



## Ecochlor FAQ

### 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 ( $\text{ClO}_2$ ) is injected into the ballast line. To create the chlorine dioxide, precursor chemicals are pumped into a small mixing chamber. An eductor then draws the  $\text{ClO}_2$  from the mixing chamber and mixes with the motive water supply to form the  $\text{ClO}_2$  solution. This solution is injected into the main ballast water stream. The Ecochlor system is capable of handling up to three (3) chemical injection points. When  $\text{ClO}_2$  is no longer required, the treatment system is thoroughly flushed with water to remove all  $\text{ClO}_2$  from the system while it is idle, awaiting the next ballast uptake.

**What is chlorine dioxide?**

Chlorine dioxide is a widely used and incredibly effective biocide. It is effective in a wide variety of land-based treatment applications, including drinking water, municipal waste, food and pulp and paper for over 70 years, and has now been proven for effective onboard treatment of 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 treatment systems that use chlorine vs. chlorine dioxide treatment are different?**

Chlorine dioxide and chlorine are two different chemical compounds that react differently when mixed with water.

- Chlorine dioxide is a dissolved gas. When the  $\text{ClO}_2$  encounters a living organism, it penetrates the bacterial cell wall and reacts with the essential amino acids in the cytoplasm of the cell to kill the organism.  $\text{ClO}_2$  has 2.5 times the disinfectant capability of chlorine and degrades naturally to salt after treatment. It is effective in all water types regardless of turbidity, salinity or temperature.
- Chlorine is a good, low-cost biocide, although not as effective as chlorine dioxide. Chlorine bleach is inherently unstable, its stability being impacted by the presence of metal ions, sunlight, and temperature. Consequently, over time, the concentration of bleach stored in tanks will decline, the amount of degradation is a function of the three factors mentioned above. When added to water, chlorine forms hypochlorous acid. It is a non-specific disinfectant reacting with both living organisms and any other organic compound which, not only reduces its effectiveness in dirty water, but it also forms undesirable by-products such as chloramines (combined chlorine) and trihalomethanes (THMs). These by-products have been cited as possible carcinogens. Typically, any water treated with chlorine must go through a neutralization process before discharging treated ballast water in the sea.

**Do other systems use the chlorine dioxide technology in the treatment of ballast water?**

Ecochlor is the exclusive worldwide licensee of Ecolab/Nalco's Purate™ BWT. Purate™ BWT is combined with 78% sulfuric acid to create the on-demand disinfection chlorine dioxide solution for the treatment of vessel ballast water. A patent was obtained in 2004 for the United States and International protection in the use, generation and control of  $\text{ClO}_2$  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 Purate™ BWT.  $\text{ClO}_2$  is generated on demand and is not stored on 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® BWMS. This was confirmed through tests on four different epoxy coatings and bare steel panels conducted by independent laboratories with samples analyzed by 3<sup>rd</sup> 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). All data was submitted to the German Authorities and the IMO / GESAMP-BWWG with the application for G9 Final Approval and G8 Type Approval.

**What are the system's safety precautions?**

The Ecochlor system provides methods of detecting the accidental release of  $\text{ClO}_2$ . The generation of  $\text{ClO}_2$  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  $\text{ClO}_2$  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<sub>2</sub> gas detector mounted on the generator cabinet, and a second within the treatment room, which will institute a system warning upon detection of 0.3 ppm ClO<sub>2</sub>. The system will shutdown if there is a detection of 0.3 ppm ClO<sub>2</sub> for a continuous 15 minutes and / or if there is a one-time detection of 1.0 ppm ClO<sub>2</sub>.

### Equipment

**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 that each main ballast pump will require 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.

**What type of tanks are used to store the precursor chemicals on board a vessel?**

The two precursor chemicals are stored at atmospheric conditions on board in storage tanks that are engineered, designed and fabricated for installation on the vessel main deck or above. The 78% Sulfuric Acid is stored in a vented carbon steel tank lined with Halar (ECTFE). The Purate™ BWT is stored in 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 degree 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 standard production lead time is approximately 26 weeks from receipt of a purchase order and deposit, contingent upon the following two items occurring within four (4) weeks of the Purchase Order execution date:

1. Completion of detailed integration engineering drawings; and,
2. Approval and acceptance of the final Ecochlor System Configuration by the customer and Ecochlor.

Delays in the engineering drawings or acceptance of system configuration will add to lead time in direct proportion.

### Vessel Compatibility with the Ecochlor System

**What types of vessels are best suited for the Ecochlor® ballast water management system?**

The Ecochlor system is best suited for vessels from mid-range to the largest ships in the world with high ballast water flow rates, typically 1,000 m<sup>3</sup>/hr. or more. 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® system to a vessel or the ship operators?**

Proven Technology: Can meet or exceed all regulatory requirements from IMO & USCG: International Maritime Organization (IMO) Type Approval – G8 (2011) & G9 (2010); and, USCG Type Approval (2017).

Benefits include:

- 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 US 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?**

There are no treatment or neutralization requirements during the discharge of ballast water treated with the Ecochlor® BWMS. Modifying a bulk carrier to allow for monitoring or re-treating the ballast water can be extremely costly and, more importantly, could lead to operational difficulties of the vessel. The normal operation on a bulk carrier with gravity discharge top side tanks is to fill the top side tanks to overflow. This process enables the excess ballast water to run directly off the vessel offering assurance against water movement. Due to the need to treat the ballast water, this run-off would no longer be possible with any treatment technology. A good replacement to this process would be to use the Ecochlor system and a radar level control (which maintains accuracy ± 2 ml) allowing the top side tank to be filled to capacity without constant monitoring.

### Operations and Maintenance

### 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<sub>2</sub> residual must be verified to ensure the maximum allowable discharge concentration (MADC) of 0.2 mg/L 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<sub>2</sub> residual is < 0.2 mg/L prior to discharge.

### What are the BWMS operating costs?

Operating costs are based on the minimal power requirements for system operation and chemical consumption. The cost of power to operate the system will vary based on current fuel prices, but is minimal due to the low power requirements to operate the system. The main cost of operation are the chemicals which are approximately USD \$0.08 per m<sup>3</sup> of treated ballast water or \$6000 of chemical to treat 75,000 m<sup>3</sup> of ballast water. This price includes the chemicals, transportation and trained technicians for the re-supply activity.

### 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 in the Maintenance Safety Manual. It is expected that filter screens (based on use) will need to be replaced once in every ten years. Maintenance activities are scheduled in a frequency ranging from 18 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, which allows for Ecochlor technicians to attend the vessel regularly and identify maintenance requirements early.

### What is the life cycle of the main treatment components?

The major components of the Ecochlor system – filters, generator and chemical storage tanks – are designed for the life of the vessel.

## 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 4 hours. The operational training is typically one of last items completed prior to leaving dry dock. Shipowners are strongly encouraged to allow enough time complete this training. 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 ship board hands-on training at commissioning, the Ecochlor installation team provides an interactive 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.

### What type of training can you bring to our office?

A portable Human Machine Interface (HMI) training kit is available to allow familiarization with the Ecochlor® BWMS operation utilizing process simulation 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 Ecochlor Training Center located in North Haven, Connecticut includes classroom instructors along with the use of an HMI training simulator that replicates the experience of using an Ecochlor system in a real-world situation. Additional, classroom training on function, safety, troubleshooting and maintenance will be provided. During the hands-on part of the training there will be an operating Ecochlor® BWMS and wet filter, as well as a dry filter on the premises 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 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. Considering logistics of cranes, safety procedure briefs, and time to fill the required volume, it will take approximately a ½ day to complete the refill process, restore all equipment and have the empty IBCs removed from the port. The Ecochlor service team has collaborated with Drew Marine to assist in providing logistics and technical support for chemical resupply and service at ports and harbors around the world.

### 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 FMDS 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 FMDS is then incorporated into a Fleet Status Update Report, allowing for proactive maintenance and support of the Ecochlor® BWMS on board the vessel.

### How do I reach your service team if I have any problems during ballasting?

Ecochlor has an international customer service call center +44.131.322.1446 that is available 24/7 for service needs. A 24-hour response time for email queries or troubleshooting is available at [ecochlorservice@ecochlor.com](mailto:ecochlorservice@ecochlor.com).

## Regulatory Compliance

### Are there any compliance requirements associated with the Ecochlor system?

Ecochlor has both IMO G8 (2011, 2018) and G9 Type Approval (2010) as well as USCG Type Approval (2017). During Ecochlor's USCG Type Approval amendment process, minor updates and improvements were made to aspects such as documentation, available filter models, and control system software. Once the USCG Type Approval amendment was complete, Ecochlor worked with DNV GL as the Recognized Organization for the Norwegian Maritime Authority to harmonize all aspects of the USCG approved system with the existing IMO Type Approval. One important update was the inclusion of additional FilterSafe models to the approved equipment list, such as FilterSafe's highest throughput SuperTurbo (ST) filter. This update increases the design and installation options for ship owners.

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

Flow Rates (TRC)	Generators 75-300/500 - 16,200 m <sup>3</sup> hr.
Chemical Dose	4.25 mg/L.
US Flag Hazardous Approved	Yes.
Minimum Hold Time	24 hrs.
Temperature	Not Applicable.
Electrolyte Feed Temp./Salinity	Not Applicable.
Salinity	Not Applicable.
TRO Not Applicable	No neutralization or retreatment at discharge.
Maximum Allowable Discharge	0.2 mg/L MADC using in-tank sample.

## EcoCare® Compliance Guarantee

### What is the Ecochlor BWMS Guarantee?

EcoCare® is a multifaceted guarantee that ensures regulatory compliance with IMO, USCG and individual U.S. state standards. Additionally, the guarantee addresses system efficacy as it pertains to treating ballast water for invasive species contamination. Finally, it insures against financial penalties up to \$1,000,000\* relating to possible fines, port charges, delays and off-hire if ballast water, properly treated using Ecochlor's BWMS, fails an invasive species test. It is the only BWMS compliance guarantee offered to shipowners in the world. \*Ask our representative for Terms and Conditions.

