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AIR POLLUTION PREVENTION

Scrubbers as an alternative compliance method under regulation 4 of MARPOL Annex VI for regulation 14 from an air quality impact perspective

Submitted by Canada

SUMMARY

Executive summary:	This document requests the Committee to evaluate the efficacy of scrubbers, currently in operation on ships, at reducing particulate matter (PM) emissions compared to low sulphur fuel and in consideration of the goals of regulation 14 of MARPOL Annex VI; encourage submissions of data on PM emissions from scrubbers; and encourage submissions on near and long-term solutions to mitigate the impact of scrubbers on the environment.
Strategic direction, if applicable:	1
Output:	1.23
Action to be taken:	Paragraph 19
Related documents:	PPR 6/INF.11; PPR 7/INF.23; PPR 9/INF.21; PPR 11/7/3; PPR 12/INF.15; MEPC 76/9/1, MEPC 76/INF.5; MEPC 79/5/3; MEPC 81/5/4 and MEPC 82/5

Introduction

1 Regulation 14 of MARPOL Annex VI (Sulphur Oxides and Particulate Matter) mandates the maximum allowable sulphur content of marine fuels, which is intended to reduce both sulphur oxides (SO_x) and particulate matter (PM). The limits were reduced from 4.5% to 3.5% starting 1 January 2012, and then to 0.50% from 1 January 2020 onwards, except in designated Emission Control Areas (ECAs). In ECAs, the maximum sulphur content was limited to 1.0% after 1 July 2010 and 0.10% in January 2015. Different types of marine fuels have varying sulphur content; this submission considers distillate fuels to be marine fuels with a sulphur content of less than 0.1%, including marine gas oil (MGO) and marine diesel oil (MDO), noting that there can be other fuels with low sulphur content. Further, it assumes that fuels such as "heavy fuel oil" (HFO), which encompasses fuels referred to as "intermediate fuel oil" (IFO) have a sulphur content above 0.5%.

2 Regulation 4 of MARPOL Annex VI ("Equivalents") allows, with the approval of the Administration, the use of alternative compliance methods for meeting emissions requirements, provided that they are "at least as effective in reducing emissions regulated by the Annex" including the standards set forth in regulations 13 and 14. Regulation 14, Sulphur Oxides and Particulate Matter, controls emissions by limiting the maximum sulphur content of fuel oil used on board ships globally and in ECAs. In the approval of "Equivalents", the Administration of a Party "should take into account any relevant guidelines developed by the Organization" (regulation 4.3). Further, the Administration "shall endeavour not to impair or damage its environment, human health, property, or resources, or those of other States" (regulation 4.4).

3 As an alternative to using low-sulphur fuels to meet regulation 14, regulation 4 of MARPOL Annex VI allows the fitting of ships with wet sulphur oxides (SO_x) exhaust gas cleaning systems (EGCS) also known as "scrubbers". This has provided cost-savings to the industry by enabling the continued use of less expensive high-sulphur HFO. The Organization has developed and updated several versions of the *Guidelines for exhaust gas cleaning systems* (EGCSs) to allow for the testing, survey, certification, and approval of scrubbers in accordance with regulation 4 of MARPOL Annex VI.

4 This document discusses the use of scrubbers from an air quality impact perspective regarding whether the current scrubbers in operation meet the requirements laid out under regulation 4 of MARPOL Annex VI as an alternative compliance method for regulation 14, as it relates to the objective of reducing PM. This document provides the regulatory context, the conclusions of a study conducted by Canada on air emissions other than SO_x from scrubbers, and a recommended way forward.

Performance of scrubbers in addressing PM

5 The use of scrubbers as an alternative compliance mechanism has been discussed at recent IMO meetings over environmental concerns, including concerns on the environmental impacts of scrubber discharge water, as well as air quality concerns stemming from air pollution emissions from engines fitted with scrubbers.

6 Regarding the environmental impacts of scrubber discharge water, the International Council for the Exploration of the Sea (ICES), an intergovernmental marine science organization whose purpose is to provide evidence on the state and sustainable use of the ocean, submitted two documents to MEPC 76 (MEPC 76/9/1 and MEPC 76/INF.5 (ICES)). These documents outlined the risks to the marine environment posed by scrubber water discharge and recommended a rapid and complete transition to the use of cleaner low-sulphur fuels, including distillate fuels (e.g. marine gas oil), liquefied natural gas, and biofuels, which can meet sulphur air emission limits without the use of scrubbers. They recommended that until the transition is complete, the discharge of scrubber water to the marine environment should be avoided. Additionally, at the request of IMO, the Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) formed a Task Team on Exhaust Gas Cleaning Systems (PPR 7/INF.23). The Task Team concluded that EGCS efficiently remove sulphur from air emissions and using Exhaust Gas Recirculation (EGR) and Selective Catalytic Reduction (SCR) can increase the efficiency, especially for NO_x. However, the Task Team also concluded that achieving high efficiency for PM is crucial, as chemicals attached to PM, such as heavy metals and polycyclic aromatic hydrocarbons (PAHs), can be better controlled in water than in air.

7 In following the discussion on scrubbers, documents MEPC 79/5/3 (FOEI et al.), MEPC 81/5/4 (FOEI et al.) and MEPC 82/5 (FOEI et al.) also expressed views on the equivalence of scrubbers in meeting regulations and all three have urged the Committee to take actions with respect to the allowance of scrubbers as equivalent compliance. It is

important to note that, unlike using high sulphur fuel in combination with scrubbers, using sulphur-compliant fuels does not result in water discharges. Further, over 45 jurisdictions have adopted measures (bans or restrictions) at different levels of jurisdictions on the use of scrubbers primarily due to the impacts of wash water discharges. While the above noted submissions raised the issue of water pollution, this submission is flagging yet another issue with scrubbers: air pollution.

8 Regarding air quality concerns, document PPR 9/INF.21 (Canada) reported that while ships using scrubbers and HFO meet the low-sulphur requirements, they are expected to result in higher amounts of CO_2, PM, and Black Carbon compared to using compliant low-sulphur fuels, in particular MGO. It was found that, when using 2.6% sulphur HFO (the global average sulphur content), direct CO_2 emissions were expected to be 4% higher compared with MGO. Further, PM emissions can be approximately 70% higher, and Black Carbon emissions can be 81% higher for a medium-speed diesel engine and more than 4.5 times higher for a slow-speed diesel engine.

9 Canada's information submission to PPR 12 (PPR 12/INF.15) further builds on this previous submission and reports on the use of scrubbers by ships in Canada and the theoretical modelling analysis on air pollutant emissions and impacts to air quality and health in Canada. It reports that, since 2018, the number of ships operating in Canadian waters fitted with scrubbers increased significantly (100 in 2018 compared to 852 in 2022). The use of scrubbers by ships was found to result in higher $PM_{2.5}$, Black Carbon and GHG emissions. The analysis shows that the use of scrubbers could be eroding the expected air quality benefits of the North American ECA and increasing ambient $PM_{2.5}$ concentrations in populated coastal areas in Canada, which will result in adverse health impacts to Canadians. Given this is the first analysis looking at the highest case possible, Canada is continuing work on this topic.

10 Document PPR 11/7/3 (FOEI et al.) reported findings from aerial surveillance operations carried out by the Royal Belgium Institute of Natural Sciences (RBINS) to monitor sulphur emissions from international shipping. These findings revealed that the use of scrubbers presents significant concerns, as ships equipped with scrubbers were more frequently found to be non-compliant in the southern North Sea, and SO_2 emissions from scrubber-equipped ships were found to be considerably higher than those Ocean-Going Vessels (OGVs) without scrubbers and using distillate fuels.

11 To reduce emissions of PM, nitrogen oxides and SO_x from shipping, California adopted the "Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline" regulation *(*OGV Fuel regulation*)* in 2008. The OGV Fuel regulation requires ships with diesel-fuelled engines to use either MGO or MDO with a maximum of 0.1% sulphur by weight, while operating in regulated California waters[1].

12 The OGV Fuel regulation was designed to improve air quality and reduce public health risks from air pollutant emissions. The California Air-Resources Board (CARB) has published some reference documents to this regulation, including a study that concludes that scrubbers effectively remove sulphur emissions to meet the fuel sulphur requirements but will result in higher PM emissions than low-sulphur MGO/MDO fuels.[2]

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1 California Air Resources Board (CARB). (2009). *Updated Informative Digest*: Regulations for Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2008/fuelogv08/uid.pdf

2 Johnson, K., Miller, W., & Yang, J. (2018). Evaluation of a Modern Tier 2 Oceangoing Vessel Equipped with a Scrubber. University of California, Riverside. Retrieved from California Air Resources Board, website: Evaluation of a Tier2 OGV with a Scrubber (ca.gov)

Discussion

13 As per its formal title, regulation 14 of MARPOL Annex VI, "Sulphur oxides (SO_x) and particulate matter", is intended to reduce emissions of both SO_x and PM. However, the existing *2021 Guidelines for exhaust gas cleaning systems* (resolution MEPC.340(77)) only require that scrubbers result in SO_2 to CO_2 ratios that are less than or equal to those that would result from burning compliant fuels. These limits are based on sulphur content and there are no limits on any air pollutant other than SO_2. This means that scrubbers are approved by the Organization based on their ability to reduce SO_x emissions only, without considering their effectiveness in reducing PM emissions. When scrubbers are employed as an alternative compliance mechanism, the exhaust gas passes through a fine spray of seawater or alkaline water, which dissolves SO_x so that sulphur levels are sufficiently reduced in air emissions.

14 Document PPR 6/INF.11 (Canada et al.) reported that, based on a presentation from the University of California Riverside (UCR) at the fifth ICCT Black Carbon Workshop (which took place in San Francisco, California in September 2018), scrubbers installed on ships are designed to remove gases and they are not specifically designed to remove solid particles. Scrubbers could be designed to remove gases and solid particles, but the design would be more complex. The removal of PM can be highly variable and will depend strongly on the design and operating conditions.[3]

15 Canada's study presented in document PPR 12/INF.15 (Canada) and those cited earlier in this document, indicate that while using HFO in combination with scrubbers may be equivalently effective at reducing SO_x compared to MGO, it is not equivalently effective at reducing PM emissions. Specifically, the use of scrubbers could be considered to not achieve the policy goals of regulation 14 of MARPOL Annex VI to reduce emissions of both SO_x and PM.

16 Canada's document PPR 12/INF.15 reports that the use of scrubbers is impacting air quality in Canada and eroding the air quality benefits of the North American ECA, which will result in adverse environmental and health impacts to Canadians. This finding is based on an analysis of health impacts associated with the changes in air quality resulting from the increased use of scrubbers and the increased ambient $PM_{2.5}$ concentrations in Canada. Considering the potential adverse risks to air quality and human health from scrubbers' limited control of PM emissions, their continued use could be considered inconsistent with the objective outlined in regulation 4.4 ("shall endeavour not to impair or damage the environment, human health, property or resources, or those of other States"), particularly regarding human health risks due to increased ambient $PM_{2.5}$ emissions in Canada.

17 The issue of scrubber's effectiveness in reducing PM emissions is in part due to the lack of a PM emissions standard under MARPOL Annex VI. While scrubber manufacturers have acted in good faith and followed the existing guidelines, this issue highlights the need to consider PM emissions performance in the design and approval of scrubbers as an equivalent compliance option under regulation 4.

[3] Wayne Miller, Fifth ICCT Workshop on Marine Black Carbon Emissions: Brief on Understanding BC Removal by Wet Scrubbers, September 19 and 20, 2018, San Francisco, California. https://theicct.org/event/5th-workshop-on-marine-black-carbon-emissions/

Conclusions

18 Studies show that ships using scrubbers and HFO do not produce emissions that are equivalent to compliant low-sulphur fuels due to the fact that a scrubber and HFO combination results in higher PM and Black Carbon emissions compared with using MGO. In order to help inform next steps on how to address this gap in regulatory compliance, including possible consideration of a PM standard under regulation 14, Canada urges additional research on this matter.

Action requested of the Committee

19 There is a need to evaluate whether the use of scrubbers, currently in operation and installed on ships, should be considered an equivalent compliance mechanism under MARPOL Annex VI regulation 4 for regulation 14. Taking into consideration the information presented in this document, the Committee is invited to:

.1 agree to initiate a process to evaluate the efficacy of scrubbers currently in operation on ships at reducing particulate matter emissions compared to low sulphur fuel and in consideration of the goals of regulation 14 of MARPOL Annex VI;

.2 encourage submissions of data on PM emissions from scrubbers currently in operation on ships; and

.3 based on the outcome of sub-paragraphs .1 and .2, encourage submissions on near and long-term solutions to mitigate the impact of scrubbers on PM emissions.