Environmental Problem

During the last century, the problem of biological infestations and chemical contamination spread through waterways has been dramatically accelerated with the advent of modern high-speed freighters and their methods of ballast water exchange. Transport and discharge of contaminated ballast water constitutes a major route by which potentially invasive species are introduced into high-traffic marine and fresh waters worldwide. The discharge of marine vessel bilge and ballast water upon destination arrival can seriously contaminate the surrounding aquatic ecosystems with nonindigenous organisms, and grey/black water effluents with high biological oxygen demand (BOD).

The most problematic organisms to be controlled are bacterial, planktonic, and egg or larval stages of higher organisms. It is almost impossible, very expensive, and environmentally damaging to control/eradicate infestation of an invasive species once it is introduced into a waterbody. The introduction of the zebra mussel into the waterways of the Great Lakes provides a well-publicized and sobering example of both the economic and ecological costs associated with such invasions. Thus, prevention of initial contamination by invasive species is the most practical approach to this problem.

SBIR Technology Solution

With support from EPA’s SBIR Program, Eltron Research, Inc., developed a unique hydrogen peroxide (H₂O₂) generation technology into a turn-key, modular, flow-through water treatment system for bilge, ballast, and wastewater treatment. H₂O₂ is long known to be effective for disinfection and organic material oxidation. The core of this treatment system is Eltron Research’s patented electrolytic technology that consumes only water, oxygen from air, and electricity.

A durable electrolytic cell design was developed for this treatment application that achieves the required H₂O₂ production rates and exceeded all expectations in performance during scale-up. Commercial production of the electrolytic cell modules demonstrated this technology’s readiness for manufacture. A 3,000 gallon per hour system successfully demonstrated the modular scalability of treatment capacity.

Eltron Research’s electrolytic technology produces H₂O₂ onsite and on-demand for about one-half the cost of the standard industrial production process based on power consumption and capital depreciation estimated over a 5-year period. Hydrogen peroxide water treatment with this new system is comparable in power consumption to the newest ultraviolet ballast water treatment systems, but provides the additional key benefits of organic destruction, reduction of BOD, an estimated 30% reduction in capital costs, and a safe source of H₂O₂.

Tests conducted by the Marine Biological Laboratory (Woods Hole, Massachusetts) in collaboration with Eltron Research demonstrated broad effectiveness of H₂O₂ to kill algae, fish, invertebrates, and planktonic and bacterial microorganisms. Introduction of 5-7 mg/L H₂O₂ into ballast water by Eltron Research’s treatment system during vessel uptake is expected to provide effective treatment against biological organisms within the first 200-500 minutes of contact time. The corrosiveness of seawater with Eltron Research developed a hydrogen peroxide water treatment system to mitigate marine vessel discharge of exotic, invasive organisms in bilge and ballast water.
Transport and discharge of contaminated ballast water constitutes a major route by which potentially invasive species are introduced into high-traffic marine and fresh waters worldwide.

Eltron Research developed a turn-key hydrogen peroxide (H$_2$O$_2$) water treatment system to mitigate marine vessel discharge of exotic, invasive organisms in bilge and ballast water.

Eltron Research’s unique electrolytic H$_2$O$_2$ production process consumes only water, oxygen from air, and electricity.

This onsite and on-demand H$_2$O$_2$ production technology is economically competitive, convenient, and environmentally safe.