Discovering Innovative Ways to Reduce Diesel Engine Emissions

Argonne National Laboratory addresses technical barriers to reducing exhaust emissions from diesel engines by developing advanced emissions control technologies and gaining detailed knowledge of diesel fuel spray fluid mechanics and diesel particulate formation.

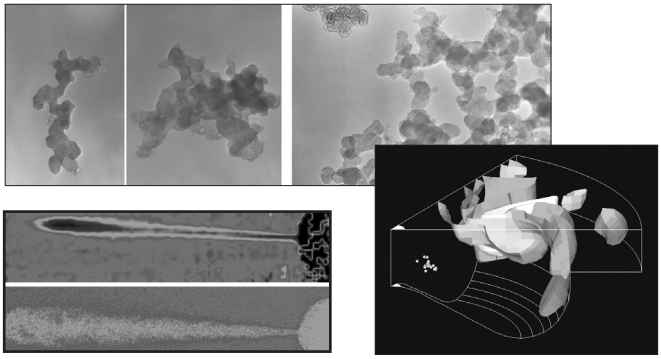
Lowering Nitrogen Oxides and Particulate Emissions

In a cooperative research and development agreement (CRADA) with Caterpillar, Inc., Argonne engineers are working to lower both nitrogen oxides (NOx) emissions and particulate matter (PM) in diesel engine exhaust by modifying in-cylinder combustion processes. The patented technology injects air directly into the cylinder late in the combustion cycle to enhance soot oxidation. Combined with an optimized fuel-injection strategy, it also provides opportunities for simultaneous NOx reduction.

Under another CRADA with a major truck manufacturer, Argonne staff is developing a clean alternative to exhaust gas recirculation (EGR): nitrogen-enriched air generated with a permeable membrane. The membrane, about the size of an air filter, supplies a stream rich in nitrogen for engine combustion. In diesel-fueled vehicles, increasing the nitrogen flow to the engine potentially reduces nitrogen oxide emissions without the problems caused by EGR.

For more information about the Caterpillar CRADA, contact Roger Cole, phone: (630) 252-6245, or Doug Longman (630) 252-4257.

For more information about the membrane CRADA, contact Steve McConnell (630) 252-3080.



Argonne employs novel approaches to reduce exhaust emissions, use x-rays to gain insight into engine performance, and understand the formation of diesel particulates.

Enabling Fuel Injection Breakthroughs

New x-ray techniques and equipment are being developed that provide extraordinary new insight into the operation of modern diesel engines. Researchers are utilizing x-rays from Argonne's Advanced Photon Source to study the structure and dynamics of diesel sprays and learn more about atomization and combustion. Recent experiments have measured the fuel distribution nearer to the nozzle than previously possible with any other measurement technique. This proved for the first time that the spray in this region is composed of a mixture of fuel and vapor, rather than a solid liquid core as previously believed. Also being developed are real-time imaging techniques that capture the internal motion of working fuel injectors and other engine parts. This will enable engine manufacturers to peer through solid steel to observe the operation of mechanical parts inside. These advances will improve the design of engines and lower the cost to develop diesels that meet stringent emissions standards.

For more information, contact Christopher Powell, phone: (630) 252-9027.

Understanding Diesel Particulate Formation

To better understand the formation and potential health impacts of diesel particulates, Argonne researchers are compiling detailed technical data on particulate morphology, microstructure, and chemistry in partnership with the University of Illinois at Chicago and Drexel University. Argonne has developed a thermophoretic sampling system to accurately measure nano-sized diesel particulates. A portable instrument, the TG1, facilitates diesel exhaust particulate measurement in real time. Based on a technique called laser-induced incandescence, it has been proven to perform better and provide a much faster response to transients than the comparable, conventional instrument.

For more information, contact Kyeong Lee (630) 252-9403 about research on particulate morphology or Sreenath Gupta (630) 252-6089 about the TG1 instrument.

For information on Argonne's entire diesel engine research program, contact Raj Sekar, phone: (630) 252-5101.

GREEN TRANSPORTATION TECHNOLOGIES