# Particle emission from loaders using normal and bio based diesel fuels

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## Background

Diesel powered loaders are used for maintenance purposes in residential, commercial and industrial areas. These machines are operated in close proximity to people and their emissions can contribute to unwanted health effects. The aim to lower $CO_2$ emissions has resulted in different type of biofuels. Here, we study how the fuel composition affects on the engine emissions by comparing the particle emissions from loaders using Neste Renewable Diesel (HVO) and EN590 B7 fuels .

## Measurements

Two different loaders (Wille 355b and 855c, Vilakone Oy) were tested with two different fuels

- EN590 B7: Commercial grade fossil diesel fuel with 7 % of fatty acid methyl esters as a bio component
- Neste Renewable Diesel: Hydrotreated fuel made of mostly waste materials (HVO)

The particle measurement setup was based on TUT PEMS (Järvinen et al. 2015) consisted of

- Two-stage ejector dilution, primary being heated, total dilution ratio (DR) 150, DR confirmed by $CO_2$ measurements
- Particle concentration and size distribution measurement using Condensation Particle Counter (A20, Airmodus Oy) and Engine Exhaust Particle Sizer (EEPS 3090, TSI Inc.). Size distribution was used to calculate mass emissions (particle effective density 1 g/cm$^3$ assumed).

The measurement cycle was selected to consist of different activities: idle, lifting, driving and driving with extra load to simulate snow plowing


Fig. 1 PEMS installed into a trailer towed by the loader.

## Results

Exhaust particle concentrations and size distributions for the smaller 355b loader are presented in Fig. 2. The mass concentrations were calculated from the EEPS size distribution (density 1 g/cm$^3$ assumed). The average results from all activities are collected into Fig. 3.

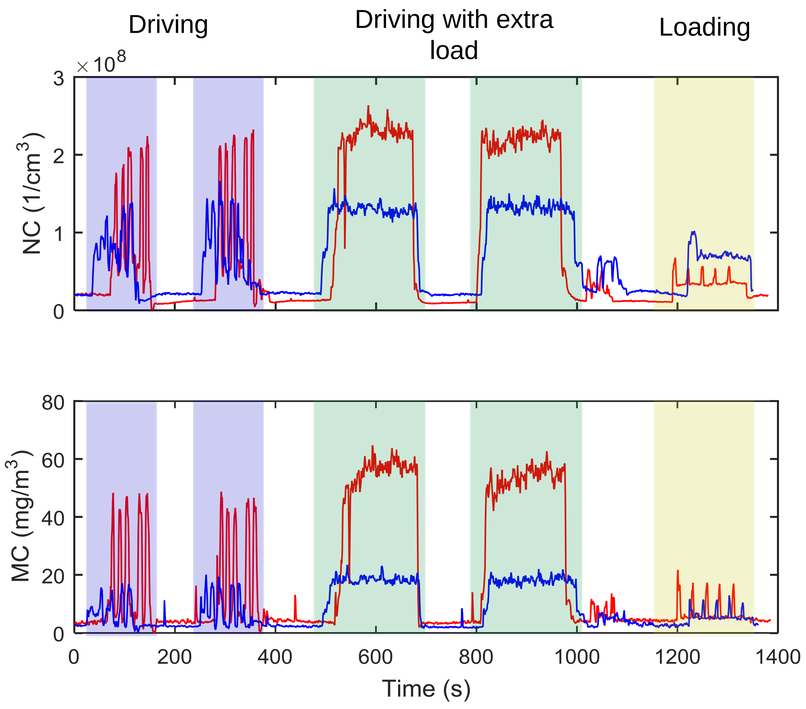


Fig. 2 The exhaust particle number concentration (NC) and mass concentration (MC) during the measurement cycle for the 355b loader using EN590 B7 and Neste Renewable Diesel.

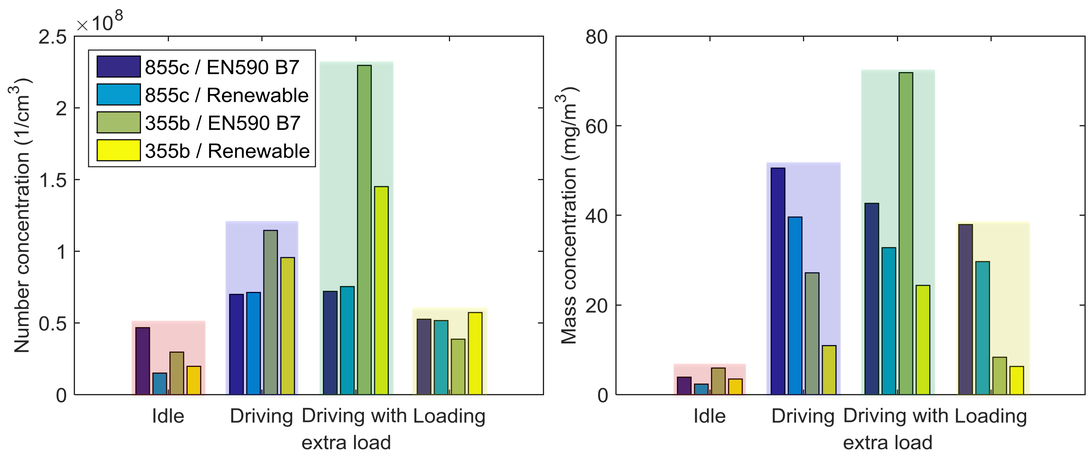


Fig. 3 Exhaust particle number and mass concentrations during different activities.

## Conclusions

Reduction of particle number emissions in case of the smaller 355b loader was observed in most activities when fuel was changed to renewable. Reduction in mass emission was observed for both loaders during all activities, which is a result of the smaller average particle size. The smaller particle size may arise from the higher cetane number (79 vs. 57) and lower aromatic content (0.3 vs. 15 wt-%).

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