Abstracts

Session 2 – Fuels and Lubrication, Part 1

THE NON-PETROLEUM BASED FUEL INITIATIVE

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ABSTRACT

The Non-Petroleum Based Fuels Initiative (NPBF) is being undertaken as a multi-year research, development, and testing activity by the Office of FreedomCAR and Vehicle Tech-nologies located in the DOE's Office of Energy Efficiency and Renewable Energy. This activity is being developed in collaboration with in-dustry, academia, and Government agency part-ners. The primary focus of this activity is to produce data that can help lead decisions relative to fuel options that improve fuel economy, reduce petroleum dependence, and ultimately pave the way to a hydrogen-based transportation system.

The multi-year work plan is being developed with input from fuel, automobile, and engine companies in order to identify which fuel options are the most viable and where gaps in knowledge or technology exist that could be addressed with pre-competitive research. The research plan for this work is being developed through a series of meetings and discussions with all interested parties.

This Diesel Engine Emissions Reduction Conference talk will present the work plan in its current, evolving form in order to help dis-seminate information and to gather comments and questions relating to this initiative.

APBF-DEC NO_X ADSORBER/DPF PROJECT: PASSENGER CAR PLATFORM

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ABSTRACT

Due to increased fuel costs and a desire to reduce dependence on foreign oil, the diesel engine is becoming a prime candidate for future medium-duty vehicle applications in the United States. The diesel engine ex-hibits high thermal efficiency and superior durability compared to the gasoline engine. The main obstacle to increased use of diesel engines is the upcoming (extremely strin-gent) EPA Tier 2 emission standards. To succeed, these vehicles must comply with emission standards while maintaining their excellent fuel economy. The availability of technologies, such as common rail fuel injection systems, low-sulfur diesel fuel, NO_x adsorber catalysts, and diesel par-ticulate filters, allow the development of powertrain systems with the potential to comply with targeted requirements. In support of this, the U.S. Department of Energy (DOE) has undertaken several test projects as part of its Advanced Petroleum Based Fuels - Diesel Emission Control (APBF-DEC) activity. Primary questions among those addressed by these projects are sulfur tolerance, durability, and performance of the NO_x adsorber/DPF system for varying fuel sulfur levels. The test bed for one pro-ject in this activity is an Audi A4 Avant equipped with a 1.9L prototype TDI engine with common rail fuel injection.

While NO_x adsorber catalyst (NAC) sys-tems have demonstrated extremely high lev-els of NO_x reduction in steady-state labor-atory evaluations, the application of NAC systems to actual transient engine appli-cations requires development of an integrated engine-emissions management system. This paper discusses the integrated engine-emissions system management and the development of regeneration control strategies. Performance of fresh and aged systems tested over the FTP-75, HFET, and US06 test cycles will also be summarized, including emissions of regulated and presently unregulated species.

APBF-DEC NO_x ADSORBER/DPF PROJECT: SUV/PICKUP PLATFORM

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ABSTRACT

Due to increased fuel costs and a desire to reduce dependence on foreign oil, the diesel engine is becoming a prime candidate for future medium-duty vehicle applications in the United States. The diesel engine exhibits high thermal efficiency and superior durability compared to the gasoline engine. The main obstacle to increased use of diesel engines is the upcoming (extremely strin-gent) EPA Tier 2 emission standards. To succeed, these vehicles must comply with emission standards while maintaining their excellent fuel economy. The availability of technologies, such as common rail fuel injection systems, low-sulfur diesel fuel, NO_x adsorber catalysts, and diesel particulate filters, allow the development of powertrain systems with the potential to comply with targeted requirements. In support of this, the U.S. Department of Energy (DOE) has undertaken several test projects as part of its Advanced Petroleum Based Fuels — Diesel Emission Control (APBF-DEC) activity. Primary questions among those addressed by these projects are sulfur tolerance, durability, and performance of the NO_x adsorber/DPF system for varying fuel sulfur levels. The heavy light-duty (HLDT) and medium-duty passenger vehi-cles (MDPV) will face the greatest tech-nological challenges in meeting the Tier 2 emissions standards. The test bed for one project in this activity is a 2500 series Chevrolet Silverado equipped with a 6.6L Duramax diesel engine certified for 2002 model year Federal heavy-duty and 2002 model year California medium-duty emis-sion standards.

While NO_x adsorber catalyst (NAC) sys-tems have demonstrated extremely high lev-els of NO_x reduction in steady-state labor-atory evaluations, the application of NAC systems to actual transient engine appli-cations requires development of an inte-grated engine-emissions management sys-tem. This paper discusses the integrated engine-emissions system management and the development of regeneration control strategies. Performance of fresh and aged systems tested over the FTP-75, HFET, and USO6 test cycles will also be summarized, including emissions of regulated and presently unregulated species.

APBF-DEC NO_x ADSORBER/DPF PROJECT: HEAVY-DUTY LINEHAUL PLATFORM

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ABSTRACT

This presentation outlines the development and integration of an advanced emission control system with a modern heavy-duty diesel engine that is being used for durability testing. The project that is discussed is one of several being conducted under the U.S. Department of Energy's Advanced Petroleum-Based Fuels - Diesel Emission Control (APBF-DEC) activity. This Government/industry collaboration is examining how systems of advanced fuels, engines, and emission control systems can deliver significantly lower emissions while maintaining or improving vehicle fuel economy. A Cummins ISX EGR engine (15 L), with a secondary fuel injection system to enable NO_x adsorber catalyst regeneration, has been developed for use in a series of durability tests with fuels of different sulfur levels. Development of the strategies for NO_x regeneration and sulfur removal as well as integration of the emission control hardware is discussed. Performance of fresh and aged systems tested over transient and steady-state cycles is summarized, including emissions of regulated and presently unregulated species.

DEMONSTRATION OF THE LOW-EMISSION POTENTIAL FOR UREA SELECTIVE CATALYTIC REDUCTION AND DIESEL PARTICULATE FILTER TECHNOLOGIES

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ABSTRACT

The demonstration of the potential for urea selective catalytic reduction (SCR) and diesel particulate filter technologies is one of the major projects in the Advanced Petroleum-Based Fuels – Diesel Emission Control (APBF-DEC) activity. The objective of this project is to integrate several diesel emission control technologies to demonstrate their capability to comply with the 2007 heavy-duty diesel engine standards. Once the engine and control system were developed, several fuels having various sulfur content were evaluated to establish the sensitivity of the control system to sulfur.

The work is being conducted on a Caterpillar C-12 heavy-duty diesel engine. Two different emission control systems, employing urea SCR catalysts and diesel particulate filters, were calibrated and showed the potential for controlling NO_x and particulate matter emissions to levels near the 2007 standards. The project will also examine the long-term durability of the control systems and their interaction with the test fuels. This presentation is a summary of this work, which is still in progress.

THE CHEMICAL STATES AND COMPOUNDS OF LUBE OIL PHOSPHOROUS IN DIESEL EXHAUST

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ABSTRACT

Phosphorous in diesel exhaust is derived from the ZDDP additive in lube oil used for wear control. Phosphorous emitted in the engine exhaust can react with an aftertreatment catalyst and cause loss of performance through masking or chemical reaction. It appears that there is a minimum level of ZDDP needed for engine durability. One of the ways of reducing the effects of the resulting phosphorous on catalysts might be to alter the chemical state of the phosphorous to a less damaging form. And, one of the first requirements of altering the chemical state of phosphorous is to be able to measure the chemical state and compounds in diesel exhaust. In this preliminary study, the phosphorous compounds in diesel exhaust were measured by a variety of analytical techniques and correlated to such variables as ZDDP concentration in the oil, exhaust temperature, and fuel doping with ZDDP. These analytical techniques will then be applied to lube oil formulation studies and to catalyst durability studies in order to reduce or eliminate phosphorous poisoning in a catalyst.