

## **BP Shipping's Ozone Generator Project to Treat Tanker Ballast**

### Issue

The worldwide transfer and introduction of non-indigenous species (NIS) is having significant and unwanted ecological, economic and human health impacts. Although most attention to date has focused on invasions in terrestrial and freshwater habitats, it is evident that NIS invasions have become a potent force of change in coastal marine ecosystems. Roughly 400 marine and estuarine NIS are known to be established in North America alone. Shipping has been the vector responsible for many of the known invasions and the global movement of ballast water now appears to be the single largest transfer mechanism for marine NIS.

The Port of Valdez is the single largest receiver of ballast in the US, delivered by a small fleet of dedicated tankers. These tankers take on ballast in West Coast ports with known NIS. On the basis of mounting regulatory pressure, continuous deballasting in Valdez and its new ship building program BP Oil Shipping Company (USA) Inc., (BPOSC) took the initiative in looking for an appropriate technology to combat this issue and decided on experimenting with ozone as a possible treatment.

### Ozone Ballast Water Treatment System Project

At BPOSC's request Nutech O3 developed and designed the world's first ballast water treatment system, (This System is now protected by three U.S. patents and international patent applications are pending.) The SCX 2000 System was installed on the tank vessel *Tonsina*, in September 2000, with initial sea trials demonstrating delivery of ozone to laden ballast tanks.

Ozone is produced by sending a stream of oxygen enriched air through an electrode. Within the electrode, a high voltage corona discharge is created (an electric arc). As the oxygen enriched air stream passes through the corona gap and a percentage of the air stream is converted into ozone. The ozone is then piped into the ballast tanks and released into the ballast water via diffusers.

Ozone is used as an oxidizing agent and as a disinfectant because as it is considered superior to chlorine. Ozone is effective in destroying bacteria, viruses and NIS. Historically, ozone has been primarily used in disinfecting water since it kills bacteria and viruses more effectively than chlorine. Major municipal water systems, such as Los Angeles, have used ozone in place of chlorine for more than 20 years. Because ozone also reacts with many other compounds, it is also being used in treating hazardous wastes and in controlling organic compounds found in all types of industrial waste water.

### Description of the Nutech Ballast Water Treatment System

The SCX 2000 System, is built into a standard steel shipping container, consists of 144 water cooled electrodes, pumps, chillers, electric transformers and includes a U.S. Coast Guard/American Bureau of Shipping approved fire suppression system. The System converts a

gas flow of 98 percent pure oxygen into 6 percent to 8 percent ozone by exposing that gas flow to 10,000 volts of electricity.

The SCX 2000 generates approximately 1,800 grams of ozone per hour. The ozone is distributed throughout the ship, to each of the 15 ballast tanks, through a system of 7,000 meters of stainless steel pipe. The ozone is distributed throughout the ballast tanks by a system of 1,200 stone diffusers. This piping system runs the entire length of the *Tonsina* and it runs vertically from top deck of the ship to the bottom of each ballast tank.

The ozone interacts with chemicals that naturally occur in sea water to create iodine and hydrobromous acid. These chemicals, in turn, kill all bacteria, viruses and NIS found in ballast water. The chemicals created by the interaction with the ozone rapidly break down and revert to iodine and bromine which are safe and do not harm local aquatic wildlife. The ozone also breaks down rapidly and reverts to oxygen, thus posing no harm either to the ship's crew, to fish, or to birds.

### Test Protocols

The U.S. Coast Guard requires that alternative treatments be as effective as water ballast exchange, however, there is little actual data on the effectiveness of ballast exchange nor guidelines to assess performance treatments. To overcome the lack of guidelines BPOSC assembled a group of scientists, government agencies and NGO's to develop a protocol to measure the efficacy of this system.

Two identical ballast tanks on the *Tonsina* are rigged with identical sampling points. The test objectives are to evaluate the chemical and biological quality of treated ballast water against the reference tank. Data will be collected to evaluate, concentrations of ozone and its residuals, abundance and diversity of several taxa of marine biota, survival of caged organisms, and a comparison of ozone induced reductions in organisms against ballast exchange.

The testing is scheduled to start on September 21, 2001 and scheduled to be completed in mid October. Should the findings determine that the system is efficient in the control of NIS BPOSC will work with NUTECH to design an automated control system for the generator.

### Project Funding Request

BPOSC budgeted a total of \$3.4m towards the project as follows:

Equipment design, manufacture & Installation	\$2.1m
Test Protocols & Peer Review	\$0.3m
Testing, sampling, analysis & consultancy	\$0.4m
Automation of Equipment	<u>\$0.6m</u>
Total	\$3.4m

What is BPOSC looking for from an equipment manufacturer?

In this project BPOSC left the design of the equipment and the method of delivery of ozone to the manufacturer but subjected the equipment to an extremely demanding test protocol to evaluate the efficacy of the equipment. The test protocol was designed by a team of third party scientists, government agencies and NGO's. BP's goal was to obtain a test result that would stand-up to a rigorous peer review and one that would be assured of compliance with pending USCG regulation concerning experimental systems designed to deal with NIS.

BP believes this is the only way for this kind of technology to gain acceptance and credibility within the Shipping community.