2024 January

4. With reference to Oily Water Separators (OWS) and the pumping of bilges, explain EACH of the following:

(a) why a positive displacement pump is preferable to a centrifugal pump as the main bilge pump; (2)

(b) why it is important that the flow rate to the separator is not exceeded; (2)

(c) why the discharge overboard line should be higher than the OWS; (2)

(d) how detergents used for bilge cleaning can affect the operation of the separator; (2)

(e) why an air release is fitted to the top of the shell of the OWS, (2)

Oily Water Separators (OWS) and Bilge Pumping: Key Considerations

(a) Positive Displacement Pump vs. Centrifugal Pump for Bilge Water:

- **Positive Displacement Pump (Preferred):**
    - Delivers a constant flow rate irrespective of the discharge pressure. This consistent flow is crucial for optimal OWS operation, ensuring the separator can process bilge water at the designed rate for efficient oil-water separation.
    - Can handle viscous fluids and solids present in bilge water more effectively compared to centrifugal pumps.
- **Centrifugal Pump:**
    - Flow rate can vary depending on discharge pressure. Fluctuations in flow can disrupt the separation process within the OWS.
    - Less suited for handling viscous fluids or solids, which can clog the pump impeller and hinder its performance.

(b) Importance of Maintaining Flow Rate to the OWS:

- **Exceeding Flow Rate:** If bilge water is pumped to the OWS at a rate higher than its designed capacity, it can overwhelm the separator. This can lead to:
    - Incomplete oil separation, resulting in oily water being discharged overboard, exceeding regulatory limits.
    - Reduced efficiency of the separation process, potentially allowing emulsified oil (oil droplets suspended in water) to pass through the separator.
- **Maintaining Designed Flow Rate:** By using a positive displacement pump and controlling the pumping rate, the bilge water can be processed by the OWS effectively, ensuring proper oil-water separation and compliant overboard discharge.

(c) Discharge Overboard Line Location:

- **Higher than OWS:** The overboard discharge line from the OWS should be positioned at a level higher than the separator itself. This creates a backpressure within the separator. This backpressure is beneficial because:
    - It helps retain oil droplets within the separator for a longer period, allowing for more efficient separation from the water.
    - It prevents untreated bilge water from siphoning back from the overboard line into the separator in case of rough seas or changes in vessel trim.

(d) Detergents and OWS Operation:

- **Negative Impact:** Detergents used for bilge cleaning can negatively affect the operation of the OWS in two ways:
    - **Emulsification:** Detergents can act as emulsifiers, breaking down oil into smaller droplets that remain suspended in water. These emulsified oil particles are more difficult for the OWS to separate effectively.
    - **Coalescence Inhibition:** Some detergents can hinder the natural process of oil droplet coalescence (merging of small oil droplets into larger ones) within the separator, reducing separation efficiency.
- **Regulations and Recommendations:** To minimize these issues, using only IMO-approved bilge cleaning detergents specifically formulated for compatibility with OWS operation is recommended.

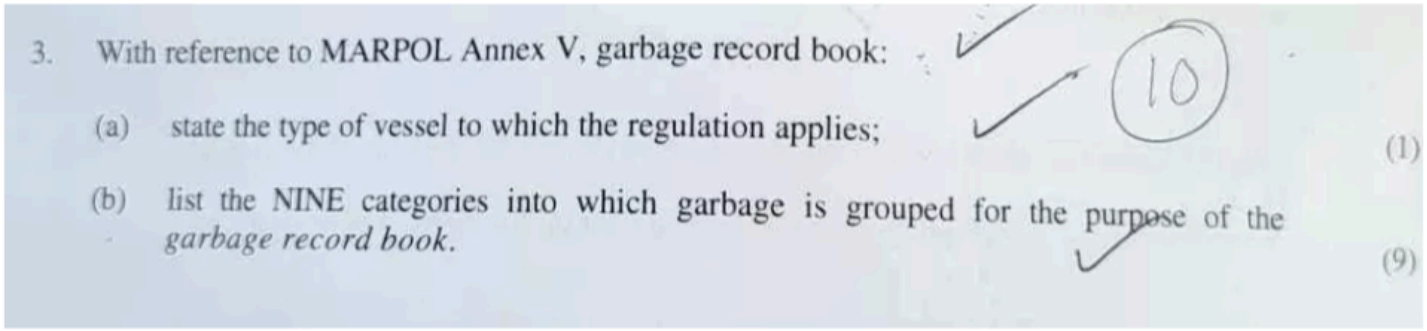
(e) Air Release on OWS Shell:

- **Purpose:** The air release valve at the top of the OWS shell serves two main functions:
    - **Venting Trapped Air:** During operation, air can become trapped within the separator. The air release valve allows this trapped air to escape, preventing it from accumulating and disrupting the oil-water separation process.
    - **Maintaining Pressure Balance:** As bilge water enters the separator, the air release valve helps maintain a slight positive pressure within the OWS. This pressure helps retain oil within the separator and prevents untreated water from siphoning back out during changes in vessel attitude.

By understanding these key aspects of OWS operation and bilge pumping, crew members can ensure efficient oil-water separation, minimize the risk of pollution, and comply with international maritime regulations.

aug 2023

AUG 2023



3. With reference to MARPOL Annex V, garbage record book:

(a) state the type of vessel to which the regulation applies; (1)

(b) list the NINE categories into which garbage is grouped for the purpose of the *garbage record book.* (9)

aug 2021

Aug 2021

3. With reference to MARPOL Annex V, garbage record book:

(a) state the type of vessel to which the regulation applies; (1)

(b) list the NINE categories into which garbage is grouped for the purpose of the *garbage record book*. (9)

MARPOL Annex V and Garbage Record Book

(a) Applicability:

The MARPOL Annex V regulation on garbage record keeping applies to:

- **All sea-going vessels of 400 gross tonnage and above** engaged on international voyages.
- **Every ship certified to carry 15 or more persons** engaged on international voyages.

(b) Nine Garbage Categories:

MARPOL Annex V categorizes garbage into nine groups for record-keeping purposes in the Garbage Record Book. These categories are:

1. **Food Wastes:**Includes all galley waste, leftovers from meals, vegetable matter, fruit peels, and other biodegradable food waste.
2. **Plastics:**Encompasses all plastics generated on board, including packaging materials, utensils, ropes, fishing gear, and plastic debris.
3. **Paper:**This category includes paper products like newspapers, cardboard boxes, paper towels, and office waste.
   Glass: Broken or unbroken glass waste generated on board, including bottles, tableware, and laboratory glassware.
4. **Metal:**Includes scrap metal, used metal containers, and other metallic waste generated during ship operations or maintenance activities.
5. **Vegetable Oils:**Used cooking oils, lubricating oils, and other oily residues from machinery operation or bilge cleaning.
6. **Cargo Residues:**Any solid material remaining from cargo handling operations, such as dunnage, lining materials, packing materials, or cleaning residues.
7. **Fishing Gear:**Lost or discarded fishing gear, including nets, lines, hooks, and other fishing equipment.
8. **Other Garbage:**This category includes any garbage that doesn't fall into the above categories, such as batteries, electronic waste, inert grinding materials, and harmful substances.

By maintaining a Garbage Record Book with these categorized entries, ship operators can effectively track waste generation onboard, ensuring proper waste management practices and compliance with MARPOL Annex V regulations.

March 21

4. (a) With reference to MARPOL 73/78 Annex IV, explain what is meant by the term *sewage*. (4)

(b) State the current regulations for the discharge of *sewage*. (6)

MARPOL Annex IV and Sewage Regulations:

(a) Definition of Sewage:

According to MARPOL 73/78 Annex IV, **sewage** refers to:

- **All waste streams** originating from sanitary facilities onboard a ship, including:
    - Toilet waste from toilets and urinals
    - Graywater from sinks, showers, laundry, and galley facilities
- **Any other waste** generated onboard that is similar in character to the wastes mentioned above.

This encompasses all human waste products and wastewater streams produced during regular ship operations.

(b) Current Regulations for Sewage Discharge:

MARPOL Annex IV sets strict regulations to minimize pollution from ship-generated sewage. The discharge of sewage is generally prohibited, with exceptions allowed under specific conditions:

- **Comminuted and Disinfected Sewage:** In **waters outside designated special areas**, treated sewage that has been:
    - **Comminuted:** Ground into small particles to aid in dispersal.
    - **Disinfected:** Treated with an approved method (e.g., chemicals) to reduce harmful bacteria and viruses. can be discharged at a distance of **more than 3 nautical miles from the nearest land**.
- **Sewage from Approved Treatment Plants:** Sewage treated onboard using an **approved sewage treatment plant** that meets specific performance standards can be discharged even closer to land, but only when the ship is **en route** and proceeding at a minimum speed. Additionally, the effluent must not produce visible floating solids or cause discoloration of the surrounding water.

- **Special Areas:** In designated **MARPOL special areas**, such as the Baltic Sea or the Mediterranean Sea, even stricter regulations apply. The discharge of any untreated sewage is generally prohibited within these special areas.

These regulations aim to protect the marine environment from the harmful effects of sewage pollution, minimizing the spread of pathogens and ensuring cleaner waters.

Feb 2021

4. Describe, with the aid of a sketch, a single stage static Oily Water Separator designed to meet MARPOL Annex I requirements. (10)

Single-Stage Static Oily Water Separator (OWS) for MARPOL Compliance

A single-stage static OWS designed to meet MARPOL Annex I requirements is a gravity-based separator that separates oil from bilge water and oily residues generated onboard a ship. Here's a breakdown of its key components and operation:

Components:

- **Coalescing Plates:** These are corrugated plates or tubes installed within the separator. Their purpose is to:
    - Increase the surface area for oil droplet contact, promoting coalescence (merging of small oil droplets into larger ones).
    - Facilitate oil droplet separation from the water due to the difference in density (oil floats on water).
- **Weir Plates:** These are strategically placed baffles that:
    - Direct the flow of bilge water upwards within the separator.
    - Help maintain a specific oil layer thickness at the top of the separator.
- **Oil Overflow Pipe:** This pipe allows the separated oil to accumulate at the top of the separator and be skimmed off periodically for proper disposal.
- **Treated Water Outlet:** This is the outlet at the bottom of the separator from where the treated bilge water (water with minimal oil content) exits the unit.
- **Level Sensors:** Sensors monitor the levels of both oil and water within the separator.

Operation:

1. **Bilge Water Inlet:** Bilge water containing oil is pumped into the separator.
2. **Gravity Separation:** Due to the difference in density, oil droplets rise to the top, while the denser water sinks towards the bottom.
3. **Coalescing Plates:** As bilge water flows through the coalescing plates, oil droplets come into contact with the increased surface area and merge into larger oil globules, accelerating separation.
4. **Weir Plates:** The weir plates ensure a specific oil layer thickness is maintained at the top and prevent oil from prematurely exiting with the treated water.
5. **Oil Skimming:** The accumulated oil layer at the top is periodically skimmed off through the overflow pipe for collection and disposal according to MARPOL regulations.
6. **Treated Water Discharge:** The treated bilge water with minimal oil content exits the separator through the treated water outlet. Level sensors monitor the water level and may trigger an alarm if it reaches a predefined limit, indicating the need for discharge or further processing.

MARPOL Compliance:

To meet MARPOL Annex I requirements, the OWS must be approved by an authorized classification society and demonstrate its ability to achieve a treated water oil content of **less than 15 parts per million (ppm)**. This

ensures that the discharged bilge water meets the regulatory limit and minimizes oil pollution from ship operations.

Additional Considerations:

- **Size and Capacity:** The size and treatment capacity of the OWS will depend on the size and type of vessel.
- **Alarm Systems:** The OWS may be equipped with alarms to indicate high oil levels, low water levels, or malfunctions requiring attention.
- **Maintenance:** Regular maintenance is crucial for optimal performance. This includes cleaning the coalescing plates, checking the level sensors, and ensuring proper operation of all components.

By employing a MARPOL-compliant single-stage static OWS and maintaining it properly, ship operators can significantly reduce oily water pollution and contribute to a cleaner marine environment.

march 2021

March 21

3. (a) State the SIX MARPOL annexes which are currently in force. (6)

(b) With reference to MARPOL Annex VI and Oxides of Nitrogen (NO_x), state which engines have to comply with the legislation. (2)

(c) State TWO other pollutants that AnnexVI is designed to limit. (2)

MARPOL Annex VI and Emissions:

(b) Engines Complying with MARPOL Annex VI NOx Regulations:

As mentioned previously, engines with a power output of more than 130 kW must comply with MARPOL Annex VI NOx regulations. This includes:

- **Main propulsion engines:** Regardless of the vessel type or size, if the main engine (or combined power of multiple main engines) exceeds 130 kW, it falls under the regulations.
- **Auxiliary engines:** Any auxiliary engine onboard, including generators, pump drives, or deck machinery engines, exceeding 130 kW in power output needs to meet the NOx emission standards.

(c) Other Pollutants Limited by MARPOL Annex VI:

While NOx is a major focus, MARPOL Annex VI addresses a broader range of air pollutants from ship operations. Two other key pollutants it aims to limit are:

1. **Sulphur Oxides (SOx):**
    - SOx emissions are primarily caused by the sulphur content in marine fuels. MARPOL Annex VI enforces stricter regulations on the sulphur content of fuels used in designated Emission Control Areas (ECAs) and globally. This helps reduce acid rain formation and respiratory issues caused by SOx exposure.
2. **Volatile Organic Compounds (VOCs):**

- VOCs are a group of organic chemicals that can evaporate at room temperature. They are emitted during fuel transfer operations and contribute to smog formation. MARPOL Annex VI regulates VOC emissions, particularly from tankers, to minimize their environmental impact.

april 2021

April 2021

4. With reference to Annex 1 of the MARPOL convention, state EACH of the following:

(a) the appropriate system to be fitted on a vessel 400GRT or above; (4)

(b) the documentation required, explaining why it is required; (2)

(c) the information to be recorded when pumping bilges overboard through an oil water separator. (4)

(a) Required System for Vessels 400 GRT or Above:

According to MARPOL Annex I, vessels of 400 gross tonnage (GRT) and above must be equipped with an **Oily Water Separator (OWS)**. This is a treatment system designed to separate oil from bilge water and oily residues generated onboard the ship.

(b) Required Documentation:

- **Oil Record Book (ORB):** Every vessel required to have an OWS must also maintain an **Oil Record Book (ORB)**. This is an official document mandated by MARPOL and serves as a record-keeping system for all operations involving oily mixtures onboard.

Reasons for Requiring an ORB:

- **Provides Transparency:** The ORB acts as a transparent record, allowing authorities to verify compliance with MARPOL regulations regarding oily waste management.
- **Facilitates Monitoring:** Regular entries in the ORB enable crew members to monitor oil discharges and identify any potential issues with the OWS or bilge water handling procedures.
- **Serves as Evidence:** The ORB can serve as evidence in case of any investigations or disputes related to oily waste management practices onboard.

(c) Information Recorded When Pumping Bilges Overboard:

When pumping bilge water overboard through an OWS, the following information must be recorded in the Oil Record Book:

- **Date and Time:** The date and time when bilge water pumping and overboard discharge commenced and finished.
- **Position of the Ship:** The geographical position of the ship (latitude and longitude) at the time of discharge.
- **Quantity Discharged:** The estimated or measured quantity of bilge water discharged overboard.
- **Operational Condition:** The operational condition of the vessel at the time of discharge (e.g., en route, maneuvering, at anchor).
- **Condition of the OWS:** A brief notation regarding the operational status of the OWS before and after discharge.

By maintaining accurate and detailed records in the ORB, ship operators can demonstrate responsible bilge water management practices and ensure compliance with MARPOL regulations.

nov 2020

Nov 2020

3. With reference to MARPOL Annex V:

(a) list the THREE recognised complimentary garbage handling techniques; (3)

(b) describe the basic requirements of a Garbage Management Plan; (5)

(c) define what is meant by *E-Waste*. (2)

Garbage Management at Sea: Techniques, Plans, and E-waste

(a) Three Recognized Complimentary Garbage Handling Techniques:

There are three main complimentary garbage handling techniques onboard ships, as stipulated by MARPOL Annex V:

1. **Reduce at Source:** This approach prioritizes minimizing garbage generation in the first place. Strategies include:
    - Using reusable items instead of disposables.
    - Implementing food waste reduction programs.
    - Choosing products with minimal packaging.
2. **Minimize Discharge at Sea:** After reducing waste generation, this technique focuses on minimizing the amount of garbage discharged overboard. This can involve:
    - Segregating and storing different garbage categories for proper disposal ashore.
    - Utilizing onboard equipment like compactors or incinerators (meeting strict emission standards) to reduce waste volume.
    - Following designated discharge restrictions in specific sea areas.
3. **Onshore Reception Facilities:** This final technique emphasizes utilizing designated onshore reception facilities for proper waste disposal. This includes:
    - Delivering segregated garbage to authorized ports for recycling, treatment, or safe disposal.
    - Following national and international regulations regarding waste reception ashore.

By implementing all three techniques in a complementary manner, ships can significantly reduce their environmental impact and comply with MARPOL regulations for garbage management.

(b) Basic Requirements of a Garbage Management Plan (GMP):

A Garbage Management Plan (GMP) is a mandatory document for all ships subject to MARPOL Annex V. It outlines the procedures and practices for handling, storing, and disposing of garbage generated onboard. Here are some basic requirements:

- **Designated Garbage Officer:** The GMP assigns responsibility for garbage management to a designated Garbage Officer onboard.

- **Inventory of Garbage Discharges:** The plan includes an inventory of the different types of garbage typically generated onboard and their estimated quantities.
- **Procedures for Segregation and Storage:** It details procedures for segregating waste into different categories (food waste, plastics, paper, etc.) and proper storage practices for each type.
- **Instructions for Record Keeping:** The GMP outlines what garbage-related information needs to be recorded in the Garbage Record Book.
- **Procedures for Port Reception Facilities:** The plan details procedures for utilizing onshore reception facilities for garbage disposal when in port.

A well-developed and implemented GMP ensures crew members are aware of their responsibilities and facilitates proper garbage handling practices onboard.

(c) E-Waste Definition:

E-waste stands for **Electronic Waste**. It refers to any electrical or electronic equipment that is no longer functioning or is outdated and no longer intended for its original use. Examples of E-waste include:

- Discarded computers, laptops, and tablets
- Used mobile phones and chargers
- Old printers, scanners, and fax machines
- Television sets, monitors, and other display devices
- Spent batteries

E-waste poses a significant environmental concern due to the presence of hazardous materials like lead, mercury, and flame retardants. MARPOL Annex V regulations require proper management and disposal of E-waste generated onboard ships, often through specialized onshore reception facilities equipped to handle such materials responsibly.

oct 2018

Oct 2018

4. With reference to Oily Water Separators and the pumping of bilges, explain the purpose of EACH of the following:

(a) a bilge holding tank; (2)

(b) an oil drain tank; (2)

(c) an oil content discharge monitor; (2)

(d) a vacuum breaker; (2)

(e) an oil detection probe. (2)

Bilge Systems and Oily Water Separators: Key Components Explained

(a) Bilge Holding Tank:

The bilge holding tank serves as a temporary storage tank for bilge water collected from various compartments within the vessel. Bilge water is a mixture of water that accumulates in the lowest bilge areas of the ship and may contain oil, grease, and other contaminants.

- **Why it's important:**
    - The bilge holding tank allows for the controlled collection and processing of bilge water. This prevents the direct discharge of untreated bilge water overboard, minimizing oil pollution.
    - It provides a buffer between bilge pumping operations and OWS processing. Bilge water can be pumped into the holding tank and then transferred to the OWS at a controlled rate for efficient oil-water separation.

(b) Oil Drain Tank:

The oil drain tank is a smaller tank used to collect oil drained from various machinery and equipment onboard the ship. This includes used lubricating oil from engines, gearboxes, and hydraulic systems.

- **Why it's important:**
    - The oil drain tank provides a dedicated space to collect used oil for proper disposal or recycling ashore. This prevents mixing used oil with bilge water in the holding tank, simplifying the separation and handling process.
    - It allows for the controlled transfer of used oil for shore-based treatment or re-refining, promoting environmentally responsible practices.

(c) Oil Content Discharge Monitor (OCM):

An oil content discharge monitor (OCM) is a crucial instrument installed on the overboard discharge line of an OWS.

- **Purpose:**
    - The OCM continuously monitors the oil content in the treated bilge water before it is discharged overboard. It ensures the oil concentration in the discharged water complies with MARPOL regulations (typically less than 15 ppm).
    - If the OCM detects an oil content exceeding the limit, it can automatically trigger an alarm and prevent the overboard discharge of non-compliant bilge water.

(d) Vacuum Breaker:

A vacuum breaker is a safety device installed on the bilge piping system.

- **Function:**
    - It prevents the creation of a vacuum within the bilge piping system. A vacuum could potentially cause seawater to be siphoned back into the bilge tanks, contaminating the bilge water with clean seawater.
    - The vacuum breaker allows air to enter the piping system when a vacuum occurs, preventing backflow and maintaining proper system operation.

(e) Oil Detection Probe:

An oil detection probe is a sensor used within the bilge system or the OWS itself.

- **Purpose:**
    - The probe detects the presence and level of oil in the bilge water or treated water within the separator.
    - This information can be used for various purposes, such as:
        - Triggering alarms if excessive oil is detected in the bilge water.
        - Controlling the pumping rate to the OWS to optimize separation efficiency.
        - Monitoring the oil-water interface level within the OWS.

By understanding the purpose of these components, crew members can ensure efficient bilge water management and proper operation of the Oily Water Separator system, minimizing the risk of oil pollution and complying with international regulations.

june 2021

June 2021

4. With reference to Annex 1 of the MARPOL convention, state EACH of the following:

(a) the appropriate system to be fitted on a vessel 400GRT or above; (4)

(b) the documentation required, explaining why it is required; (2)

(c) the information to be recorded when pumping bilges overboard through an oil water separator. (4)

MARPOL Annex I and Bilge Water Management

(a) Required System for Vessels 400 GRT or Above:

According to MARPOL Annex I, vessels of 400 gross tonnage (GRT) and above must be equipped with an **Oily Water Separator (OWS)**. This is a treatment system designed to separate oil from bilge water and oily residues generated onboard the ship. The OWS removes oil contaminants from the bilge water, allowing the treated water to be discharged overboard within the regulatory limits set by MARPOL.

(b) Required Documentation: Oil Record Book (ORB)

Every vessel required to have an OWS must also maintain an **Oil Record Book (ORB)**. This is an official document mandated by MARPOL and serves as a record-keeping system for all operations involving oily mixtures onboard.

Reasons for Requiring an ORB:

- **Transparency:** The ORB acts as a transparent record, allowing authorities to verify compliance with MARPOL regulations regarding oily waste management.
- **Monitoring:** Regular entries in the ORB enable crew members to monitor oil discharges and identify any potential issues with the OWS or bilge water handling procedures.
- **Evidence:** The ORB can serve as evidence in case of any investigations or disputes related to oily waste management practices onboard.

(c) Information Recorded During Bilge Overboard Discharge with OWS:

When pumping bilge water overboard through an OWS, the following information must be recorded in the Oil Record Book:

- **Date and Time:** The date and time when bilge water pumping and overboard discharge commenced and finished.
- **Position of the Ship:** The geographical position of the ship (latitude and longitude) at the time of discharge.
- **Quantity Discharged:** The estimated or measured quantity of bilge water discharged overboard.

- **Operational Condition:** The operational condition of the vessel at the time of discharge (e.g., en route, maneuvering, at anchor).
- **Condition of the OWS:** A brief notation regarding the operational status of the OWS before and after discharge. This may include readings from the Oil Content Monitor (OCM) or any observations about the separator's performance.

By maintaining accurate and detailed records in the ORB, ship operators can demonstrate responsible bilge water management practices and ensure compliance with MARPOL regulations.

aug 2020

Aug 2020

4. With reference to the use of Oily Water Bilge Separators:

(a) state, with reasons, the type of pump which should be used; (3)

(b) explain the effect of the bilge water feed rate on the performance; (3)

(c) explain the purpose of EACH of the following:

(i) a bilge holding tank; (2)

(ii) an oil content discharge monitor. (2)

Oily Water Bilge Separators: Pumps, Feed Rate, and Key Components

(a) Pump Type for Bilge Water with OWS:

- **Positive Displacement Pump (Recommended):**
  - Delivers a consistent flow rate regardless of discharge pressure. This consistent flow is crucial for optimal OWS operation.
  - Can handle viscous fluids and solids present in bilge water more effectively compared to centrifugal pumps.

Reasons for Choosing a Positive Displacement Pump:

- **Consistent Flow:** Ensures the OWS can process bilge water at the designed rate for efficient oil-water separation.
- **Handles Challenges:** Can effectively handle the presence of viscous fluids or solids in bilge water, which can clog centrifugal pumps.

(b) Effect of Bilge Water Feed Rate on OWS Performance:

- **Excessive Feed Rate:**
  - If bilge water is pumped to the OWS at a rate exceeding its designed capacity, it can overwhelm the separator. This can lead to:
    - Incomplete oil separation, resulting in oily water being discharged overboard, exceeding regulatory limits.

    - Reduced efficiency of the separation process, allowing emulsified oil (oil droplets suspended in water) to pass through the separator.
- **Maintaining Designed Feed Rate:** By using a positive displacement pump and controlling the pumping rate, the bilge water can be processed by the OWS effectively, ensuring proper oil-water separation and compliant overboard discharge.

(c) Purpose of Key Oily Water Separator Components:

(i) Bilge Holding Tank:

- **Purpose:** Provides temporary storage for bilge water collected from various compartments within the vessel.
- **Benefits:**
    - Prevents direct discharge of untreated bilge water overboard, minimizing oil pollution.
    - Acts as a buffer between bilge pumping operations and OWS processing, allowing controlled transfer of bilge water at a suitable rate for the separator.

(ii) Oil Content Discharge Monitor (OCM):

- **Function:** Continuously monitors the oil content in the treated bilge water before it is discharged overboard.
- **Importance:**
    - Ensures the oil concentration in the discharged water complies with MARPOL regulations (typically less than 15 ppm).
    - Triggers an alarm and prevents overboard discharge if oil content exceeds the limit, protecting the marine environment.

jan 2021

29 January 2021

5. (a) State the MARPOL Annex number which deals with the disposal of sewage. (1)

   (b) With reference to the Annex stated in part (a), state the rules for EACH of the following:

   (i) when the sewage is untreated; (2)

   (ii) when the sewage is comminuted and disinfected. (2)

   (c) Explain why the final discharge from an approved sewage treatment plant is chlorinated before discharge. (2)

   (d) Explain how chlorination is carried out and monitored. (2)

   (e) State the correct chlorine content of the final discharge. (1)

MARPOL Annex and Sewage Disposal

(a) MARPOL Annex for Sewage Disposal:

The MARPOL Annex dealing with sewage disposal is **Annex IV - Regulations for the Prevention of Pollution by Sewage from Ships**.

(b) Sewage Discharge Rules:

(i) Untreated Sewage:

The general rule under MARPOL Annex IV is that the discharge of **untreated sewage** from ships is **prohibited**. Exceptions are allowed only in very specific circumstances, such as:

- **When the nearest land is more than 12 nautical miles away** (certain designated special areas may have stricter rules).
- **The ship is en route** and proceeding at a speed of not less than 4 knots.
- The sewage is not proveniente from spaces containing live animals or toilets used by passengers.

(ii) Comminuted and Disinfected Sewage:

The discharge of **comminuted and disinfected sewage** is allowed under certain conditions:

- The sewage must be **comminuted** (ground into small particles) to promote faster dispersal.
- It must be **disinfected** using an approved method (e.g., chemicals) to reduce harmful bacteria and viruses.
- The discharge can only occur **when the nearest land is more than 3 nautical miles away**.
- The ship must be en route and proceeding at a speed of not less than 4 knots.

(c) Chlorination of Final Discharge from Sewage Treatment Plant:

The final discharge from an **approved sewage treatment plant** onboard a ship may be chlorinated before discharge for several reasons:

- **Disinfection:** Chlorine is a powerful disinfectant that inactivates harmful bacteria and viruses present in treated sewage. This helps protect public health and the marine environment from potential pathogens.
- **Reduced Biological Oxygen Demand (BOD):** Chlorine can also help reduce the BOD of the treated sewage. BOD refers to the amount of oxygen required by microorganisms to decompose organic matter in the water. Lower BOD helps minimize oxygen depletion in the receiving water body, which is crucial for maintaining a healthy marine ecosystem.

(d) Chlorination Process and Monitoring:

- **Chlorination System:** Ships with approved sewage treatment plants typically employ an automated chlorination system. This system injects a measured amount of chlorine solution into the treated sewage effluent before discharge.
- **Monitoring:** The chlorine residual level in the final discharge is continuously monitored using chlorine residual analyzers. This ensures the appropriate level of disinfection is achieved without exceeding the permissible chlorine content limits.

(e) Correct Chlorine Content of Final Discharge:

The permissible chlorine content in the final discharge is strictly regulated by MARPOL Annex IV. The specific limits may vary depending on the discharge location and specific regulations. However, it is generally recommended to maintain a **low but measurable chlorine residual** in the treated effluent to ensure effective disinfection while minimizing environmental impact.

30 October 2020

4. With reference to Oily Water Separators and the pumping of bilges, explain the purpose of EACH of the following:

(a) a bilge holding tank; (2)

(b) an oil drain tank; (2)

(c) an oil content discharge monitor; (2)

(d) a vacuum breaker; (2)

(e) an oil detection probe. (2)

Oily Water Separators and Bilge Systems: Component Purposes

(a) Bilge Holding Tank:

The bilge holding tank acts as a temporary storage reservoir for bilge water collected from various compartments within the vessel. Bilge water is a mixture of water that accumulates in the lowest bilge areas and may contain oil, grease, and other contaminants.

- **Purpose:**
  - Prevents the direct discharge of untreated bilge water overboard, minimizing oil pollution at sea.
  - Provides a buffer between bilge pumping operations and the Oily Water Separator (OWS). Bilge water can be pumped into the holding tank and then transferred to the OWS in a controlled manner for efficient oil-water separation.

(b) Oil Drain Tank:

The oil drain tank is a dedicated tank used to collect used oil drained from various machinery and equipment onboard the ship. This includes lubricating oil from engines, gearboxes, and hydraulic systems.

- **Purpose:**
  - Provides a separate space to collect used oil for proper disposal or recycling ashore. This prevents mixing used oil with bilge water in the holding tank, simplifying the separation and handling process.
  - Allows for controlled transfer of used oil for shore-based treatment or re-refining, promoting environmentally responsible practices.

(c) Oil Content Discharge Monitor (OCM):

An oil content discharge monitor (OCM) is a crucial instrument installed on the overboard discharge line of an OWS.

- **Function:**
  - Continuously monitors the oil content in the treated bilge water before it is discharged overboard. It ensures the oil concentration in the discharged water complies with MARPOL regulations (typically less than 15 ppm).

- If the OCM detects an oil content exceeding the limit, it can automatically trigger an alarm and prevent the overboard discharge of non-compliant bilge water.

(d) Vacuum Breaker:

A vacuum breaker is a safety device installed on the bilge piping system.

- **Function:**
  - Prevents the creation of a vacuum within the bilge piping system. A vacuum could potentially cause seawater to be siphoned back into the bilge tanks, contaminating the bilge water with clean seawater.
  - The vacuum breaker allows air to enter the piping system when a vacuum occurs, preventing backflow and maintaining proper system operation.

(e) Oil Detection Probe:

An oil detection probe is a sensor used within the bilge system or the OWS itself.

- **Purpose:**
  - Detects the presence and level of oil in the bilge water or treated water within the separator.
  - This information can be used for various purposes, such as:
    - Triggering alarms if excessive oil is detected in the bilge water.
    - Controlling the pumping rate to the OWS for optimal separation efficiency.
    - Monitoring the oil-water interface level within the OWS.