CROE SCRUBBING SYSTEMS

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With the 2015 ECA already in effect and the 2020 Global sulfur limit getting very close, the shipping industry is evaluating their options. One of the best options available is to use scrubbing systems. Most of today's scrubbing systems reduce dangerous particulate in addition to meeting the sulfur emissions requirements. This is very positive for the industry, the environment and our health. It is reported that there are now more than 400 scrubbers sold and many operating around the globe. But that is only scratching the surface. That is only a very small percent of all the vessels that could benefit from scrubbers. Many companies are now selling scrubbers into the shipping industry and many are ready to join the competition as soon as the market is ready for it. The supply capacity is significant and is growing by the day but unfortunately it is significantly underutilized. The industry is now ready and waiting for the newbuilds and retrofits required to meet the 2020 and the existing 2015 targets.

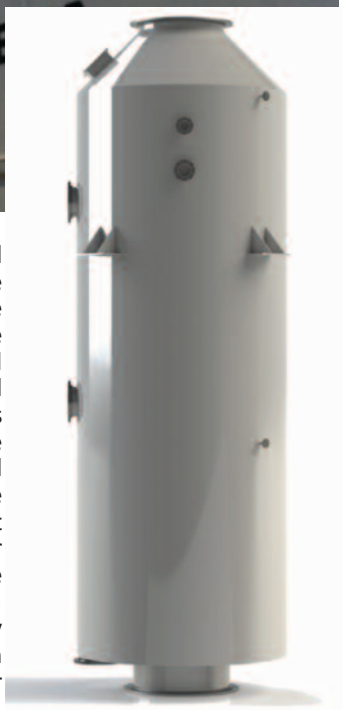
Several years ago, having forecasted the shipping industry need for scrubbing systems, CR Ocean Engineering LLC (also known as CROE®) converted one of their most successful land based scrubber designs to an on board marine design. CROE's roots date back to 1917 and its scrubber experience goes back to 1960 with more than 24,000 systems sold. Its vast experience allowed it to develop one of the best systems available to the maritime market. When using a CROE scrubbing systems, ship owners will take advantage of unparalleled experience and reputation. They can be assured that they will be able to continue using the lower cost high sulfur fuel oil even in the Environmental Controlled Areas (ECA). The system has a complete automatic control panel and will adjust its operation based on specific engine and fuel being used.

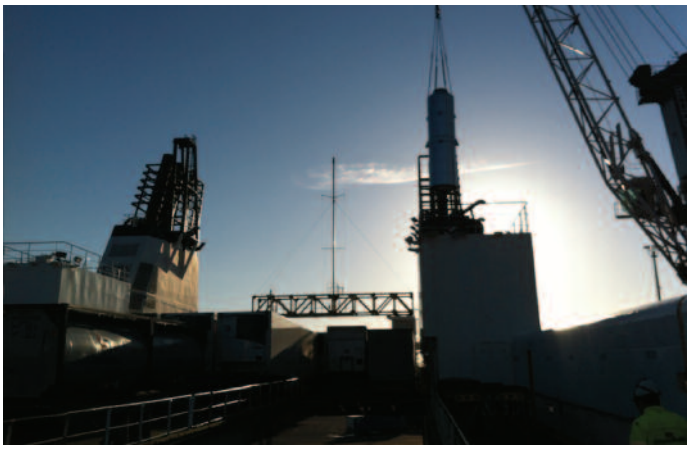
The CROE scrubbing system is designed to be relatively small in both diameter and height, highly efficient and very cost effective. It is designed to have low backpressure, has an all metal construction, requires no bypass and can run dry without concerns. An advanced technology washwater system is also provided by CROE as part of the total package. The CROE Scrubbing System is available in Open Loop (a once trough design using seawater to neutralize the collected sulfur emissions), Closed Loop (using a freshwater solution with an alkaline solution to neutralize the collected sulfur compounds) or Hybrid configurations (deigned to be both Open Loop and Closed loop and able to switch from one configuration to the other on demand).

The CROE® system can be retrofitted into existing ships or installed on new-builds. It can be used as a dedicated in-line scrubber or it can be used as multi-stream. The smaller diameter and shorter height of the CROE® scrubbing system make it the preferred system for many ship applications.

Presently CROE scrubbers are successfully operating in the North American Great Lakes, in the Baltic and the North Sea. They are presently installed on Bulk Carriers, RoRo and RoPax and on Cruise Ships. With a CROE scrubbing systems ship owners can continue using the lower cost high sulfur fuel oil even in the 2015 and 2020 Environmental Controlled Areas (ECA).

In the Great Lakes project, two CROE scrubbers have been operating for almost 2 years on a very large bulk carrier. CROE supplied the ship modification designs, foundations, demolition plan and the Closed Loop scrubbers with all peripheral equipment. The CROE system was selected among many other technologies that had been evaluated. The CROE scrubbers are presently reducing the SO2 emissions from the two main engines burning a high sulfur fuel. The major prerequisite for this installation was that the ship's exterior look would not be changed and that the installation would have to be performed from the inside of the vessel. The final design for this retrofit project allowed the 2 scrubbers to be built from within the existing funnel in sections and replaced the existing silencers. The scrubbers utilize the space and the structure that is presently being used by the silencer without any major modification to that structure or the funnel itself. This became possible due to the smaller size and simplicity of the CROE scrubber. The scrubbing system was delivered to the ship in 4 sections and then lifted into place one section at the time for final assembly and welding. In parallel, 2 storage tanks were installed in the ship's voids so that valuable space was not wasted. All other mechanical and instrumentation components were installed by separate crews while the welding and fitting took place. The scrubbers is allowing the client to continue using the lower cost HFO while meeting all the requirements of the 0.1% Sulfur equivalency requirements of the North American ECA in a fresh water environment.





Other CROE scrubbers are also operating in the European Baltic/North Sea ECA. Those clients chose to use the CROE Open Loop design with the proprietary CROE Caustic-Assist™ feature. With this design the ships can operate using seawater even when the alkalinity and salinity is very low. In today's very competitive shipping industry owners and operators need to take advantage of every avenue that is available to them. Installing the CROE scrubbers and using the lower cost fuels makes a significant difference in a company's competitiveness.

Scrubbers work. Many scrubbers are now in operation and many others in design and installation phases. With more than 60 years of successful scrubbing systems under its belt, CROE's is the perfect partner for any scrubbing project. In the end all parties want a successful system operation for many decades and all can benefit by this IMO established equivalency.