NOx adsorber data from chassis dynamometer tests with a 1999 Mercedes A170 CDI at ORNL

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Main Reference:
C. Scott Sluder and Brian H. West, "Effects of Regeneration Conditions on NOx Adsorber Performance," SAE Paper #2002-01-2876. Society of Automotive Engineers, Warrendale, PA, 2002.

Supplemental References:
C. Scott Sluder and Brian H. West, "NOx Adsorber Performance in a Light-Duty Diesel Vehicle", SAE Paper #2000-01-2912. Society of Automotive Engineers, Warrendale, PA, 2000.

C. Scott Sluder and Brian H. West, "Performance of a NOx Adsorber and Catalyzed Particle Filter System on a Light-Duty Diesel Vehicle", SAE Paper #2001-01-1933.
Society of Automotive Engineers, Warrendale, PA, 2001.

Detailed Description/Comments:

Documentation for these data files compiled by V.Y. Prikhodko and reviewed by C.S. Daw, Brian West, and Scott Sluder, 2/05/2003.

The associated data files are taken from data recorded under a NOx adsorber testing project at Oak Ridge National Lab (ORNL) during FY 2002. More detailed documentation on this project is given in the companion reference: "Effects of Regeneration Conditions on NOx Adsorber Performance" by Brian H. West and C. Scott Sluder, SAE 2002-01-2876.

This particular test series was focused on measuring the performance of prototype NOx adsorbers installed in a Mercedes A170 1.7-liter diesel vehicle. Experiments were conducted with 5 candidate NOx adsorber monoliths (identified with labels A-E) to determine their emissions reduction performance as the air:fuel ratio and duration of the rich regeneration pulse were varied. Each prototype adsorber was installed downstream of a close-coupled diesel oxidation catalyst (at the turbocharger exit) and a catalyzed diesel particulate filter (CDPF). Details of the oxidation catalyst and CDPF are given in the main reference.

The prototype adsorber monoliths were supplied by members of the Manufacturers of Emissions Controls Association (MECA). All of the prototypes were cylindrical, 144 mm in diameter and 152 mm long. Other monolith characteristics were as follows:

Prototype	Cell density/cm^2	Pt Group Metal Loading (g/L)	Ba/Alkali Metals
A	62	5.79	Yes/Yes
B	62	4.24	Yes/No
C	62	4.24	Yes/No
D	62	5.79	Yes/No
E	46	3.53	unknown

All of the prototype monoliths were degreened in an oven and exposed to vehicle exhaust prior to testing. The monoliths were relatively fresh in that they had not been rapidly aged or sulfur poisoned. The fuel used was the Diesel Emissions Control Sulfur Effects (DECSE) 3 ppm S fuel. A combined LA4 drive cycle was used in most of the tests to simulate realistic driving conditions.

NOx adsorber regeneration was accomplished using periodic injection of bottled gas containing 66% CO, 31% H2, and 3% C2H4. The gas was injected through four automotive natural gas fuel injectors located just upstream of the close-coupled oxidation catalyst. For each injection event, the amount of gas injected was controlled by setting both the duty cycle of the pulse-width-modulated injectors, and the duration of the event. Event durations examined were 1.5 s, 2.0 s, or 2.5 s. The pulse-width-modulation frequency affected the relative richness of each injection event. These five different levels were distinguished by their impact on the average minimum indicated air-fuel ratios at the inlet of the NOx adsorber as indicated by a UEGO sensor. The five indicated air-fuel ratios were 10.2, 11.2, 11.6, 11.9, and 14.2.

Not all combinations of injection duration and air:fuel ratio were tested for each adsorber material. The driver?s aid system was used to control the fixed timing of the regeneration events during the LA-4 cycle. The injection schedule focused on regenerating at engine-idle conditions and as needed in areas of the cycle where idle conditions do not occur very frequently. This schedule allowed most regeneration events to occur when the adsorber space velocity was below 11,000 1/hr.

Adsorber inlet and exit gas concentrations were measured on a continuous basis using heated chemiluminescence instruments for NOx, heated flame ionization instruments for hydrocarbons, and non-dispersive infrared instruments for CO and CO2. The time response for each of the gas analysis instruments was approximately 1s. The associated files contain time resolved measurements of the following at 0.4 s time intervals:
Adsorber inlet-gas temperature , A/F ratio, total NOx, CO2, total hydrocarbon, CO;
Adsorber outlet- total NOx, total hydrocarbon.

From the name of the file it is possible to determine the catalyst that was used, injection duration and injection richness (indicated air fuel ratio - iAFR). For example, in the following file name a_2s_102_b.xls: a - adsorber A; 2s - 2 second duration; 102 - min AFR of 10.2; b - number of the run.

All of the data is divided into the following groups which appear as separate submissions on the CLEERS website.

The following group of files is for NOx adsorber A operating with 2 seconds injection duration:

a_2s_102_b.xls
a_2s_102_c.xls
a_2s_102_d.xls

a_2s_112_b.xls
a_2s_112_c.xls
a_2s_112_d.xls

a_2s_116_b.xls
a_2s_116_c.xls
a_2s_116_d.xls

a_2s_119_b.xls
a_2s_119_c.xls
a_2s_119_d.xls

a_2s_142_b.xls
a_2s_142_c.xls
a_2s_142_d.xls

The following group of files is for NOx adsorber A operating with 2.5 seconds injection duration:

a_25s_102_b.xls
a_25s_102_c.xls
a_25s_102_d.xls
a_25s_102_e.xls
a_25s_102_f.xls
a_25s_102_g.xls
a_25s_102_h.xls
a_25s_102_i.xls
a_25s_102_j.xls

a_25s_112_b.xls
a_25s_112_c.xls
a_25s_112_d.xls

a_25s_116_b.xls
a_25s_116_c.xls
a_25s_116_d.xls

a_25s_119_b.xls
a_25s_119_b.xls
a_25s_119_b.xls

The following group of files is for NOx adsorber A operating with 1.5 seconds injection duration:

a_15s_102_b.xls
a_15s_102_c.xls
a_15s_102_d.xls

a_15s_112_b.xls
a_15s_112_c.xls
a_15s_112_d.xls

The following group of files is for NOx absorber B operating with 2 and 2.5 seconds injection duration:

b_2s_102_b.xls
b_2s_102_c.xls
b_2s_102_d.xls

b_2s_112_b.xls
b_2s_112_c.xls
b_2s_112_d.xls

b_25s_102_b.xls
b_25s_102_c.xls
b_25s_102_d.xls

b_25s_112_b.xls
b_25s_112_c.xls

b_25s_112_d.xls

b_25s_116_b.xls
b_25s_116_c.xls
b_25s_116_d.xls
The following group of files is for NOx absorber C operating with 2 seconds injection duration:

c_2s_102_b.xls
c_2s_102_d.xls
c_2s_102_e.xls

c_2s_112_b.xls
c_2s_112_c.xls
c_2s_112_d.xls

The following group of files is for NOx absorber D operating with 2.5 seconds injection duration:

d_25s_102_b.xls
d_25s_102_c.xls
d_25s_102_d.xls

The following group of files is for NOx absorber E operating with 2 and 2.5 seconds injection duration:

e_2s_102_b.xls
e_2s_102_c.xls
e_2s_102_d.xls

e_25s_102_b.xls
e_25s_102_c.xls
e_25s_102_d.xls

e_25s_112_b.xls
e_25s_112_c.xls
e_25s_112_d.xls