Assessment of particulate matter emission from Diesel vehicles equipped with DPF

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Introduction

Since 2011, all Diesel cars are equipped with a Diesel Particulate Filter (DPF) and respect European standards (Euro 6) for particulate matter emissions which combine a limit number (PN: 6.0×10¹¹part/km) with a limit mass (PM: 4.5 mg/km). However, vehicle emission during cold start and regeneration are known to be higher and not yet regulated. Otherwise, there is limited data concerning particle number, mass, morphology, chemical composition during these two phases.

In this study we propose a new approach based on the combination of three techniques: AMS, MAAP and MPS to characterize particles emitted from one Diesel Euro5 vehicles equipped with Fuel Born Catalyst Filter (FBCF). Collections were carried out during cold and hot start NEDC driving cycle and during regenerations phases.

Experimental set up

I: Transient test

- NEDC cycle : cold start

- NEDC cycle : hot start

> Nothing was measured with the MAAP during the hot start

II: regeneration

- Start regeneration

- End regeneration

Results:

Conclusions

Diesel engines equipped with DPF mainly emit particles during cold start and DPF regenerations.

- During cold start, in the first ten minutes, the particles emitted are mainly carbon soot. Later, big droplets with metal content appear especially during heavy acceleration.

- During hot start, is observed only large droplets especially during heavy acceleration. It seems that the increase of engine speeds during cycles resulted in increase of fractions of metal contents in particulate matters.

Sources of droplet and metal emissions:

- Abrasion from piston ring, cylinder liner, valves (abraded metal)
- Lubrication oil
- Trace metals in Fuel

- During the DPF regenerations, PM size distributions are classified as bimodal, mainly consisting of the nucleation and accumulation modes. Typically, these particles are composed of a complex mixture of soot and small droplet like particles. These results are repeatable.

Literature:

F. Drevetck (2005) 36:637-658