Session 32: Mining Safety

Enabling Technologies for Reduced Exposure Mining—Welch JH

Between 1986 and 1995, there were 337 deaths and 72,748 severe injuries to workers in underground U.S. mining operations. Many jobs in an underground coal mine are clustered around the area where machinery digs coal from the surrounding rock, called "the face". The potential hazards in this area are numerous: When the coal is removed, the ground around it becomes unstable and can cave in on workers. The mining machinery used there are large, heavy, powerful, and move in different directions in a very confined space, presenting danger to workers. The machines churn up coal dust that causes black lung and generate noise that causes hearing loss.

The NIOSH, Pittsburgh Research Center, recently completed a research program to develop enabling technologies that might substantially reduce worker exposure to face hazards in underground mines by relocating equipment operators to an area of relative safety and health. This reduced exposure mining concept is an alternative approach to other safety and health research efforts to reduce potential health hazards such as dust and noise exposure and to reduce accidents in the work place. In this research program, sensor and computer technologies have been developed to allow remote control of mobile mining equipment, specifically continuous mining machines and haulage systems, in the face area. This paper describes these technologies for reduced exposure mining, many of which also have non-mining applications for worker safety and health.

Safety Issues and the Use of Software-controlled Equipment in the Mining Industry—Sammarco JJ, Kohler JL, Novak T, Morley LA

Software-controlled equipments are increasingly employed in mining, because of its ability to effectively solve complex industrial control problems. For mining, the human element is almost always involved and, therefore, safety is critical. Software control is relatively new to mining, and this industry can benefit from lessons learned from applications in other industries. These include guidelines, methods, and processes for safety-critical software and systems. Accordingly, the National Institute for Safety and Health (NIOSH) has initiated a project to address processor-controlled equipment safety. A systems-level approach has been taken. A panel from industry, academia, and other agencies has provided project input. Software development and human-machine interaction were identified as the leading concerns of the panel. Additionally, extramural activity was established with The Pennsylvania State University and The University of Alabama to survey and analyze mining equipment and processes. These researchers met with manufacturers, the Mine Health and Safety Administration (MSHA), and mine operators. Their findings and recommendations are given in the paper, and include issues involving hardware, training, human factors, documentation, software, and compatibility. More than 200 standards and guidelines have been reviewed for applicability to mining, and an identified select list is presented. A framework for system and software safety guidelines has been investigated for mining applications, and this information is used to conclude the paper.

Reducing Acute Injury From Mine Roof Failures During Remote-Control Mining of Extended Cuts—Bauer ER, Steiner LJ

Underground coal mine workers are subject to many injury causing hazards, including injuries resulting from falling roof rock. One particular work task that seems to be especially susceptible to accidents from falling roof is the remote-control operation of the continuous mining machine. Remotely-operated continuous mining machines are widely used in the U.S. coal industry and are an essential part of mining extended (deep) cuts. Prior to development of remote control, continuous mining machine operators were located in the deck of the machine and protected by an overhead canopy. The use of remote control has removed the operator from the machine and out from under the protective canopy. The operator is now free to move about and position himself where he can best see the mining operation. While remote control has taken the operator further from immediate face area hazards, it has increased work crew exposure to known hazards and introduced them to new hazards. Fall of roof and rib as well as interaction with other running equipment are now major concerns for remote-control continuous mining machine operators and others working in the face area. Reducing exposure to these hazards requires a systematic evaluation method to address aspects of work procedures and work environment.

This presentation will address the mine worker population at risk, review the associated accidents and fatalities, and describe the major worker safety issues specific to remote-control mining. In addition, NIOSH roof fall accident prevention research efforts will be described, and the injury/accident prevention techniques being implemented by the mining industry to reduce acute injuries from falls of roof will be presented.

Lower Injury Risk for Underground Low-coal Equipment Operators Using Ergonomic Seat with Viscoelastic Foam—Mayton A, Merkel R, Gallagher S

Operators of underground mobile equipment, particularly shuttle cars, experience significant levels of shock and whole-body vibration (WBV). Research sponsored by the U. S. Bureau of Mines (USBM) has indicated that as many as one-third of underground equipment operators may be exposed to adverse levels of shock and WBV. Moreover, cumulative back, neck, and abdominal disorders are linked to prolonged exposure of equipment operators to shock and WBV. Also, traditional seats on mining equipment are inadequate concerning the human needs of the equipment operator. In the extreme, a mining vehicle seat has sometimes consisted of a bent steel plate bolted to the machine frame or hard rubber on a steel bench. Further, restricted space in low-coal mines makes seat suspension systems difficult to use in isolating operators from shock and WBV. The Human Factors group at the NIOSH—Pittsburgh Research Center is responding to these issues with research on viscoelastic foams applied to an ergonomically designed seat. For the full-load case, an ergonomic seat with viscoelastic foam isolated the low-coal shuttle car operator from shock down to 15 Hz. With results from foam testing, an analytical model identified viscoelastic foam capable of lowering the isolation frequency for vehicle shock to below 5 Hz. This paper discusses work that has led to improvements in a low-coal shuttle car seat.