

A Comparative Study of Black Carbon Emission Characteristics from Marine Diesel Engines Using Light Absorption Method

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Abstract : Recognition of the needs about protecting environment throughout worldwide is widespread. In the shipping industry, International Maritime Organization (IMO) has been regulating pollutants emitted from ships by MARPOL 73/78. Recently, the Marine Environment Protection Committee (MEPC) of IMO, at its 68th session, approved the definition of Black Carbon (BC) specified by the following physical properties (light absorption, refractory, insolubility and morphology). The committee also agreed to the need for a protocol for any voluntary measurement studies to identify the most appropriate measurement methods. Filter Smoke Number (FSN) based on light absorption is categorized as one of the IMO relevant BC measurement methods. EUROMOT provided a FSN measurement data (measured by smoke meter) of 31 different engines (low, medium and high speed marine engines) of member companies at the 3rd International Council on Clean Transportation (ICCT) workshop on marine BC. From the comparison of FSN, the results indicated that BC emission from low speed marine diesel engines was ranged from 0.009 to 0.179 FSN and it from medium and high speed marine diesel engine was ranged 0.012 to 3.2 FSN. In consideration of measured the low FSN from low speed engine, an experimental study was conducted using both a low speed marine diesel engine (2 stroke, power of 7,400 kW at 129 rpm) and a high speed marine diesel engine (4 stroke, power of 403 kW at 1,800 rpm) under E3 test cycle. The results revealed that FSN was ranged from 0.01 to 0.16 and 1.09 to 1.35 for low and high speed engines, respectively. The measurement equipment (smoke meter) ranges from 0 to 10 FSN. Considering measurement range of it, FSN values from low speed engines are near the detection limit (0.002 FSN or ~0.02 mg/m³). From these results, it seems to be modulated the measurement range of the measurement equipment (smoke meter) for enhancing measurement accuracy of marine BC and evaluation on performance of BC abatement technologies.

Keywords : black carbon, filter smoke number, international maritime organization, marine diesel engine (two and four stroke), particulate matter

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