NIOSH highlights mine fire research

With a growing concern over mine fires, prevention and suppression are hot topics. NIOSH researchers Michael Trevits, Alex Smith and Edward Thimons discuss their research in the area.

The leading causes of US mine fires include flame cutting and, welding operations, frictional heating and ignitions, electrical shorts, mobile equipment malfunctions and spontaneous combustion. From 1990 through 2007, there were 1601 reportable fires that occurred in the US mining industry - an average of 89 fires per year.

The fact that mine fires are occurring with alarming regularity reinforces the importance of recognizing and eliminating the potential hazards. These statistics also show the need for improved control and suppression technology to ensure worker health and safety if a mine fire does occur.

National Instirute for Occupational Safety and Health is conducting a comprehensive program of research addressing metal/nonmetal, and coal mine fire prevention, detection and suppression. They include the areas of spontaneous combustion, flame cutting and welding, conveyor belt fire suppression and remote methods for addressing coal mine fires.

Spontaneous combustion

Most spontaneous combustion fires occur in gob areas that are not accessible and require remote detection and extinguishing efforts. The hazard is of particular concern in mines with both a high spontaneous combustion risk and high levels of methane gas.

A computer model has been developed from existing computational fluid dynamic (commonly called "CFD") codes to describe the ventilation pathways through the immediate gob. Simulations have been conducted for a variety of bleederless and bleeder ventilation scenarios and also to evaluate the effect of methane emission rate and ventilation on self-heating in longwall gob areas with a bleederless ventilation system.

This work can be used to assist in the design of ventilation systems where spontaneous combustion risk is high.

Flame cutting and welding

To determine the causes of the fires and injuries caused by flame cutting or welding operations, accident investigations were scrutinized, workers were interviewed, and flame cutting and welding operations at several underground coal mines were observed. The data from these investigations were analyzed to determine the root cause of flame cutting and welding fires in the coal mining sector.

Promising direct interventions to prevent the root causes of flame cutting and welding fires were identified and evaluated in field tests at operating underground coal mines. Existing training methods and procedures were examined and improvements to these methods and procedures were developed and tested in the field. A safety awareness toolbox, Tame the Flame, is planned for release in the near furure.

Conveyor belt fire suppression

NIOSH, in partnership with the US Mine Safety and Health Administration (MSHA), initiated a test program to determine the effectiveness of fire suppression systems on conveyor belt fires in entries with high-velocity airflow. Full-scale experiments evaluated the effectiveness of dry powder chemical suppression systems, water sprinkler systems and water deluge systems in conveyor belt entries at air velocities of zero, 500ft/ min and 1400ft/min.

The data from this work will be used to develop guidelines for the installation and use of fire suppression systems in ventilated belt entries. In late 2007, the scope of this research was modified to include the recommendations made by the Technical Srudy Panel on the utilization of belt air and the composition and fire retardant properties of belt materials in underground coal mining.

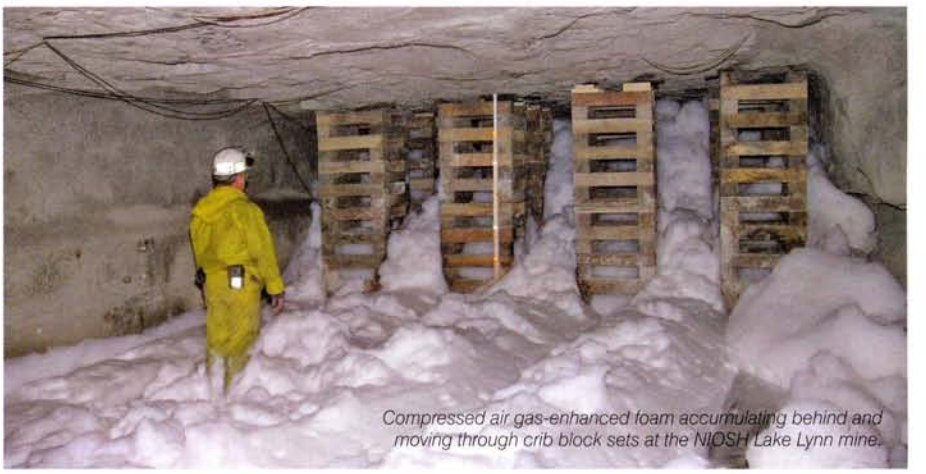
In a related study, conveyor belting, typical of the types used in metal/nonmetal mines, where no mandatory fire resistance standards apply, were evaluated for their fire resistance. The results clearly showed the hazards of using non-approved conveyor belting and demonstrated that the use of approved conveyor belting can significantly reduce potential fire hazards.

Remote methods for addressing coal mine fires

The ability to remotely address coal mine fires can reduce worker exposure to hazardous siruations. The objective of this work is to evaluate, improve or modify remote fire-fighting technologies, including remotely installed mine seals (ventilation barriers), and lire control and suppression technology.

This research effort is being conducted with active industry participation and with the input from MSHA technical specialists serving as research partners. Full-scale remote mine seal installation experiments have been conducted to evaluate cement-based and rigid-foam-based materials.

This work has resulted in new understandings of the limitations of the technology and development of novel down-hole tools to facilitate accurate placement of mine seal materials. Preliminary research on nitrogen gas-enhanced foam (foam resulting from commingling of nitrogen gas, water and a specialized foam concentrate) shows that foam



Compressed air gas-enhanced foam accumulating behind and moving through crib block sets at the NIOSH Lake Lynn mine.

can be stable in the mine opening and can accumulate and flow through mine workings.

Planned work in the summer of 2008 will evaluate the capability of inert gas, nitrogen gas-enhanced foam and jet engine exhaust gas to extinguish full-scale, deep-seated coal fires at the NIOSH Lake Lynn Experimental Mine.

Mine fires represent one of the greatest threats to those working in the underground mine environment. NIOSH mine fire research is addressing a wide spectrum of problem areas facing the metal/ nonmetal and coal mining industries.

The intent of the research is to provide the mine operator and miners with an understanding of the conditions that could lead to a fire, the capability to detect unusual heating or fire conditions and the technology to suppress and extinguish a fire to ensure the best outcome possible.

Research papers outlining much 0/ the work presented in this article, including the research program, are available through NIOSHs website: http://www.cdc.gov / niosh/ mining