Outlook to further AECC work on RDE testing on GDI-GPF and Diesel vehicles

AECC Technical Seminar on Real-Driving Emissions

Brussels, 29 April 2015
GASOLINE DIRECT INJECTION
The GDI Particles issue

• CO$_2$ legislation promotes fuel-efficient Gasoline Direct Injection (GDI) in the EU.
• The number of particles emitted by DI gasoline vehicles is higher than the PN levels allowed for diesel cars.
• Euro 6b introduced a PN limit for GDI in 2014, 10 times higher than the Diesel limit.
• PN limit will align with Diesel in 2017 ($6\times10^{11}$ #/km)

Source: AECC light-duty test programmes
The GDI Particles RDE issue

• Real-world particle number emissions from GDI can be substantially higher than on regulatory test cycle.

• Legislation needs to ensure that gasoline engine particle emissions are controlled also in real world.

Source: Deutsche Umwelthilfe Press Conference Berlin, 29 October 2013
Pictures and test results: AFHB Bern, Switzerland

Source: T&E Briefing Particle emissions from petrol cars, November 2013
Gasoline Particulate Filters (GPF)

- GPF offer the most effective route for control of PN emissions under a wide range of driving conditions.

Gasoline Particulate Filters (GPF)

- GPF offer a durable solution to control ultrafine particles emissions even in aggressive driving conditions.

GPFs can meet Euro 6c PN Limit
Durability Run Completed

2.0 L Audi TFSI

Test converter layout
Close-Coupled Three Way Catalyst + Underfloor coated GPF
- TWC 1.24L 64g/ft³
- GPF 1.68L 10g/ft³

Replacing series catalyst
Close-Coupled Three Way Catalyst TWC
- TWC 1.24L 80g/ft³

Averaged Particulate Number in NEDC test [#/km]

Engine-out PN > 2X
EU6 PN limit

Tailpipe emissions for NEDC phases

Source: MECA - CAPoC 9, August 2012
GPF reduces particle emissions even at cold ambient temperatures

FTP Particle Emissions in Bag 1 (Cold-start) and Bag 3 (Hot-start)

Source: MECA & Environment Canada - SAE Paper No. 2013-01-0527
Exhaust system suppliers’ GPF offer

- 1 April 2015: TENNECO announces developing Gasoline Particulate Filter technology for European light vehicles

- 20 April 2015: FAURECIA introduces world’s first GPF for passenger vehicles.
GPF first series production application

- Daimler has equipped the serial production Mercedes S500 V8 gasoline engine with a GPF.
- Source: VCD’s Auto-Umweltliste 2014/2015 report
  - published by the Verkehrsclub Deutschland (VCD, German Traffic Club).
AECC GPF-GDI Test Programme

• AECC and Concawe have contracted a test programme
  – Vehicle: Mercedes S500, 4.7 litre, 335 kW V8 twin turbo gasoline engine, 7-speed automatic transmission, 2-wheel drive.
  – Twin exhaust systems with GPF in each line.

• Testing is currently on-going.
  – NEDC and WLTC chassis dyno tests
  – On-road tests with same route as Clean Diesel RDE tests.
  – PEMS instrument for gaseous and PN emissions

Exhaust gas system

GPF canning

TWC canning
Scheduled PEMS route for RDE evaluation

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<td><strong>Maximum speed</strong></td>
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<td><strong>Altitude</strong></td>
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CLEAN DIESEL
Commercial S-DPF application

- Audi 2.0l TDI Ultra engine uses close-coupled SCR on DPF (S-DPF).

Source: Lörch, Audi; 22nd Aachen Colloquium Automobile and Engine Technology 2013
AECC clean Diesel benchmark

- AECC has contracted Ricardo, UK to test an Audi A5 TDI Ultra. Testing is currently on-going.
- NEDC and WLTC chassis dyno tests
- On-road tests with PEMS measurement of gaseous and PN emissions.
Results to date

- Certification data: CO$_2$ 111g/km and NOx 56.4 mg/km (from KBA database).

- Emissions Analytics’ database indicates on-road NOx emissions of 73 mg/km on trip including 79% urban, 6% rural, and 16% motorway driving.

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Thank you for your attention