



Ballast Water Management System



Frequently Asked Questions

Ecochlor Treatment Technology

What is the treatment process of the Ecochlor® ballast water management system? The Ecochlor ballast water management system (BWMS) uses a two-step process to treat ballast water. First, the ballast water is filtered using a 40-micron, self-cleaning filter. Second, 4.25 mg/L of chlorine dioxide (ClO_2) is injected into the ballast line. ClO_2 is generated on demand and is not stored onboard the vessel. To generate the chloride dioxide, two precursor chemicals are pumped into a small mixing chamber. An eductor then draws the ClO_2 from the mixing chamber and mixes with the motive water supply to form the ClO_2 solution. This solution is injected into the main ballast water stream. The Ecochlor BWMS is capable of handling up to three (3) chemical injection points. When ClO_2 is no longer required, the treatment system is thoroughly flushed with water to remove all the ClO_2 from the system while it is idle and waiting the next ballast uptake.

What is chlorine dioxide? Chlorine dioxide is a widely used and incredibly powerful biocide. It has been effective for over 70 years in a wide variety of land-based treatment applications, including drinking water, municipal waste, food and pulp and paper, and has now been proven as a powerful treatment technology for ballast water. Chlorine dioxide offers a number of advantages over other disinfection chemicals and techniques. It is effective on all aquatic organisms, including bacteria and other pathogens.

How is the Ecochlor chlorine dioxide treatment technology different from BWMSs that use chlorine to treat ballast water? Chlorine (bleach) and chlorine dioxide are both oxidizing agents. However, chlorine dioxide is more selective in its reactions (with 2.6 times the oxidative power than chlorine) making it effective at lower concentrations.

Chlorine dioxide reacts with living cells by first penetrating the bacterial cell wall and then reacting with the material within the living cell in order to kill the organism. Chlorine dioxide has very limited reactions with organic matter present in ambient water and works exceptionally well where high levels of organic materials ("dirty" or turbid waters) are anticipated to be present. This greatly reduces the formation of disinfection by-products and means that chlorine dioxide treatment effectiveness is not affected by turbidity, salinity or temperature.

On the other hand, chlorine reacts with almost any organic material (living and non-living) such as oil, algae, sediments, etc. This means that waters with high levels of organic matter can increase the demand for chlorine, leaving less of the chemical available to treat living organisms; thus, requiring an increase in dose. Due to the types of reactions that chlorine has with both organic and inorganic compounds, chlorine has a greater potential to form undesirable by-products in the water. These by-products can pose toxicity risks to both aquatic organisms and human health.

The high levels of chlorine required to treat ballast water comes with operating limitations — neutralization is required to ensure chlorine can be discharged safely. **Chlorine dioxide does not require neutralization or re-treatment of the ballast water prior to discharge** because it naturally decays to a safe discharge concentration.

Solubility is another important advantage of chlorine dioxide for water treatment. Chlorine dioxide is 10 times more soluble in water than chlorine, making it faster-acting, even in cold water conditions.

Are there any hold times for treated ballast water discharge?

The Ecochlor system's minimum hold time is 24 hours. Prior to discharge of treated ballast water, the ClO_2 residual must be verified to ensure the maximum allowable discharge concentration (MADC) of 0.2 mg/L ClO_2 is not exceeded. Using a simple test, the crew collects two independent in-tank ballast water samples at different depths representing the middle and bottom of the tank to confirm the ClO_2 residual is less than 0.2 mg/L prior to discharge.

Do other systems use the chlorine dioxide technology in the treatment of ballast water? No, Ecochlor is the only BWMS manufacturer using ClO_2 technology for the treatment of ballast water. United States and International patents were obtained in 2004 for the use, generation and control of ClO_2 for the elimination of aquatic invasive species in ballast water.

Chemical storage temperature range? The recommended temperature range for the space in which the precursor chemicals are stored is 5 °C – 40 °C. The low temperature is based on the temperature required to prevent the possibility of water lines freezing within the BWMS dedicated space and to maintain the quality of the chemicals. ClO_2 is generated on demand and is not stored onboard the vessel.

Will the use of chlorine dioxide have any effect on ballast tank coatings or increase corrosion inside the ballast tanks? There should be no effect on tank coatings or corrosion rates when utilizing the Ecochlor system. This was confirmed through tests on four different epoxy coatings and bare steel panels conducted by independent laboratories with samples analyzed by 3rd party experts, including a marine coatings supplier. At the conclusion of the study, International Paint also provided a letter indicating that the Ecochlor BWMS is unlikely to have a detrimental effect on epoxy ballast tank coatings approved to IMO Resolution MSC.215 (82).

What are the system's inbuilt safety measures? The Ecochlor system provides methods of preventing the accidental release of ClO_2 . The generation of ClO_2 is equipped with numerous fault interlocks that prevent the operation of the generator without the prerequisite motive water flow and proper vacuum in the mixing chamber. The BWMS is also equipped with a flow deviation alarm which reconciles the flow of motive water entering the generator to the flow of the ClO_2 solution at the injection points. In the event that the flow deviation alarm is activated, the system will automatically shut down. If a chemical leak is detected, the system will automatically shut down and the system ventilation will increase to 30 air exchanges per hour.

Additionally, the system includes a ClO_2 gas detector mounted on the generator cabinet skid, and a redundant unit within the treatment system deckhouse, which will trigger a system warning upon a one-time detection of 0.3 ppm ClO_2 . The system will shutdown if there is a detection of 0.3 ppm ClO_2 for a continuous 15 minutes and / or if there is a one-time detection of 1.0 ppm ClO_2 .

Equipment

What type of tanks are used to store the precursor chemicals on board a vessel? The two precursor chemicals are stored at atmospheric conditions onboard in storage tanks that are engineered, designed and fabricated for installation on the vessel main deck or above. One tank is a vented carbon steel tank lined with Halar (ECTFE). The other tank is a vented 316L stainless steel tank. Each tank is mounted inside a secondary containment system made from carbon steel coated with a chemical resistant coating and designed to hold 100% of the tank volume at a 37° vessel list. The secondary containment is equipped with sensors to detect the presence of fluid with an alarm condition to shut down the system and alert the crew.

What is the lead time for production of an Ecochlor System? Ecochlor has short delivery times. Contact your local sales representative to discuss specific details.

Will each ballast pump require a filter? Will the aft peak system require its own filter? If a vessel has more than one small capacity ballast pump and there is a common ballast water header, a single filter may be an option. For large capacity ballast pumps, the vessel will likely require each main ballast pump have its own filter. Aft peak tanks may require a separate filtration and injection point if the tank cannot be filled with a branch from the main ballast piping system; this is a common approach on tankers.

Vessel Compatibility with the Ecochlor BWMS

What types of vessels are best suited for the Ecochlor BWMS? The system is best suited for vessels from mid-range to the largest ships in the world. Chlorine dioxide is completely effective on all potential aquatic invasive species regardless of turbidity, salinity, or temperature of the incoming ballast water. This allows for a consistent, easy-to-use system for the crew without the uncertainty of its effectiveness when faced with varying water types. Vessels that have routes in challenging waters often look to the Ecochlor BWMS as a solution.

What are the key advantages of the Ecochlor BWMS to a vessel or the ship operators? Ecochlor's powerful treatment technology meets or exceeds regulatory requirements from IMO & USCG: International Maritime Organization (IMO) Type Approval – BWMS Code (2020) & G9 (2010); and, USCG Type Approval (2017).

Benefits include:

- The BWMS is engineered for reliability and low maintenance
- Minimal crew involvement during system operation
- Small footprint even for vessels with high flow rates
- Low power requirements, possibly the lowest in the industry
- Treatment efficacy not affected by turbidity, salinity, or temperature
- Installation flexibility; Treatment System can be placed in any convenient location as modular components. The Ecochlor System allows for the flexibility to design a skid-mounted system
- No ballast water treatment or neutralization required at discharge

Can the Ecochlor system be installed in a Tanker with hazardous zones?

The system is approved for installation in both U.S. Flag and foreign flag vessels in hazardous zones rated Zone 1 or Zone 0. The treatment system equipment must be installed within an enclosed, non-hazardous area, typically a deckhouse or dedicated space. In some situations, the deckhouse or dedicated space can be installed in a hazardous zone in accordance with the vessel's Classification Society's rules. The main ballast filtration system, consisting of the filters and associated equipment, can be installed within a Zone 1 or Zone 0 hazardous zone requiring the use of properly-rated equipment.

What are the advantages to installing an Ecochlor system on a Bulk Carrier with gravity-discharge top side tanks? The normal operation on a bulk carrier with gravity discharge top side tanks is to discharge the ballast tanks directly overboard without using pumps or transferring the ballast water back through the pump or engine room. This discharge method would not be possible with any treatment technology that needs to treat or neutralize the ballast water at discharge without modifications. Adjustments to a bulk carrier to allow for this ballast water to be retreated or neutralized can be extremely costly and, more importantly, could lead to operational difficulties of the vessel. There are no treatment or neutralization requirements during the discharge of ballast water treated with the Ecochlor BWMS making it a superior option for bulk carriers with gravity-discharge top side tanks.

Operations and Maintenance

What is the life cycle of the main treatment components? The major components of the Ecochlor system include filter(s), generator and chemical storage tanks and are designed for the life of the vessel.

What are the maintenance requirements? The Ecochlor BWMS requires very little periodic maintenance. During commissioning a preventative maintenance schedule is provided to the crew in the Operation Maintenance Safety Manual (OMSM). It is expected that filter screens (based on use) will need to be replaced once every five years.

Maintenance activities are scheduled in a frequency ranging from 12 to 60 months and involve routine inspection activities. It is recommended that the ships have some key spare parts on board. Chemical resupply will be performed approximately two (2) times annually (dependent upon the number of ballasting operations), which allows for the Ecochlor technicians to attend the vessel regularly and identify maintenance requirements early.

Installation Service Options

What additional services do you offer shipowners to assist with the installation? Ecochlor offers a full range of ad-on options to facilitate system installations:

- Door to door shipping including assistance with ocean or air shipping, customs clearance and storage
- Installation supervision / commissioning testing attendance (with Class approval)
- Purchase and shipment of Alloy 20, 316 and other stainless-steel piping using U.S. high-grade steel to support the installation
- Spare parts and delivery savings

Training

How is your commissioning training and first ballast operation set up? Training is provided at the end of the BWMS installation period and includes both classroom training as well as hands-on operational training. Classroom training is usually held sometime within the first 15 days of dry dock and runs approximately two hours. The operational training is typically run during the BWMS manufacturer's commissioning. In addition, Ecochlor can also offer hands-on training at the ship's first full ballast operation, allowing for a more realistic, stress-free learning experience with the engineers on board the vessel.

Do you offer computer-based training? After shipboard hands-on training at commissioning, the Ecochlor installation team provides an interactive computer training program, produced by MARPOL Training Institute, Inc., to the vessel. This software training program, with classification society DNV GL certification, can be installed on the ship's computer network or given to an owner's facility for access on their server during corporate training sessions.

Do you offer training at shipowner facilities? A portable Human Machine Interface (HMI) training kit is available for onsite training at the Owner's training facilities. The portable simulator allows familiarization with the Ecochlor's system operation utilizing process replication and a full size [HMI] panel. Various operating and alarm conditions can be simulated to provide initial introduction to the system as well as responses to normal and abnormal variations in operating conditions.

Do you have a training facility where we can send our management and/or crew? The Training Center is located at Ecochlor's Corporate Headquarters in the USA. The facility includes classroom training on operation, safety, troubleshooting and maintenance as well as the use of an HMI training simulator that replicates the experience of using an Ecochlor system in a real-world situation. During the hands-on part of the training there will be an operating Ecochlor BWMS, both a wet and dry filter allowing for the equipment to be disassembled to view inner workings and functions.

Resupply and Service Support

Will the vessel's crew be responsible for chemical resupply? An authorized Ecochlor representative will plan supply logistics in getting to the vessel and then, resupply the chemicals; the crew assists only in the operation of a crane in loading chemicals on board the ship. The entire process is closed, using specially selected equipment and trained personnel with no direct human contact to chemicals. Resupply takes approximately a ½ day to complete (dependent on tank size); this includes the refill process, clean up and the removal of empty IBCs. The Ecochlor service team provides logistics and technical support for chemical resupply at ports and harbors around the world. Locations are continually expanding to align with the needs of the client base. Contact the chemical support team at chemops@ecochlor.com for the latest update on supply locations.

How do I reach your service team if I have any problems during ballasting? Ecochlor has Service Engineers strategically located across three major time zones to ensure quicker service time to vessel crews

located anywhere in the world. Contact ecochlorservice@ecochlor.com for service support.

What service support do you offer the crew after the installation? Each ship with an Ecochlor system on board is assigned their own "vessel delegate" to ensure a quick response to any issues encountered during ballasting operations. After each ballast operation, the crew sends the Ecochlor vessel delegate a Functional Monitoring Data Sheet (FMDS) via email to analyze. The data sheet provides critical information to the service team, such as the location and date of the last ballasting operation, various operational parameters and, most importantly, monitors the amount of chemicals used during the operation and the amount currently available on board the vessel. This information is then incorporated into a Fleet Status Update Report, allowing for proactive maintenance and support of the Ecochlor system onboard the vessel.

Regulatory Compliance

Are there any compliance requirements associated with the Ecochlor system?

Ecochlor has BWMS Code (2020) and G9 Type Approval (2010) as well as USCG Type Approval (2017)

Class Type Approvals

ABS, BV, LR, RMRS, DNV GL, KR

Flag State Type Approvals

IMO Cyprus Type Approval, IMO Hellenic Type Approval, IMO Norwegian Type Approval

The Ecochlor® BWMS regulatory guidelines by IMO and USCG Type Approval include:

Flow Rates (TRC): 500 - 16,200 m³/hr.

ClO₂ Dose: 4.25 mg/L

U.S. Flag Hazardous Approval: Yes

Minimum Hold Time: 24 hours, plus confirmation of MADC

Maximum Allowable Discharge Concentration: Less than 0.2 mg/L ClO₂, confirmed with an in-tank sample

Temperature: Not Applicable

Electrolyte Feed Temp./Salinity: Not Applicable

Salinity: Not Applicable

TRO: Not Applicable

Discharge Standards: No neutralization or retreatment at discharge