In-Use Emission Measurements from Two High-Speed Passenger Ferries Operating in California

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In 2007, the California Air Resources Board (CARB) adopted an in-use regulation to reduce emissions from Commercial Harbor Craft (CHC), which includes ferries, tug boats, barges, and other vessel categories. After full implementation of the CHC regulation in 2022, many CHC vessels operating in California will be equipped with engines certified to the U.S. Environmental Protection Agency (EPA) Marine Tier 2 or Tier 3 standards. Although the CHC regulation will have achieved substantial emission reductions by accelerating turnover to cleaner engines, no marine engines are originally equipped with diesel particulate filters (DPF) to control particulate matter (PM). Consequently, CHC are expected to remain one of the top three seaport sources of cancer risk due to exposure to diesel PM.

In this study, we measured in-use particulate matter (PM) and gaseous emissions – including carbon monoxide (CO), carbon dioxide (CO_2), nitric oxide (NO), and nitrogen dioxide (NO_2) from two high-speed passenger ferries in the San Francisco Bay Area: one equipped with Tier 2 engines with 18,096 hours, the other equipped with Tier 3 marine engines with 6,392 hours at the commencement of the study. Whereas marine engines are certified by United States (U.S.) Environmental Protection Agency (EPA) over the ISO 8178 E3 steady-state cycle, we used Portable Emissions Measurement Systems (PEMS) to measure emissions during normal revenue service, which includes some transient and some steady-state operation. Emissions were below relevant certification limits; average in-use NOx emissions were 4.62 and 3.62 g/bhp-hr for the Tier 2 and Tier 3 engine, respectively, and PM emission were 0.044 g/bhp-hr for the Tier 3 engine. The second vessel, equipped with Tier 3 standards engines, was also equipped with an aftermarket selective catalytic reduction (SCR) and diesel oxidation catalyst (DOC) system. In-use data in this study can be used to further evaluate the need for transient versus steady-state certification test cycles, support emission inventory development, and underscores the complexity of aftermarket control of NOx using SCR.