



Clean Air Facts

Emission Controls for Diesel Engines

Overview

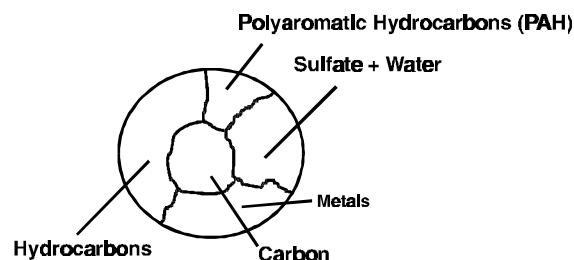
Recently, health experts in the U.S. have identified serious health risks associated with emissions from diesel engines, especially oxides of nitrogen (NOx) and particulate matter (PM) emissions. Cost-effective diesel exhaust control options such as catalysts and particulate filters are available which can significantly reduce emissions from diesel-powered trucks, buses, and off-road equipment.

Health Effects and Emissions Inventory

- Emissions from diesel engines contribute to serious public health problems in the U.S. These problems include premature mortality, aggravation of respiratory and cardiovascular disease, aggravation of existing asthma, acute respiratory symptoms, chronic bronchitis, and decreased lung function. Numerous studies also link diesel exhaust to increased incidence of lung cancer.
- On-road diesel-fueled vehicles contribute approximately 27 percent of the NOx emission inventory and 62.5 percent of the PM emissions.
- An older, dirtier diesel vehicle can emit almost 8 tons of pollution per year. This amounts to 160 to 240 tons of pollution over the life of the engine.
- A heavy-duty truck can create the same amount of air pollution as 150 passenger cars.

Particulate Matter from Diesel Engines

- Diesel particulate consists of small carbon particles that are coated with several compounds which are formed during the engine combustion process and the subsequent travel of these particulates down the exhaust stream.



- Diesel engines emit a very large number of particulates that are extremely small (less than 10 microns) consisting of a carbon core and known and possible cancer-causing substances (e.g., polyaromatic hydrocarbons) that are carried directly into the lungs where a large fraction remains.
- Diesel particulates are also of concern because they are typically emitted directly into the breathing zone where the urban population works and recreates.

So Why Continue to Use Diesel Engines?

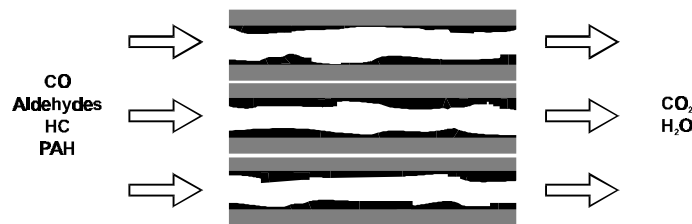
- Diesel engines are reliable, fuel efficient, durable, easy to repair, and inexpensive to operate.
- A diesel engine commonly has a life of one million miles in heavy-duty trucks, and can power city buses for 15-20 years.
- Diesel engines are inherently cleaner in some ways, including:
 - better fuel efficiency means lower global-warming emissions and
 - very low emissions of carbon monoxide and hydrocarbons, although the latter is one of the primary ingredients of urban smog and consists of toxic HC species.

Emission Control Technologies

Diesel Oxidation Catalysts (DOCs)

- Like catalytic converters already used on all new gasoline vehicles, diesel oxidation catalysts (DOCs) cause chemical reactions to reduce emissions without being consumed and without any moving parts.

Diesel Oxidation Catalyst Functional Diagram



- The catalysts reduce particulate emissions by as much as 50 percent (and can reduce visible smoke by even more) and can virtually eliminate the pungent odor of diesel exhaust.
- The catalysts can reduce the invisible gaseous ozone-forming hydrocarbons and carbon monoxide emissions by as much as 90 percent.
- DOCs have been equipped on over 200,000 off-road diesel engines worldwide, and on over 1.5 million diesel trucks in the U.S. In Europe, over 6 million diesel automobiles have been equipped with catalysts.
- DOCs can be installed on new vehicles or can be retrofitted on vehicles already in-use.

Selective Catalytic Reduction (SCR)

- Selective catalytic reduction (SCR) systems are similar to DOCs except that a reductant is added to the exhaust stream in order to help convert NO_x to nitrogen and oxygen in an oxidizing environment. The reductant in mobile source applications is normally urea. As the exhaust gases along with the reductant pass over a catalyst applied to a substrate, NO_x, HC emissions, and PM emissions are reduced.

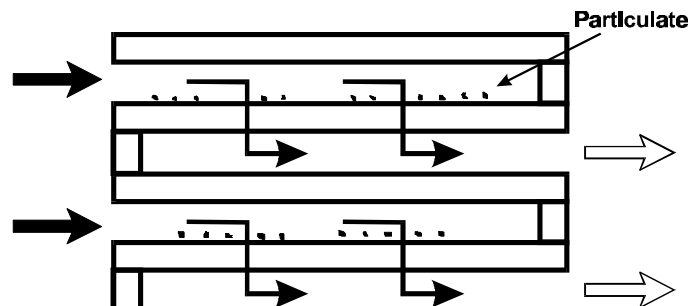
NOx Adsorbers

- NOx adsorber technology is a new catalyst technology for removing NOx in a lean (i.e., oxygen-rich) exhaust environment for both diesel and gasoline lean-burn direct-injection engines.
- NOx adsorber technology has made significant progress and is currently being optimized for diesel engine emission control. Reductions in engine out NOx emissions of as high as 90 percent has been demonstrated and it appears possible to develop the system into a functional and durable NOx control system for diesel exhaust.

Diesel Particulate Filter or "Trap Oxidizer"

- The trap oxidizer system consists of a filter that can collect over 90 percent of the diesel particulate emissions while allowing the exhaust gases to flow through.

Diesel Particulate Filter Schematic



- Since the collected particulate builds up over time, a trap oxidizer also includes a method to automatically clean or regenerate the trap. This is usually accomplished by oxidizing or combusting the collected particulate.
- Around the world, thousands of trap-equipped trucks and buses are participating in demonstration programs. Traps have been used successfully on a variety of off-road engines since the mid-1980s.

Regulations

- In October 1999, EPA proposed to reaffirm that the NMHC+NOx standard promulgated in October 1997 for heavy-duty diesel engines is both necessary and feasible. This standard, to take effect in 2004, represents about a 50 percent reduction in emissions of nitrogen oxides, as well as reductions in hydrocarbons, from diesel trucks and buses.
- In May 2000, EPA proposed more stringent emission standards for heavy-duty vehicles that would reduce smog-causing emissions from trucks and buses by 95 percent beyond current levels and PM emissions by 90 percent starting in 2007. The proposal also requires the sulfur content of diesel fuel to be capped at 15 parts per million, a 97 percent reduction from current levels.

For more information:

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