incineration Options (1)

<table>
<thead>
<tr>
<th>Typical examples</th>
<th>Special handling by vessel personnel before incineration</th>
<th>Incineration characteristics</th>
<th>Onboard storage space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper packaging, food and beverage containers</td>
<td>Minor - easy to feed into hopper</td>
<td>Combustibility</td>
<td>Reduction of volume</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Over 95%</td>
<td>Powder ash</td>
</tr>
<tr>
<td>Fiber and paper board</td>
<td>Minor - reduce material to size for feed; minimum manual labor</td>
<td>High</td>
<td>Over 95%</td>
</tr>
<tr>
<td>Plastic packaging, food and beverage containers, etc.</td>
<td>Minor - easy to feed into hopper</td>
<td>High</td>
<td>Over 95%</td>
</tr>
<tr>
<td>Plastic sheeting, netting, rope, and bulk material</td>
<td>Moderate manual labor time for size reduction</td>
<td>High</td>
<td>Over 95%</td>
</tr>
</tbody>
</table>
## Incineration Options (2)

<table>
<thead>
<tr>
<th>Typical examples</th>
<th>Incineration characteristics</th>
<th>Onboard storage space</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Special handling by vessel personnel before incineration</td>
<td>Combustibility</td>
</tr>
<tr>
<td>Rubber hoses and bulk pieces</td>
<td>Major manual labor time for size reduction</td>
<td>High</td>
</tr>
<tr>
<td>Metal food and beverage containers, etc.</td>
<td>Minor - easy to fed into hopper</td>
<td>Low</td>
</tr>
<tr>
<td>Metal cargo, bulky containers, thick metal items</td>
<td>Major manual labor time for size reduction (not easily inornated)</td>
<td>Very Low</td>
</tr>
<tr>
<td>Glass food and beverage containers, etc.</td>
<td>Minor - easy to fed into hopper</td>
<td>Low</td>
</tr>
<tr>
<td>Wood, cargo containers and large wood logs</td>
<td>Moderate manual labor time for size reduction</td>
<td>High</td>
</tr>
</tbody>
</table>

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**Annex VI - Prevention of Atmospheric Pollution by Ships**
Definitions

**Emission** - means any release of substances, subject to control by this Annex from ships into the atmosphere or sea.

**Sludge oil** - means sludge from the fuel or lubricating oil separators, waste lubricating oil from main or auxiliary machinery, or waste oil from bilge water separators, oil filtering equipment or drip trays.

**Ozone Depleting Substances** - substances that may be found on board ship include, but are not limited to:
- Halon 1211 Bromochlorodifluoromethane
- Halon 1301 Bromotrifluoromethane
- Halon 2402 1,2-Dibromo-1,1,2,2-tetrafluoroethane (Halon 114B2)
- CFC-11 Trichlorofluoromethane
- CFC-12 Dichlorodifluoromethane
- CFC-113 1,1,2-Trichloro-1,2,2-trifluoroethane
- CFC-114 1,2-Dichloro-1,1,2,2-tetrafluoroethane
- CFC-115 Chloropentafluoroethane

Prevention of Atmospheric Pollution by Ships

**Application**
- The provisions of this Annex shall apply to all ships.
Prevention of Atmospheric Pollution by Ships

Regulates

• Substances that affect the ozone
• Emissions of Nitrogen Oxides (NOx) from Diesel engines
• Content of Sulphur Oxides (SOx) in the Fuel Oils
• Emission of Volatile Organic Compounds from cargo tanks of tanker ships
• Incinerators
• Reception Facilities
• Quality of the Fuel Oils
• Issuing of the Certificate

Shipboard Incineration

• Shipboard incineration shall be allowed only in a shipboard incinerator
• Incineration of the following substances shall be prohibited:
  - Annex I, II and III cargo residues of this convention and related contaminated packing materials
  - polychlorinated biphenyls (PCBs)
  - garbage, containing more than traces of heavy metals
  - refined petroleum products containing halogen compounds
• Incineration of sewage sludge and sludge oil generated during the normal operation of a ship is accepted in the main or auxiliary boilers, but not inside ports, harbours and estuaries.
• Incineration of polyvinyl chlorides (PVCs) shall be prohibited
Annex VI Revision

- The revised MARPOL Annex VI (Regulations for the Prevention of Air Pollution from Ships) and the revised NOx Technical Code 2008 were adopted by IMO’s Marine Environment Protection Committee in October 2008.
- Entry into force date of 1 July 2010.
- The reviewed documents includes:
  - The revised MARPOL Annex VI (Regulations for the Prevention of Air Pollution from Ships), including emission limits and operational requirements
  - The NOx Technical Code 2008, is made mandatory under MARPOL Annex VI for all marine diesel engines with a power output of 130 kW or more, and provides the requirements for the testing, survey and certification of marine diesel engines
  - Interim guidelines for application of the NOx Technical Code 2008
  - Standard specifications for shipboard incinerators.
Protection of the Marine Eco-Systems

- It is estimated that about 10 billion tons of ballast water are moved annually by the merchant ships, 100 millions of tons of sediments and microscopical marine species are transferred to environments in relation to which they are foreign and often noxious or destructives.

- The ballast water is responsible, for example, for the introduction of the toxic dinoflagelaciae, a type of algae.

- These algae can survive during year inside the ballast tanks.

- Once discharged into another environment they are able to poison some marine species and even humans.

Technologies Applied

- Reduction of the entry of organisms on board (filters)
- Retention of the ballast water on board
- Treatment systems by facilities on shore
- Renewal of the ballast water in the sea
- Treatment of the ballast water on board, before discharging
Retention of the Ballast Water on Board

• Not compatible with the normal operations of loading/unloading

• Can be not feasible due to safety reasons related with the trim and the stability of the ship

• Generally it is not an option for the ocean going ships

• Requires reception facilities on shore

Treatment Systems by Facilities on Shore

• Requires the ship to have a ballast system with capacity to pump to shore

• The salt content of the water and the high flow rate required prevents the usage of most port systems
Renewal of the Ballast Water

Advantages
- Most used
- Does not require adaptations of the ship
- It is not very costly

Disadvantages
- Demands the ballast to be pumped 3 times
- Hull subject to a stress increase
- Stability problems
- Higher FO consumption
- More emissions

Ballast Water Treatment Systems

- **Separation/filtering** - to minimize the quantity of sediments coming into the ballast tanks
- **Ultra-Violet Radiation**
Ballast Water Management

• Entries into force 12 month after the ratification by 30 states, representing 35% of the tonnage of the world merchant fleet

• Reception Facilities
  - The ports and terminals where ballast tank cleaning or repairs occur shall have adequate reception facilities for the sediments

• Research and Monitoring
  - The scientific and technical research on ballast water management shall be promoted
  - The results from the ballast water management shall be monitored

• Inspection and Certificates

Water Ballast Management Plan

• Ships shall implement and have on board a Water Ballast Management Plan, approved by the Administration

• Ships shall have a Ballast Water Register Book, where it is recorded:
  - When the ship is ballasted
  - When the ballast is renewed or treated
  - When ballast is discharged into the sea
  - When ballast is discharged into reception installations, on shore
  - Accidental ballast discharges