Chlorine Dioxide is NOT Chlorine
by Ricky Dixon, Director of Sales, North America

It is perplexing how many ballast water treatment consultants assume that chlorine dioxide (ClO₂) is actually chlorine. In response to efforts to distinguish between the two, more than one person has commented to me, “But it has chlorine in the name!” I refer them to water (H₂O), which has H₂ in the name, but behaves very differently from hydrogen gas. The most significant difference between ClO₂ and chlorine is in its activity when mixed with water. In water, chlorine reacts to form hypochlorous acid(s). Chlorine dioxide, on the other hand, does not react in water; instead, it remains a dissolved gas.

Chlorine dioxide only reacts with living cells, not organic compounds. When ClO₂ encounters a living organism, it penetrates the bacterial cell wall and reacts with essential amino acids in the cytoplasm of the cell to kill the organism. This reaction makes ClO₂ very effective at removing slimy films of bacteria that adhere to surfaces, otherwise known as biofilm. Industries have adopted ClO₂ for its excellent biofilm removing properties; it has been used to disinfect even the nastiest of environments. Chlorine on the other hand, can be a good, low-cost bactericide, however, it’s not nearly as effective as ClO₂. Chlorine is a non-specific disinfectant, and it reacts with both living organisms and any other organic compound, such as humic acids, bath oils, ammonia, etc. Not only does this tendency reduce chlorine’s effectiveness in dirty water, but ClO₂ has 2.5 times the disinfectant capability of chlorine - but it also forms undesirable by-products such as chloramine (combined chlorine) and trihalomethanes (THMs), which have been cited as possible carcinogens.

Another important distinction between the two chemicals is that chlorine is an effective biocide only in waters with a pH less than 8, whereas ClO₂ is effective throughout a much broader pH range from 2 to 10. Over the last 70 years industrial process have turned to ClO₂ due to its unique disinfection properties. ClO₂ was first used to disinfect drinking water in 1944; 12 years later it was utilized as a drinking water disinfectant on a much larger scale. It is now approved by the United States Environmental Protection Agency and the World Health Organization and used as a disinfectant on a global scale.

Current land-based applications include:
- Mouthwash
- Oil and gas water treatment
- Municipal drinking water
- Food processing (wash water for vegetables)
- Zebra and quagga mussels in water intakes
- Mold
- Cooling towers
- Ballast water treatment

Ecochlor’s proprietary ballast water treatment technology

In 2001, the founders of Ecochlor proposed the use of ClO₂ as a safe and effective treatment for shipboard ballast water. A patent was obtained for US and International protection for the use, generation and control of an active substance (ClO₂) for the elimination of aquatic invasive species in ballast water. Using this ClO₂ technology, the Ecochlor® Ballast Water Treatment System (BWTS) is highly effective at killing potential aquatic invasive species including zooplankton, phytoplankton, algae, microorganisms and even pathogens and viruses, regardless of turbidity, salinity or temperature.

The Ecochlor® BWTS uses a two-step process that includes filtration and treatment with ClO₂. The heart of the treatment system is a generator that delivers a dilute solution of ClO₂ to treat the incoming ballast water.

Chlorine dioxide is generated on demand and is not stored on the vessel. Precursor chemical metering pumps are flow paced to produce ClO₂ as required for the measured ballast water flowrate. The ClO₂ is generated in a small mixing chamber, which operates under a vacuum. An eductor draws the ClO₂ from the mixing chamber and mixes with the motive water supply to form the ClO₂ solution that is immediately injected into the main ballast water stream. When treatment is no longer required, the Treatment System is thoroughly flushed with water to remove all ClO₂ from the system while it is idle, awaiting the next ballast uptake.

The operation is quite simple and when the system is off, there are no stored chemicals in the generator. Ecochlor’s first system was placed in operation in 2004 and it has been proven effective and reliable for over 12 years at sea.