

Black Carbon measurements on board a LNG/Diesel dual fuel engine-powered ship

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We performed emissions measurements onboard a LNG/diesel dual-fuel engine-powered ship, testing emissions during LNG and diesel operation. On that same engine, the Black Carbon (BC) emitted in LNG mode was approximately 30 times smaller than the BC emissions in diesel mode in units of mg/kWh. The different instruments used to measure BC (PAX, CAPS, MSS, LII 300 and AVL 415SE) were statistically similar except for the AVL 415SE, which was measuring higher eBC than other instruments during LNG operations only. Filters for thermal-optical analysis were also collected but the results are not available at this time.

The use of LNG reduced CO₂ emissions. Methane slip was observed at low loads with an as-received engine. Engine management software with various strategies was tested at low loads and yielded methane emission reductions of about 50%. Operational strategies to reduce time spent at low load were developed, tested and modelled. Based on current operation of the ship studied, reductions could reach values up to about 70% when currently available operation-based and engine-based strategies are combined and used optimally. Due to the technology being relatively new, we anticipate the environmental performance of the engine to improve further as technology develops.

In conclusion, we found that LNG operation in the Arctic is a very effective BC control measure and offers co-benefits due to a significant reduction in CO₂ emissions.