

[The DEEP program] has shown that these filters have significant potential for reducing DPM exposure of miners, but that there are numerous technical and operational issues that need to be addressed through research and in-mine evaluations before they can be readily implemented on a broad-based scale in U.S. mines.

MSHA has found that most mine operators can successfully resolve their implementation issues if they make informed decisions regarding filter selection, retrofitting, engine and equipment deployment, operations, and maintenance. The Agency recognizes that practical mine-worthy DPF systems for retrofitting most existing diesel powered equipment in underground metal and nonmetal mines are commercially available and are mine worthy to effectively reduce miners' exposures to DPM. MSHA also recognizes that installation of DPF systems will require mine operators to work through technical and operational situations unique to their specific mining circumstances. In view of that, MSHA has provided comprehensive compliance assistance to the underground metal and nonmetal mining industry.

Commenters to the ANPR responded to the question of changing a diesel engine model to accommodate a control device by stating that anything other than the original engine model is essentially incompatible and would require prohibitive design engineering analysis and implementation. MSHA agrees that it may not be feasible to change engines on some diesel powered equipment. However, as engine manufacturers develop cleaner engines over time, they are phasing out older models and newer, cleaner engine models are available from the same engine manufacturer. In some cases, the new engine models are direct replacements for an older model. The benefits of retrofitting a machine with a cleaner engine are better fuel economy, less DPM emitted from the tailpipe, better lubrication systems, and better diagnostic tools, especially with the electronic engines. A cleaner engine that emits less DPM will deposit less DPM on the filter, thus permitting more time between regeneration, especially in active regeneration systems or combination active/passive regeneration systems.

Filter Workshops

Recently, government, labor and industry sponsored two workshops on "Diesel Emissions and Control Technologies in Underground Metal and Nonmetal Mines" held in Cincinnati, Ohio, on February 27, 2003, and Salt

Lake City, Utah, on March 4, 2003. These workshops focused on implementation of DPM control technologies capable of reducing DPM exposures to particulate matter and gaseous emissions from diesel-powered vehicles that are presently available to the underground metal and nonmetal mining industry in this country. The workshops provided an excellent forum for open discussion and the exchange of ideas and experiences relative to the use of diesel powered equipment in underground mines.

At the workshops, industry experts discussed issues pertaining to the installation and use of DPFs in underground mines. Application of technology and mine operators' experiences with using filters on their diesel powered equipment are becoming more commonplace in the mining industry since the promulgation of the DPM rule.

MSHA, NIOSH, and industry speakers presented their first-hand experiences with the implementation and use of diesel particulate filters in underground mines since promulgation of the existing DPM rule. Major diesel filter manufacturers and vendors of control technologies and engines also participated in the workshops.

NIOSH compiled a summary report to capture presentations, comments and discussions rendered at the workshops, including comments offered by industry representatives who shared their experiences with the effectiveness of DPM filters. MSHA believes that NIOSH's account of the workshops helps to demonstrate feasibility of control technology measures that mine operators have found beneficial and effective. MSHA mailed copies of the NIOSH report to mine operators covered by the proposed rule. This information also is available on the NIOSH Diesel List Server. At the workshops, the following information was discussed:

DPF Efficiency: Laboratory and field studies indicate that filtration efficiency for elemental carbon is above 95% and perhaps is as high as 99%.

MSHA worked with NIOSH at MSHA's laboratory to determine the efficiency of several ceramic filters. MSHA ran steady state tests on the dynamometer and collected DPM samples for NIOSH 5040 analysis. The results of the filter tests showed efficiency results close to 99% for elemental carbon. NIOSH commented:

The INCO project includes two Kubota M5400 tractors powered by Kubota F2803B 50 hp engines [Stachulak 2002]. Both are fitted with actively regenerated DPFs that have a silicon carbide (SiC) filter core. The SiC cores come from the same manufacturer;

the DPF systems are supplied by different manufacturers. The filtration efficiency at the tailpipe is >99 percent for EC as determined by NIOSH using the EchoChem Analytics PAS 2000 carbon particle analyzer. One DPF system uses active on-board regeneration; electric heating coils are integrated into the unit and the unit is plugged into a regeneration controller mounted off board. The other unit is an active off-board system in which the DPF is removed from the vehicle and exchanged with the previously regenerated filter. The soot-laden filter is placed in a regeneration station. Both vehicles are assigned to "special groups" of individuals who ensure that the regenerations are performed as needed.

MSHA stated in the preamble to the January 19, 2001 Final Rule that filter efficiency for cordierite and silicon carbide media used in many DPF systems is 85% and 87% respectively for diesel DPM. These efficiencies were based on whole diesel particulate as collected per part 7, subpart E specifications for measuring DPM. The mining industry has expressed concern that laboratory results do not reflect the real world in both duty cycle and operational environment, so the Metal and Nonmetal Diesel Partnership and MSHA will conduct a set of in-mine tests before mid-2003.

DPF Selection: To use DPF systems successfully, mine operators must do their homework prior to ordering DPF systems. It is critical for filter performance and efficiency to match the filters to the diesel powered equipment and consider how the equipment is to be used in the underground mine. Mine operators should assume that every application is unique.

Following promulgation of the existing DPM rule, most mine operators were unaware that filter selection involves consideration of these factors. Therefore, in February 2003, MSHA and NIOSH posted on their web sites a comprehensive compliance assistance tool titled "A DPM Filter Selection Guide for Diesel Equipment In Underground Mines" (Filter Selection Guide). The guide provides mine operators with detailed step-by-step considerations in selecting DPF system compatible with the specific equipment. Also, the Filter Selection Guide provides information on modifications and adjustments to diesel powered equipment that mine operators may have to make to successfully apply DPF systems.

Mine operators should start by making certain that they are properly maintaining their engines and not consuming excessive amounts of crankcase oil. The mine operator may then obtain exhaust temperature logs or traces for several shifts, and use these