Wet or Dry? Which Scrubber Type will Reign Supreme?

New IMO regulations for the restriction of shipping vessel air pollution are on the very near horizon. These new regulations will require significant reductions in a variety of emissions within Emissions Control Areas (ECAs): most important of which are sulfur oxides (SOx) which will need to be lowered to 0.1% by 2015 (within ECAs) and 0.5% globally by 2020 (in non ECA areas). Additionally, Tier III limitations for nitrogen oxides (NOx) for all ships built after January 2016 will require reductions depending on the speed of the vessel and whether it is within an ECA or other waters. CO2 emissions from these vessels will also have to be lowered.[i]

These more strict standards for air pollution emissions have companies worldwide looking to a variety of techniques for mitigating their emissions. Scrubbers are one of the current popular choices for ensuring fleet compliance, but there are several types, each of which offer their own benefits. Which one will gain the advantage and become the system of choice as the shipping industry moves toward a greener reputation?

Pros and Cons of Wet and Dry Scrubbers

Scrubbers represent one exhaust gas cleaning system (EGCS) available to marine vessels for reducing air emissions. Any time an EGCS system is considered, there are several factors that need to be weighed in order to make the optimal choice, including weight and stability, water handling systems, stack arrangements, exhaust backpressure, and electrical power needed to run the systems. Wet and dry scrubbers offer advantages and disadvantages along all of these metrics.

To begin, wet scrubbers use either fresh or sea water to remove exhaust gas impurities. The waste water is then discharged into the sea or retained within a closed loop when discharging it is not permitted. An open loop sea water system is a passive solution in that it has very few moving parts and requires hydraulic pressure provided by a pump in order to run. The system includes pumps and strainers, was water filters, sludge handlers, effluent monitors, and exhaust gas monitors.

In an open loop system, waste water is simply put overboard while at sea. This type of system requires regular maintenance, de-fouling, and operational checks, but is otherwise low maintenance. It also doesn't need a great deal of space for storage of waste material.

In a closed loop fresh water wet scrubbing system, there's a buffer tank, a heat exchanger, pumps and strainers, a sodium hydroxide unit, and water treatment device. Like the open system, there are no internal moving parts, and other than occasional inspections there is very little maintenance required. One disadvantage of this option, however, is that it requires storage space (the buffer tank) to hold waste water until it can be discharged.

The downside to using a wet scrubber is that is cools the exhaust gas, a problem that's not faced by dry scrubbers. Additionally, with wet scrubbers, selective catalytic reduction systems must operate before the scrubbers. Fitting all of this together, especially for dual-fuel engines can be quite complex.

Dry scrubbers also effectively remove exhaust gas pollutants, but they employ a filter or bed of granulated hydrated lime. The chemical reaction between the SOx and the lime creates calcium sulfate which can then be disposed of as solid waste when the ship reaches a port.

A dry scrubber offers several advantages. First, this type of system does not result in the production of liquid effluent that must be disposed of overboard. Of course, most importantly, dry scrubbers will reduce NOx emissions substantially, however, on the downside, dry scrubbers require significant onboard storage to handle the dry bulk reactants and products associated with the process.

Additionally, there must be a readily available supply of the reactants. These reactants can also be quite costly, especially when you add in urea for NOx abatement and calcium hydroxide for SOx abatement.

Shipping companies have begun to employ both types of scrubbers, working to find which technology best suits their purposes. Both pose challenges, not least of which is the weight of the equipment. Mounted above the engine, scrubbers can create challenges for a ship's stability, which requires some kind of compensation such as extra ballast or disposition of cargo.

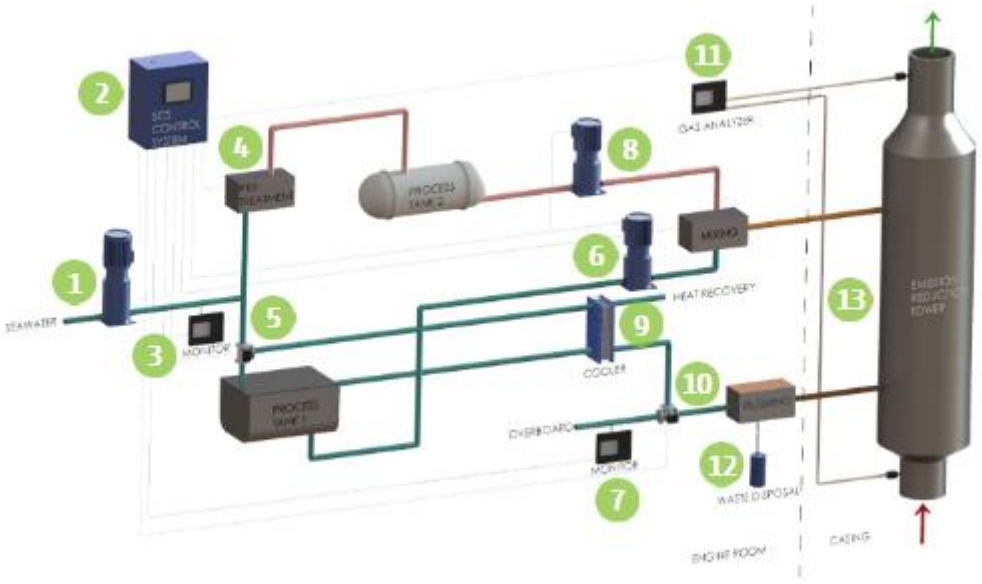
Hybrids: A Simple Solution for Retrofitting Vessels with Scrubbers

Some of the most interesting advancements in scrubber technology are happening within the wet scrubber segment. Ecospec of Singapore, for instance, has been working on a hybrid emissions solution called the CSNOx system. The first stage of this solution uses an open loop wet scrubber, whereas the second stage scrubber uses sea water specifically conditioned by ultra-low-frequency waves to absorb any remaining SOx. It also absorbs NOx and CO2, making it a three-in-one solution.[ii]

The system has been verified to remove 99% of SOx, 77% of CO2, and 66% of NOx when tested on a 100,000 tonne Aframax tanker. This mans the system will remove SOx and NOx emissions to Tier III levels as required by Annex VI.[iii] The White Sea vessel of Tanker Pacific is currently run tests of this system. The CSNOx has also been installed recently in Canada Steamship Lines' Great Lakes vessel.[iv]

Green Tech Marine has developed an innovative wet scrubber design called the GTM R15. This system, which can be installed on heavy fuel oil ships as a way of achieving the strict IMO Tier III SOx emissions requirements, can simply replace a ship's exhaust silencer without any structural modifications. It's lightweight which means there are few stability implications. It is also a hybrid system that can operate in both open and closed loop conditions.[v]

Wartsila also has a hybrid scrubber system that can operate as closed-loop while at port and as an open loop while at sea using only sea water. The system boasts the ability to re-

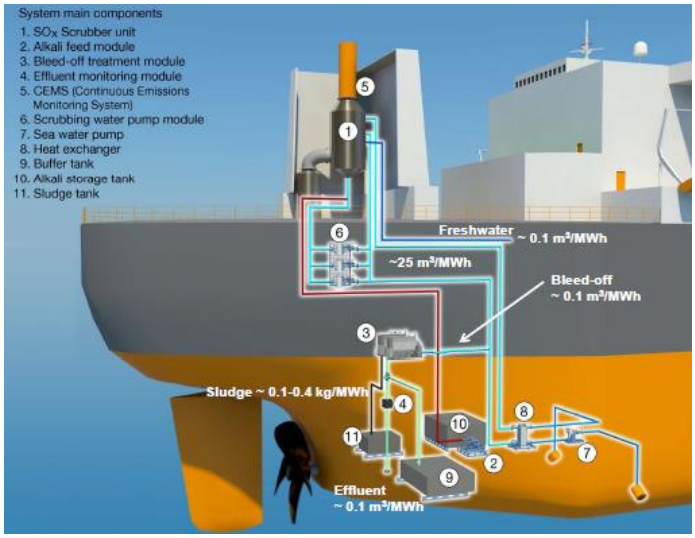


Green Tech Marine's GTM R15 Hybrid Wet Scrubber

oxygenate the water before discharging it, which is important in sensitive marine areas such as Alaska. Most importantly, the system is said to reduce SOx by 97% emissions in a cost-effective manner.

Challenges to the Adoption of Scrubber Solutions

The more stringent emissions standards have not yet come fully into effect, and so there is still time for companies to consider their options, with many still expressing concerns about the viability of scrubbers. For instance, some ship owners are hesitant to install technologies that have had little testing time in maritime conditions. As a result, adoption of these new technologies has been slow ahead of mandates that require them. This is especially true if a particular vessel operates primarily outside of ECAs.[vi]



Wartsila Hybrid Scrubber System

There is also skepticism about the cost-effectiveness of scrubber technology. On the one hand, some have argued that installing a scrubber can reduce fuel expenses so substantially that they offer a competitive advantage. In fact, a recent Glosten Associates report prepared for the Ship Operations Cooperative Program in the US showed this to be true after testing three ship types within an ECA.

The report explicitly states, "On the one hand, the fuel cost savings for those operating within an emissions control area (ECA) is so substantial that an EGCS may be a competitive necessity. On the other hand, installations are discouraged because the technology is not yet fully mature, places a significant burden on ship arrangements and operations, and raises some environmental impact concerns."[vii] That said, the report concludes that any ship that burns 4,000 metric tons or more of fuel oil within an ECA should use an exhaust gas cleaning system of some type.

Even in other circumstances, the report suggests that in spite of challenges associated with retrofits, the changes are worth the cost.

Additional complexities of using scrubber technologies are posed for those vessels with multiple engines. Here again, Wartsila has offered a cost-effective solution with their new Krystallon Exhaust Gas Cleaning System. The system can remove both SOx and particulate matter from exhaust bases produced by both main and auxiliary engines. The system will be installed in agreement with Wilh Wilhelmsen ASA for their MV Tamesis vessel.[viii]

Conclusion

Many innovations are developing in the shipping industry to address the need to meet tighter emissions regulations, with scrubbers playing a leading role. Even the software industry is jumping on board, with IT experts pointing out that greater emphasis needs to be placed on software solutions to replace logbooks and noon reports for monitoring fuel consumption and emissions data.[ix] Which technology will win out as the dominant choice for meeting IMO regulations has yet to be determined. It's a fast-moving segment of the shipping industry and one that's worth watching over the next few years.

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A student of all things green, Maryruth has a special interest in cleantech and green buildings. In recent years, Maryruth has worked as the senior editor of The Green Economy magazine, is a regular blogger for several green business ventures, and has contributed to the editorial content of not one, but two eco-living websites: www.ecolife.com and www.GreenYour.com. You can learn more about Maryruth's work by visiting her site, www.jadecreative.com.

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