ABS BWMS operational survey

30th May 2018
31st May 2018

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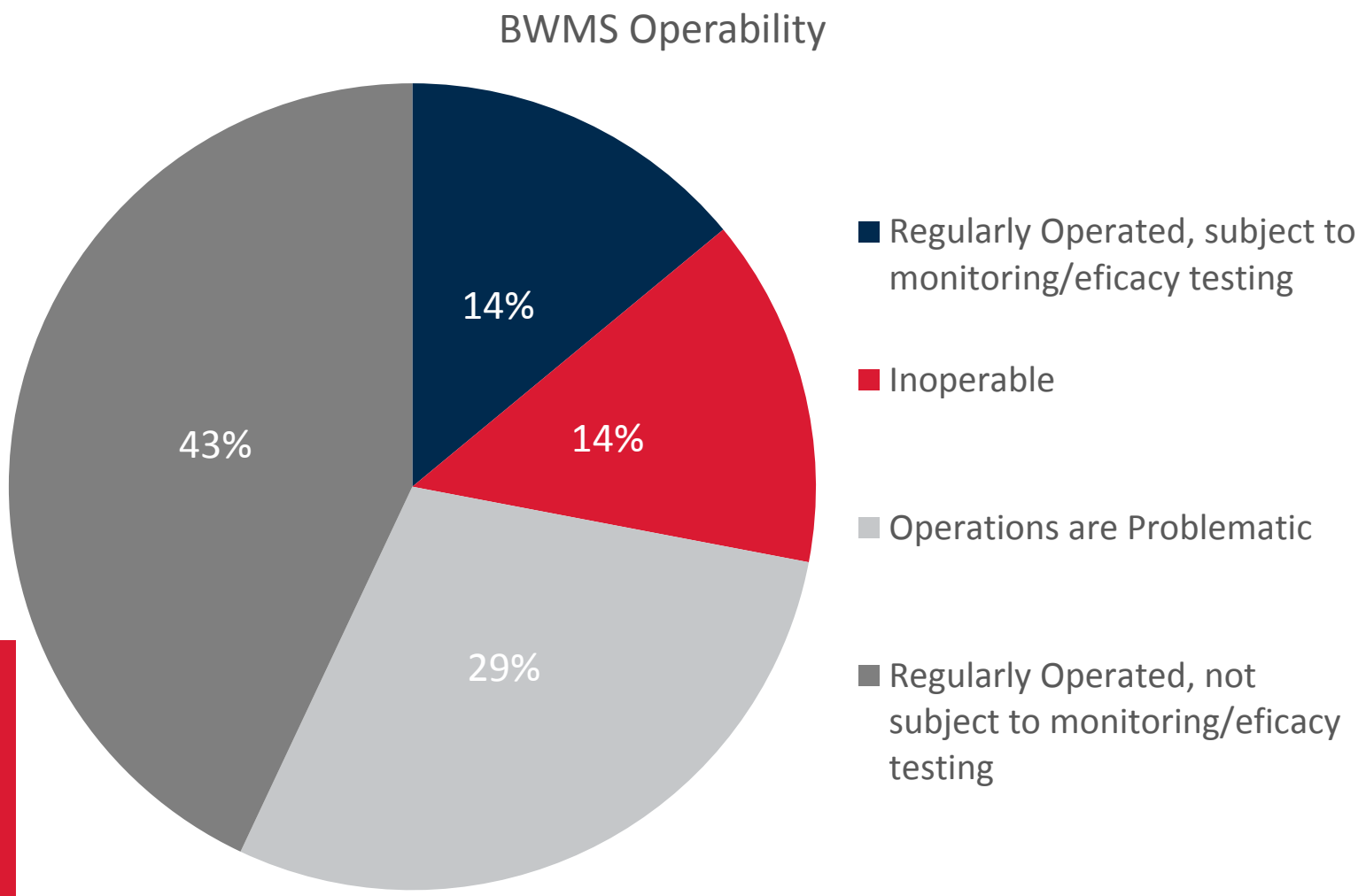
Workshop Background

- ABS/MARTECMA sent out a questionnaire inquiring about shipowners challenges and lessons learned regarding BWTS
- Questionnaire Responses
  - 27 Shipowners
  - 220 vessels (bulk carriers, tankers, container ships, LNG carriers, and gas carriers)
  - 8 types of Ballast Water Treatment Systems
- ABS led an open discussion with the shipowners using this aggregated data from the responses

Sample System Data



Survey results included responses from 27 owners representing 220 installations

BWMS Technologies

Ballast Water Management System

- **Physical Separation***
  - Filtration
  - Hydrocyclone
  - Coagulation

+

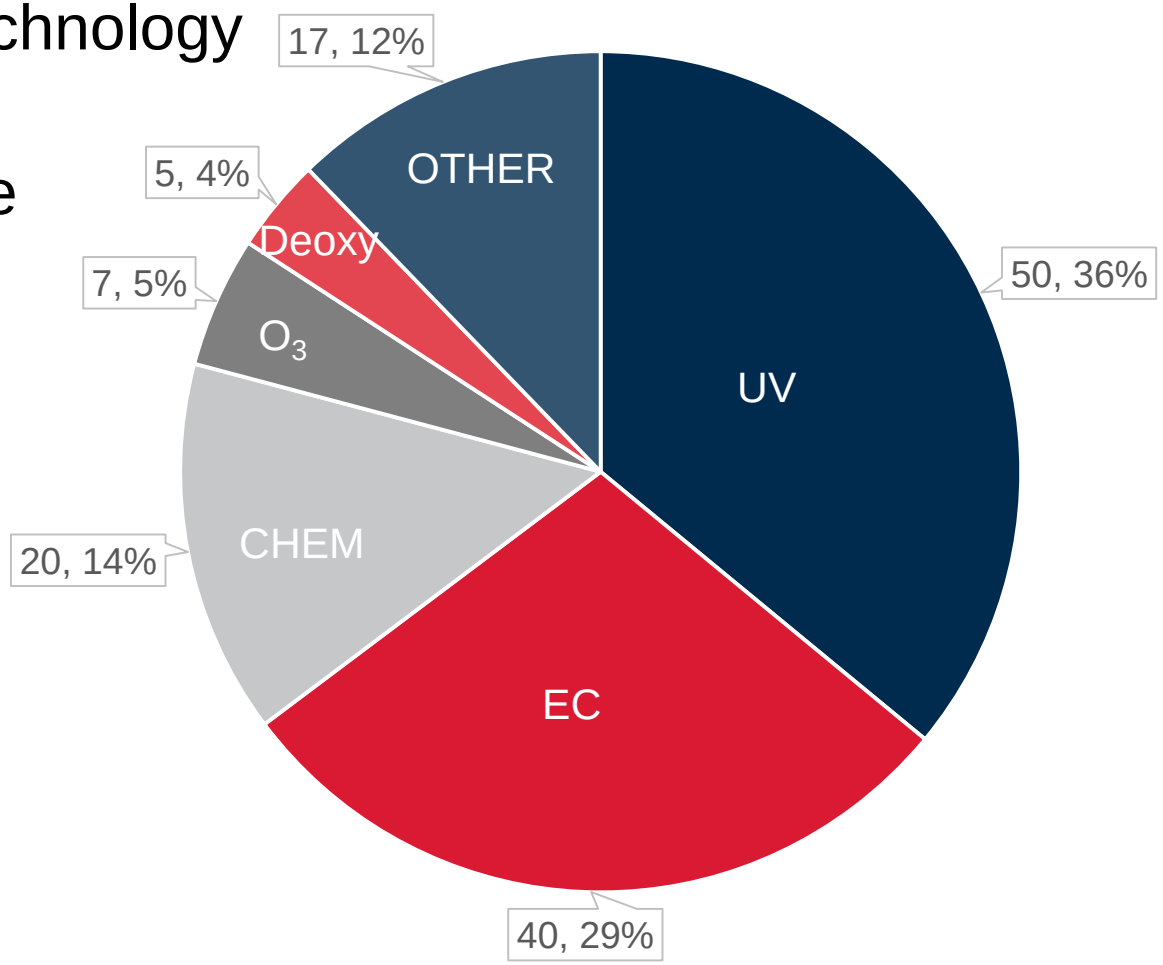
- **Disinfection***
  - **Chemical Disinfection**
    - Electro-chlorination
    - Chlorine-based Chemicals
    - Ozone
    - Other disinfectants
  - **Physical Disinfection**
    - UV
    - De-oxygenation
    - Heat
    - Magnetic Separation
  - **Other Disinfection methods**
    - Cavitation
    - Ultrasound
    - Catalyst
    - Plasma

*Note: BWMS have been developed using different combinations of the technologies

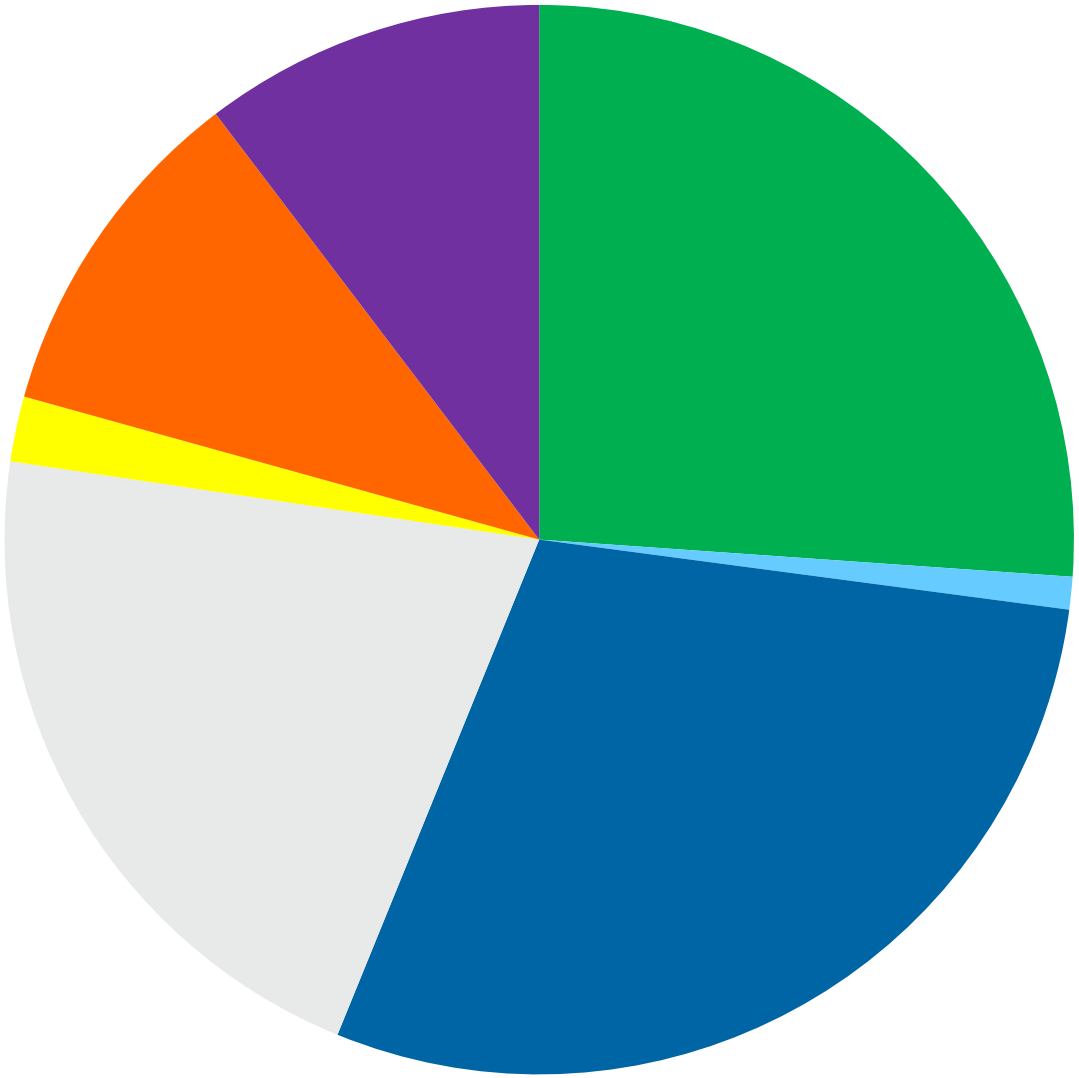
ABS

BWMS – Available or In Development by Technologies

- Most BWMS use filtration and another technology
- Some BWMS use combinations of technologies – those are counted multiple times

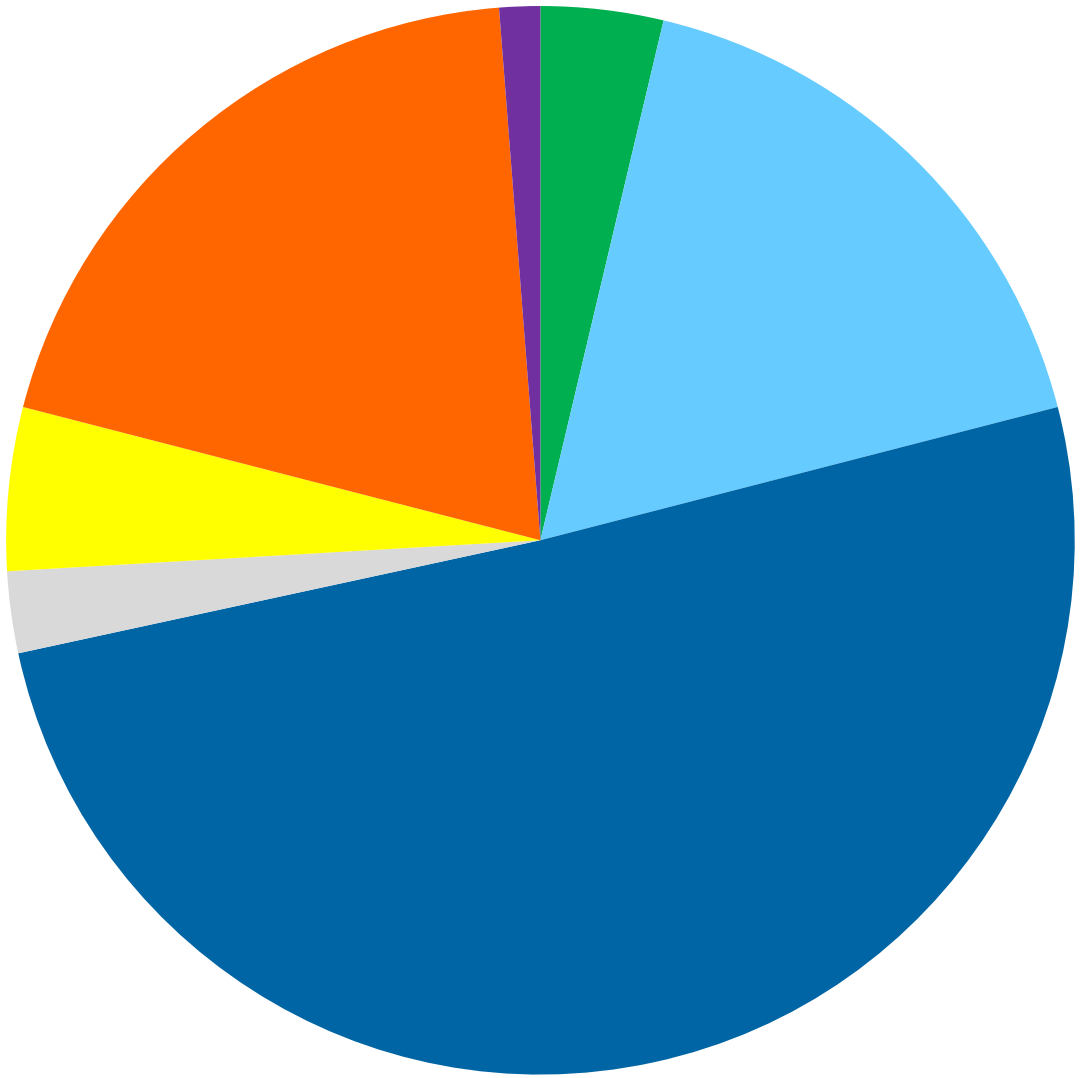


Breakdown of Installations on ABS-Classed Vessels by Technology



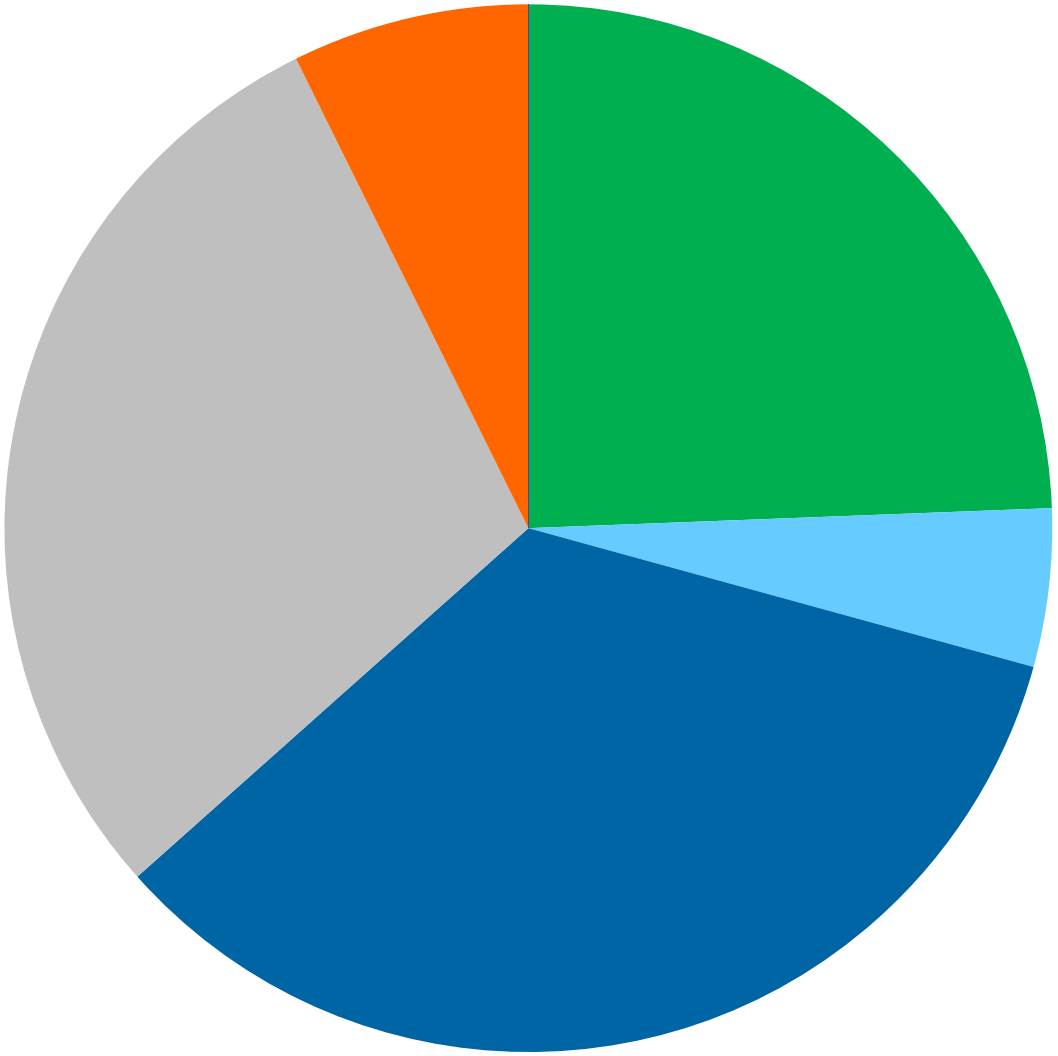
- Filtration + UV (26%)
- Filtration + Chlorination (1%)
- In-Line Electrolysis (29%)
- Filtration + Side-Stream Electrolysis (21%)
- Deoxygenation (2%)
- Ozone Treatment (10%)
- Filtration + Oxidation (10%)

Breakdown of Installations on ABS-Classed Oil Carriers



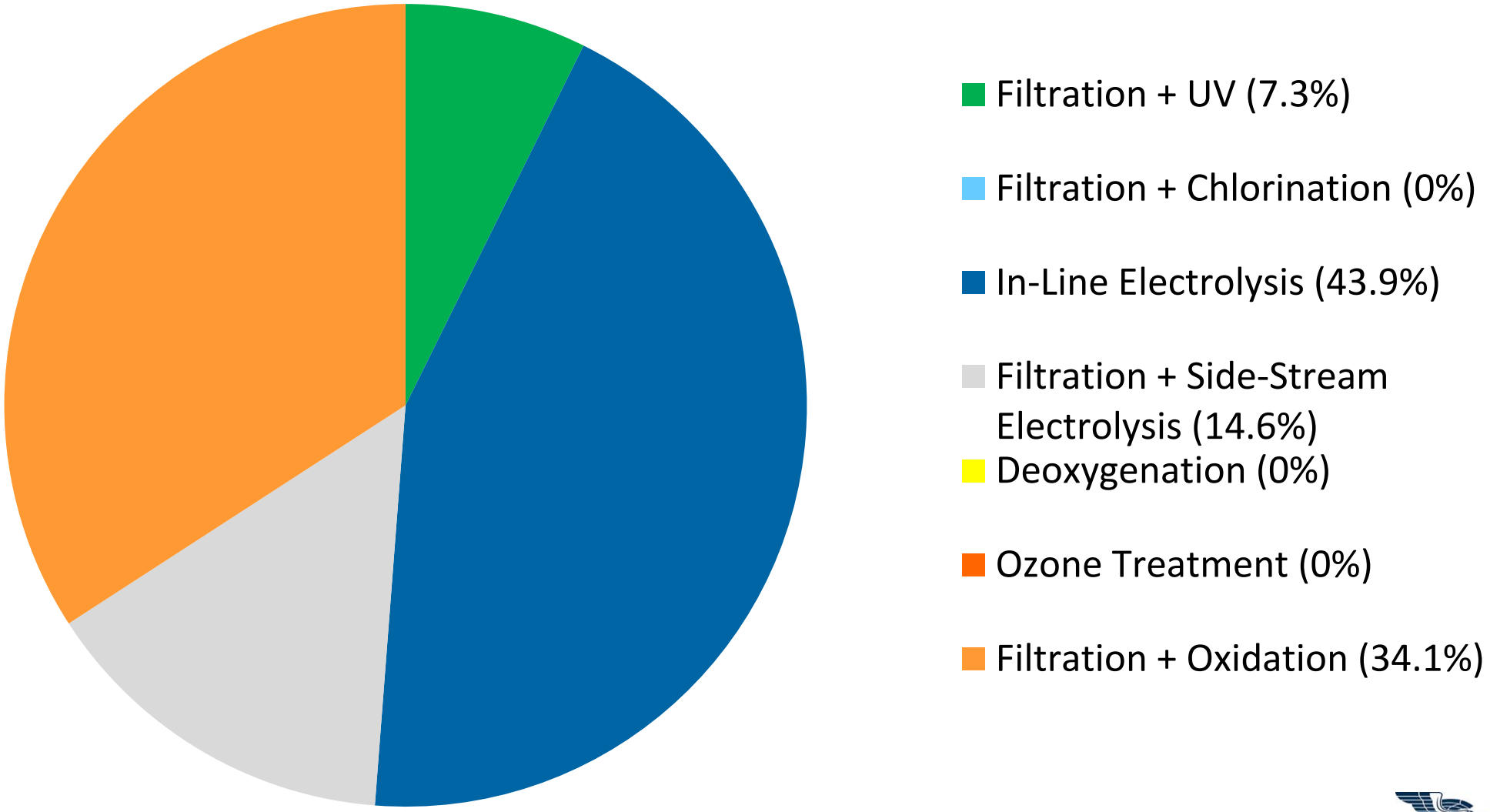
- Filtration + UV (3.7%)
- In-Line Electrolysis (17.3%)
- Filtration + Side-Stream Electrolysis (50.6%)
- Filtration + In-Line Electrolysis (2.5%)
- Deoxygenation (4.9%)
- Ozone Treatment (19.8%)
- Filtration + Oxidation (1.2%)

Breakdown of Installations on ABS-Classed Bulk Carriers

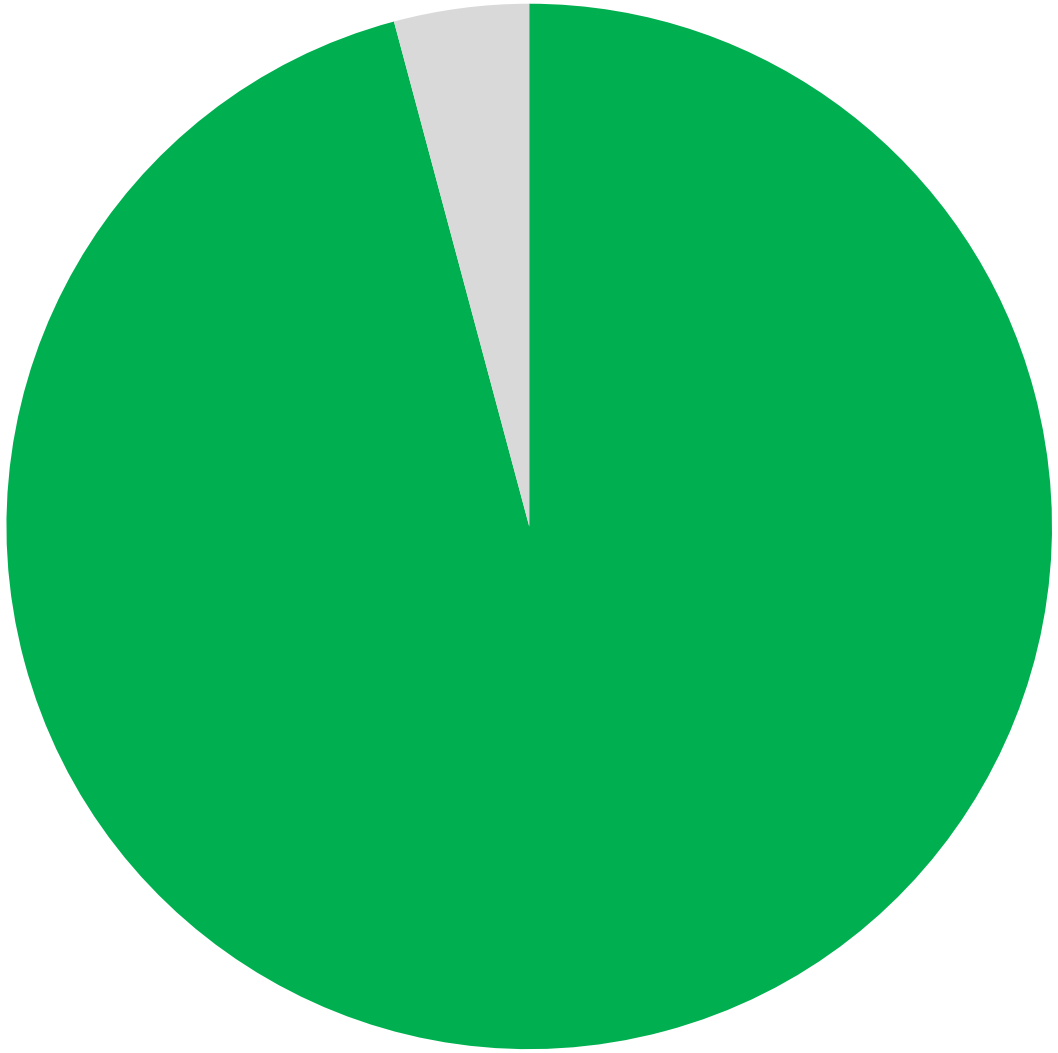


- Filtration + UV (24.4%)
- Filtration + Chlorination (4.9%)
- In-Line Electrolysis (34.1%)
- Filtration + Side-Stream Electrolysis (29.3%)
- Deoxygenation (0%)
- Ozone Treatment (7.3%)
- Filtration + Oxidation (0%)

Breakdown of Installations on ABS-Classed Container Ships

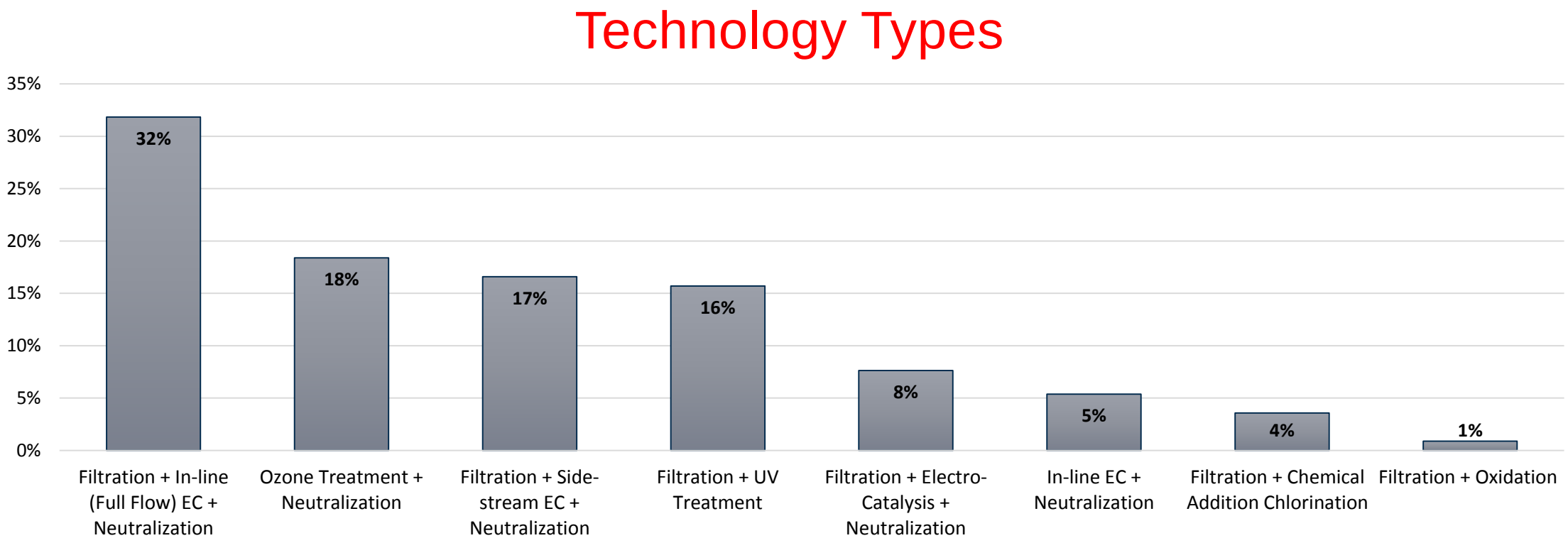


Breakdown of Installations on ABS-Classed OSVs

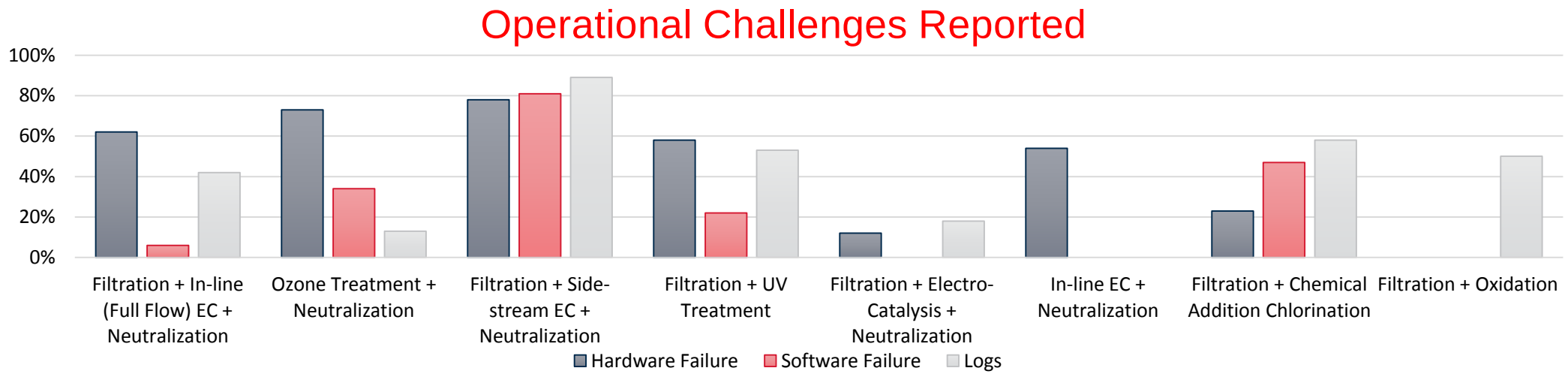


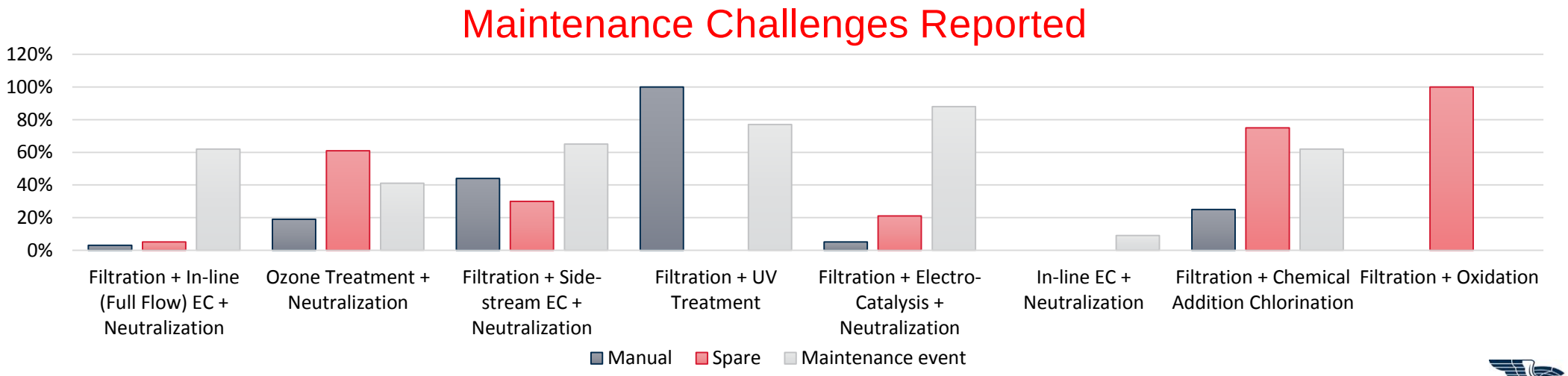
- Filtration + UV (95.6%)
- Filtration + Chlorination (0%)
- In-Line Electrolysis (0%)
- Filtration + Side-Stream Electrolysis (0%)
- Deoxygenation (0%)
- Ozone Treatment (0%)
- Filtration + Oxidation (4.2%)

BWMS Operational Experience Questionnaire Results



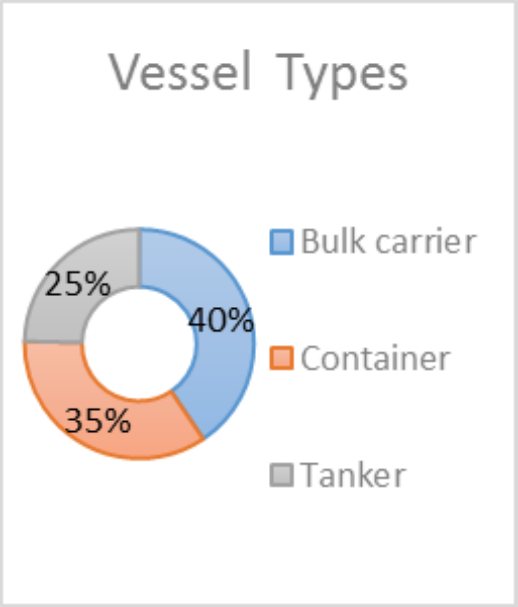
BWMS Operational Experience Questionnaire Results

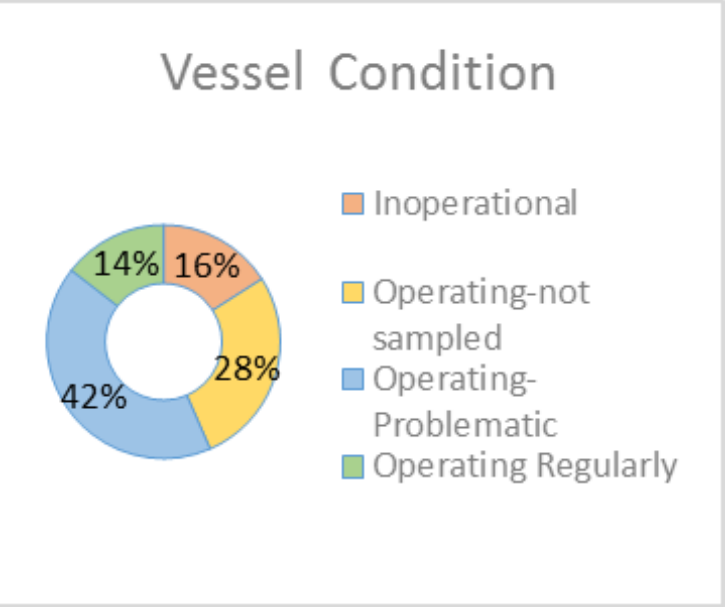


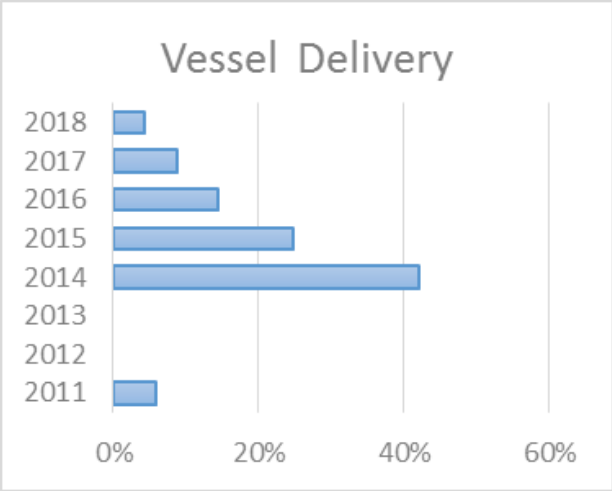


Filtration + In-line (Full Flow) EC + Neutralization – 32%

- Hardware Failure (62% reported)
  - TRO sensor/TRO concentration low
  - Filters clog in certain ports/rivers
- Software Failure (6% reported)
  - Valve order out of sync/rectifier communication
- Human error (6% reported)
  - System is very complicated
  - Equipment installed in separate locations
- Health and Safety Issues (4% reported)
  - Chemicals used during operations
- Reduction in Ballast rate (43% reported)
- Other issues/Challenges (42% reported)
  - Do not notify when working out of parameters
  - TRO reagent shelf life
  - TRO dosage either low/too low or high/too high for de-ballasting

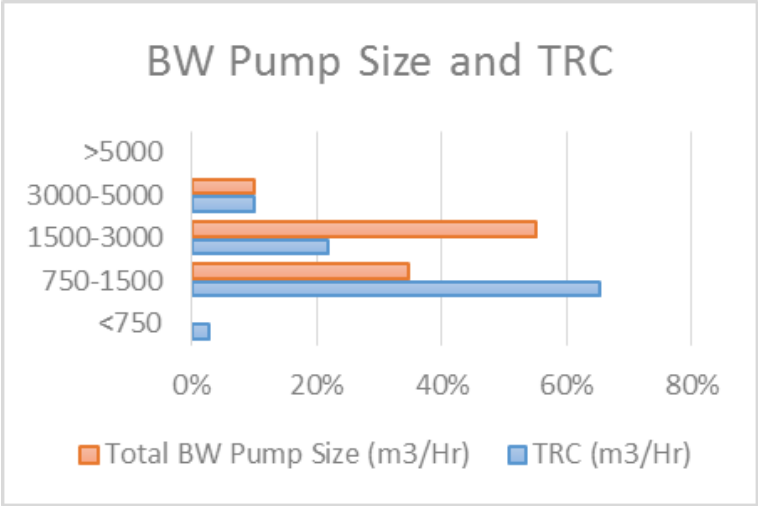


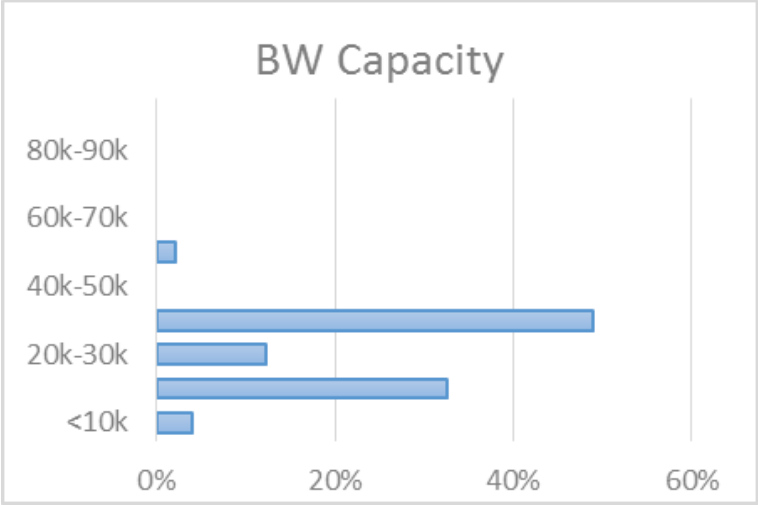




Filtration + In-line (Full Flow) EC + Neutralization – 32%

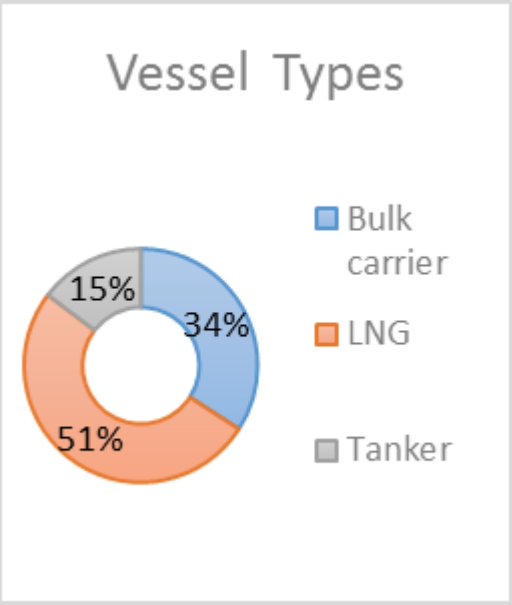
- Systems logs regularly monitored (75% reported)
  - (25%) Satisfied with regular system logs
- OMM Completeness (87% reported)
  - (97%) Satisfied with manual
- After sales Service (78% reported)
  - (94%) Satisfied with spare parts
- Maintenance event, issues/challenges (62% reported)
  - Several errors of installation and service requirements with spare parts
  - 6-7 claims per vessel
  - Sensors, transmitters, indicators, etc. are very sensitive
- Consumable Replenishment, issues, and challenges (23% reported)
  - Chemical supplies are required as a consumable
  - Required chemicals are not easily permitted in some ports
  - Neutralization chemical solidified due to humidity

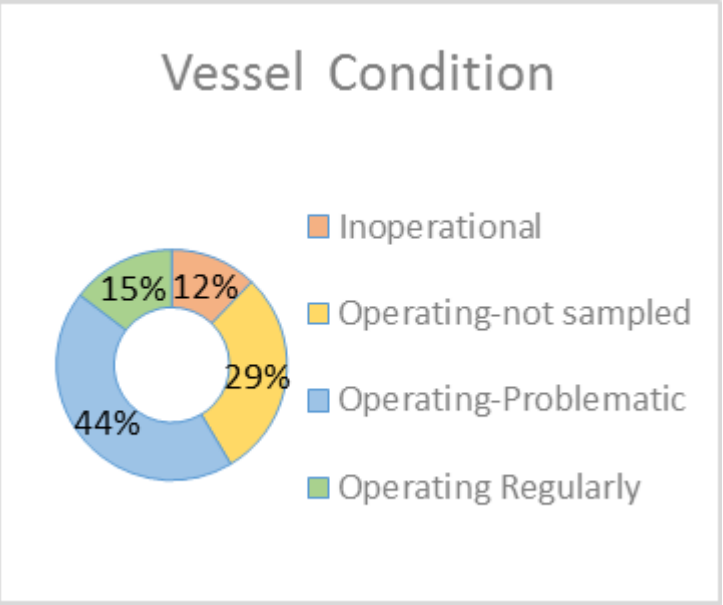


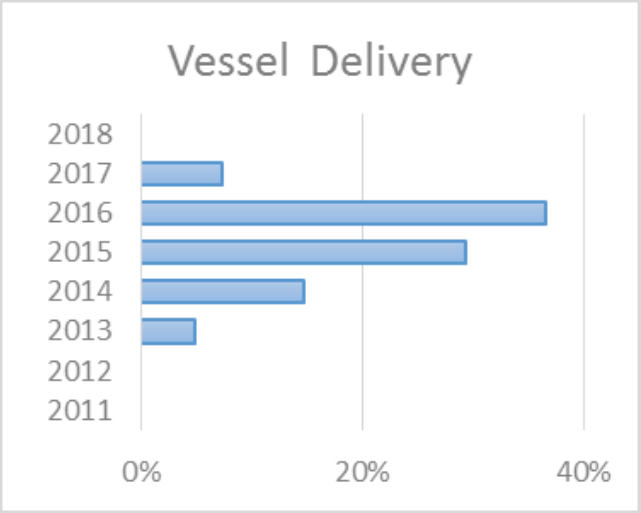


Ozone Treatment + Neutralization – 18%

- Hardware Failure (73% reported)
  - Oxygen sensor/analyzer
  - Ozone sensor
  - Water chiller malfunction
- Software Failure (34% reported)
  - Low ozone output
  - System data can't be saved
  - Inaccurate output of log files
  - Injection pump has no signal
  - PLC failure, O3 production fail in auto mode
- Impact on coating/piping (7% reported)
  - O3 injection pipe holed
  - Neutralizer solution pipes in P/R void were replaced due to plenty of pin hole

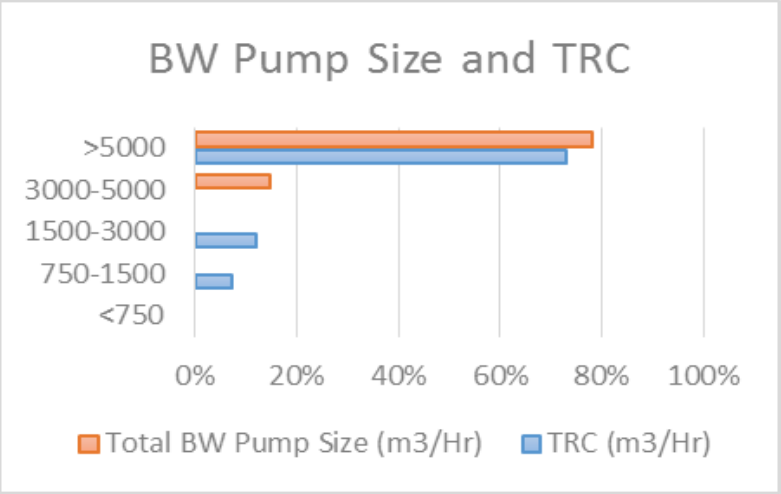


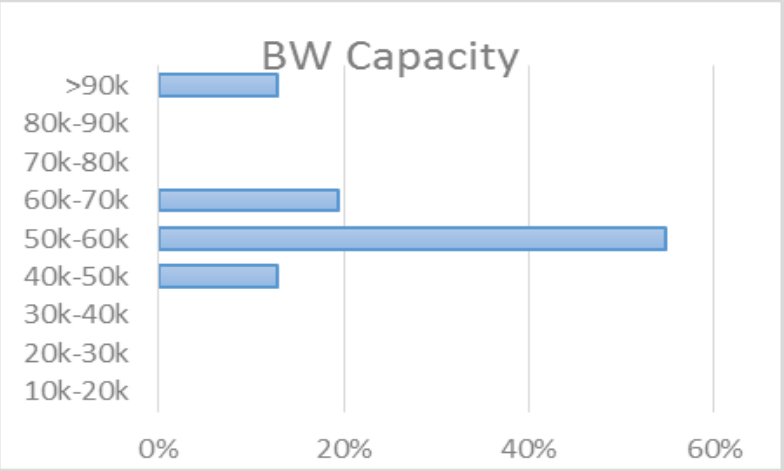




Ozone Treatment + Neutralization – 18%

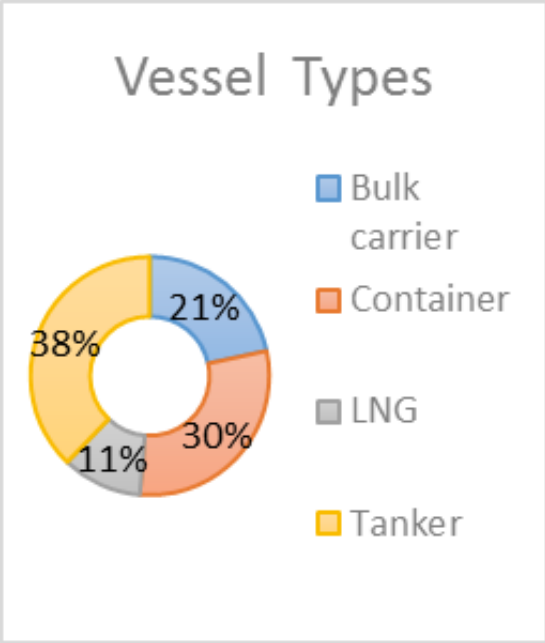
- Systems logs regularly monitored (78% reported)
  - (87%) Satisfied with system logs
- OMM Completeness (92% reported)
  - (79%) Satisfied with the Manual
- After sales Service (78% reported)
  - (22%) Satisfied with the after sale service
- Maintenance event, issues and challenges (41% reported)
  - TRO analyzers creates difficulty, require constant cleaning
  - Maker has difficulty attends to the events and replacements
- Replenishment challenges (37% reported)
  - (13%) All consumables have been supplied
  - Low after sale quality
  - Limited supply network

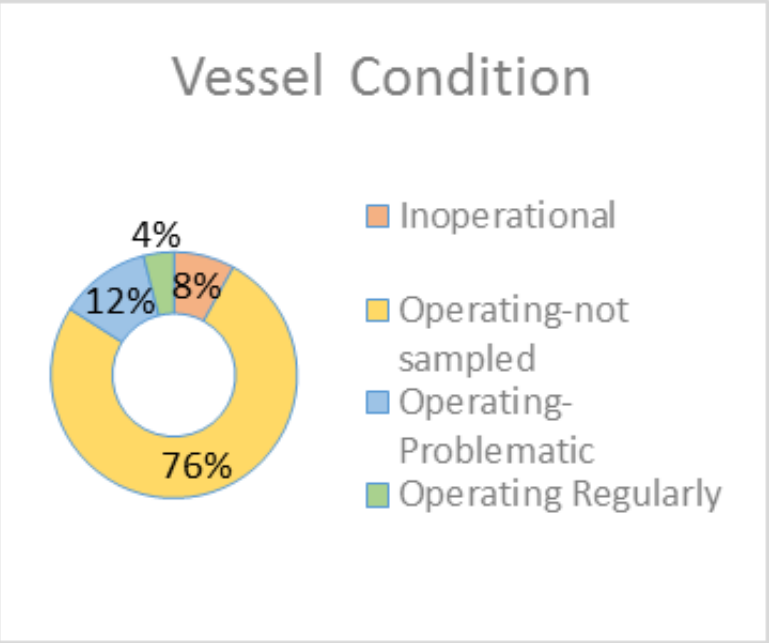


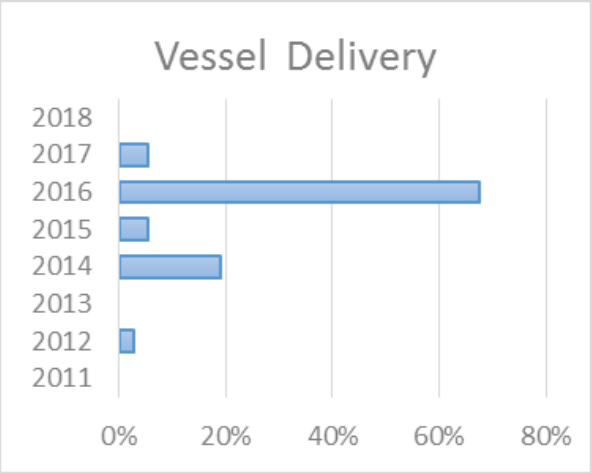


Filtration + Side-stream EC + Neutralization – 17%

- Hardware Failure (78% reported)
  - Flow meter faulty low reading that cause alarm
  - Fuse for rectifier
  - PSU flowmeter
  - Filter drain line holes
  - Valve actuator malfunction
  - Gas sensors malfunction
- Software Failure (81% reported)
- Human error (0% reported)
- Impact on coatings/pipes (0% reported)
- Health and Safety Issues (13% reported)
  - Chlorine and hydrogen gas production
- Reduction in Ballast rate (43% reported)
- Other issues/Challenges (67% reported)
  - Do not notify when working out of parameters
  - Calibration of various sensors
  - Mimic display is not user friendly

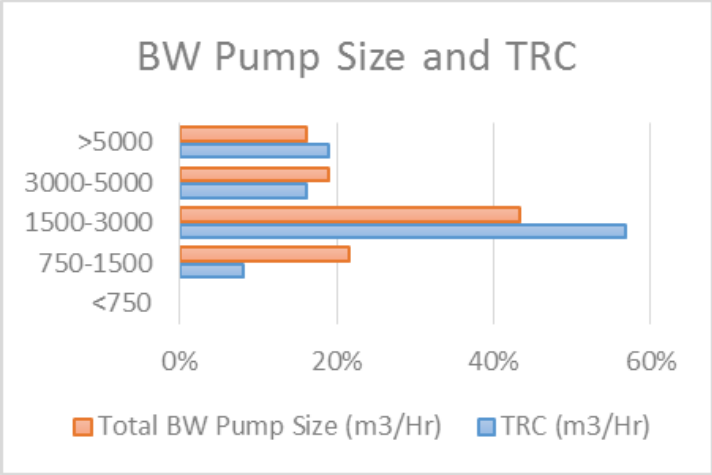


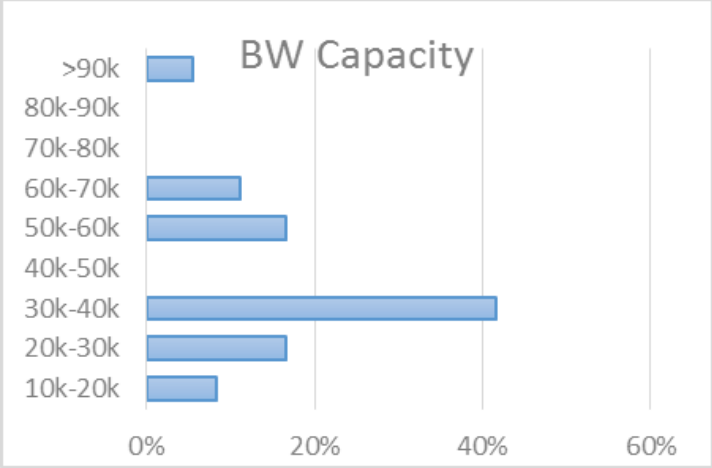




Filtration + Side-stream EC + Neutralization – 17%

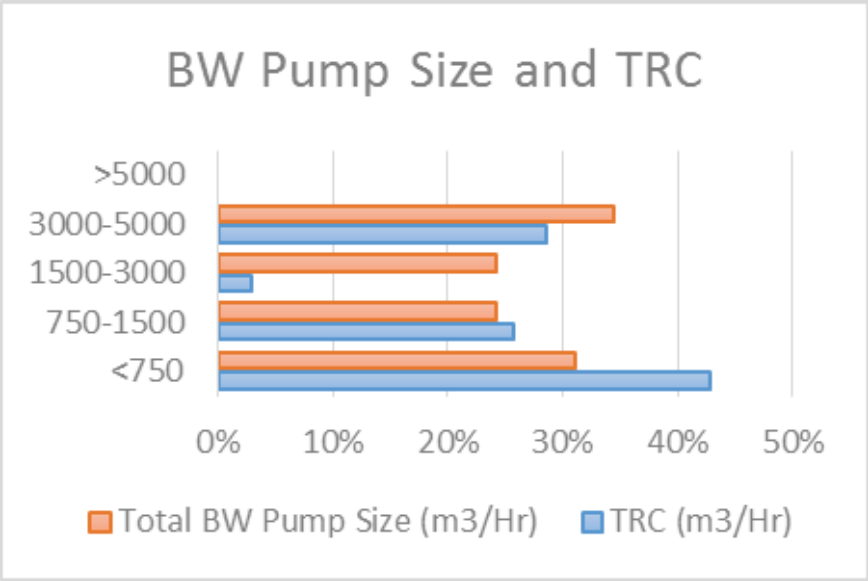
- Corrective action and contingency measures (83% reported)
  - Fuse for rectifier
- Systems logs regularly monitored (89% reported)
- OMM completeness (97% reported)
  - (55%) Satisfied with the manual
- After sales service (86% reported)
  - (65%) Satisfied with the with spare parts
- Maintenance event, issues and challenges (65% reported)
  - Chlorine ppm slow to build up to required 5.5 ppm leading to shut down
  - Frequent false alarms distracting officers on critical cargo operation
  - Frequent shutdown of ballast pumps overheats the motor starter
  - Too many to log, recorded in planned maintenance system
- Replenishment challenges (38% reported)
  - TRO sensor agent kit need replacement every 3 months
  - TRO sensor reagents take too long to be delivered
  - Reagent limited lifetime, limited supply network

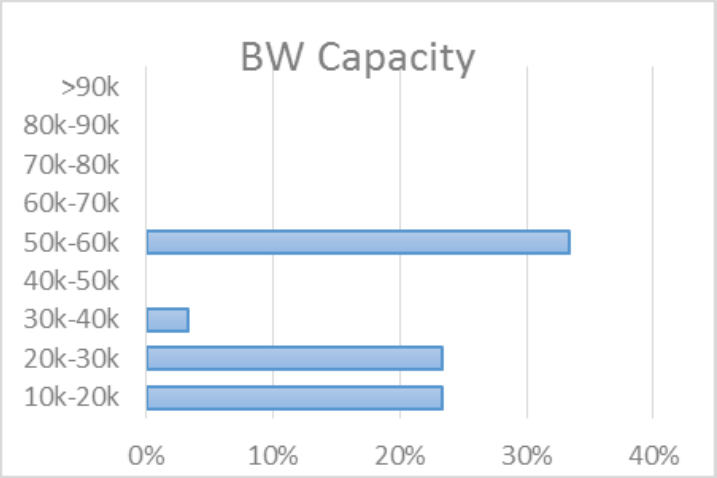




Filtration + UV Treatment – 16%

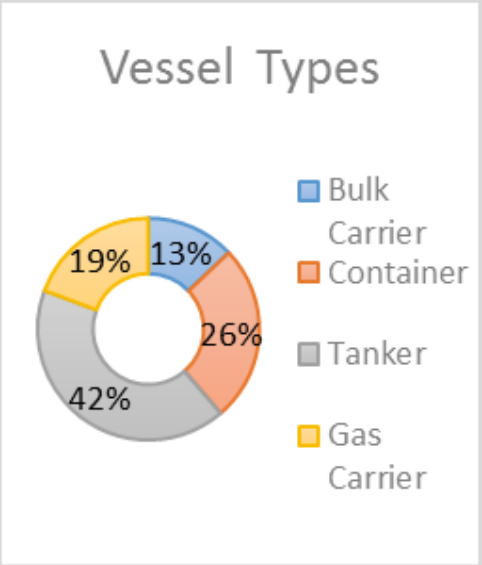
- Corrective action and contingency measures (74% reported)
  - Service engineer modified the program
- System logs regularly monitored (68% reported)
  - (22%) System logs satisfied
- OMM completeness (100% reported)
  - Considered useful
- After sales service (86% reported)
  - Availability is good
- Maintenance event, issues and challenges (77% reported)
  - Failure occurred on system's control panel
  - Software needed updating by maker
  - Filter cleaning / UV lamp replacement
- Replenishment challenges (61% reported)
  - Frequent failure of UV lamps
  - Spare parts are expensive
  - Vulnerable parts: UV sensors, the purge units and lamp wipers

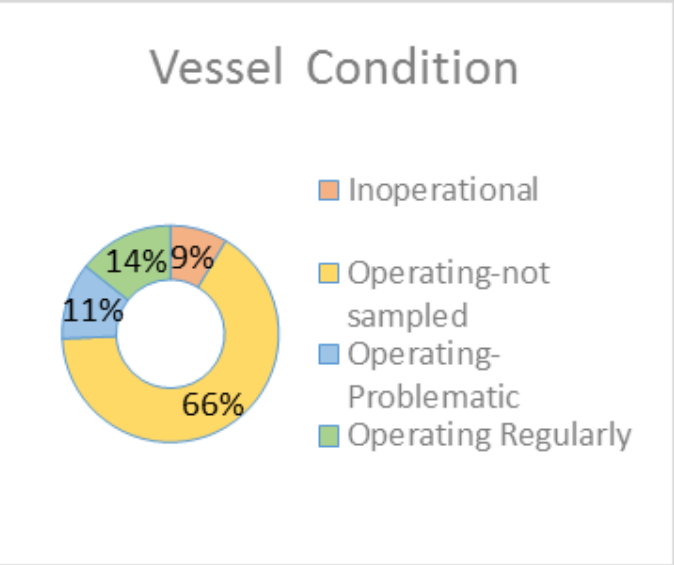


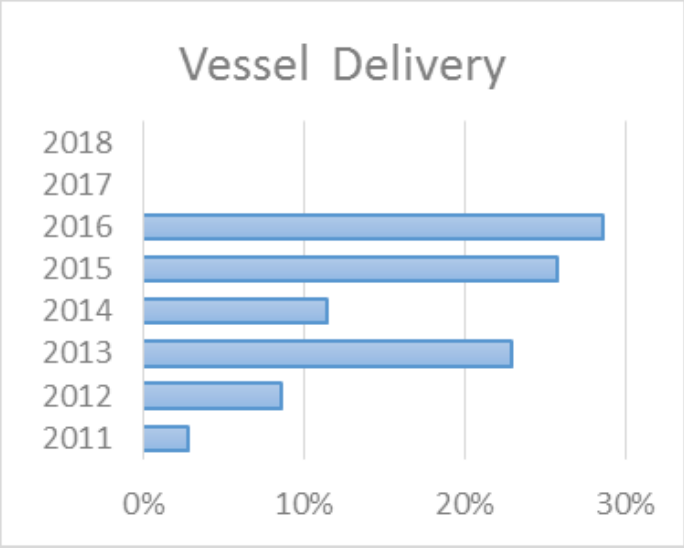


Filtration + UV Treatment – 16%

- Hardware Failure (58% reported)
  - Burning of UV lamps
  - Frequent cleaning of UV lamps required
  - UV intensity meter sensor failure
  - Back-flush filter pressure switch broken
  - Control panel hard disk failure
  - Reactors flooding due to defective seals
- Software Failure (22% reported)
- Human error (38% reported)
- Impact on coatings/pipes (0% reported)
- Health and Safety Issues (0% reported)
- Reduction in Ballast rate (22% reported)
- Other issues/Challenges (64% reported)
  - Calibration of various sensors
  - Unable to use ballast-deballast by gravity method
  - Manpower required to operate manually operated valves







Installation Considerations

- Location
- Existing space vs. purpose built
- Pipe routing
- Control and monitoring station(s)
- Hazardous areas
- System generated hazards

Timeline

- Cleaning BW tanks
- Factory acceptance testing
- Owner, vendor, SY supply
- Extent location of prefab
- Location of flow meters
- Site management
- Crew training
- Contract arrangements
- BW Management Plan
- Underway completion

Commissioning

- Agreed Plan
  - Clear objectives
  - Ambient available water
  - Extent of test
  - Manage language issues

- Timeline
- Responsibilities
- Factory acceptance trials
- Vendor technical team availability
- Onboard modifications
- Setting control parameters
- Sensor calibration
- Crew involvement
- Training expectations
- Efficacy confirmation
- Class/Flag approval
- Availability of critical spares

Training

- Complexity of BWMS is frequently reported as an operational challenge
- Role of after service technician
- Extent
  - Read operating manual
  - Hands on
  - Classroom
  - Learn from commissioning crew
  - Crew changeover

- Qualification strategy
- Competency assessments
- Technology transferability
- Continuous
- Ship specific vs. technology
- Sampling expectations

Operations

- Approved BW Management Plan
- Manual vs. Auto Logging Records
- Understanding Upset Conditions
- System Design Limitations
- Interpreting Alarms and Alerts
- Effective Ballast Rate
- Manual vs. Automatic Operation

- Start up and shut down sequencing
- Transient vs. continuous operations
- Recording of by-pass events
- Data storage and retrieval
- Continuous vs. programmatic filter backflush
- Stripping
- Condition of consumables
- Sediment management
- Spare parts
- Periodic sampling

Maintenance and Repair

- Maintenance Intervals
  - Per use/cycle
  - Activity duration
  - Calendar
- Consumables
- Spare Parts
- Crew Repairs and Maintenance
- Validity of Certificate

- Incorporate M&R activities into vessel's plan
- Availability of consumables
- Support network availability
- Condition based repair
- Calibration procedures
- Non-OEM replacement parts
- Adequate accessibility
- Working with TRO sensor shelf life considerations
- Software updates

Contingency Measures

Contingency measure means a process undertaken on a case by case basis after a determination (by the ship or the port state) that ballast water to be discharged from a ship is not compliant, in order to allow ballast water to be managed such that it does not pose unacceptable risks to the environment, human health, property and resources

- Measures should include processes required to support effective implementation when problems are:
  - Identified by the ship prior to entry into port;
  - Identified on arrival in port;
  - Identified before discharge of ballast water;
  - Identified during discharge of ballast water; and
  - Identified during sampling and analysis

ABS Support

- BWM Technology Evaluation Service
  - Analysis of vessel arrangement and operating profile
  - Identification of appropriate technologies
  - Detailed explanation of shortlisted solutions
  - Comparative suitability assessment
  - Assist understanding of vendor’s offerings

Thank You

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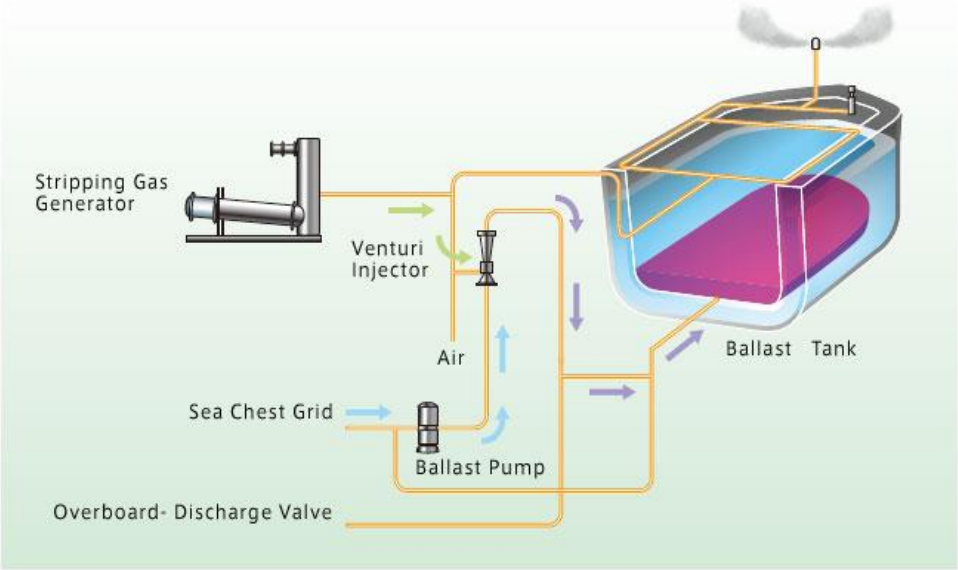
Inert Gas De-oxygenation Systems

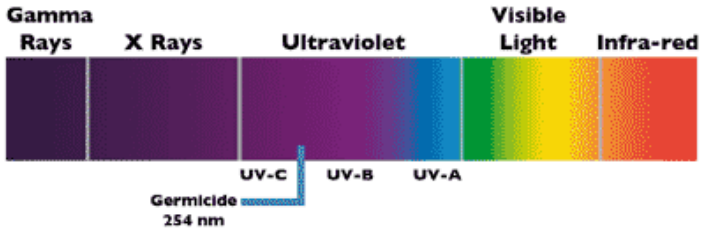
- Controls that safeguard that ballast tanks will not be subjected to excessive pressure or vacuum:
  - P/V valves
  - P/V breaker
  - Pressure sensors
- Prevent the return of hydrocarbon vapor to the machinery space or to any gas safe space
  - Gas regulating valve
  - Non-return valve
  - Water seal
  - Venting arrangement between gas regulating valve and non-return valve
  - Water loops to each associated water supply and drain pipe and each venting or pressure-sensing pipe leading to gas safe spaces
- Design and location of scrubbers and blowers with relevant piping and fittings in order to prevent flue gas leakage into enclosed spaces



When ballasting

Ultraviolet: Irradiation (UV) System

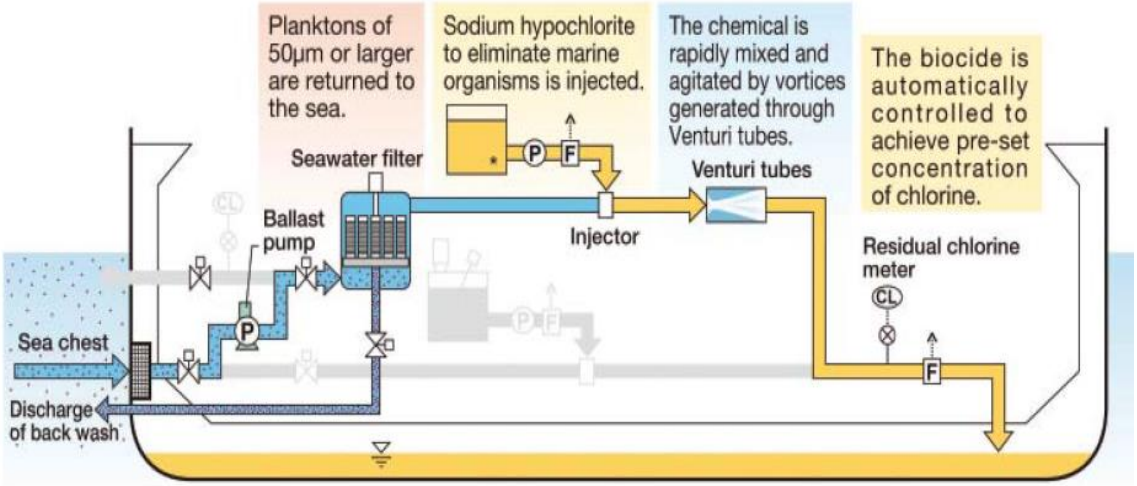
- Arrangements are to be provided such that the crew will not be exposed to excessive amounts of UV light



- High temperature alarm
- High-high temperature alarm with an automatic shut down
- A UV intensity meter
- Means to prevent the accumulation of air in the top of the lamp enclosure or treatment chamber
- A means (i.e. interlock) to prevent operating the UV lamps without water in the treatment chamber in order to avoid over-heating the UV unit
- Protection of electrical equipment with respect to the degree of enclosure (IP), insulation materials and maximum ambient temperatures (45°C)

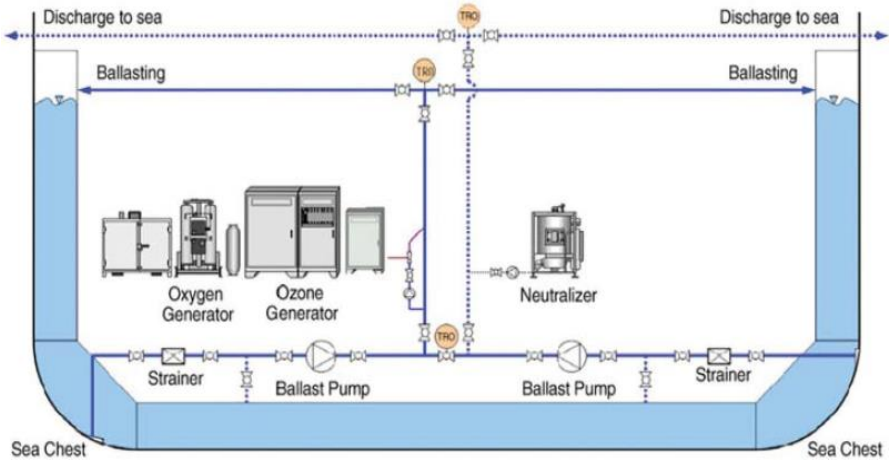
Prepared Chemical Treatment Systems

- A safety assessment study to address the risk to the vessel and its crew:
- The loading and storage of chemicals or preparations onto the vessel
  - Chemical containment system, ventilation system, fire protection and extinction, personnel exposure (PPE)
- The transfer and application of chemicals from storage to the BWMS
- The position of the BWMS and associated piping
- Operation of the BWMS, specifically any potential impacts for the ship's crew
- Maintenance of the BWMS and safe work procedures
- Spillages from the BWMS and emergency response plan



Ozone Injection Systems

- Ozone, due to its strongly oxidizing properties, is a primary irritant, affecting especially the eyes and respiratory systems
- Ozone piping is not to pass through accommodations or service spaces
- Ozone sensors are to be installed in the immediate vicinity of the ozone generating unit and along the route of the ozone piping
- The ozone sensors are to activate an alarm at a manned location when a concentration of 0.1 ppm or more is detected
- Independent vents from the oxygen receiver safety relief valve and any ozone destructor unit are to be led directly to the open deck
- Automatically shut down the system, close the power operated valves and stop all pumps when:
  - High oxygen concentration (25%);
  - High ozone concentration (0.2 ppm);
  - Activation of fire alarm in installation area



Electro-Chlorination Systems

- Electro-chlorination process produces hydrogen (flammable) and chlorine (toxic)
- If the electro-chlorination unit (ECU) of a BWMS is installed in a dedicated space or a machinery space:
  - Interlocked with the ventilation system
  - Failure of ventilation is to give an audible and visual alarm
  - A fixed hydrogen gas detection system is to be provided with alarm and an automatic shutdown system
  - All welded exhaust piping vents for any flammable or harmful are to be led directly in the open deck

- ECU chamber is to be always filled with water to avoid creating an explosive atmosphere and also to avoid excessive surface temperature;
  - ECU cannot be energized if water flow is less than an acceptable flow rate
  - Drop in the water level the electrical power to the ECU is shutdown
  - Safety shutdown for excessive temperature or pressure in the ECU
- The potential of flammable or toxic gas release into the ballast tanks to be assessed
  - Measures to be provided (e.g. venting arrangements, gas gauging system in tank, etc.)

Thank You

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