Reduced particle emissions from paraffinic diesel blended with polyoxymethylene dimethyl ether

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Introduction

New synthetic electrofuels, mimicked here by a renewable-based paraffinic and an oxygenate component, are potential methods to reduce engine emissions. In previous studies, polyoxymethylene dimethyl ether (OME) as a blend component has been observed to reduce particle emissions of a single cylinder test engine [1, 2].

Methods

Three different diesel fuels were tested: fossil EN 590 diesel, HVO-type paraffinic diesel and HVO-type paraffinic diesel blended with 10.6 vol-% of OME.

Engine-out emissions were measured from a modern 4.4 L turbocharged common-rail non-road diesel engine, which was used in this study without any aftertreatment system. The engine was run according to the RMC-C1 cycle and additional 5 static loads were also tested. The engine speed and torque was set to the same values for all the fuels.

Gaseous emissions were measured with an FTIR (Gasmet DX-4000) and an exhaust analyzer (Horiba PG-250). Particulate matter (PM) emission were measured with ISO 8178 type sampling system. Elemental and organic carbon (EC/OC) analysis were conducted from quartz filter samples. Particle number emissions (Non-volatile PN23) were measured with a dilution system (Dekati eDiluter followed by DEED) and a 23 nm CPC (Airmodus A23).

Results

Fuel type affected gaseous emissions. CO emissions were reduced with paraffinic diesel and even further with OME-blend. Paraffinic diesel produced the lowest THC emissions (measured with FTIR) . OME-blend resulted in similar THC with EN 590 and larger than with paraffinic. Formaldeldehyde emissions from OME-blend were high compared to other fuels. NO_x emissions were relatively similar with all fuels.

OME-blend resulted in large decrease in non-volatile PN23. Paraffinic and OME-blend produced lower PM emissions than EN 590. EC emissions from paraffinic diesel were lower than from EN 590. OME-blend produced clearly the lowest EC emissions. The reduction in EC but not in PM with OME-blend may be related to relatively high THC emissions with the OME-blend.

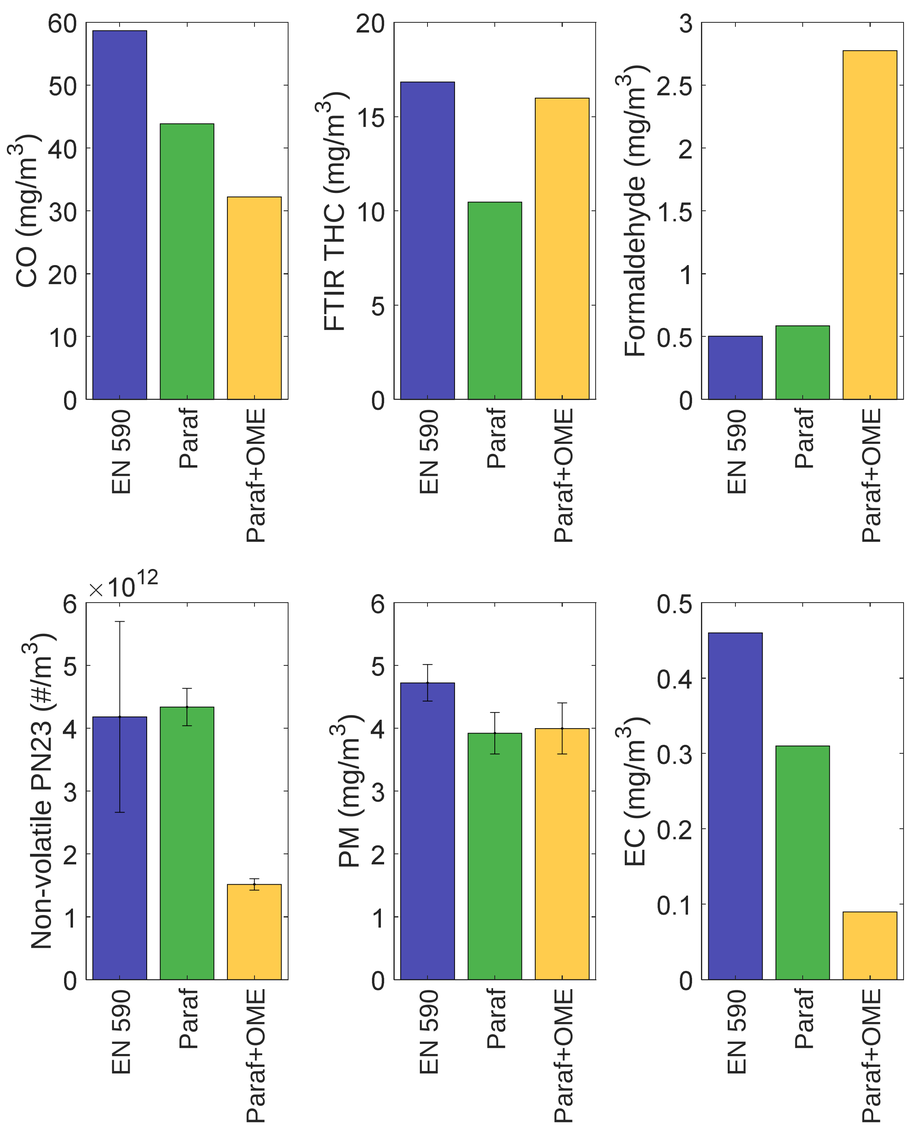

Figure 1. Average engine-out (no aftertreatment) CO, FTIR THC, formaldehyde, non-volatile PN23, PM and EC emissions with different fuels for RMC-C1 cycle. Errorbars shown represent the standard deviation.

Conclusion

- **OME blending significantly reduced engine-out emissions of black/elemental carbon and non-volatile particle number but not PM.**
- **OME blending increased emissions of hydrocarbons compared to paraffinic diesel and formaldehyde compared to paraffinic and EN 590 diesels.**
- **Further study is needed to evaluate emissions with OME when engine is equipped with exhaust aftertreatment**

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