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To:	All Surveyors/Auditors
Applicable to flag:	All Flags
	High sulfur fuels
Reference:	Air Pollution and BWM

High sulfur fuels

By reducing the SOx emissions, the scrubber also controls much of the secondary PM that is formed in the atmosphere from these emissions.

Scrubbing chemistry

The sulfur oxides of shipping exhausts typically consist of ~95 percent sulfur dioxide, SO2, and the remaining ~5 percent of sulfur trioxide, SO3. When dissolved, a reaction occurs whereby the sulfur dioxide is ionised to bisulfite and sulfite, which is then readily oxidized to sulfate in seawater containing oxygen.The ionization of SO2 and the sulfuric acid formed from sulfur trioxide (SO3) also produces acidity, whence the corrosion problems scrubbers cause (in addition to low pH).

The sulfuric acid in the water then reacts with carbonates and other salts in the seawater to form sulfates (USEPA, 2009a). The acidity is neutralized initially by the alkalinity of the seawater, due to its natural bicarbonate content. After the initial buffering capacity is consumed, the pH of washwater is reduced significantly (some reports down to three). At low pH, the ionization of sulfur to sulfite is negligible and exhaust gas cleaning is limited.

Why is sulfur discharged to sea better than keeping it in the exhaust?

Questions arise to whether it is at all better to remove sulfur from the exhaust and then discharge it back to the sea. As we have seen above, the SOx from scrubbers end up as sulfate. Sulfate is an abundant and conservative component of seawater; therefore, the discharge of this parameter

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does not represent a limiting factor for seawater scrubbing. Studies have shown that sulfate increase from exhaust gas scrubbing would be insignificant when compared with the quantity already in the oceans. Thus, removing the harmful SOx from exhaust gas and diluting it to the sea seem to be a better deal, at this stage (refer to my conclusion and recommendation below).

Are there other concerns with discharged washwater from scrubbers?

The following issues are usually recognized as matters of concern in washwater of scrubbers:

COD: Chemical Oxygen Demand, which is a measure of the theoretical oxygen consumption of a water sample. The oxidization of bisulfite and sulfite to sulfate increases the COD, which could potentially have an adverse impact on aquatic systems.

Metals: Metals are a diverse group of pollutants, many of which are toxic to aquatic life and humans. While some metals, including copper, nickel and zinc, are known to be essential to organism function, many others, including thallium and arsenic, are non-essential and/or are known to have only adverse impacts. Even essential metals can do serious damage to organism function in sufficiently elevated concentrations.

The IMO Guidelines do not contain any limits for the concentrations of metals in washwater discharge, although the IMO requests shipowners to sample and analyze washwater for a suite of metals. Turbidity is monitored as a surrogate for suspended solids. The underlying assumption is that by maintaining a low turbidity level, metals, which are usually bound to particles or were particulates themselves, are effectively removed by the washwater treatment plant.

This assumption is highly contended (some tests have shown already in 2011 that washwater contain arsenic, copper, lead, nickel, zinc, cadmium, chromium, vanadium and selenium) at concentrations that could pose a risk to the environment.

Nitrates: Nitrate is the most highly oxidized form of nitrogen, and excess nitrate concentrations in aquatic systems can be harmful. The IMO has limitations on nitrate concentrations in washwater.

PAH: Polycyclic aromatic hydrocarbon. PAHs are the largest known group of carcinogenic substances and include many individual chemical substances containing two or more condensed aromatic rings. PAHs occur naturally in petroleum and are also produced as by-products of fuel combustion. PAHs are an important class of environmental contaminants that are known to accumulate in ecosystems.

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The IMO has set limitations on discharged PAH in therms of the maximum continuous PAH concentration in the discharged washwater, measured in phenanthrene equivalence (PAHphe). There are numerous concerns to the way the IMO has approached the PAH issue, including even the equivalency between PAH concentrations and PHAphe as a measuring equivalency, which is not clearly explained in the IMO documentation.

pH: There is some concern that sending seawater back into the ocean with acidic sulfur-containing wastewater is harmful to the marine ecosystem. The washwater from a seawater scrubber unit can have a pH as low as three. Therefore, to avoid a negative impact on ecosystems and potential corrosion issues, neutralization and dilution is required to meet the minimum pH standards set out by the IMO, which are measured differently than the U.S. EPA.

Turbidity: Turbidity is a measure of the amount of suspended solids in the water, based upon the loss of optical transparency (i.e. cloudiness) of the water. When combined with PAH, the measurement of turbidity is intended to demonstrate that the scrubber and washwater treatment system is operating correctly. However, turbidity is not a direct method of determining the amount of exhaust particles that end up in the washwater, because there is no direct correlation between turbidity and particle concentration. Further, turbidity values are strongly dependent on the size of particles in the water; smaller particles are likely to have significantly less influence on the measured turbidity than larger ones.

Recommendations

A quick analysis of the concerns raised with washwater from scrubbers indicate that more independent research and a more thorough analysis of the environmental risks those systems pose is needed. This applies regardless of whether the system is open, closed or hybrid.

Currently, with Ballast Water Management Systems, Active Substances are subject to approval by the IMO's expert panel, GESAMP, before those systems are allowed to be type approved and commercially applied. This approval is based on a holistic risk assessment using MAMPEC and other risk assessment tools.

It is currently unknown why the IMO has not required the same assessment be done on washwater effluents from scrubbers within the frame of the same GESAMP group. While there might be a justification of each of the concerns raised above, and manufacturers might have done those risk

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assessments, the whole point of the GESAMP group is to look into the combination of all issues and factor inn as a consolidated result of the environmental impact, in a systematic and similar way, regardless of the type approval authority.

REFERENCES:

- Air Pollution. Courtesy of Jad Mouawad, Mouawad Consulting

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Kindest Regards,

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