Solution of SOx Regulation and References in Europe
- Scrubber Solutions by Bilfinger Engineering & Technologies GmbH

Lars Justus Ravens

The market offers a huge diversity of possibilities how to meet the new requirements of sulphur emissions. The scrubber not only commercially offers the most attractive solution but will also provide reliable and well-proven technology in de-soxing emissions. Bilfinger in the market, provides sophisticated and advanced solutions which is tailor made for each vessel considering a scrubber with both open and closed loops, single and multi-stream, and by-pass and in-line methods. The advanced solutions that Bilfinger can provide is originally from its accumulated experience with flue gas cleaning system onshore to various applications. With its rich experience in flue gas cleaning, Bilfinger has successfully retro-fitted inline-multi-stream-hybrid-scrubber to a 24,000dwt chemical tanker which now has the ability to clean the exhaust gas of 6 emission sources simultaneously.

Fig. 1  SOx Scrubber Retro-Fitted Chemical Tanker by Bilfinger Engineering & Technologies GmbH

1. Introduction

The worldwide concern about uncleaned ship flue gas emissions from high sulphur fuels are almost daily topics in the maritime news and 2020 is approaching and the world wide sulphur cap of only 0.5% in marine fuels will become effective.

The ship owners and ship operators are forced to set new strategies in regard to the bunker for their vessels, since the conventional HFO cannot be used anymore.

The market offers a huge diversity of possibilities how to meet the new requirements of sulphur
emissions. These possibilities reach from conventional low sulphur fuels (distillates or gas oils) over hybrid fuels and alternative fuels (LNG, LPG, etc.) to exhaust gas after treatment solutions (scrubbers).

Commercially the scrubber offers the most attractive solution, since the cheapest fuel can be used to operate the vessel and technically the extend of installation and integration work on board, even in case of a retrofit is acceptable and in a good ratio of cost and value.

Since the beginning of 2015, the Northern European and Northern American seas were declared as ECAs (Emission Controlled Area). In these areas the rules for shipping business are even more strict. The maximum sulphur content in marine fuel may not exceed 0.1% sulphur, unless the vessel is equipped with a scrubber. Alternative fuels are another option, but not feasible when not subsidized by the governments.

The majority of ship owners and ship operators of those, who decided to take measure to avoid the higher fuel cost due to low sulphur bunker, decided to install scrubbers, either they retrofitted or equipped their newbuildings with scrubbers during the construction phase.

The commercial benefit to operate the vessel within the ECAs on high sulphur fuel and to clean the exhaust gas with a scrubber and by this to gain on the low fuel costs is by far the most attractive solution when the vessel entirely or by majority operate within the ECA.

The technology of scrubbers is a reliable and well-proven and so it is a very good measure for the ship owners, ship operators as well as the ship designers and ship yards to consider to comply with the regulations and requirement coming into force worldwide.

This article shall deliver some explanation and clearing up about the different solutions of scrubber which are feasible to apply on ship.

2. Bilfinger Engineering & Technologies GmbH (BET)

BET is part of Bilfinger SE which is leading international industrial services provider. Bilfinger is a German stock-listed enterprise with about 37,000 employees. Bilfinger. BET has decades of experience with flue gas cleaning systems onshore for all kind of applications. This expertise and background BET uses to offer scrubber solutions for the maritime industry.

3. Scrubber Technology for Ships

3.1 Scrubber process

To desulfurize the exhaust gas of main engines, auxiliaries and oil fired boilers (single called source, all together called sources) the scrubber has to work with dry or a wet cleaning process. Due to the space limitation on board of a ship only wet processes make sense.

The wet scrubbing process uses water clean the exhaust gas of sulphur. Therefore, the water is used for two purposes. First, the exhaust gas from the source has to be cooled down as the chemical process of desulfurization takes place far below the regular exhaust gas temperature and second the water is used to clean the exhaust gas from sulphur emissions. The result of the cleaning process is a sulphate of different composition depending on if an open loop or a closed loop.

3.1.1 Open Loop Scrubber Process

The open loop scrubber process uses sea water and its natural alkalinity to clean the exhaust gas. Due to this the scrubber is forced to use as much as sea water as required to clean the exhaust gas. The wash water discharges to the sea without being used again.
3.1.2 Closed-Loop Scrubber Process

Contrary to the open loop, the closed-loop process works with wash water which circulates in a closed circuit. Due to this water has to be mixed with a reaction agent to run the chemical process and to clean out the sulphur from the exhaust gas. Depending on the used chemical as reaction agent, e.g. caustic soda, soda or magnesium oxide, the sulphur is ligated again as a sulphate in the wash water. As the wash water runs a circuit and continuously gets in contact with the hot exhaust gas, the wash water has to be cooled itself again to regain some of the wash water which evaporates during the exhaust gas cooling. If the wash water will not be cooled, the water amount to feed up the circuit would be a huge amount and would make the process not feasible. The wash water circulates from process tank into the scrubber and back again. Since the sulphate content increases over the time the same wash water has to be discharged and replaced by new water. The discharged water has to be treated by a water treatment system, before discharging to sea.

3.1.3 Hybrid Scrubber

The hybrid scrubber combines the two processes of open loop and closed loop. The system is able to switch between the two processes.

3.2 Scrubber Concepts

The scrubber concepts are differentiated between the number of sources which are connected to the scrubber and if there by-passes are connected.

3.2.1 Single Stream / Multi-Stream Scrubber

A single stream scrubber receives the exhaust gas of only one source. The scrubber has to be designed only in accordance to one specific source, so the dimensioning is relatively simple while a multi-stream scrubber receives the exhaust gas of two or more sources.

The multi-stream-scrubber is designed to serve two or more sources at the same time. The load of the various sources can differ from the source or the others sources. This requires from the scrubber maker good and extensive experience in regard of process and flow technology.

3.2.2 By-pass / In-line Scrubber Unit

The scrubber unit can be designed in two ways and this refers to the scrubber tower where the exhaust gas is cleaned inside. Either the scrubber tower is capable to run dry, so the exhaust gas can go through the scrubber tower without being cooled and cleaned. This means the material of the
scrubber tower has to be accordingly.

If the scrubber is not made to run dry, the scrubber unit requires a by-pass of the exhaust gas, so that the hot exhaust gas can go through the by-pass when the scrubber is not in operation.

3.3 Emission Measurement Technology
A very important part of the scrubber system is the emission measurement technology which has to take care of the air emission side and the emissions to the sea. Both emission sides, air and sea, continuously have to be monitored and recorded so that authorities can follow the track history at all time. The measurement technology has to be chosen very carefully, since it is a very important part to ensure a reliable function and operation of the scrubber system.

4. BET's Specifics of Scrubber Technology and Concepts

The BET scrubber has the specialty not to be made as a series product. The design is flexible and tailor made for the individual vessel.

The BET scrubber uses for the cleaning process only spray nozzle and does not use internal packing material or layers with filling material. This packing or filling material have the disadvantage that is can block when not cleaned from time to time.

The flexibility of the design means there is no given geometry, so the scrubber can be designed cylindrical or squared.

Figure 4 shows the example of a multi-stream hybrid scrubber. This scrubber has the common inlet of the exhaust gas at the low side end and in front of it the exhaust gas collector. This unit collects the exhaust gas before entering the scrubber.

By all this the BET scrubber is very compact in size and is of very much interest, but not only, when space restriction is essential.

5. Reference of a Bilfinger Scrubber for Maritime Applications

BET shows its expertise and experience of the scrubber technology for maritime application on board of a 24,000dwt chemical tanker very impressively summarized in Figure 5. The installed scrubber system is multi-stream-hybrid-scrubber. This scrubber is designed to clean the exhaust gas of 6 sources simultaneously.

This means the vessel run on HFO with a high sulphur content at all time. This save the operator every day several thousands of dollars and makes
his very more economical compared to its competitors.

Fig 5  Summary of Chemical Tanker Scrubber

Authors

• Lars Justus Ravens
• Born in 1980
• Bilfinger Engineering & Technologies GmbH
• Graduated from Kiel University of Applied Science