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Office of Mobile Sources

Environmental Fact Sheet

Emission Control Potential for Heavy-Duty Diesel Engines

Diesel engines are typically used to power trucks, buses and nonroad equipment (for farming, construction, mining, etc.) because of their exceptional fuel economy and durability advantages. To reduce oxides of nitrogen (NOx) and particulate matter (PM) emissions from these engines, the Environmental Protection Agency (EPA) is collaborating with engine manufacturers to research the potential control options.

Diesel engines use compression instead of spark plugs to ignite the fuel. The high temperatures typical of diesel compression ignition cause oxygen and nitrogen from the intake air to combine as NOx. NOx reacts with hydrocarbons (HC) and sunlight to form ground-level ozone (smog); NOx also combines with other atmospheric constituents to form fine particulate matter. Ozone and particulate matter are associated with many adverse health and welfare effects, including respiratory illness, acid rain, eutrophication, and visibility problems (haze).

Despite previous design improvements, diesel engines contribute a substantial portion of the NOx, PM, and, to a lesser extent, the HC emissions from mobile sources. Manufacturers have begun a comprehensive review of diesel engine design to move toward more effective controls for NOx, PM and HC. One strategy may be to better manage the process of air and fuel delivery to the cylinder, reducing emissions production.

Another strategy may be to use “after treatment” (post-combustion) technologies to break down or capture emissions. Diesel engines of the future may use a combination of strategies, possibly incorporating fuel changes as well. The following is a brief description of several potential diesel emission control options:

Fuel Delivery

Designing electronic controls and improving fuel injectors to deliver fuel at the best combination of injection pressure, injection timing and spray location to burn its fuel more efficiently without causing the temperature spikes that increase NOx emissions.

Air Intake

Redesigning turbochargers, aftercoolers and intake valving to provide optimum pressure, temperature and routing of the intake air is important for managing the physical and chemical processes needed to achieve good air-fuel combustion. Exhaust gas recirculation (mixing some exhaust gas with the intake air) is an established diesel engine technology that could be used more extensively in future diesel engines.

Aftertreatment Technologies

Catalysts and particulate traps can be used to convert or capture emissions prior to exhaust. Traps are used to remove and eventually burn particulate emissions. Catalysts for diesel engines are more complex than similar technologies used in cars, but hold promise for reducing NOx and particulate emissions by converting them to less-harmful compounds.

Diesel Fuel Parameters

Employing fuel additives and improving fuel properties such as raising the cetane number, lowering the aromatics content and decreasing sulfur may contribute to reduced NOx and PM emissions and may also provide engine manufacturers with greater flexibility to use new emission control technologies.

As part of its current rulemakings, EPA, in conjunction with industry and other concerned groups, is researching and comparing the costs and benefits of these and other potential engine and fuel changes to determine the most feasible, cost-effective, durable and safe emission-reduction program for heavy-duty diesel engines.

For further information, please call the NOx/PM Initiative voice mailbox at (313) 741-7887, or write to:

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