



Construction

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An Emerging Issue: Silicosis Prevention in Construction

John B. Moran, Column Editor

Reported by Kenneth D. Lynch and Joseph C. Cocalis

Introduction

How often have you driven along a highway construction site and noticed a worker in a "cloud of dust"? You look closer and notice that the worker is wearing a disposable "paper mask" respirator or no respirator at all. This worker is possibly being overexposed to respirable crystalline silica and therefore may be at an increased risk of developing silicosis, a chronic, fibrotic disease of the lung caused by the inhalation of respirable crystalline silica.

Lofgren⁽¹⁾ reported sample results from similar operations where construction workers were cutting or drilling concrete and found that excessive exposures to respirable quartz are likely to occur. Lofgren's data indicated that exposure, averaged over an 8-hour shift, at times surpassed the protection factor of 10 times accepted exposure limits assigned to half-face, negative-pressure respirators.

The need to control crystalline silica exposure among construction workers is supported by epidemiological data. In a review of death certificate data for primary cause of death for 61,682 white male construction workers in 19 states between 1984 and 1986, the National Institute for Occupational Safety and Health (NIOSH) found the proportionate mortality ratio for silicosis, with a *p* value of 0.01, to be 327; this is second only to that for asbestosis.⁽²⁾

Concrete is made of cement, sand, rock, and water. Sand is normally very high in crystalline silica (quartz) content and most rock contains some silica; therefore, any time concrete is drilled, sawed, ground, blasted with abrasive, or otherwise made into a fine dust and made airborne, the potential for exposure to respirable crystalline

silica exists. An estimated 700,000 construction workers are exposed to crystalline silica.⁽³⁾ A typical construction setting exposure is often of high-intensity, intermittent, and highly variable. The workforce is often transient, and most construction workers are not enrolled in a medical screening or surveillance program.

Surface coal mine drilling operations are similar in many ways to construction. Many mines contract with drilling/blasting contractors who work both construction sites and mines. Just as in a typical construction setting, exposure to crystalline silica in surface coal mine overburden (highwall) drilling is often of high-intensity, intermittent, and highly variable. The purpose of this article is to broadly discuss actions taken to prevent silicosis in surface coal mining and to suggest actions that would help to prevent future cases of silicosis in construction.

Background

Silicosis has long been observed in surface coal mine drillers and driller helpers, and it continues to occur. Northern West Virginia case histories are used as examples. Nine cases of silicosis in surface coal mine drillers were reported between 1978 and 1988 at West Virginia University Hospital, including two cases of acute silicosis and five cases of accelerated silicosis. The median age at the time of diagnosis was 35.⁽⁴⁾

A sentinel case occurred in May 1992, when a 45-year-old surface coal mine highwall driller was admitted to West Virginia University Hospital with respiratory failure. He had operated a drill in numerous pits over a 22-year period, had not seen a doctor in years, and never had a chest xray. He was diagnosed with severe silicosis. A follow-up investigation revealed two additional

cases of severe silicosis in area drillers, one of which was in a drilling contractor who drilled at multiple surface mines and other jobs. The surface mines where the drillers worked were inspected on a semiannual basis by the Mine Safety and Health Administration (MSHA). In August 1992, NIOSH issued an *Alert*, "Preventing Silicosis and Deaths in Rock Drillers"⁽⁵⁾ and initiated an investigation into why current regulatory safeguards were ineffective in preventing silicosis in these surface coal miners.

Based on interviews with MSHA inspectors and Bureau of Mines researchers in 1992 and 1993, NIOSH (accompanied by MSHA inspectors) identified and visited over 30 surface coal mine drilling operations. The investigations yielded several concerns, all of which are applicable to construction. Those concerns included:

1. difficulty in identifying and tracking small employer contract drillers who intermittently bring poorly controlled drills onto mine sites;
2. the inability of semi-annual sampling to identify silica overexposures in a highly variable environment;
3. the need to control excessive exposures during the period between the date of sampling and the date sample results are received; and
4. biases that may result if drill operators choose to alter drilling techniques, during sampling, so that samples do not accurately represent exposures.

Discussion

Cost of Dust Controls

The technology exists to control dust exposure from drilling operations, and many surface coal mines operate adequately controlled drills.

However, well-controlled drills cost more to purchase, operate, and maintain.⁽⁶⁾ The U.S. Bureau of Mines reported in 1986 that a typical dry dust collector with a 10-year life costs approximately \$13,500 to install and \$2,000 per year to maintain with the cost of a wet system being approximately 40 percent that of a dry system, or \$4,250.⁽⁶⁾ Poorly controlled drills continue to be used in mining (similar equipment is used in construction). Based on a review of information supplied by MSHA, NIOSH estimates that drills at 118 of 998 inspected operations (12%) lacked cabs to isolate drillers from dust exposure. Wet drilling techniques were used at 26 of the 118 operations. An estimated 163 of the drills with cabs lacked air conditioners, the outcome being that the drillers were prone to keep the doors open in hot weather.

Costs associated with silicosis can exceed the costs associated with purchases, operation, and/or maintenance of dust controls. For example, a 33-year-old surface coal mine drill operator in western Pennsylvania with 10 years of experience developed accelerated silicosis in the mid 1980s. The drill was equipped with a dust collector and the company claimed to have an acceptable sampling history from MSHA. The driller became a candidate for a lung

transplant but died before one could take place, approximately 5 years from the onset of symptoms. The insurer paid out \$95,000 in medical payments and \$250,000 to a 33-year-old widow and 5-year-old child.⁽⁷⁾

In another case, a 29-year-old drill operator from a Virginia-based surface mine with 10 years of experience was diagnosed with acute disease of the lungs consistent with silicosis in 1981. He later developed massive pulmonary silicosis and died in 1987 at age 35 after spending the last months of his life on a respirator. He left a 29-year-old widow and an 8-year-old daughter. The insurer paid out \$140,000 in indemnity and \$60,000 in medical payments.⁽⁷⁾

Sampling as a Risk Indicator

Sampling alone may not be an effective health risk indicator. Exposure in the construction setting is often highly variable and a function of work practices, equipment controls, site settings, and meteorological conditions. For example, Figure 1 is a photograph taken at a construction site of a drill that is not equipped with a cab to isolate the driller from exposure. The drill produces "a cloud of dust." If sampling is conducted when the wind is blowing a plume of dust away from the drill operator, the results may not be representative of longer-term exposure. In this in-

stance, an inspector may not require controls in a situation where excessive exposure is possible and controls are clearly warranted.

Even up-to-date sampling and analytical techniques can be problematic. Excessive exposures of potential health significance may go unabated during the period between when an air sample is taken and when the results of the analysis are received. Furthermore, the construction job setting is likely to have changed during this period.

Sampling can also be misleading due to varying work practices at the construction site. Workers can alter techniques or be less likely to position themselves in the "dust cloud" during periods when they are wearing a sampling pump and are being observed.

MSHA took a proactive approach to addressing these concerns by recently (effective April 1994) revising their standards to require wet drilling or the other effective dust control measures (such as an air-conditioned pressurized cab used in conjunction with a dry dust collection system) at surface coal mine drilling operations.⁽⁸⁾ Citations can now be issued for operations where excessive exposures are likely in the absence of sampling (e.g., a driller positioned in a "cloud of dust"). Additional surveillance is needed. MSHA and NIOSH are currently involved in a joint project to identify and provide physical examinations to selected high-risk populations and to target those operations associated with silicosis for increased enforcement.

The lessons learned from surface coal mine drilling apply to construction where similar excessive intermittent exposures, with a lack of medical and environmental surveillance oversight, continue to occur. The Occupational Safety and Health Administration (OSHA) adopted the 1970 threshold limit value (TLV)⁽⁹⁾ as a separate permissible exposure limit (PEL) for silica (quartz) in the construction industry.⁽¹⁰⁾ This PEL, which is based on the impinger sampling method for quartz, is clearly in need of updating. NIOSH has a recommended exposure limit of 0.05 mg/m³ for respirable crystalline silica. A regulatory approach

FIGURE 1. A poorly controlled drill at a construction site.



based on engineering controls, augmented by sampling, is necessary to prevent potential exposures that sampling alone fails to address.

Respirators

Respirators may not be protective in all instances. During the surface coal mine visits, NIOSH observed instances where bearded drillers had disposable "paper mask" respirators available for use (see Figure 2). Based on review of information supplied by MSHA, NIOSH estimates that respirators were available for use at approximately two-thirds (680 of 998) of surface coal mine drilling operations. Although respirators were available, they were intermittently used at approximately 310 or one-third of the operations inspected. The MSHA inspectors also noted that respirator training was provided at approximately one-half of the operations inspected, and fit testing was performed at approximately 14 percent of the operations. The protection afforded by respirator availability under these conditions is questionable.

There are similarities to construction. Construction workers often use respirators during "dusty" operations. Concerns regarding respirator use in construction include: the use of disposable respirators with an assigned

FIGURE 2. A bearded driller with a disposable paper-mask respirator attached to his hard hat.



protection factor (APF) of 5 in extremely high silica concentrations; the use of any filtering respirator by workers with beards; and the use of loose-fitting type-CE, continuous-flow, abrasive-blasting respirators with an APF of 25 for sandblasting operations.⁽¹¹⁾ NIOSH issued a notice to all users of type-CE, continuous-flow, abrasive-blast respirators on October 4, 1993, that warned that this type of respirator may be inappropriate for sandblasting.⁽¹²⁾

Medical Screening and Surveillance

It is believed that many cases of silicosis in the construction industry go unreported because chest xray screening and surveillance are not provided for the workforce. NIOSH reported that 23 percent of small employers (8-99 employees) in the construction trades provide chest xrays to all or selected workers in the National Occupational Exposure Survey.⁽¹³⁾ If a chest xray surveillance program were in place for

surface coal mine drillers as well as construction workers, some of the cases of silicosis could be identified in the early stages and corrective action taken to reduce exposures and, hopefully, the severity of the disease.

Chest xray surveillance is necessary to identify silicosis in the early stages of development with reporting to appropriate government health departments or agencies for follow-up preventive action. Many small construction firms do not provide medical surveillance to employees. NIOSH recommends that medical monitoring be available to all workers who may be exposed to crystalline silica; such examinations should occur before job placement and at least every 3 years thereafter.⁽¹⁴⁾ More frequent examinations (annually, for example) may be necessary for workers at risk of acute or accelerated silicosis (e.g., drillers who use high-risk equipment; sandblasters). Examinations should include at least the following items:⁽¹⁴⁾

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- a medical and occupational history to collect data on occupational exposure to crystalline silica and signs and symptoms of respiratory disease;
- a chest xray classified according to the 1980 International Labour Office (ILO) International Classification of Radiographs of Pneumoconiosis (ILO 1981);
- pulmonary function testing (spirometry); and
- an annual evaluation for tuberculosis (ATS/CDC 1986).⁶⁵

Training

Silicosis prevention should be addressed in worker training programs. During the NIOSH visits to surface coal mines, drillers, in general, were often aware of the term "black lung disease," but were unaware of the term silicosis or of the hazards associated with drilling rock with a high crystalline silica content such as sandstone. Some drillers expressed the belief that "wearing a paper mask respirator will prevent black lung." Workers should receive training that includes information about the adverse health effects of silica exposure, instruction about the use and care of appropriate protective equipment (including respiratory protection), and proper work practices and engineering controls to reduce exposure to acceptable levels.

Conclusions

From surface coal mine drilling experience, we have learned that a regulatory approach, based on sampling alone, will be ineffective in preventing silicosis. Other issues that need to be addressed include engineering controls, respirator use, medical surveillance, and training. An approach based on primarily engineering controls and augmented by sampling is necessary to prevent potential exposures that sampling alone fails to adequately address. These lessons apply to the construction industry, where an estimated 700,000 workers (including 13,000 water-well drillers) may have similar exposures to crystalline silica.

Recommendations

The preceding discussion has identified several factors that place construction workers at increased risk for the development of silicosis. Steps which could be taken to reduce those risks include the following.

- Before construction begins, contractors and businesses hiring contractors should assess the potential for exposing workers to crystalline silica as part of the job hazard analysis.
- For operations where exposure potential exists, augment the OSHA performance standard with job specifications that enable construction inspectors (in the absence of sampling) to require controls such as wet drilling. Job specifications should include requirements for engineering controls such as wet methods, provision of medical surveillance and training, and enforcement of the proper use of respiratory protection.

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