INTERNATIONAL MARITIME ORGANIZATION

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MARINE ENVIRONMENT PROTECTION COMMITTEE
80th session
Agenda item 7

MEPC 80/7/10
28 April 2023
Original: ENGLISH
Pre-session public release: ☒

REDUCTION OF GHG EMISSIONS FROM SHIPS

Exhaust gas preparation and conditioning for onboard CO_2 capture

Submitted by IBIA

SUMMARY

Executive summary:	This document identifies requirements for preparation of marine diesel engine exhaust gases for shipboard carbon capture (SBCC) technologies, provides an indication of the merits of onboard carbon capture as a transition solution toward a net zero goal and outlines proposals to develop a standard for pre-SBCC exhaust gas preparation.
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 13
Related documents:	MEPC 79/15, MEPC 79/7/16, MEPC 79/7/22 and MEPC 79/INF.27

Background

1 This document is submitted in relation to an invitation by MEPC 79 for interested Member States and international organizations to submit further information, comments and proposals on onboard CO_2 capture to MEPC 80 (MEPC 79/15, paragraph 7.53).

2 The outlook for the fuel consumption mix in 2040 as presented by the Maersk McKinney Moller Centre for Zero Carbon Emissions Shipping is that fossil fuel will make up between 65% to 75% of the bunker pool, with total CO_2 emissions no less than the current 2023 global maritime CO_2 emissions. The projection assumes a steady growth in energy demand from international shipping year on year of 1%. The assumption is that there will be a mix of fuels including LNG, methanol and ammonia. Some fuels may have been produced from renewable sources and some may not. In the face of the challenges of achieving carbon-neutrality on a well-to-wake basis for marine fuels, removal of carbon before entering the atmosphere post combustion appears to have at least short-term merits in meeting IMO ambitions to reduce GHG emissions from international shipping.

Discussion

3 The separation of CO_2 is commonly used in many industrial plants. The several technologies for separation are well known. The most common method of removing large volumes of CO_2 from gas streams is the separation of the CO_2 by absorption into a carrier fluid. The most commonly used carrier fluids are amine based. The separation technology is effective to up to 98% CO_2 separation. The amine fluid is constantly recycled absorbing and desorbing CO_2.

4 The adoption of SBCC could enable significant early reduction in marine carbon emissions, helping to achieve initial GHG reduction targets before a full suite of carbon-neutral solutions are readily available. In practice, SBCC is not limited by the effectiveness of the separation technology, but is constrained by the practical challenges of storage on board ship. Recent work by members of the Exhaust Gas Cleaning Systems Association (EGCSA) has suggested a practical limit of an average of 40% carbon capture and storage on board ship. This percentage would vary dependent upon the energy demand for CO_2 capturing and the storage method, including the energy consumption to prepare the CO_2 for storage and the frequency of off-loading the CO_2.

5 Assuming a 40% SBCC target, emissions reduction of fossil sourced carbon may effectively be reduced by much more than 40%, perhaps as high as 90%. This could be achieved if the captured carbon is recycled to produce a synthesised fuel, such as e-methanol, which requires a source of carbon as well as a source of hydrogen. In the case of SBCC carbon, which is recycled, it may then be a substitute for carbon sourced from biomass.

6 CO_2 that is not recycled might be permanently sequestered. In either recycling or sequestration, the CO_2 captured on board becomes a zero-emission part of the fuel combustion cycle.

7 In order to process the exhaust gas and present it to the separation medium, the exhaust gas must be free from particulates and other compounds.

8 There are a number of methods used in land-based applications to "clean" a gas prior to CO_2 separation. Such technologies include bag filters, catalysed particulate traps, filters and more. Many of these gas "cleaning" methods have been experimented with for cleaning shipboard exhaust gases. Most, if not all, have proven to be ineffective or very short-lived in a marine diesel engine exhaust gas environment.

9 Marine diesel exhaust gases have been successfully "cleaned" to a degree suitable for carbon capture using wet exhaust gas cleaning technology. In cases where the carbon capture process is very sensitive to the quality of the exhaust gas, more advanced gas cleaning technology can be applied. These advanced technologies utilize electrostatic charges to maximise particulate and gas separation. Such units are used for land based static plants for the separation of extremely difficult gas compositions. Examples include the removal of odour from tobacco processing or the removal of ultrafine dust from fertiliser manufacturing.

10 The application of advanced wet scrubbing technology would not only be a key enabler for SBCC, it would also address harmful air pollution emissions which are not currently regulated by MARPOL Annex VI. A report on impacts of air pollution published in April 2023 by Imperial College London noted that "it is clear that a substantial part of the health burden from air pollution comes from small respirable particles, most especially those referred to as PM2.5, and also from the gas, nitrogen dioxide." The Imperial College study has built on the Royal College of Physicians (RCP) 2016 report which stated "that air pollution harms our health throughout our lives, from conception to old age". The adoption and use of an advanced exhaust gas cleaning technology would provide health benefits as well as facilitating SBCC.

Proposals

11 Interested parties could be invited to provide criteria, scope, content and other information to assist in the preparation of suitable and comprehensive documentation to enable advanced exhaust gas cleaning technology to meet required performance criteria for both human health and SBCC, including means to assure effective and measured performance in service.

12 Such documentation could form the basis of a standard for pre-SBCC exhaust gas preparation.

Action requested of the Committee

13 The Committee is invited to consider the information in this document, the proposals in paragraphs 11 and 12, and to take action as appropriate.