

NO 2 ways about it

Government bodies and engine filtration manufacturers are working toward a common goal: to protect underground mining workers and equipment operators from harmful emissions.

by Michelle EauClaire



Emissions regulations are definitely not a new topic in the on- and off-highway equipment industries.

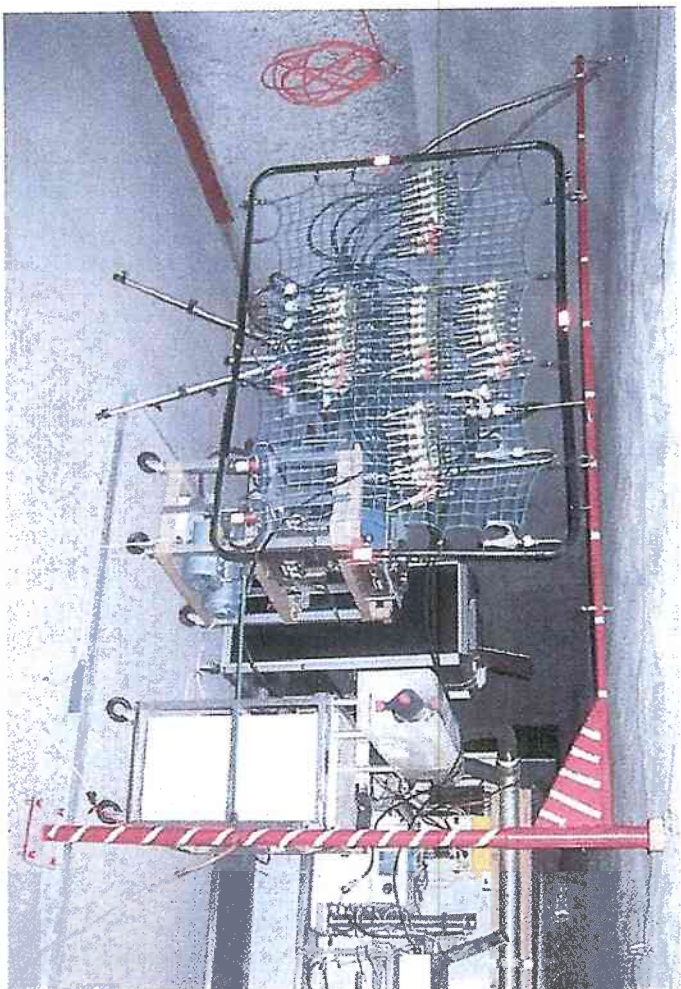
Engine and equipment manufacturers have poured millions of dollars into laboratory and test facility updates, product research and development, testing, and manufacturing of diesel particulate matter reducing technologies and other aftertreatment devices. Equipment manufacturers have redesigned machines repeatedly to accommodate for larger engine system packages, where space was already at a premium.

Underground mining specifically is unique to the challenges of combating emissions because of the tight constraints of the engine package and the equipment itself within the narrow underground mine drifts. The limited space also means that the emissions released into the air are more contained and cannot

dissipate into the air as easily as equipment running in an open environment.

Government regulation

Steve Mischler is the team leader in the Dust Control, Ventilation and Toxic Substances Branch, Office of Mine Safety and Health Research (OMSHR), National Institute for Occupational Safety and Health (NIOSH) an agency within the Center for Disease Control. His group looks for ways to monitor and control diesel emissions, both particulate and control diesel emissions, both particulate matter and in the gaseous form, among other responsibilities and areas of focus. "As a government research facility, we work to reduce occupational exposure," he says. "We work with manufacturers as often as we can to find



NIOSH (the National Institute for Occupational Safety and Health) sets up a down-stream emissions sampling station in an underground mine.

and help solve the issues they are dealing with within the mining industry."

Mischler's group looks at any and all technologies available for diesel particulate matter (DPM) reduction efforts. The Mine Safety and Health Administration's (MSHA) regulatory standard for DPM concentration limit is 160 micrograms per cubic meter of total carbon. The standard went into effect May 20, 2008.

According to a document released by MSHA in September of 2006 entitled "Metal and Nonmetal Diesel Particulate Matter",



Above and right: NIOSH workers take tailpipe samplings of the diesel emissions from a mining vehicle (NIOSH photos).

DPM is a component of diesel exhaust. DPM includes diesel soot and solid aerosols such as organic carbon compounds, ash, metallic abrasion particles, sulfates and silicates. The majority of diesel exhaust particles are less than 1.0 µm in size. Diesel soot particles have a solid core mainly consisting of elemental carbon, with a wide variety of other substances attached to the surface.

Exposure to high concentrations of DPM can result in a variety of serious adverse health effects. These health effects have been found to include: (i) sensory

irritations and respiratory symptoms serious enough to distract or disable miners; (ii) premature death from cardiovascular, cardiopulmonary, or respiratory causes; and (iii) lung cancer.

"When you attempt to implement DPM control strategies," says Mischler, "each mine is an individual. Often when one DPM control technology works in a mine, it may not work in another." For example, the use of biodiesel to reduce particulate emissions works well in locations where the ambient temperature is warmer; however, if biodiesel is used in a machine that is running in a below-freezing environment, the fuel can congeal and become difficult for the engine to handle.

Current solutions

There are plenty of technologies currently in place that effectively reduce the amount of particulate matter and toxic gasses. Selective catalytic reduction (SCR) systems, diesel oxidation catalysts (DOCs) and diesel particulate filters (DPFs) are just a few examples.

"We know that diesel particulate filters will filter a large amount of the particulates coming out of an engine. They're over 90% efficient and do a nice job of reducing diesel particulates in a mine, but they also have issues," Mischler explains. While DPM accumulation does make the filter more effective at remov-



ing particulates, as more accumulates it will eventually plug the system causing the engine to shutdown.

Besides the necessary regeneration process for a DPF system, technologies used in underground mining also have to be aware of the amount of nitrogen dioxide (NO₂) released into the air. "On-highway DPF technology utilizes catalysts to coat the filter material. The catalysts enable the soot to burn off via chemical reaction, but the use of catalysts may also result in the formation of NO₂ which is a health hazard," he says.

In an enclosed space such as a mine, workers should be concerned about any increase in the amount of NO₂. "When we put these

control technologies into the mining industry we have to ensure that the DPM control technology does not result in an increase in NO₂ concentrations to above levels established mining regulations."

We want to reduce health effects and reduce the exposure to diesel particulate matter, and we'll do that any way we can.

—Steve Mischler, NIOSH

ENGINES



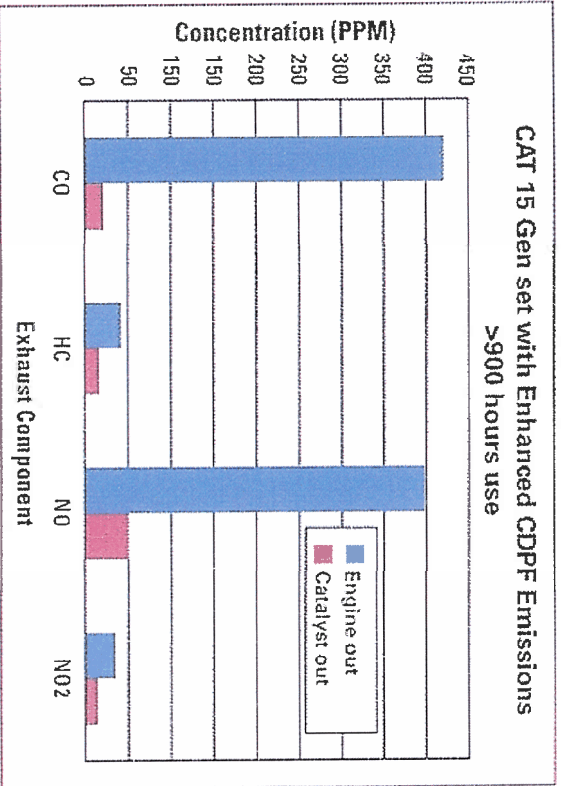
AirFlow's EZCat system requires no DOC, filter pack or heat exchanger, and keeps NO2 within regulated levels. (AirFlow photo)

Cutting-edge, cutting DPM

Airflow Catalyst Systems Inc. of Rochester, NY, specializes in the development of catalytic technology. Its EZCat™ DPM and gaseous emissions (hydrocarbons, carbon monoxide, and NOx) reduction system for diesel exhaust

systems is a continuously regenerating, passive system based on a low temperature chemical reaction, especially well-suited for underground mining.

Unlike common DPM reduction systems, the EZCat system does not require a DOC or a filter



AirFlow's EZCat was retrofitted on a Caterpillar diesel generator (CAT G-15) in an underground salt mine to reduce NO2 emissions. The chart demonstrates concentration levels of emitted exhaust components. (AirFlow image)

24 hour-a-day mining operation

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