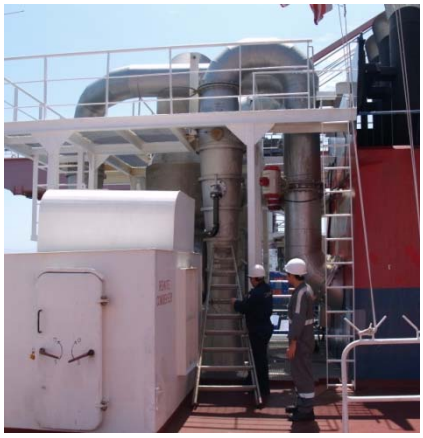
Bluefield Holdings/Krystallon Ocean Going Vessel Scrubber Demonstration Project

Technology Manufacturer
Bluefield Holdings/Krystallon

Co-Participants
Port of Long Beach and Port of Los Angeles, California Air Resources Board, APL

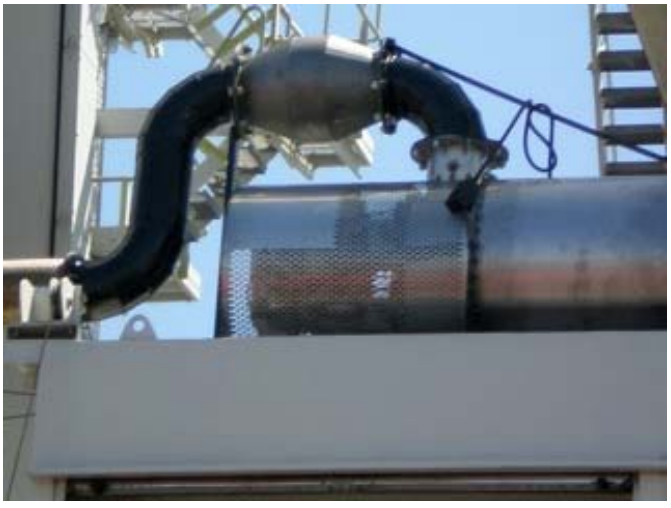


Background

Bluefield holdings completed demonstration of a Krystallon sea water scrubber to reduce auxiliary engine emissions aboard the container ship *APL England*. The seawater is used to "scrub" or filter particulate contaminants from the ship exhaust stream before the exhaust is emitted to the atmosphere.

Project Objective

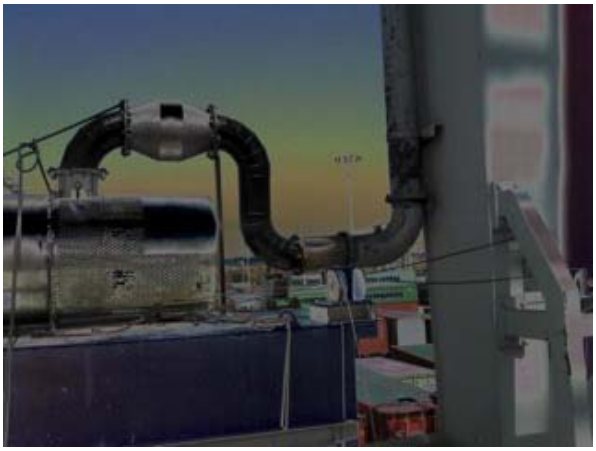
The primary focus of this project was to demonstrate the reduction of emissions of sulfur oxides (SO_x) from an Ocean Going Vessel using an exhaust gas cleaning device to meet the International Maritime Organization (IMO) fuel sulfur limits in Emission Control Areas (ECA) and further to reduce particulate matter (PM), and volatile organic compound (VOC) emissions. The project also demonstrated the removal of particulate waste from the washwater and maintained the pH of the washwater within the IMO guidelines prior to discharge overboard.



Technology Description

For this TAP project, Bluefield Holdings installed, demonstrated, and quantified the emission reduction capabilities of a seven (7) megawatt (MW) Krystallon SC 500 scrubber on the APL England, an APL C-11 class container ship. This was the first SC 500 type scrubber built by Krystallon to be commissioned and installed on an OGV. The Krystallon scrubber was configured to treat the combined emissions from three auxiliary engines. The demonstration plan included operating the scrubber within 200 nautical miles (nm) from shore all the way to the berth. Heavy fuel oil (HFO), compliant with IMO regulations at the time of the evaluation, was used in all engines from 200 nautical miles (nm) to 24 nm; distillate fuel compliant with CARB regulation was used within 24 nm of the California coast.

The real-time continuous emissions monitoring system (CEMS) was included as a component of the scrubber system. The CEMS data compared favorably with the emissions measured by the third-party testing contractor. The CEMS allows the project team to track emissions from the scrubber. The continuous monitoring equipment functions whenever the scrubber is operating. Average and instantaneous measurements are made for: carbon monoxide (CO), carbon dioxide (CO_2), nitric oxide (NO), sulfur dioxide (SO_2) and water.



A washwater monitoring system installed on the APL England contains sensors on the intake and discharge lines to measure the following: temperature, turbidity, PAH at intake and outlet; Washwater supply pressure to the scrubber; temperature, PAH, pH and turbidity downstream of the treatment plant; temperature at washwater discharge; differential pressure across the water treatment plant; and exhaust gas pressure at the scrubber inlet and outlet.

In addition to the CEMS, a third party contractor collected and analyzed discreet emission samples, including DPM, while at berth. This testing included engine operation emission results while the engines were using both residual fuel oil and marine distillate fuels. Sampling and testing of emissions and treated washwater took place at berth in the US and while underway between Taiwan and mainland China.

Environmental Benefits

Both emissions and discharges from the scrubber were tested using U.S. EPA standard test methods and supplemented by an onboard CEMS. With the scrubber running HFO fuel, sulfur reductions were in the range of 98 to 99 percent and PM reductions ranged from 56 to 70 percent. There were only minimal reductions of NO_x (2 to 5 percent) when operating on HFO. When the scrubber ran marine gas oil (MGO) fuel, sulfur reductions ranged from 95 to 97 percent and PM reductions ranged from 68 to 75 percent[1]. There were only minimal reductions of NO_x (2 to 8 percent) when operating on MGO.

Results

The APL England completed its four-call requirement in August 2012. The draft final report documenting the results of the scrubber's performance throughout the demonstration, and emissions reduction efficiency levels, was submitted to the Ports for review in late 2012. Based on this review, additional testing of the discharge water was requested to alleviate concerns with metal particles (zinc and copper) found in the discharge water during the demonstration[2]. Additional samples taken from the scrubber discharge water in February 2013 measured copper as non-detectable and zinc at 16.7 μg/L, far below the water quality criteria of 90 μg/L. The revised draft final report was submitted in May 2013 and accepted by the Ports.

[1] Since there is less PM in MGO, the scrubber can remove a higher percentage of PM in MGO than in HFO.

[2] Upon inspection of the scrubber, it was found that one of the brass nozzles fell down into the scrubber and deteriorated causing metal particles (i.e., zinc, copper) were found in the discharge water. The nozzles were subsequently replaced with ceramic nozzles.

Project Costs

The TAP funding contributions were used to partially offset the costs associated with the scrubber equipment, as well as scrubber installation, testing, and reporting. Total TAP funding applied to the seawater scrubber demonstration was $1.65 million ($825,000 dollars per port) and Bluefield/Krystallon contributed $1.75 million.