Emission characteristics by DPF regeneration and Ash contents in 1.6 L CRDI Diesel Vehicle

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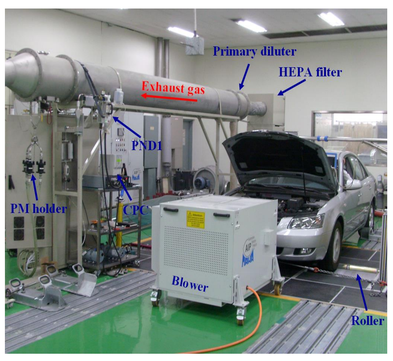
Background &Objective

- ◆ In a Diesel vehicle, PM and PN are hot issues. But DPF makes the emission from diesel vehicle clean.
- ◆ During regeneration of DPF, the emission was increased and ash was remained in DPF channel.
- ◆ Ash remains in DPF and slowly increases the back pressure. It is reason why DPF replacement is needed in higher mileage diesel vehicle.

➔ Determination of engine oil contribution in the exhausted PM through physical and chemical analysis methods.

Test apparatus

<Chassis Dyno. system>

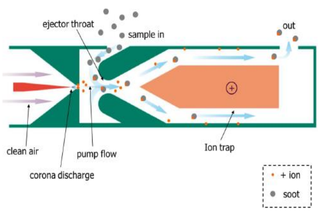


<Test Vehicle & Spec>

Model (Manufacturer)	Accent (Hyundai)
Fuel type	Diesel
Boost	Turbo
Injection type	CRDI
Displacement	1.6
Engine Oil	5W-30
Model year	2011
Odometer	167,068 km

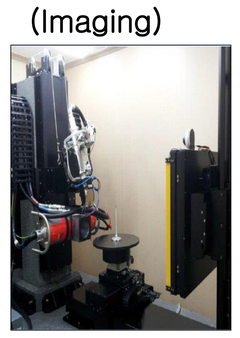
<Exhaust gas Analyzer>

<PPS-m> (PM # Counter)



<FE-SEM> (Imaging& analysis)

<x-CT> (Imaging)

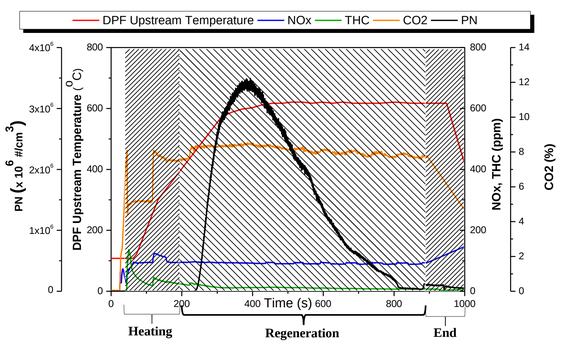


<XRF> (Analysis)

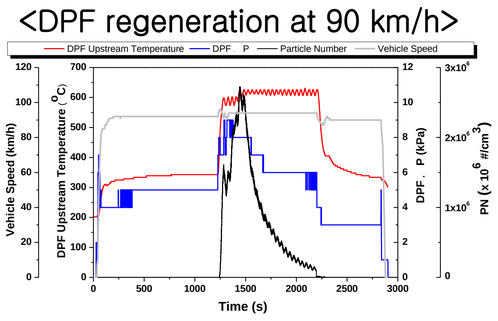
RESULTS

DPF regeneration

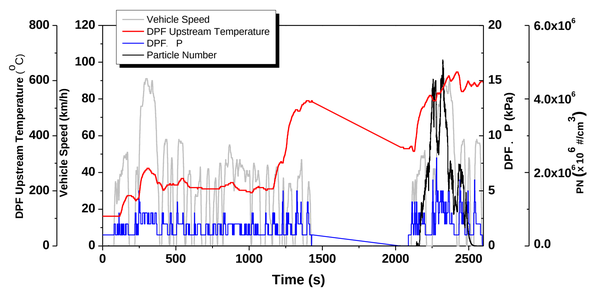
<DPF regeneration at Idle state>



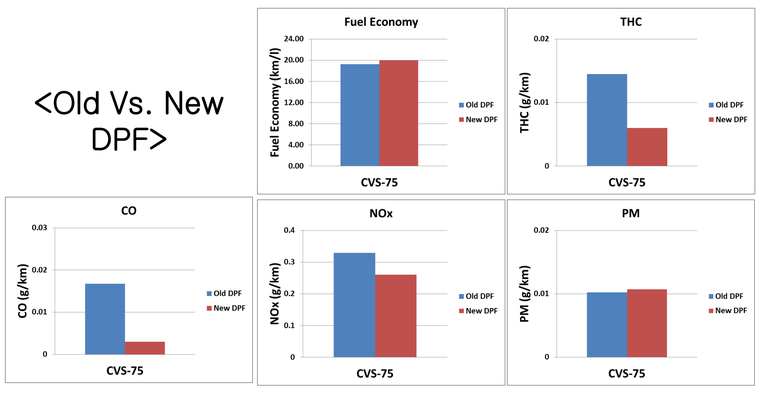
<DPF regeneration at 90 km/h>



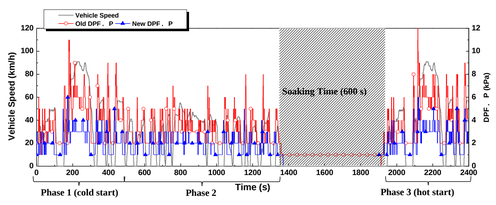
<DPF regeneration at FTP-75 mode>

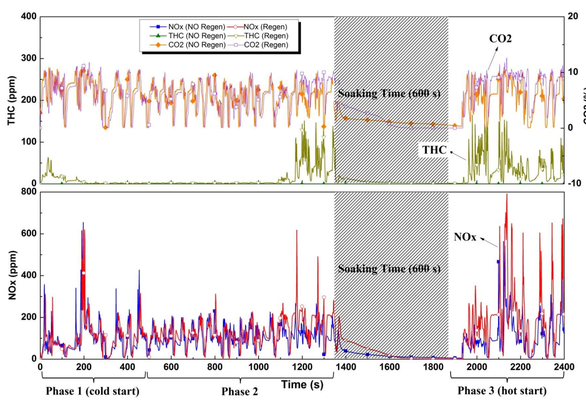


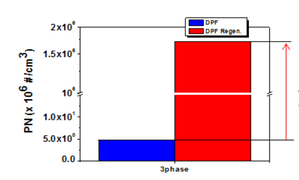
<Old Vs. New DPF>

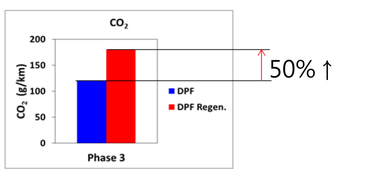


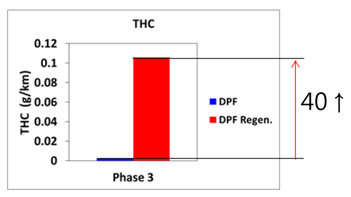
Del P of New DPF lower than Old DPF

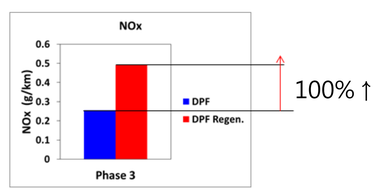






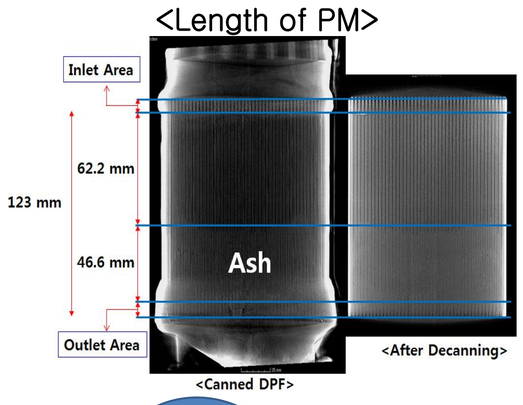






PM & Ash analysis

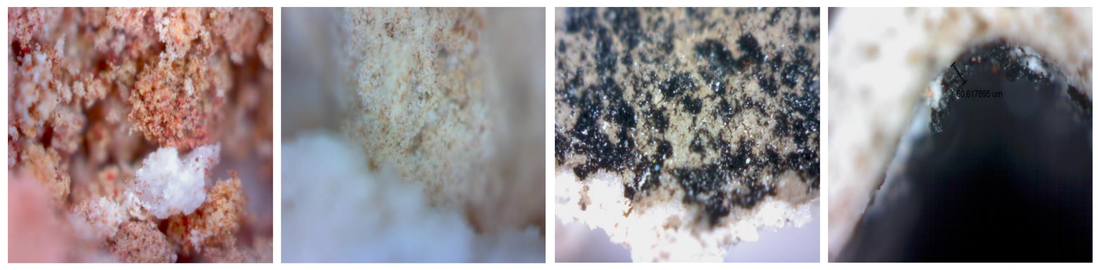
<Length of PM>



1st zone 2nd zone 3rd zone 4th zone

1st zone : Oldest Ash, red brown color
2nd zone : Middle phase Ash, light pink color
3rd zone : Latest Ash, white color
4th zone : Mostly Soot

<Zone of PM in DPF>



1st zone | 2nd zone | 4th zone | Inlet of 4th zone

Red brown by Iron oxide

soot and ash

<PM component analyzed by SEM-EDS at 4th zone>

<PM component analyzed XRF>

시료명 / 분석항목	1st zone	2nd zone	3rd zone
Mg(wt%)	0.15	0.38	0.96
Al(wt%)	2.12	1.62	1.56
Si(wt%)	1.40	0.66	0.71
P(wt%)	8.52	11.66	13.71
S(wt%)	16.39	17.39	14.75
Cl(wt%)	trace	trace	trace
K(wt%)	0.09	0.05	0.07
Ca(wt%)	32.85	41.78	41.92
Ti(wt%)	2.56	2.84	2.90
Cr(wt%)	0.16	trace	0.07
Mn(wt%)	0.16	0.08	trace
Fe(wt%)	14.25	3.70	2.72
Ni(wt%)	0.24	0.11	0.07
Cu(wt%)	1.02	1.03	0.92
Zn(wt%)	18.57	17.02	17.69
Sr(wt%)	1.29	1.37	1.60
Mo(wt%)	0.14	0.30	0.36
Pd(wt%)	trace	trace	trace

SUMMARY

1) The PN, THC, NOx and CO2 emissions and fuel consumption during DPF regeneration were higher than without those at DPF regeneration state. Especially, PN increased over 10^5 times.
2) The THC, CO and NOx and fuel consumption with new DPF was lower than those with old DPF because of the lower del. P and catalytic activity.
3) The length of loaded ash inside DPF measured by x-CT was shorter than that of direct measurement. The shape of ash observed by microscope looks like piles of sand.
4) Ash Over 50% of Ash is composed of Zn, Ca and P elements that were main lubricant's additives. Soot were coexist with ash at inlet area of DPF. From inner space to DPF's wall, C element and additive elements of lubricant was detected by SEM-EDS.

Acknowledgments

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