

## **Clean Shipping Alliance 2020 Answers 10 Key Questions about Scrubbers**

October 18, 2018 -- Clean Shipping Alliance 2020 (CSA 2020) is a new organization consisting of 25 leading maritime companies representing over 2,000 ships from the commercial shipping and cruise industries. The international organization was formed with the mission of providing information about the environmental benefits of Exhaust Gas Cleaning Systems (EGCS), also commonly referred to as “scrubbers.”

The following are 10 questions and answers regarding EGCS (scrubbers) operations:

### **1. How does a scrubber reduce sulfur oxide (SO<sub>x</sub>) emissions?**

A scrubber sprays alkaline water into the vessel’s exhaust, which removes SO<sub>x</sub> from the ship’s engine and boiler exhaust gases. In a seawater system the sea’s natural alkalinity largely neutralizes the results of SO<sub>2</sub> removal before discharge back to the sea. In a fresh water system, the wash-water used for scrubbing and neutralization is treated with an alkaline chemical such as sodium hydroxide. In both cases the sulfates resulting from the SO<sub>2</sub> removal will be discharged with the wash-water to the sea.

### **2. Is the sulfur included in the wash-water from the scrubbing process harmful to the sea?**

Sulfur in the form of sulfate is the end product of the scrubbing process and is a naturally occurring constituent of seawater and therefore not harmful to the sea. The oceans are the Earth’s natural reservoir of sulfur and play a key role in the sulfur cycle. Sulfur is one of the most common elements and is both biologically necessary and critical to many metabolic processes.

To provide perspective, consider the following: If all the sulfur in the oceans were accumulated at the bottom of the ocean the layer would be five feet thick; adding all the sulfur from all the oil and gas reserves in the world would add only the thickness of a sheet of paper. Compared with the quantity of sulfate existing in the oceans, the small amounts of sulfate contributed by exhaust gas scrubbing are insignificant and benign.

Removing sulfur from the exhaust via the scrubbing process has the important added environmental benefit of reducing the negative impact of emissions to air, as air emissions in the form of SO<sub>2</sub> can add to the formation of particulate matter.

(Source: Nyman GBG Tokerud A. (1991). Seawater scrubbing removes SO<sub>2</sub> from refinery flue gases. Oil and Gas Journal 89. 51-55).

### **3. Do scrubbers have an acidification effect on seawater?**

During the desulfurization process within the scrubber, SO<sub>2</sub> gas is absorbed by the seawater spray. Through a series of reactions within the wash-water, the SO<sub>2</sub> is converted to an end product of sulfate (SO<sub>4</sub>), water (H<sub>2</sub>O) and carbon dioxide (CO<sub>2</sub>).

During the scrubbing process any decrease in the pH of the wash-water is largely neutralized by the natural alkalinity found in seawater. This ensures that the pH of the discharged water is in compliance with guidelines established by the International

Maritime Organization (IMO). The resulting discharge contains only a slight increase in the natural concentration of sulfate in water.

Direct measurements on 40 ships monitored by maritime classification societies while the ships were in port have shown that pH levels of scrubber discharge water revert to ambient seawater pH levels within two to four meters of the discharge point – exceeding the IMO requirement. As shown by a 2012 Danish Environmental Agency study, there is negligible acidification effect from scrubbers, even in semi-enclosed ocean areas with high traffic levels of scrubber-fitted ships.

(Source: Andreasen, A. and Mayer, S.: Use of Seawater Scrubbing for SO<sub>2</sub> Removal from Marine Engine Exhaust Gas, *Energy Fuels* 21, 3274–3279, 2007).

(Source: COWI2012: Kjølholt, J., S. Aakre C. Jürgensen, J. Lauridsen Assessment of possible impacts of scrubber water discharges on the marine environment, (COWI, 2012) Danish Environmental Protection Agency).

#### **4. How is it ensured that the water discharged into the sea does not harm the environment?**

The following discharge water parameters are continuously monitored through water analysis instruments, and the results are securely logged against time and the ship's position:

- (a) pH (with temperature compensation),
- (b) polycyclic aromatic hydrocarbons (PAH), and
- (c) turbidity.

All are per IMO Resolution MEPC 259(68) 2015 Guidelines for Exhaust Gas Cleaning Systems. The data must be retained on board for a period of not less than 18 months from the date of recording and is subject to auditing and verification by port states and by classification societies, on behalf of flag states.

#### **5. Do scrubbers on ships using heavy fuel oil (HFO) reduce SO<sub>x</sub> emissions as efficiently as the use of compliant fuel?**

According to several studies, such as a 2014 Fridell and Salo study, scrubbers on ships using HFO remove more than 98 percent of the sulfur oxides from the exhaust, resulting in emissions lower in sulfur oxides than those of marine gasoil (MGO), which is considered the benchmark for the IMO's 0.5 percent sulfur cap scheduled to be implemented on January 1, 2020. As a result, scrubbers are an approved method of compliance with the sulfur regulation by the IMO, European Union and US Environmental Protection Agency.

(Source: Fridell, Erik & Salo, Kent. (2014). Measurements of Abatement of Particles and Exhaust Gases in a Marine Gas Scrubber. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*. 230.10.1177/1475090214543716)

#### **6. Do scrubbers reduce other type of emissions as well?**

Independent studies and research demonstrate that scrubbers are capable of removing 60 to 90 percent of particulate matter (PM), including a portion of small PMs (10 and 2.5

micron, and ultrafine) which results in releasing fewer PMs in the atmosphere compared to using MGO.

Scrubbers are also effective in removing black carbon (BC), of particular interest because of the potential impact in Arctic regions.

(Source: Lack, DA, Thuesen, J, Elliot, R, Stuer-Lauridsen, F, Overgaard, S, et al. 2012 Investigation of appropriate control measures (abatement technologies) to reduce Black Carbon emissions from international shipping. IMO)

### **7. Will the use of scrubbers increase the speed of the vessels and subsequently CO<sub>2</sub> emissions?**

No, there is no link between scrubbers and vessel speed. All practical methods which reduce CO<sub>2</sub> emissions are welcome, and the option of slow steaming is one, way of reducing fuel usage and CO<sub>2</sub> emissions that is always available. Scrubbers do not interfere with this in any way.

(Source: CE Delft; The ICCT; Mikis Tsimplis, 2012. Regulated Slow Steaming in Maritime Transport: An Assessment of Options, Costs and Benefits, Delft: CE Delft)

### **8. What other environmental benefits do scrubbers have?**

Scrubbers allow vessels to continue using HFO, a residual fuel with high energy content that is difficult to refine, providing an environmentally sound outlet for this refinery byproduct. To further process HFO, refineries would need to invest heavily in upgrading their facilities, which would take years to materialize.

Less refining also means less greenhouse gas emissions associated with HFO versus MGO production. Also, the lower combustion temperatures of HFO result in less NO<sub>x</sub> production.

### **9. Is scrubbing technology new to the shipping industry?**

Inert gas systems installed on tanker vessels have been using the same principle as exhaust gas scrubbers for decades. Scrubbers for SO<sub>x</sub> removal have been in operation in the global maritime sector for over 10 years. Currently, hundreds of vessels are successfully using scrubbing technology to comply with the 2015 sulfur regulation in existing Sulfur Emission Control Areas (ECAs) under rules from the IMO/Marine Environment Protection Committee (MEPC) Guidelines, as well as the EU Sulfur Directive, US EPA Vessel General Permit and US Coast Guard Directives.

Scrubbers for SO<sub>x</sub> removal have also been in successful use on land for many years all over the world and continue today, including for oil-fired power generation plants.

### **10. Are scrubbers a better way to comply with the IMO 2020 sulfur cap compared to compliant fuel?**

Both scrubbers and compliant fuel are equally acceptable and environmentally sound methods of compliance with the 2020 sulfur cap, and scrubber use is an equivalency under Marpol VI for global operations. However, CSA 2020 believes that both are essential tools for significantly reducing the environmental impact of the maritime sector.

Members of the CSA 2020 include:

1. Blystad Group
2. Cargill Inc.
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4. Delta Tankers and Marmaras Navigation
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