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METHANE AND COEMITTED AIR POLLUTANTS FROM TWO LNG-POWERED VESSELS BUILT IN 2021 AND 2022

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INTRODUCTION

The use of liquefied natural gas (LNG) as shipping fuel has increased in recent years and about 20% of the total vessel orders in 2021 were LNG-fuelled. The most popular way is to use LNG in low-pressure dual-fuel engines together with diesel fuel for ignition. It has been shown in previous publications that the emissions onboard an LNG-fuelled vessel are different from emissions of conventional diesel-fuelled vessel. Lower sulphur and nitrogen oxides, together with lower particulate emissions are reported with LNG use. Moreover, CO2 emissions are lower as well but there is an issue with the methane slip with the LNG used in low-pressure dual fuel engines. The methane being a strong greenhouse gas and regulations introduced to consider methane emissions from ships, have made the engine manufacturers to take further development steps in preventing the methane slip. By today, there are still only few studies presenting emissions of methane from LNG-powered vessels with engines built in 2020 or after. The present study provides the results of the emission studies conducted onboard two LNG-powered vessels built in 2021 and 2022.

METHODS

Emission measurements were conducted on-board two state-of-the-art LNG vessels. The first campaign took place on-board a Ro-Pax ferry (built in 2021) operating in the Baltic Sea and the second was conducted on-board a cruise ship (built in 2022) operating in the Mediterranean. During both on-board experiments, one measurement point in the exhaust pipe, located a few meters away from the engine, was used for sampling raw exhaust gas. Sampling lines were heated to 180°C. The speciation of methane was performed using a gas chromatograph (Agilent MicroGC) and Fourier transform infrared spectroscopy (FTIR, DX4000 by Gasmet). In addition, other gaseous emissions were measured with the FTIR while we also used a CLD for NOx measurement. Particle emissions were studied using particle number measurement with a Dekati Engine Exhaust Diluter (DEED) and Condensation Particle Counters (CPCs) with cut-of sizes 10nm and 23nm. In part of the studies, Micro Soot Sensor (MSS) was used to measure black carbon.

RESULTS

The methane measurements conducted at different engine load modes, with both vessels studied, show lower methane levels at higher engine loads (see figure 1). When looking at the vessel operation data these higher loads are also utilized more than the lower load conditions during the vessel normal operation. However, there are also conditions when varying loads are used like the harbor approach. When comparing the methane emission data of this study (two engines of the RoPax ferry, namely ME4 and ME3, and one engine from the Cruise ship, namely DG5) to other published onboard studies, the levels are clearly lower than the ones published from engines built before 2020 (with one exception being the Andersson et al.).

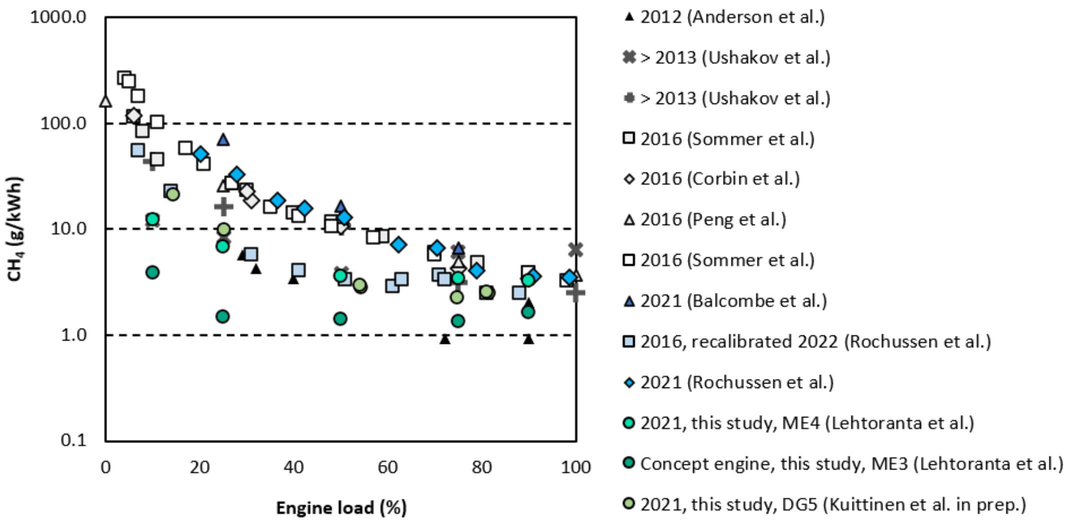

Figure 1. Specific methane emissions from on-board measurements conducted on LPDF 4-S engines in this study (green markers), other engines built or calibrated after 2020 (in blue) and older (in greyscale).

CONCLUSIONS

The results indicate that the current state-of-the-art LPDF engines show lower methane levels compared to previous studies, which is good news when thinking of the climate effects. Air pollution levels from LNG use are again proven to be lower than from diesel use, contributing to better air quality. Overall, LNG is considered to be a transition fuel and the technologies developed today should be capable of utilizing biobased gas or a renewable synthetic in origin. Methane slip minimization and avoiding other pollutants produced are not only important today but also for future fuels, even though such fuels could be produced sustainably.

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