## 2024 January

1. Describe the method of testing EACH of the following:

   (a) a bilge high level alarm switch; (3)

   (b) a diesel engine cooling water high temperature alarm probe; (3)

   (c) an oil mist detector. (4)

## 2024 January

2. State the action to be taken by the watch keeping engineer in the event of EACH of the following:

   (a) flooding; (6)

   (b) failure of main propulsion machinery. (4)

## 2024 January

3. (a) State the purpose of a planned maintenance system. (4)

   (b) State THREE parameters on which planned maintenance may be based. (3)

   (c) State how an approved planned maintenance system can influence classification society requirements. (3)

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)

2024 January

5. With reference to microbiological contamination of marine gas oil:

(a) state the conditions that must be present for the microbes to live and multiply; (2)

(b) describe the effect of microbiological growth in the fuel; (2)

(c) explain how the contamination may be detected; (2)

(d) state how the risk of contamination may be reduced; (2)

(e) explain how the contamination may be removed. (2)

2024 January

6. With reference to sewage treatment plants:

(a) state the purpose of the vent, and explain why it is fitted with a gauze; (3)

(b) explain the difference between aerobic and anaerobic micro organisms; (3)

(c) explain why air is bubbled through the effluent in the aeration tank; (2)

(d) explain why calcium hypochlorite is added to the treated sewage before discharge overboard. (2)

## 2024 January

7. (a) With reference to food storage rooms:

(i) state, with reasons, the possible danger present in a room used for storing vegetables and fruit; (2)

(ii) state the devices necessary to prevent a person from becoming trapped in a storage room. (3)

(b) State FOUR methods of detecting a refrigeration gas leak. (4)

(c) State the name of the international agreement which stipulates that the production and consumption of compounds that deplete ozone in the stratosphere is phased out. (1)

## 2024 January

8. Explain, with the aid of sketches, the principles of reverse osmosis as a method of producing fresh water. (10)

## 2024 January

List the important operations that should be included when organising fire drills. (10)

## 2024 January

10. With reference to ocean going vessels, define EACH of the following:

(a) trim;

(b) freeboard;

(c) camber;

(d) length between perpendiculars;

(e) length overall;

(f) sheer;

(g) stem;

(h) draft marks;

(i) draft;

(j) depth.

2024 January

1. Describe the method of testing EACH of the following:

(a) a bilge high level alarm switch; (3)

(b) a diesel engine cooling water high temperature alarm probe; (3)

(c) an oil mist detector. (4)

# Testing Safety Equipment:

Here's how to test each piece of equipment:

**(a) Bilge High Level Alarm Switch:**

1. **Manual Test:** Most bilge high level switches have a built-in mechanism for manual testing. This is usually a lever or float that simulates a high water level. Activate the lever and check if the alarm sounds or activates the bilge pump (depending on the system).

2. **Water Simulation (if safe):** With the power off and bilge pump disabled (for safety), slowly introduce clean water into the bilge well until the switch reaches its activation point. The alarm should sound or trigger the bilge pump. **Caution:** Only do this if it's safe and there's no risk of overflowing the bilge or electrical components getting wet.

**Important:** Always refer to the manufacturer's instructions for the specific testing procedure for your bilge switch model.

**(b) Diesel Engine Cooling Water High Temperature Alarm Probe:**

1. **Mimic High Temperature (Simulate):** Most probes have a specific resistance value that triggers the alarm when coolant temperature exceeds a limit. Consult the manufacturer's manual for the resistance value. Use a resistor with that value to simulate a high temperature and check if the alarm activates.

2. **Scan Tool (if available):** Modern engines might have a diagnostic port that allows connecting a scan tool. This tool can read sensor data, including coolant temperature, and might have a test function to simulate high temperature and trigger the alarm.

**Caution:** Never tamper with the probe itself or the engine coolant system while the engine is running.

**(c) Oil Mist Detector:**

1. **Test Can (Manufacturer-supplied):** Some manufacturers provide a test can containing a safe oil mist simulant. Spray a small amount of the simulant near the detector according to the manufacturer's instructions. The detector should activate and sound an alarm.

2. **Functional Test (Controlled Environment):** In a controlled environment (not near the engine), briefly introduce a small amount of a safe, approved oil mist near the detector. The alarm should activate.

**Important:** Never use actual engine oil or any flammable liquids for testing. Always consult the manufacturer's instructions for the specific testing procedure for your oil mist detector model.

2024 January

2. State the action to be taken by the watch keeping engineer in the event of EACH of the following:

(a) flooding; (6)

(b) failure of main propulsion machinery. (4)

## Watchkeeping Engineer's Actions in Emergencies:

**(a) Flooding:**

The watchkeeping engineer's actions in case of flooding are crucial for crew safety and vessel stability. Here's what they should do:

1. **Raise the Alarm:** Immediately sound the emergency alarm and notify the bridge of the flooding location and severity.

2. **Assess the Situation:** Locate the source of the flooding and try to isolate it by closing watertight doors and valves.

3. **Activate Pumps:** Start the bilge pumps and any other pumps appropriate for the flooded area.

4. **Control the Spread:** Take steps to prevent the flood from spreading to other compartments. This might involve shoring up doorways or using temporary patching.

5. **Standby for Instructions:** The Chief Engineer or Captain will take over the overall damage control effort. The watchkeeping engineer should be prepared to follow their instructions.

**Remember:** Crew safety is paramount. If the flooding is severe or the source cannot be contained, prioritize evacuating the engine room and following ship evacuation procedures.

**(b) Failure of Main Propulsion Machinery:**

A main propulsion failure can severely impact the vessel's maneuverability. Here's how the watchkeeping engineer should respond:

1. **Safely Shut Down Engine:** Following established procedures, safely shut down the main engine to prevent further damage.

2. **Assess the Situation:** Try to diagnose the cause of the failure using instrumentation and alarms.

3. **Inform the Bridge:** Immediately notify the bridge of the engine failure and its potential impact on maneuverability.

4. **Attempt Standby Power (if available):** If the vessel has auxiliary engines or emergency propulsion systems, attempt to bring them online according to procedures.

5. **Standby for Instructions:** The Chief Engineer will assess the situation and determine the next course of action. The watchkeeping engineer should be prepared to assist with troubleshooting or repairs.

**Important:** During a main propulsion failure, prioritize the safety of the crew and vessel. Communicate effectively with the bridge and follow established emergency procedures.

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3. (a) State the purpose of a planned maintenance system. (4)

(b) State THREE parameters on which planned maintenance may be based. (3)

(c) State how an approved planned maintenance system can influence classification society requirements. (3)

# Planned Maintenance Systems and Classification Societies:

**(a) Purpose of a Planned Maintenance System (PMS):**

A Planned Maintenance System (PMS) is a proactive approach to maintaining equipment and assets. Its primary purpose is to:

- **Prevent Equipment Failures:** By scheduling regular maintenance tasks, the PMS aims to identify and address potential problems before they escalate into critical failures that can cause downtime, safety hazards, or costly repairs.
- **Optimize Equipment Performance:** Regular maintenance helps ensure equipment operates efficiently and within its designed parameters, leading to increased reliability, availability, and overall lifespan.
- **Reduce Maintenance Costs:** A PMS can help control maintenance costs by preventing major breakdowns and associated repair expenses. Predictive maintenance tasks can also help identify components nearing failure, allowing for cost-effective replacements before a complete breakdown occurs.
- **Improve Safety:** By proactively addressing equipment issues, a PMS can help create a safer working environment by minimizing the risk of accidents due to equipment malfunction.

**(b) Parameters for Planned Maintenance:**

Planned maintenance tasks can be scheduled based on various parameters, including:

- **Running Hours:** This is a common method for equipment with components that wear out over time. Maintenance is scheduled based on the number of hours the equipment has been operating. For example, engine oil changes might be scheduled every 500 running hours.
- **Operating Calendar:** Certain maintenance tasks might be time-based, regardless of usage. For example, annual inspections or filter replacements might be scheduled based on a calendar timeframe, ensuring preventive maintenance even for infrequently used equipment.
- **Condition Monitoring:** Modern PMS incorporate condition-based maintenance techniques that utilize sensors and data analysis to monitor equipment health. Maintenance tasks are then triggered based on actual equipment condition rather than predetermined intervals. This can optimize maintenance schedules and avoid unnecessary servicing.

**(c) Influence of Approved PMS on Classification Societies:**

Classification societies, like DNV or Lloyd's Register, are organizations that set standards for ship design, construction, and operation to ensure safety and environmental compliance. An approved Planned Maintenance System can positively influence classification society requirements in a few ways:

- **Reduced Survey Scope:** A well-documented and effectively implemented PMS demonstrates a commitment to proactive maintenance. This can lead to reduced scope during classification society surveys, as there's greater confidence in the vessel's overall condition.
- **Improved Operational Efficiency:** A functioning PMS can contribute to a vessel's operational efficiency by minimizing equipment downtime and ensuring regulatory compliance. This can be viewed favorably by classification societies.
- **Enhanced Safety Culture:** A strong PMS demonstrates a focus on preventative maintenance and safety, which aligns with the goals of classification societies.

Overall, an approved PMS can streamline interactions with classification societies, potentially reducing survey burdens and demonstrating a commitment to safe and reliable vessel operation.

# Planned Maintenance Systems: Purpose, Parameters, and Classification Society Influence

**(a) Purpose of a Planned Maintenance System (PMS):**

A Planned Maintenance System (PMS) is a structured approach to maintaining equipment and machinery. Its primary purpose is to:

- **Prevent breakdowns:** By proactively scheduling maintenance tasks, a PMS aims to identify and address potential problems before they escalate into major failures.
- **Optimize equipment lifespan:** Regular and appropriate maintenance helps extend the operational life of machinery by minimizing wear and tear.
- **Enhance safety:** A well-maintained system reduces the risk of accidents and injuries associated with equipment malfunctions.
- **Improve efficiency:** Proper maintenance ensures equipment operates at optimal performance levels, leading to increased fuel efficiency and reduced emissions.
- **Reduce maintenance costs:** By preventing major breakdowns and extending equipment life, a PMS can help minimize overall maintenance expenditure.

**(b) Parameters for Planned Maintenance:**

Planned maintenance schedules are typically based on a combination of three key parameters:

1. **Manufacturer's recommendations:** Equipment manufacturers usually provide recommended maintenance intervals for specific components based on their design and expected lifespan.

2. **Operating hours/cycles:** Maintenance tasks are often scheduled based on the accumulated operating hours or number of cycles the equipment has undergone. This ensures critical components are serviced before they reach their wear limits.

3. **Condition monitoring:** Modern PMS may incorporate data from condition monitoring systems like vibration analysis or oil analysis. This allows for more tailored maintenance schedules based on the actual health and performance of the equipment.

**(c) Influence of Approved PMS on Classification Societies:**

Classification societies (CS) play a vital role in ensuring vessel safety and regulatory compliance. An approved Planned Maintenance System can positively influence a vessel's classification society requirements in several ways:

- **Demonstrates proactive approach:** A well-documented PMS demonstrates the owner's commitment to preventive maintenance and safety. This can lead to smoother inspections and potentially fewer deficiencies identified by CS surveyors.

- **Aligns with regulations:** Approved PMS are often designed to align with international maritime regulations and CS guidelines. This simplifies compliance efforts and reduces the risk of regulatory violations.

- **Reduces risk of breakdowns:** By minimizing breakdowns and equipment failures, an effective PMS lowers the chance of incidents that might require CS involvement or detain the vessel for repairs.

- **Provides operational data:** Record keeping within the PMS can provide valuable data on equipment performance and maintenance history. This data can be beneficial for CS surveyors in assessing the overall condition of the vessel and its machinery.

In essence, an approved Planned Maintenance System promotes a culture of safety and proactive maintenance, which aligns with the goals of classification societies. This can lead to a more streamlined classification process and contribute to the safe and reliable operation of the vessel.

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.

## 2024 January

5. With reference to microbiological contamination of marine gas oil:

(a) state the conditions that must be present for the microbes to live and multiply; (2)

(b) describe the effect of microbiological growth in the fuel; (2)

(c) explain how the contamination may be detected; (2)

(d) state how the risk of contamination may be reduced; (2)

(e) explain how the contamination may be removed. (2)

# Microbiological Contamination in Marine Gas Oil: Causes, Effects, and Solutions

**(a) Conditions for Microbe Growth:**

Microbes, like bacteria and fungi (often referred to as "diesel bug" or "tank slime"), can thrive in marine gas oil under specific conditions:

- **Presence of Water:** Water is essential for microbial growth. Even small amounts of water trapped at the fuel-oil interface in storage tanks can create a breeding ground for microbes.
- **Warm Temperatures:** Microbial growth accelerates in warmer environments. Elevated fuel temperatures due to ambient conditions or machinery heat can exacerbate contamination.
- **Nutrients:** Trace amounts of organic material or impurities present in the fuel can serve as nutrients for microbial growth.

**(b) Effects of Microbiological Growth:**

Microbial growth in marine gas oil can lead to several detrimental effects:

- **Reduced Fuel Quality:** Microbes can break down fuel components, reducing its energy content and combustion efficiency. This can lead to increased fuel consumption and reduced engine power output.
- **Blocked Filters:** Microbial biofilms and slimes can clog fuel filters, restricting fuel flow and potentially leading to engine shutdown.
- **Corrosion:** Microbial waste products can be corrosive, causing damage to fuel tanks, pipes, and engine components.
- **Fuel System Sludge:** Microbial growth can contribute to the formation of sludge deposits within the fuel system, further impacting fuel flow and engine performance.

**(c) Detection of Contamination:**

Several methods can be used to detect microbial contamination in marine gas oil:

- **Visual Inspection:** Discoloration, cloudiness, or the presence of a visible "diesel bug" layer at the fuel-oil interface during tank inspections can indicate contamination.
- **Microbial Testing:** Laboratory testing of fuel samples can accurately identify and quantify the presence of microbial growth.

- **Fuel Analysis:** Changes in fuel properties, such as increased water content or presence of microbial waste products, might suggest contamination.

**(d) Reducing the Risk of Contamination:**

- **Minimize Water Ingress:** Strict procedures for fuel handling and storage are crucial to prevent water ingress into fuel tanks. This includes proper tank venting, regular tank cleaning, and using clean, dry fuel during bunkering operations.
- **Maintaining Fuel Quality:** Using high-quality fuel with biocide additives can help suppress microbial growth. Regular fuel testing helps monitor quality and identify potential contamination risks early on.
- **Temperature Control:** Maintaining fuel storage at cooler temperatures can slow down microbial activity.
- **Tank Cleaning:** Periodic tank cleaning removes accumulated water and sludge, reducing the habitat for microbes.

**(e) Removing Contamination:**

If microbial contamination is detected, several methods can be used for removal:

- **Biocide Treatment:** Adding biocides specifically formulated for marine fuels can kill existing microbes and suppress further growth.
- **Fuel Polishing:** Centrifugation or filtration systems can remove microbial biomass and water from the fuel oil.
- **Tank Cleaning:** In severe cases, tanks might require thorough cleaning to remove sludge and residual microbial contamination.

By implementing a combination of preventive measures and appropriate treatment methods, the risk of microbiological contamination in marine gas oil can be effectively managed, ensuring optimal fuel quality and reliable engine performance.

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6. With reference to sewage treatment plants:

(a) state the purpose of the vent, and explain why it is fitted with a gauze; (3)

(b) explain the difference between aerobic and anaerobic micro organisms; (3)

(c) explain why air is bubbled through the effluent in the aeration tank; (2)

(d) explain why calcium hypochlorite is added to the treated sewage before discharge overboard. (2)

# Sewage Treatment Plants on Ships: Components and Processes

**(a) Vent with Gauze:**

- **Purpose:** The vent on a sewage treatment plant allows the release of gases generated during the treatment process. These gases can include methane, carbon dioxide, and potentially some unpleasant odors.
- **Gauze:** The vent is fitted with a gauze to:

- Prevent the escape of larger particles or aerosols that might carry bacteria or viruses.
- Allow for proper ventilation while minimizing the spread of potential airborne contaminants.

**(b) Aerobic vs. Anaerobic Microorganisms:**

- **Aerobic Microorganisms:**
  - Thrive in environments with dissolved oxygen.
  - They play a crucial role in sewage treatment by breaking down organic matter in the presence of oxygen.
  - Examples include bacteria like nitrifying bacteria and some protozoa.
- **Anaerobic Microorganisms:**
  - Function in environments with little to no dissolved oxygen.
  - They break down organic matter through a different process that doesn't require oxygen.
  - Examples include some bacteria and archaea.

Sewage treatment plants on ships typically utilize a combination of aerobic and anaerobic processes for efficient waste breakdown.

**(c) Air Bubbling in Aeration Tank:**

The aeration tank is a vital component in the aerobic treatment process. Air is bubbled through the effluent in the aeration tank for several reasons:

- **Supplies Oxygen:** The bubbles provide dissolved oxygen necessary for the survival and activity of aerobic microorganisms.
- **Mixing:** The air bubbles promote efficient mixing of the effluent, ensuring all parts of the wastewater come into contact with the microorganisms for optimal biological treatment.
- **Flocculation:** The air bubbles can also aid in the formation of flocs, which are clumps of organic matter and microorganisms that settle more readily for separation during later stages.

**(d) Calcium Hypochlorite Addition:**

Calcium hypochlorite (Ca(OCl)2), also known as bleaching powder, is often added to the treated sewage before discharge overboard for disinfection purposes. Here's why:

- **Disinfection:** Calcium hypochlorite releases chlorine when added to water. Chlorine is a powerful disinfectant that inactivates harmful bacteria and viruses present in the treated sewage effluent. This helps minimize the risk of spreading pathogens in the marine environment and protects public health.
- **Controlled Dosage:** The amount of calcium hypochlorite added is carefully controlled to ensure effective disinfection while minimizing the environmental impact of chlorine.
- **Alternative Methods:** Some treatment plants may utilize other disinfection methods like ultraviolet (UV) radiation instead of chlorine, depending on regulations and specific considerations.

2024 January

7. (a) With reference to food storage rooms:

(i) state, with reasons, the possible danger present in a room used for storing vegetables and fruit; (2)

(ii) state the devices necessary to prevent a person from becoming trapped in a storage room. (3)

(b) State FOUR methods of detecting a refrigeration gas leak. (4)

(c) State the name of the international agreement which stipulates that the production and consumption of compounds that deplete ozone in the stratosphere is phased out. (1)

# Food Storage and Refrigeration Safety

**(a) Food Storage Rooms:**

**(i) Dangers in Vegetable and Fruit Storage:**

There's a potential danger of **oxygen depletion** in a room used for storing vegetables and fruit. Here's why:

- **Respiration:** Fruits and vegetables continue to respire (use oxygen) even after harvesting. This process consumes oxygen ($O2$) and releases carbon dioxide ($CO2$).
- **Confined Space:** In a closed storage room, the oxygen level can gradually decrease as fruits and vegetables consume it without proper ventilation.
- **Dangers of Low Oxygen:**
  - **Suffocation:** If the oxygen level in the room falls below a safe level (around 19.5% or lower), a person entering the room could experience suffocation.
  - **Fire Risk:** Low oxygen levels also increase the risk of fire, as combustion requires oxygen.

**(ii) Devices to Prevent Trapping:**

To prevent a person from becoming trapped in a food storage room, the following devices are essential:

- **Self-Closing Door:** The door should be self-closing to ensure it automatically closes behind someone entering or leaving the room. This prevents accidental latching from the outside.
- **Panic Hardware:** The door should be equipped with panic hardware (e.g., push bar) on the inside to allow for easy exit in case of an emergency.
- **Signage:** Clear signage should be displayed on the door indicating it's a food storage room and may have low oxygen levels.

**(b) Refrigeration Gas Leak Detection:**

Here are four methods for detecting a refrigeration gas leak:

1. **Gas Detectors:** Specialized gas detectors can be installed in food storage rooms to automatically detect leaks of specific refrigerants. These detectors trigger alarms when they sense a gas concentration exceeding safe limits.

2. **Visual Inspection:** Regular visual inspections of the refrigeration system are crucial. Signs of a leak might include visible damage to pipes, hissing sounds, or frost formation around connection points. 3. **Sniffing (with caution):** While not the most recommended method, some refrigerants have a distinct odor that can be detected during inspections. However, caution is advised, as inhaling some refrigerants can be harmful. Always prioritize using gas detectors and proper ventilation.
3. **Temperature Monitoring:** A sudden increase in storage room temperature or malfunctioning of the refrigeration system could indicate a refrigerant leak.

**(c) Ozone Depletion Agreement:**

The international agreement that aims to phase out the production and consumption of ozone-depleting substances is the **Montreal Protocol on Substances that Deplete the Ozone Layer**.

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8. Explain, with the aid of sketches, the <u>principles</u> of reverse osmosis as a method of producing fresh water. (10)

Reverse osmosis (RO) is a water purification technique that utilizes a semi-permeable membrane to separate dissolved contaminants from water. Here's a breakdown of the principles behind it:

**Natural Osmosis:**

Imagine a container divided by a semi-permeable membrane separating salty water (high solute concentration) from pure water (low solute concentration). Osmosis, a natural process, will cause the pure water to flow through the membrane towards the saltier side. This happens because water molecules are constantly moving, and the semi-permeable membrane only allows them to pass through, not the salt ions. This movement of water molecules tries to balance the concentration of solutes on both sides.

**Reverse Osmosis:**

In RO, we apply pressure to the salty water side, overcoming the natural osmotic pressure. This applied pressure forces the pure water molecules from the salty water solution to pass through the membrane in the opposite direction of natural osmosis, hence the term "reverse." The filtered water, devoid of most salts and impurities, is collected on the other side of the membrane as permeate. The remaining concentrated brine solution (reject water), containing the filtered-out contaminants, is discharged from the system.

**Key Components:**

- **Semi-permeable membrane:** This is the heart of RO, allowing only water molecules to pass through while rejecting most dissolved ions and larger molecules.
- **High-pressure pump:** This pump pressurizes the feed water (salty water) to overcome the osmotic pressure and drive the process.
- **Pre-treatment (optional):** Depending on the feed water quality, pre-treatment steps like filtration or chlorination might be necessary to protect the RO membrane from damage.

**Applications:**

Reverse osmosis is a versatile and efficient method for desalination, turning seawater or brackish water into fresh water for various purposes:

- **Drinking water:** RO is widely used to produce clean drinking water from saline sources, especially in regions with limited freshwater resources.
- **Industrial processes:** RO purified water is used in various industries where high-purity water is required, such as electronics manufacturing and pharmaceutical production.
- **Irrigation:** RO can help reduce salinity in water used for agriculture, protecting crops from salt damage.

**Limitations:**

- **Energy consumption:** The high-pressure pump requires significant energy to operate.
- **Membrane maintenance:** RO membranes are susceptible to fouling and require periodic cleaning or replacement.
- **Wastewater disposal:** The concentrated brine solution from RO needs proper disposal to avoid environmental impacts.

Overall, reverse osmosis is a powerful technology for producing fresh water from various saline sources, playing a crucial role in water security and sustainable water management.

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## 2024 January

List the important operations that should be included when organising fire drills. (10)

sept 2020

## Sept 2020

9. List the important operations that should be included when organising fire drills. (10)

Fire drills are essential for ensuring the safety of crew and passengers on marine vessels. Here's a list of important operations that should be included when organizing fire drills for marine applications:

**1. Alarm Activation and Response:**

- Simulate a fire alarm by activating the fire alarm system in the designated drill area.
- Crew members should practice their immediate response to the alarm, including:
  - Reporting to their assigned muster stations.
  - Donning personal protective equipment (PPE), including breathing apparatus if applicable.
  - Taking headcount to ensure everyone is accounted for.

**2. Fire Reporting and Communication:**

- Simulate the discovery of a fire by a crew member.
- Practice proper procedures for reporting the fire location and size to the designated personnel (bridge, control room).
- Test communication protocols between different teams (e.g., bridge team informing firefighting teams).

**3. Firefighting Operations:**

- Depending on the scenario, practice various firefighting techniques:
  - Using fire hoses to extinguish flames with simulated fire sources (following safety precautions).
  - Operating portable fire extinguishers on designated training fires.

    - Utilizing fire blankets to smother small fires.
    - Sealing watertight doors to isolate the fire zone.

**4. Evacuation Procedures:**

- Practice emergency evacuation procedures for the designated area:
    - Following designated escape routes according to muster station assignments.
    - Using emergency exits and life-saving equipment (lifeboats, liferafts) if applicable to the drill scenario.
    - Conducting headcount at the designated assembly stations after evacuation.

**5. Search and Rescue:**

- In some drills, simulate search and rescue operations for missing crew members within the designated area.
- Practice utilizing search equipment (thermal imaging cameras) and proper rescue techniques.

**6. Abandon Ship Procedures:**

- In specific scenarios, practice complete abandonment ship procedures:
    - Boarding lifeboats and liferafts following assigned stations.
    - Launching lifeboats and deploying liferafts.
    - Signaling for help using distress flares or radios.
    - Performing emergency first aid and survival techniques while awaiting rescue.

**Additional Considerations:**

- **Different Scenarios:** Conduct drills for various fire scenarios, including engine room fires, galley fires, and cabin fires.
- **Realistic Environment:** As far as practical, create a realistic environment during the drill to simulate the stress and confusion of a real fire.
- **Debriefing:** After each drill, conduct a debriefing session to discuss performance, identify areas for improvement, and answer any questions from crew members.
- **Record Keeping:** Maintain accurate records of fire drills, including date, time, scenario, participants, and any observations or lessons learned.

By incorporating these essential operations and considering these additional factors, you can ensure that your marine fire drills are effective in preparing crew members for real-world emergencies. Remember, the goal is to instill a sense of urgency, practice teamwork, and ensure everyone onboard knows their roles and responsibilities in case of fire.

2024 January

10. With reference to ocean going vessels, define EACH of the following:

(a) trim;

(b) freeboard;

(c) camber;

(d) length between perpendiculars;

(e) length overall;

(f) sheer;

(g) stem;

(h) draft marks;

(i) draft;

(j) depth.

## Ocean Vessel Dimensions and Characteristics:

Here's a breakdown of the terms you requested with reference to ocean-going vessels:

(a) **Trim:** Trim refers to the longitudinal (fore-and-aft) balance of a vessel. It's the difference in the amount of water a vessel displaces at the forward (bow) and aft (stern) perpendiculars.

- **Even Trim:** The vessel floats level with equal water depths at the bow and stern.
- **By the Bow:** The vessel sits deeper in the water at the bow than the stern.
- **By the Stern:** The vessel sits deeper in the water at the stern than the bow.

Trim affects a vessel's performance, maneuverability, and stability. Proper trim is crucial for optimal efficiency and safe operation.

(b) **Freeboard:** Freeboard is the vertical distance between the waterline and a specific deck on the vessel's side, typically the uppermost continuous deck exposed to weather. It's a safety measure that ensures sufficient buoyancy and prevents excessive wave washing over the deck.

(c) **Camber:** Camber refers to the slight curvature upwards of a ship's deck from the centerline towards the sides. This curvature provides structural strength and helps to shed water overboard. Camber is most noticeable on weather decks exposed to rain and waves.

(d) **Length Between Perpendiculars (LBP):** LBP is the horizontal distance measured along the waterline between the forward perpendicular (FP) and the aft perpendicular (AP). It represents the length of the vessel's underwater hull and is a constant value for a specific ship, independent of the cargo load.

(e) **Length Overall (LOA):** LOA is the horizontal distance between the extreme forward point (usually the stem) and the extreme aft point (usually the rudder post) of the vessel. Unlike LBP, LOA can vary slightly depending on the design of the bow and stern.

(f) **Sheer:** Sheer refers to the longitudinal curvature of a vessel's deck from bow to stern. The deck is typically higher at the bow and stern compared to the midships section. This sheer helps shed water from the deck and improves seakeeping performance in rough seas.

(g) **Stem:** The stem is the forwardmost vertical structure of a vessel that cuts through the water. The shape of the stem can influence the vessel's wave-piercing ability and overall hydrodynamic efficiency.

(h) **Draft Marks:** Draft marks are permanent markings on the port and starboard sides of the vessel amidships. These markings indicate the depth of the vessel's underwater hull, with a reference line corresponding to the vessel's unloaded draft (sometimes called "light ship draft"). Additional markings may indicate different draft depths based on the vessel's load condition.

(i) **Draft:** Draft is the vertical distance between the waterline and the bottom of the vessel's keel. It represents the depth of the vessel underwater and is influenced by the vessel's weight and cargo load. A deeper draft indicates a heavier loaded vessel.

(j) **Depth:** Depth, in this context, refers to the overall vertical distance from the water surface to the seabed. It's a crucial measurement for navigation to avoid grounding the vessel on underwater obstacles. Draft should always be considered when determining safe navigation depth.