EMERGING REGULATORY AND CONTROL ISSUES FOR SILICA DUST IN MINING

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ABSTRACT

Exposure to respirable mine dusts (coal and crystalline silica) continues to be considered the major health concern facing the mining industry today. Silicosis is a disabling and sometimes fatal lung disease which can afflict mine workers who are overexposed to fine airborne particles of respirable crystalline silica. It was long thought that silicosis was not a problem for mine workers. However, recent medical studies have specifically linked silicosis to surface mining, and the potential for overexposure remains just as real in underground mining operations. Each year, more than 250 American workers die with silicosis, with the most frequent occupation being listed as mining machine operator. The National Institute for Occupational Safety and Health (NIOSH) has recently recommended that the exposure limit for respirable crystalline silica not exceed 0.05 mg/m^3, and the Advisory Committee on the Elimination of Pneumoconiosis Among Coal Mine Workers has suggested "the Mine Safety and Health Administration cause the lowering of silica exposure of miners."

In the Fall of 1996, the Department of Labor, together with the National Institute for Occupational Safety and Health, Department of Health and Human Services launched a national silicosis prevention effort. This effort is a partnership between labor, industry, and Federal Agencies that will serve to abate, and ultimately eliminate, the enormous human and financial cost of unnecessarily high exposures to mine dusts. As part of this initiative, the Mine Safety and Health Administration has instituted a program of increased regulatory efforts and special enforcement activities throughout the mining industry, while the Pittsburgh Research Laboratory of NIOSH has identified improved control technologies which can be used to mitigate the potential exposure of mine workers to respirable crystalline silica. Both of these activities are described in detail within this report. Both Agencies have joined in a campaign of outreach, education, surveillance, and control. Remember, *"If It's Silica, It's Not Just Dust."*

BACKGROUND

Dust disease in miners has been known to exist since ancient times. There was little concern with health problems of miners in the United States until the early twentieth century. In the 1930's, a tunnel driven through a

sandstone mountain near Gauley Bridge, West Virginia, caused the death of several hundred workers due to acute silicosis. The severity of the disease became known to the public and prompted the U.S. Congress to enact laws to reduce dust levels.

Silicosis is a disease of the lungs which can result from breathing excessive amounts of dust containing respirable crystalline silica (SiO_2). Silica dust can cause fibrous or scar tissue formations in the lungs which reduce the lungs' ability to extract oxygen from the air. A person may develop acute silicosis with high exposures to silica dust and may develop shortness of breath and fever after short periods of exposure. Lung function can be severely damaged. Chronic silicosis usually occurs after 10 or more years of exposure to lower levels of crystalline silica. Silicosis is a severe lung disease which may continue to worsen even if the worker is removed from the contaminated environment. Miners with chronic silicosis have developed Progressive Massive Fibrosis (PMF), a condition in which large areas of lung tissue become scarred and collapse. Silicosis may also increase the susceptibility to infectious lung diseases, such as tuberculosis, and may be related to the onset of lung cancer. Unfortunately, exposure to crystalline silica has not been eliminated as a hazard to miners, and recent studies have shown that silicosis remains a serious health concern of the present.

To illustrate the continued cause for concern, recent medical surveillance studies indicate that up to 2,500 surface coal mine workers may be afflicted with silicosis (USDOL, 1995). Senior NIOSH officials have stated that these results are of significant concern, and MSHA officials have asked that miners and mine operators recognize this problem and take the steps necessary to prevent silicosis. United Mine Worker Officials have expressed grave concerns that workers are being exposed to massive quantities of dust and are dying at unacceptable rates. As many as 250 workers may be dying yearly of silicosis.

Employees working at surface and underground mines are covered by Mine Safety and Health (MSHA) regulations. Coal mine operators must comply with the MSHA permissible exposure limit (PEL) of 2.0 milligrams of respirable coal mine dust per cubic meter of air (2.0 mg/m^3). However, when the respirable quartz (crystalline silica) content of the dust is greater than 5%, the PEL is adjusted as follows (30 CFR 71.101): [PEL ($mg/m^{3)}$ = 10/% quartz]. For metal and nonmetal mines, the MSHA PEL for respirable dust is calculated as follows (30 CFR 56.500): [PEL (mg/m^3) = 10/% crystalline silica + 2].

The NIOSH recommended exposure limit (REL) for respirable crystalline silica is 50 $\mu g/m^3$ as a time-weighted average (TWA) for up to 10 hours/day during a 40-hour workweek (NIOSH 1974). This REL is intended to prevent silicosis; however, the International Agency for Research on Cancer (IRAC) has recently reclassified silica as a Level 1 carcinogen. NIOSH is in the process of reviewing the data on carcinogenicity and their recommendation for an exposure limit.

Analysis of recent data collected as part of MSHA's mandatory compliance sampling at coal mines indicates that the overall average concentration for respirable crystalline silica currently exceeds the mandatory Federal standard, with 35% of roof bolt, 25% of continuous miner, 18% of shearer, and 70% of surface highwall drill operator samples exceeding 0.1 mg/m^3 (MSHA, 1994). Twenty-nine underground and 15 surface occupational categories have at least 10% of their silica samples above 0.1 mg/m^3. It is apparent that a significant portion of the coal mining industry is still experiencing considerable difficulty complying with current, mandatory Federal dust standards. There has been no significant reduction in the percentage of samples exceeding permissible exposure levels during the past decade (NIOSH, 1994).

Approximately 25% of metal/nonmetal mine samples currently exceed the mandatory Federal standards, with an average respirable crystalline silica level of 45 $\mu g/m^3$. The occupations which are most frequently cited for overexposure to respirable crystalline silica include crusher operators (28%), ball and rod mill operators (23%), and baggers and packers (22%). The most common surface mine operations cited for overexposure to respirable crystalline silica are sandstone mills and granite quarries (20%), while underground silver and copper mining operations are most frequently cited (53%).

REGULATORY ISSUES

The Mine Safety and Health Administration's Coal Mine Safety and Health Division is proactively and aggressively enforcing regulations, educating mining personnel, and working with operators to reduce and eliminate the hazards of silicosis.

Surface Coal Mines

In April of 1994, MSHA began enforcing a new health regulation for coal mines. 30 CFR 72.620 requires that, "Holes shall be collared and drilled wet, or other effective dust control measures shall be used, when drilling non-water-soluble material. Effective dust control measures shall be used when drilling water-soluble material." Up to this point, MSHA was required to take up to 5 respirable dust samples in order to issue a citation for an ineffective dust control system corrected. During the first 6-month period, 92 citations were issued nationally for 30 CFR 72.620. During the week of October 21-25, 1994, MSHA conducted a surface health sweep to determine the level of compliance for the new regulation. There were 999 highwall drills inspected. The results indicated that the majority of highwall drills now had an effective means of dust control installed. The majority of citations issued during this sweep indicated that where a dust control system was in place, it was not being maintained in an effective manner. From that time until April 20, 1997, MSHA had issued 527 citations for 30 CFR 72.620 (ineffective dust control of surface drill dust).

In the summer of 1994, MSHA and NIOSH jointly offered health screenings including chest x-rays to surface miners in the Johnstown, Pennsylvania, area. The Johnstown area was selected based on reports of surface coal miners receiving compensation for silicosis and the large number of operating surface coal mines. The intent of the study was to concentrate on offering x-rays to highwall drillers, although any surface miner could participate. Current regulations do not mandate chest x-rays for surface miners as they do for underground miners. Therefore, in some cases, this was the first chest x-ray that a miner had received. One hundred and fifty surface miners agreed to participate with 91 of them being drillers. The results were discouraging.

In April 1995, MSHA and NIOSH held a joint news conference releasing the results of the Johnstown study. Eight of the 150 individuals had been diagnosed with silicosis. Seven of the eight were individuals employed in drilling operations. These results indicate the importance of maintaining effective dust controls to reduce the risk of getting silicosis. Attention has also been given to other surface occupations that can potentially be exposed to silica such as bulldozer operators, truck drivers, and front-end loader operators.

When the results of the Johnstown study were released, MSHA initiated a concerted effort to better educate miners on the hazards of exposure to silica. The Compliance Analysis Program (CAP) was initiated in MSHA District 2. The CAP program was set up to utilize seasoned inspectors who had knowledge of surface mining. They were asked to relinquish their Authorized Representative cards and talk to as many surface miners as possible for a three-month period on the hazards of silica. The

program was very well received. Both the mine operators and the miners were very interested in the initial Johnstown study results. Surprisingly, many of the miners did not know much about the hazards of silica. Handout material, pocket cards, and stickers were used to raise awareness. The program was also initiated in MSHA District 3 in Morgantown, West Virginia.

The program was extended based on the positive feedback from operators, miners, and our own CAP personnel. It was felt that this holistic approach had really gotten the attention of the surface miners who were concerned about the hazards of silica. Information meetings, videos, and handouts were again used to supplement the miners' knowledge. In April of 1997, MSHA instituted a national CAP program. One focus of the first 6 months will be to educate all miners of the hazards of silicosis.

The National Conference to Eliminate Silicosis was held March 25-26, 1997, in Washington, D.C. The conference was part of the "If It's Silica, It's Not Just Dust" campaign launched on October 31, 1996, by the Secretary of Labor. The intent of the conference was to bring people together to exchange ideas and share solutions that will help in the elimination of silicosis for all workers. The ongoing campaign is a joint effort of the U.S. Department of Labor's Mine Safety and Health Administration and Occupational Safety and Health Administration (OSHA), U.S. Dept. of Health and Human Services' National Institute for Occupational Safety and Health (NIOSH), and the American Lung Association.

During the week of April 21-25, 1997, MSHA conducted another surface coal mine health sweep. This coincided with the National Conference to Eliminate Silicosis. It also had been approximately 3 years since the highwall drill standard had become effective. The results indicated that of 942 highwall drills inspected, a total of 107 citations were issued. The results again indicated that almost all of the drills had a dust collection system installed and that the majority of citations were issued because of failure to maintain the controls.

MSHA has also seen the total number of Designated Work Positions (DWP's) involving the highwall drilling operation increase. Prior to the new regulation going into effect (April of 1994), there were 25 DWP's in place for highwall drill operators and helpers. Three years later (April of 1997), there were 133 DWP's for highwall drill operators and helpers.

It is hard to determine the exact impact of the new standard (30 CFR 72.620) on the number of DWP's because another change was made to the quartz program. In October of 1994, MSHA began to preweigh respirable dust cassette filters. Until October of 1994, the total weight gain on the respirable dust filter had to exceed 0.45 mg to be analyzed for quartz. Historically, the weight gain on a significant number of surface respirable coal mine dust samples had been less than 0.45 mg. Therefore, these samples could not be analyzed to determine if excess quartz was present. MSHA has upgraded the equipment used to process these samples, which allows for a more precise determination of quartz content. A total weight gain of only 0.1 mg is now needed for analysis. As a result, more samples can be analyzed for quartz content, allowing greater protection for miners from overexposure in cases where the quartz content is greater than 5%.

A second health screening was also conducted in Western Pennsylvania during the summer of 1996. It was a joint program between the state of Pennsylvania, NIOSH, and MSHA. There were more than 660 participants included in the study with the majority being active surface miners. The preliminary review indicted a similar percentage of illness when compared to the initial Johnstown study. A third health screening has recently been completed in Eastern Pennsylvania (Anthracite region). Results are also forthcoming from this study.

Underground Coal Mines

MSHA has also taken a proactive approach to reducing the hazards of silica in underground mining. Two programs have been initiated to both reduce the silica exposure in underground mining and to make the miners more aware of the hazards of silica.

In March of 1996, MSHA implemented the "Silica Reduction Initiative Program" to reduce the amount of free and combined silica in the mine atmosphere to which underground miners are exposed. This consisted of MSHA inspectors sampling occupations that were on reduced standards due to quartz. They were instructed to work with both the mine operators and miners to develop specific controls to alleviate recognized and potential silica hazards. As of May 1, 1997, there were 261 active mining units (designated occupations) and 391 active designated areas (roof bolters, shuttle car operators, etc.) on reduced standards because of quartz. The program was also implemented to raise the awareness to potential health problems associated with silica as the surface program has done. The program is ongoing at this time.

In November of 1996, MSHA implemented the "Silica Awareness Campaign," which is also being used to raise awareness to this serious hazard. It includes posters, discussions with miners, stickers, brochures, and silica tip sheets which are given to each miner. Feedback has been positive from the mine operators and miners. They are more aware of the hazards associated with silica. They especially like the silica tip sheets which can be used as a check list for the individual miners. The program is also being used at surface mines.

The Advisory Committee on the Elimination of Pneumoconiosis Among Coal Mine Workers

On January 31, 1995, the Advisory Committee on the Elimination of Pneumoconiosis Among Coal Mine Workers was formed by the Secretary of Labor. Their charge was to make recommendations to the Secretary on how to eliminate pneumoconiosis and silicosis in coal workers, among other things. The committee submitted a report of their findings and recommendations to the Secretary of Labor on November 14, 1996. They identified a number of issues concerning silicosis and developed findings and recommendations that were relative to each issue. These included:

- developing and enforcing separate permissible exposure limits (PELs) for exposure to silica and coal mine dust;
- exploring appropriate methods for determining compliance with exposure limits for mixtures of silica and coal mine dust;
- suggesting that MSHA cause the lowering of the silica exposure of miners;
- extending medical testing to surface miners; and
- evaluating training concerning health hazards of respirable silica dust.

Based on the committee's report, MSHA has recently issued four program instruction letters to address certain recommendations, which are as follows:

1. Conduct follow-up inspections when respirable dust sample results indicate silica concentrations in excess of 100 $\mu g/m^3$.

2. Inspection procedures for assessing compliance with respirable dust control on-shift examination and certification.

3. Ensure the protection of mine construction workers, contract drillers, and other contract employees from respirable coal mine dust and silica exposures by sampling potentially exposed contract workers.

4. Maintenance of dust controls on roof bolters and machine mounted dust collectors on continuous mining machines.

In addition, MSHA has formed a committee to respond to each of the recommendations. MSHA's intent is to release an interim report by September, 1997, announcing what progress has been achieved concerning each of the recommendations.

CONTROL TECHNOLOGY FOR SILICA DUST

Surface Coal Mines

The primary source of respirable crystalline silica occurring at surface coal mines originates during the borehole drilling operation. Large quantities of overburden must be removed, and often this material contains a significant amount of quartz. There are three areas of major concern: dust escaping the drill shroud, dust escaping the collar of the drill table, and dust that becomes airborne during the collector dump cycle. Effective control technologies have been identified and evaluated for each of these quartz dust generation sources.

Two principle methods of drill dust control employed on highwall drills are dry dust collection systems and wet drilling systems. The Pittsburgh Research Laboratory of NIOSH has developed guidelines for optimizing both of these control technologies (Zimmer, 1987). The use of dry collection systems involves enclosing the area around the drill steel platform and the top of the ground surface. This is usually accomplished by hanging conveyor belting or a cloth shroud from the bottom of the drill deck. The enclosure is connected to a dust collector which serves to provide negative pressure under the deck shroud, thus capturing the airborne dust cloud as it escapes the drill hole. The distance between the bottom of the shroud and the top of the ground is probably the single most important factor that determines overall system performance. Minimizing the open distance between the bottom of the shroud and the ground significantly reduces the amount of dust escaping into the ambient environment of the drill operator. Field tests have shown that greater than 90% collection efficiency can be obtained by keeping the open area to six inches or less. Wet drilling consists of pumping water into the downhole air line. The water droplets in the bailing air agglomerate the dust particles as they travel up the drill hole as the cuttings are removed from the hole. Field tests have shown that greater than 90% control efficiencies can be obtained with water flow rates of 0.6 to 0.8 gpm. During these tests, flow rates approaching 1.0 gpm began to cause operational problems.

A second major source of airborne respirable quartz from the surface drilling operation occurs due to leakage around the area where the drill stem passes through the drill platform. This annular opening is usually equipped with a mechanical rubber seal; however, this seal is rapidly abraded due to drill steel rotation and removal of the drill stem from the hole. NIOSH's Pittsburgh Research Laboratory has developed and evaluated an air-powered, non-mechanical seal to replace the donut-type rubber seal currently standard equipment on most surface mine drill rigs (Whitehead, 1990). The Air-Ring Seal is a simple, non-mechanical system consisting of a compressed-air source and a header with a selected pattern of orifices along the length of the header. These studies have also provided guidelines for determining optimum exhaust airflow to bailing airflow ratios. These studies indicate that the optimum ratio is 4:1 or greater. The effectiveness of the air-ring seal is dependent on the airflow ratio, and utilization of this technology is critical at lower airflow ratios.

A third major source of airborne respirable quartz from surface, dry-drilling mining operations occurs during the dry dust collector dump cycle. Dust is released into the ambient environment and may pass over the drill operator; further dispersion may occur when the dust impacts the ground, and the dust pile formed during the collector dump may be redispersed by mobile equipment driving across the bench area.

One potential method to address all of these concerns involves the use of a commercially available dust pelletizer. The pelletizer is a pin-type agglomerator, which mixes the dust with an aqueous liquid forming a small solid material approximately 10-mm in diameter. NIOSH's field evaluation of the dust agglomerator showed overall airborne respirable dust levels were reduced by approximately 70% (USBM, 1989).

Underground Coal Mines

A previous study conducted be NIOSH's Pittsburgh Research Laboratory has shown that, while most of the roof bolter operator's dust exposure comes from upwind sources (C.M. machine), approximately one-third of the bolting machines underground allow a significant amount of dust to escape the dust collector system and contaminate the work environment. Approximately 25% of the continuous miner operator's quartz dust exposure can be attributed to dust from the bolting operation. One of the most efficient techniques to prevent exposure to upwind dust sources is double-split face ventilation. While quite effective, this technique has several problems from an operational and cost standpoint and is not applicable on a large number of underground sections.

Dust in the blower exhaust is the most common and serious problem encountered on roof bolting machines (USBM, 1984). Common causes for this are damaged or improperly seated filters and disconnected lines to the pressure check gauge. Cloth bag (sock) type dust collection filters are often less effective than pleated paper cartridge filters since they allow dust to bleed through the system and out the exhaust, whereas the dust collection efficiency of the pleated paper filters increases as the cartridge is loaded with dust. Many of the roof bolter dust collectors examined showed accumulation of dust between the filters and blower, due to past or current filter leaks. With the filters removed and the access door open, this dust can be removed by backflushing the system with compressed air or by running the blower for several minutes.

Inadequate airflow to the chuck or bit can be detected as a visible plume emitted from the collar of the drill hole. Air leaks in the system occur primarily at loose hose connections, through the pressure relief valve, and through poorly fitting dust collector access doors. All of the systems examined during the survey showed leakages exceeding 50%. When system leaks were corrected and filters changed, airflow at the bit generally increased by 30%.

Extensive laboratory tests were conducted to determine the effects of bit type on the level of dust escaping from the drill hole. Shank-type bits allowed from three to ten times more dust to escape from the drill hole collar than "dust hog" bits. Most of this dust escaped during the first few inches of bit penetration. Typically, the dust hog bits generate one-fifth of the dust generated by the shank bits in the initial 30 centimeters (12 inches) and one-third of the dust over the full length of the hole.

MSHA conducted an extensive cooperative program with mine operators to evaluate the effectiveness of these recommendations from a compliance standpoint (Thaxton, 1984). During the MSHA survey, the mine operators replaced all duct hoses and filters and the blower muffler, repaired the vacuum system and dust box seals, and cleaned the blower unit. Results showed that 90% of the bolters surveyed were in compliance with the applicable standard after these clean-up procedures were instituted.

Flooded-bed scrubber systems are found in widespread application throughout the underground coal mining industry. NIOSH's Pittsburgh Research Laboratory has conducted a series of full-scale and in-mine studies to

determine the respirable quartz dust capture efficiency of these systems while testing a wide variety of filter densities and different filter materials. Although initial studies had shown that collection efficiencies greater than 90% could be obtained for both coal and quartz (Colinet, 1990), a differential collection efficiency was found to exist between the mineral types. Further testing of multiple wire-mesh densities, nonwoven synthetic fiber, and nylon brushes indicates a wide range of collection efficiencies (NIOSH, 1997). The 30-layer and synthetic fiber panels had the densest filter media, which resulted in the highest silica dust collection, 90-95%). The 20-layer wire-mesh, and brush-type filters had quartz collection efficiencies between 70-85%, while the 10-layer wire-mesh filter had the lowest collection efficiency, 60-75%. Based on these findings, NIOSH recommends using the 30–layer stainless steel wire mesh or the synthetic filter panels in flooded-bed scrubbers. Use of the 10-layer wire mesh filter should be avoided.

Previous studies have shown that most of the dust generated by continuous mining machines occurs under the boom, as the cutter head shears down. The primary source of respirable quartz dust on many continuous mining operations is cutting or trimming roof rock immediately prior to shearing. Water sprays, located under the boom, can be used very effectively to control respirable coal and quartz dust trapped in this location before it is released into the ambient mine environment. NIOSH has conducted an extensive underground evaluation of side, shovel-mounted water sprays to determine their effect on respirable dust levels at the machine operator and downwind locations (Jankowski, 1987). With the addition of a single underboom spray manifold on the off-curtain side of the machine, respirable dust levels at the operator and return locations were reduced 90% and 30%, respectively. Quartz dust levels at the operator's position were essentially eliminated, while quartz dust levels in the return were reduced by 60%.

Metal/Nonmetal Mineral Processing

Most mineral plant and processing facilities can be considered closed systems. Any dust that is produced within the facility and is not captured or controlled will remain within the structure and cause dust levels to rise over the balance of the shift. One potential solution to this problem involves the use of mill ventilation, where clean makeup air is drawn into the facility near the base of the structure and exhausted through wall or roof ventilators located at the top. The air throughput will provide general purging and ventilation to stagnant, dust laden areas throughout the mill. Researchers at NIOSH's Pittsburgh Research Laboratory have designed and evaluated total mill ventilation systems at several mineral processing facilities (Cecala, 1993). The systems reduced respirable dust concentrations between 40% and 65% through the plant buildings.

Many types of mineral products are packaged into 50-lb to 100-lb bags for sale to industrial or consumer users. These bags are often filled using fluidized air bagging machines, and a substantial amount of dust is generated during the fill cycle. These products contain free crystalline silica ranging from 0% to 100%. An improved bag nozzle system had been designed and evaluated by Foster-Miller, Inc., under an earlier U.S. Bureau of Mines contract effort (Cecala, 1984). The system was shown to eliminate the principal source of dust emission during the bag filling operation, the "rooster tail" as the bag is released from the fill station. During field evaluations, the system was shown to reduce the bagging operator's exposure by approximately 85%.

SUMMARY

Silicosis is a severe disease of the lungs resulting from breathing excessive amounts of dust containing respirable crystalline silica and has been known to exist in mine workers since

ancient times. Silicosis may continue to worsen even if the worker is removed from the contaminated environment. The NIOSH recommended exposure limit for respirable crystalline silica is 50 $\mu g/m^3$ as a time-weighted average for up to a 10-hour work shift; however, IRAC has recently reclassified silica as a Level 1 carcinogen. Employees working at surface and underground mines are covered by Mine Safety and Health regulations. For coal, the standard is: [PEL (mg/m^3) = 10/% quartz]; for metal/nonmetal, the standard is: [PEL (mg/m^3) = 10/% crystalline silica +2]. MSHA's mandatory compliance sampling indicates that over 70% of surface highwall drill operator samples exceed 0.1 mg/m^3, while approximately 30% of crusher operator samples exceed the M/NM crystalline silica dust standard.

The Mine Safety and Health Administration's Coal Mine Safety and Health Division is proactively and aggressively enforcing regulations, educating mining personnel, and working with mine operators to reduce and eliminate the hazards of silicosis. In April of 1994, MSHA began enforcing a new health regulation for coal mines, addressing primarily highwall drill equipment.

MSHA's District 2 coal health division has initiated a Compliance Assistance Program in the southwestern PA area where inspectors meet with miners and mine operators to increase the awareness of the silica hazard. The program has gone nationwide as of April 1997. In March of 1997, MSHA implemented the Silica Reduction Initiative Program. The objective of this program is to raise the awareness to potential health problems associated with silica exposure at underground mining operations. In response to the Report of the Advisory Committee on the Elimination of Pneumoconiosis Among Coal Mine Workers, MSHA recently issued four Program Instruction letters which call for follow-up inspections at all operations where the silica dust concentration exceeds 100 $\mu g/m^3$; assessment of compliance with on-shift examination and certification; sampling of contract workers potentially exposed to respirable crystalline dust; and maintenance of dust controls on roof bolters and machine-mounted dust collectors.

NIOSH's Pittsburgh Research Laboratory has developed and evaluated numerous procedures for the control of respirable crystalline silica dust. Guidelines have been developed for optimization of wet and dry drilling systems used on surface mine drills. A simple, non-mechanical seal has been developed to reduce the dust escaping from the area where the drill steel passes through the drill platform. A dust agglomerator system has been developed to reduce the amount of respirable crystalline silica that escapes into the ambient environment during the dust collector dump cycle. Implementation of these control technologies can reduce the amount of quartz that becomes airborne between 70 and 90%.

To reduce the amount of airborne respirable quartz found in the underground coal mine environment, NIOSH had developed guidelines to optimize the roof bolt hole drilling operation and performance of the dust collector located on the drilling machine. When these guidelines were implemented by the mining industry, MSHA surveys indicated that 90% of the bolters surveyed were in compliance with the applicable dust standard. NIOSH has also developed guidelines to improve the overall performance of flooded-bed dust collectors commonly used on continuous mining machines. Based on these findings, NIOSH recommends using a 30-layer stainless steel wire mesh or a synthetic filter panel in flooded-bed scrubbers. NIOSH has also conducted extensive underground evaluations of side, shovel-mounted water sprays on continuous mining machines. Results have shown that quartz dust levels at the operator's position can be essentially eliminated, while quartz dust levels in the return can be reduced by 60%.

For metal/nonmetal mineral processing operations, researchers at NIOSH's Pittsburgh Research Laboratory have designed and evaluated total mill ventilation systems at several mineral processing facilities. Guidelines for the number of air changes per hour, and locations for fresh-air intakes and roof-mounted exhausters have been developed. Under an earlier U.S. Bureau of Mines contract research effort, an improved bag nozzle system was developed and evaluated. This system has been shown to eliminate the principle source of dust emission during the bag filling operation.

In the Fall of 1996, the Department of Labor, together with the National Institute for Occupational Safety and Health, Department of Health and Human Services launched a national silicosis prevention effort. This effort is a partnership between labor, industry, and Federal Agencies that will serve to abate, and ultimately eliminate, the enormous human and financial cost of unnecessarily high exposures to mine dusts. Both Agencies have joined in a campaign of outreach, education, surveillance and control. Remember, "If It's Silica, It's Not Just Dust."

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