62 Reducing silica exposure to miners at surface operations in the United States

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Workers at surface mining operations in the United States are often exposed to high levels of silica and other harmful respirable dusts. In an effort to lower respirable dust exposures, the National Institute of Occupational Safety and Health (NIOSH) has been conducting research to address this problem in a practical and economically viable manner. This article will discuss two research projects addressing areas of high silica exposure in surface mining operations today. The first deals with enclosed cabs. Many types of heavy equipment, including drills, dozers, loaders, and scrapers, as well as a vast array of different haulage vehicles and trucks, have enclosed cabs to protect equipment operators from health and safety hazards. If cabs are not properly designed or fabricated, or if components significantly deteriorate over time, the protection provided can be seriously jeopardized, potentially causing an overexposure to silica and other respirable dusts. NIOSH has been involved in an extensive research effort investigating how to improve the protection of workers in enclosed cabs, including a number of cooperative studies with mining companies, heating and air conditioning companies, and cab filtration manufacturers. The majority of this work has investigated retrofitting older cabs with new filtration and pressurization systems and these studies have shown very cost-effective reductions. Retrofits to older cabs have resulted in respirable dust reductions in the 80 to 90 percent range for enclosed cabs on drills and loaders. For an enclosed cab to be effective in controlling respirable dust, two key components are necessary: 1) effective filtration, and 2) cab integrity. An effective filtration system should be composed of both a re-circulation and a clean outside-air system. Cab integrity is necessary in order to achieve some level of pressurization, a critical component for an effective clean cab system. To prevent dust laden air from infiltrating the cab, the static pressure within the cab must be higher than the velocity pressure of the prevailing wind. The second major research area involves reducing the respirable dust exposures of bag operators and bag stackers at mineral processing operations. For the past 20 years, dust exposure records for mineral processing plants have shown that both of these job functions normally have the highest respirable dust exposures. NIOSH=s research effort focused on engineering controls that were adapted to existing facilities to reduce the dust generated by these two job processes. This control technology was successful in lowering the respirable dust exposures of the bag operators and bag stackers by 80 to 90 pct. This research also examined various controls for secondary dust exposure, including general ventilation requirements for mill buildings, the effects of background dust sources, and personal work practices. The majority of this research was performed in the silica sand industry and was highly successful in reducing workers=respirable dust exposures.

63 Blasting abrasives: health hazard comparison

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Historically the most common form of abrasive blasting, sand blasting, has generated respirable quartz dust, which can lead to the development of silicosis, a deadly lung disease that continues to occur in abrasive blasters. Several substitutes for silica sand have been suggested, but little data exist which compare the respiratory health hazards of substitute abrasives to silica sand. This study compares the dust generation characteristics and *in vivo* toxicity of several blasting abrasives (table 1). Studies were conducted in controlled environments to compare concentrations of respirable quartz, respirable dust, and various toxic contaminants for each of the substitute abrasives relative to silica sand. Abrasive blasting with silica sand generated respirable quartz concentrations much greater than the NIOSH recommended exposure limit of 0.05 mg/m^3, while the concentrations of respirable quartz were much lower when using substitute abrasives (table 2). However, some substitute abrasives generated concentrations of potentially toxic components more than 10 times the NIOSH REL (table 3). Steel grit was the only substitute abrasive that generated significantly less respirable dust than silica sand. NIOSH investigators reported the relative short-term *in vivo* toxicity of these substitutes by using intratracheal instillation of equal respirable dust concentrations of each abrasive in male rats. Short-term *in vivo* evidence indicates that, compared to silica sand, steel grit and specular hematite have less potential to cause lung disease. The potential long-term toxicity of steel grit requires further studies because it contains arsenic and nickel and some forms of arsenic and nickel can cause cancer. Each of the other substitute blasting abrasives caused *in vivo* lung toxicity similar to or greater than silica sand. Regardless of the choice of abrasive, effective engineering controls, work practices, and respiratory protection (i.e., Type CE abrasive-blasting supplied-air respirators for abrasive blasters) should be used to reduce the hazards associated with blasting abrasives and substrates.

Table 1 - *Short-term animal lung toxicity relative to silica sand (1.0)*

Type of abrasive	Inflammation	Damage	Fibrosis
Steel Grit*	0.0*	0.1*	0.0*
Sp. Hematite*	0.0*	0.2*	0.2*
Nickel slag	0.2**	0.5**	0.7
Copper slag	0.6**	0.5	1.0
Staurolite	0.9	0.7	0.7
Garnet	0.9	1.1	0.5
Cr. Glass	1.3	1.1	0.5
Coal slag	1.9	1.9	0.7
Olivine	4.2	3.8	0.9

* Significantly less than sand and similar to control
** Significantly less than sand and greater than control

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