

A laboratory emission study on biodiesel fuelled low duty engines

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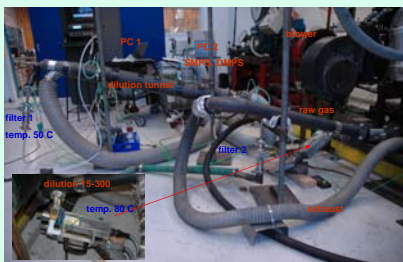
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INTRODUCTION

- Anthropogenic emissions of particles are under discussion in relation to global climate change and their cause of health effects.
- In particular, the role of soot particles is of high importance as these particles are expected to be detrimental to human health.
- Diesel engines are known to emit high numbers of aerosol particles (especially soot).
- Fleet of low duty diesel engines is rapidly changing (EURO 2 – EURO 4) as well as the type of fuel (standard diesel – biodiesel blend) used.

OBJECTIVE

- Investigate particulate emissions from different low duty diesel engines (EURO 2 and EURO 4) in dependence on the use of fuel (standard petrochemical reference diesel - 20% (B20) and 100% (B100) biodiesel – based on either animal fat (AFME) or rapeseed oil (RME)) in a lab experiment.



Laboratory set up at the Danish Technical Institute.

METHODS

All emissions were investigated by running the engines at different operational modes simulating various driving conditions according to ISO/EN 8178.

GAS PHASE MEASUREMENTS

- NO, NO₂, CO, CO₂, and total organic volatile compounds (TVOC)

were measured in the raw gas exhaust.

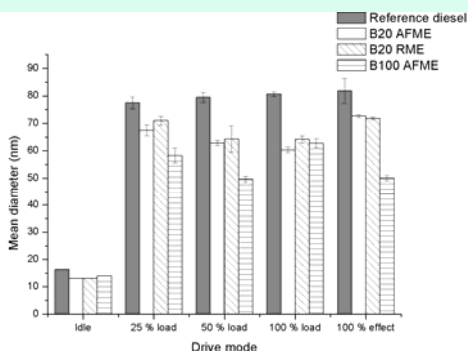
PARTICLE PHASE MEASUREMENTS

- Carbonyls, particle-bound polycyclic aromatic hydrocarbons (PAH), Elemental carbon (EC) / Organic carbon (OC)

were sampled from the dilution tunnel (dilution ratio 1:10) connected to the raw gas exhaust.

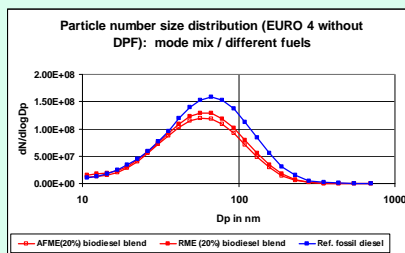
- Particle number size distributions (DMPS/SMPS with size range between 10 – 700 / 6 - 650 nm)

were measured downstream of a rotating disc diluter (variable dilution: 15-300 times) connected to the raw gas exhaust.



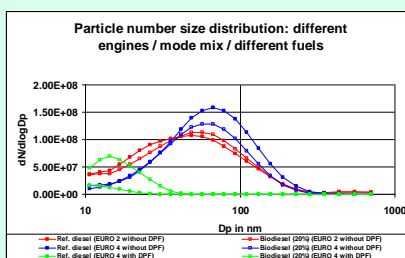
RESULTS

Mean diameter of particle number size distribution tends to decrease with increasing fraction of biodiesel used.



RESULTS

Mean diameter of size distribution, particle number and mass decrease, when 20% (B20) biodiesel is used compared to the standard petrochemical (reference) diesel.

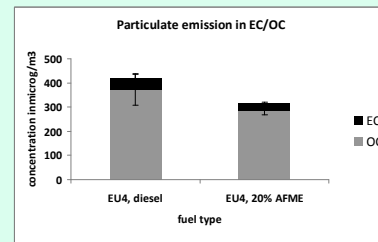


RESULTS

Mean diameter of size distribution, particle number and mass increases for EURO 4 engine compared to EURO 2 engine.

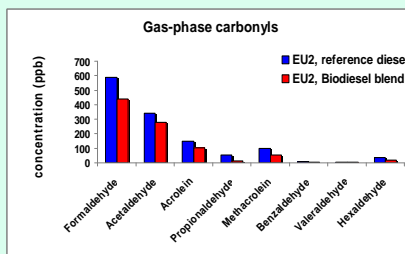
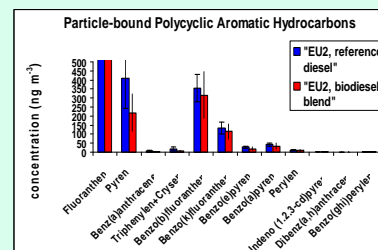
RESULTS

Total carbonaceous volume concentrations and EC/OC ratio emitted from the EURO 4 engine (without DPF) decrease, when 20% (B20) biodiesel is used compared to standard petrochemical (reference) diesel.



RESULTS

Masses of PAHs emitted from the EURO 2 engine are 11 to 56% lower, when the engine is fuelled with 20% (B20) biodiesel compared to standard petrochemical (reference) diesel.



RESULTS

Gas-phase carbonyl concentrations show a tendency to decrease, when 20% (B20) biodiesel is used compared to standard petrochemical (reference) diesel.

SUMMARY

- Substantial differences in submicrometer particle number, volume and mass were found in dependence on used engine type (EURO 4 and EURO 2).
- Emissions from standard petrochemical (reference) diesel were compared to those from 20% (B20) biodiesel:
 - Particle mean diameter of number size distribution, number-, and volume concentration decreased
 - Gas-phase carbonyl concentrations decreased
 - Particle-bound PAH volume concentrations decreased