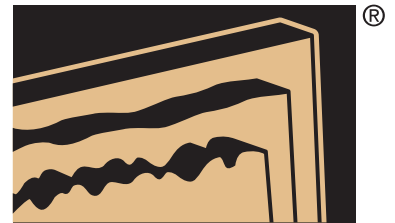
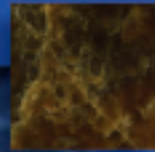


MIA Technical Module

Silicosis

An Industry Guide to Awareness and Prevention



MARBLE
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of America

*Setting the Standards in the
Natural Stone Industry*

Silicosis

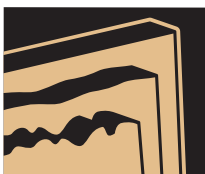
An Industry Guide to Awareness and Prevention

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I. History of Silicosis

For hundreds of years, silicosis has been a serious occupational health issue for workers in mining, quarrying, stone cutting, stone grinding and other occupations where crystalline silica dust is generated.

Silicosis [sil-i-koh-sis] is caused by exposure to respirable crystalline silica dust. Crystalline silica is a basic component of soil, sand, granite, and most other types of rock, and it is used as an abrasive blasting agent. Silicosis is a progressive, disabling, and often fatal lung disease. Tobacco smoking adds to the lung damage caused by silica.

In fact, silicosis was first identified in 1705 by Bernadino Ramazzini of Italy, considered the founder of occupational/industrial medicine. Ramazzini noticed sand-like substances in the lungs of stone cutters. While most of the stone cutting in Ramazzini's day was done by hand, the incidence of silicosis grew rapidly years later when the Industrial Revolution began and went into full swing.

Today, silicosis is the most common occupational lung disease in the world and can be disabling and debilitating. The disease is especially common in developing countries where modern control technologies are not fully deployed, and it afflicts millions of workers as a result.

II. Cases of Silicosis Around the World

According to the World Health Organization and the World Labor Organization, which held a summit in 2003 on the elimination of silicosis, here are some of the sobering statistics for industrialized nations:

United States

- 1.7 million workers are exposed to crystalline silica dust.
- 10% of those workers are at risk of contracting silicosis.

Germany

- 3,000 new cases of silicosis were diagnosed annually during the 1990s.

Japan

- 1,000 new cases of the disease were reported yearly.

Australia

- More than 1,000 cases of silicosis are predicted each year.

France

- 300 new cases of silicosis are diagnosed each year.

And in developing countries, there is an epidemic of silicosis.

China

- 10 million people were exposed to silicosis – with 5,000 deaths reported.
- From 1991-1995, there were an estimated 24,000 deaths from silicosis each year.

Brazil

- 6.6 million workers were exposed to crystalline silica dust.

South Africa

- 600,000 accumulated cases of silicosis exist among miners.

Obviously, silicosis is not something you want to get.

But while you work in an industry where it is possible to contract the disease, silicosis is preventable, if you and your company take the proper steps to avoid over-exposure to dust containing silica.



Bernadino Ramazzini



Working with stone - past



Working with stone - present

Effects of Silicosis

- ✓ **Lung cancer** – Silica has been classified as a human lung carcinogen.
- ✓ **Bronchitis/Chronic Obstructive Pulmonary Disorder.**
- ✓ **Tuberculosis (TB)** – Silicosis makes an individual more susceptible to TB.
- ✓ **Scleroderma** – a disease affecting skin, blood vessels, joints and skeletal muscles.
- ✓ Possible **Renal Disease.**

Symptoms of Silicosis

The typical symptoms of silicosis manifest themselves, depending on the severity of the disease, but can include:

- ✓ Fever
- ✓ Cough
- ✓ Weight loss/loss of appetite
- ✓ Severe breathing difficulty
- ✓ Trouble sleeping
- ✓ Chest pain
- ✓ Nails with a bluish tint

Sources of Exposure

- ✓ Sandblasting for surface preparation.
- ✓ Crushing and drilling rock and concrete.
- ✓ Masonry and concrete work (e.g., building and road construction and repair).
- ✓ Mining/tunneling; demolition work.
- ✓ Cement and asphalt pavement manufacturing.

III. How Silicosis Develops

Silicosis is developed when the victim inhales very small, unseen particles of crystalline silica. The particles travel deep into the lungs where they get lodged and cause inflammation in the lungs.

Like most places in the body, inflammation can ultimately lead to scarring. And if there is scarring deep down in the lungs, it can lead to breathing difficulties.

Many people develop silicosis that never really bothers them with symptoms, but it only appears on a chest x-ray. However, when symptoms do arise, the most common are coughing and shortness of breath.

The most common form of silicosis manifests itself from prolonged exposure to crystalline silica. In the natural stone industry, this exposure comes primarily from cutting or grinding granite, slate or other materials containing quartz, without the proper controls or personal protective equipment.

However, there are also situations where you can get a very short term, but very high intensity exposure that leads to the disease much faster.

Short or long term, those who get scars in their lungs can get very sick and develop shortness of breath that limits their ability to maintain normal activities. Or, in worst case scenarios, these scars can lead to death.

IV. Types of Silicosis

There are four types of silicosis:

- ✓ **Chronic Silicosis** - Can come after 20 years of exposure to crystalline silica.
- ✓ **Asymptomatic Silicosis** – When early phases of the disease do not present any symptoms.
- ✓ **Accelerated Silicosis** – Develops five to ten years after high exposure to silica dust. Symptoms include severe shortness of breath, weakness and weight loss.
- ✓ **Acute Silicosis** – Develops a few months to two years after exposure to very high concentrations of silica dust, causing disabling shortness of breath, weakness, weight loss, and often leading to death.

V. Silicosis: Incurable, but Preventable

Unfortunately, there is no cure for silicosis.

Once the aggressive form of silicosis is present, the scarring in the lungs progresses rapidly. And there is no effective medication to halt the scarring.

Therefore, the only treatment for silicosis is prevention, or avoiding exposure to silica dust.

VI. How to Prevent Silicosis

That is the primary focus of this special report – to show owners, managers and workers in the natural stone industry how to prevent silicosis in the workplace, thereby preventing disability and death.

Preventing silicosis in the stone industry - particularly in those facilities that cut granite, slate or other materials containing quartz - must be a team effort.

It is the responsibility of ownership and management to provide the necessary systems that rid the air of crystalline silica, along with the personal protection equipment for the people who operate the cutting and forming machinery in the shop and perform hand finishing operations.

Likewise, the workers operating the equipment have an obligation - for their own safety - to use these safety devices to their fullest.

In a perfect world, the secret to eliminating silicosis as a threat would be to eliminate the unseen crystalline silica dust.

That is easier said than done.

VII. Wet Cutting and Grinding

The natural stone industry and its vendors have made great strides in this effort to eliminate unseen crystalline silica dust, but there is still a long way to go. One of the best methods to reduce the silica dust is through wet cutting and grinding.

Wet cutting and grinding has been gaining in momentum during recent years. For instance, in a recent survey of fabricators belonging to the Marble Institute of America (MIA):

- ✓ 73% of the respondents said their shops ranged from 90 to 100 percent wet.
- ✓ 8% said they were 80 to 90 percent wet.

A. Water Treatment Systems

The residual dust from cutting and grinding wet can be removed with new, state-of-the-art water treatment systems, which remove the particles from the water and compress them into cakes for later disposal.

The system then recycles the water so that it can be returned to cutting, grinding and polishing applications. These systems virtually eliminate disposing of waste materials into local sewer systems and because they recycle the water, significantly reduce the amount of water consumed in the plant operations.

VIII. Air Purification Systems

There are also powerful air purification systems that extract the crystalline silica out of the air and deposit it into disposable cartridges. These, too, can be very effective.

Either one of these methods – wet cutting with water treatment or airborne dust collection – can virtually eliminate the threat of exposure to airborne crystalline silica.

IX. OSHA Standards for Exposure Limits

In the United States, the Occupational Safety and Health Administration (OSHA) has done quite a bit to address the issue of crystalline silica dust in the workplace. In the mid 1990s, OSHA launched a special emphasis program, which targets enforcement at companies where there are high exposures to crystalline silica.

Unfortunately, there is no national surveillance program in the U.S. for monitoring the incidence of silicosis or other diseases related to exposure to crystalline silica. However, some states do conduct surveillance programs of their own.

In accordance with the OSHA standard for air contaminants:

Employee exposure to airborne crystalline silica shall not exceed an 8-hour time-weighted average limit, or, if a state-administered OSHA plan is in effect, the limit set by that state agency is used.



Water treatment system



Air purification



OSHA inspection

OSHA's current standard for crystalline silica (as described above) is an exposure limit on respirable dust containing crystalline silica. Respirable dust is made up of small particles that cannot be seen with the naked eye. These are particles that can get deep into the lungs and cause the greatest potential for disease.

A. Exposure Limit Formula

The exposure limit is a formula, which is 10 milligrams per cubic meter, divided by the percent of quartz, plus two.

$$\frac{10\text{mg}/\text{m}^3}{\% \text{ quartz} + 2}$$

To apply an example to this formula, if a specific material has eight percent quartz in it, take ten divided by eight plus two, which is ten over ten, or one milligram of respirable dust in the air. That is the exposure limit. Workers cannot exceed that exposure limit.

$$\frac{10\text{mg}/\text{m}^3}{8 (\% \text{ quartz}) + 2}$$

Or, if the quartz content is 48 percent, the respirable dust limit is 0.2 milligrams per cubic meter.

$$\frac{10\text{mg}/\text{m}^3}{48 (\% \text{ quartz}) + 2}$$

X. Air Quality Monitoring

Wet or dry, there is only one way to determine the level of silica exposure.

And that is with air monitoring.

OSHA currently does not have a specific requirement to conduct air monitoring. However, air monitoring is the only way to be sure you are in compliance with the permissible exposure limit for crystalline silica.

There is no way to tell what employees are being exposed to without exposure monitoring, even in shops using predominantly wet methods.

The use of the wet method very likely will reduce dust levels, compared to grinding or cutting dry. But there are a lot of factors that influence the levels that are going to result from a particular process, such as how the water is applied. In addition, the rate at which the water is applied could influence the amount of dust that escapes from the process.

If your company is using a dry ventilation system, the issue is making sure that the system is set up properly and pulling enough air through to filter the silica out of the air and away from the worker.

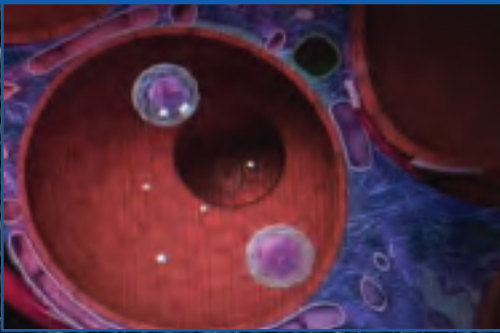
The bottom line is that only with professional air monitoring can you establish a benchmark for the air quality in your shop, whether you employ wet processing or dry processing.

Many health and occupational health organizations offer free air quality testing. If that is not available to you, there are also numerous qualified private laboratories that can provide the service.

A. Follow Government Testing Methods

No matter where you are located - in the United States or any other country - it is important that you use the same methods that the government testing body in your country uses to monitor air quality. Many methods are available, but those used by your government are likely to be mandatory and legally enforceable.

And regardless of the method used, the first assumption should be made that since no measurement has been established, a health hazard may be present. Therefore, it is necessary for employees to



Silica dust (enlarged view)



Normal view

wear respiratory protection until air quality has been sampled and safe exposure levels have been verified.

XI. Respirable Sampling

In monitoring air quality, OSHA uses breathing zone sampling to measure what employees are inhaling.

The OSHA procedure is called employee exposure monitoring. Personal sampling pumps are used to measure the air where people are working.

But before the sample can be taken, the equipment must be calibrated outside of the area where it will be used. This adjustment makes sure that the monitor is pulling through the right amount of air.

The personal monitor is required for particulate sampling, but it can also be used to measure gasses and other contaminants, depending on the type of filter that is used.

A. Sampling Equipment

Basically, the sampling systems consist of two components: a personal sampling pump, which is a small battery-powered vacuum pump, and a collection media, or filter, from which the silica can be collected.

Filters are required to measure particulates, such as silica. In addition, since the silica standard is based on respirable dust, a third component – in this case, a cyclone – must be used to make sure that only the respirable part of the dust is collected on the filter.

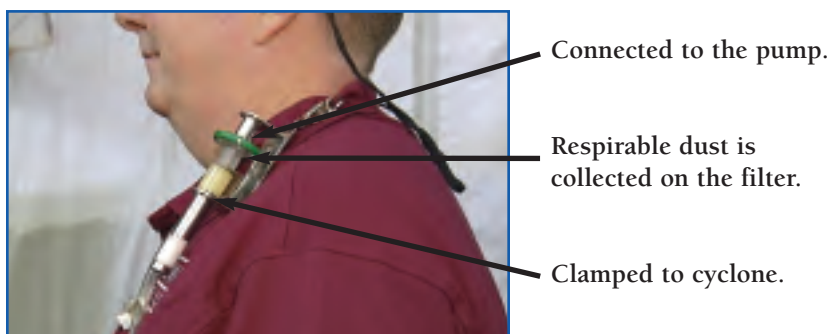
The pump is attached to the worker's belt either behind the back or above the hip using a belt clip on the pump. The cyclone and filter - supported by a holder - is clipped to the employee's shirt collar in the breathing zone. The holder is attached to the air inlet fitting on the pump with a short length of plastic tubing that is run behind the employee's back.

The combination of pump, cyclone and filter is called a sampling train.

B. Equipment Operation

When the pump is turned on, it pulls air through the cyclone where heavier, non-respirable dust falls out. The lighter and smaller respirable dust is collected on the filter in the same way that the air filter in a car collects road dust. The filters look like very thin plastic discs with the consistency of stiff tissue paper.

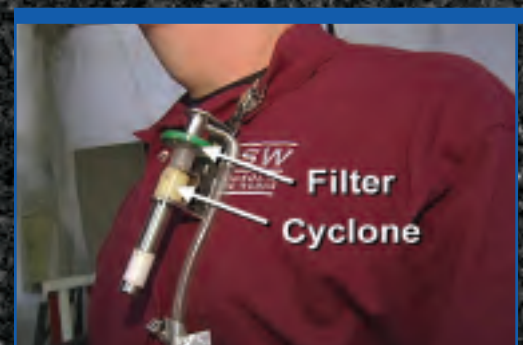
Because the filters are so delicate, each filter is put on a back-up pad and then placed in a small plastic cassette to facilitate handling. The cassette has openings on both ends. One end is connected to the pump with a length of plastic tubing. The other is clamped to the cyclone.



At the end of the sampling period, the cassette is removed from the holder and cyclone, the openings on the ends of the cassette are



Personal monitor



Personal monitor - filter and cyclone



Personal sampling pump

sealed with a plug and the cassette is sent to the laboratory for analysis. When sampling with filters, the laboratory is also provided with the volume of air sampled. This quantity is determined from the flow rate of the pump known from calibration and the duration of the sampling period.

Whether you are using an air quality control system that removes the crystalline silica from the air or work in an exclusively wet shop, once the air quality is measured and has been confirmed to be at or below the allowable limit, individual respirators are generally no longer required.

However, standard practice calls for scheduled monitoring at least once a year to verify that the air quality remains within compliance levels.

If you have an all wet shop, are using the water properly and have monitored to make sure the levels are below the maximum allowable OSHA levels for silica, or perhaps even lower, then workers will not need to wear a respirator.

It should go without saying that air quality and water treatment systems - which have become the lifeline of protection - should be continually and carefully monitored to make sure they are always functioning at maximum levels.

C. Other Dust Capturing Options

In addition to large systems that remove dust from major sections of a fabricating plant, vendors have developed a number of other dust capture tools. These include portable collectors that can be moved around the shop as situations demand.

These tools are particularly helpful in plants where minimal dry cutting or polishing occurs. It is extremely important to use such devices when monitoring areas where workers perform dry cutting and polishing functions.

XII. Safety Precautions for Workers

In shops that are dry or partially wet, or where only sections of the facility are covered with dust collection systems, these precautions should be taken to minimize exposure to crystalline silica:

- ✓ Wear disposable or washable protective clothing at the worksite.
- ✓ Limit your exposure to the workplace. When you take silica dust home, you contaminate your house and your car. You will be exposing your family to crystalline silica dust as well. This is why OSHA advises employees to keep their work clothes at work, and to wash and shower when possible before leaving at the end of the day.
- ✓ Always wear adequate respiratory protection as specified by your company.
- ✓ The employer must establish a comprehensive respiratory protection program.
- ✓ Key elements of the program should include:
 - Periodic environmental monitoring
 - Regular training
 - Selection of proper NIOSH-approved respirators
 - An evaluation of the worker's ability to perform the work while wearing a respirator



Portable dust collector



Vendor provided dust collection accessory



Disposable/washable protective clothing

- Respirator fit testing and maintenance
 - An evaluation of facial hair that may interfere with a proper seal or valve function
 - Periodic inspections
 - Cleaning and storage of respiratory protection equipment
- ✓ Post warning signs to mark the boundaries of work areas that may exceed the Permissible Exposure Limits (PEL) for contamination from crystalline silica.
 - ✓ Workers should be provided with training that includes information about health effects, work practices and protective equipment required for respirable crystalline silica.
 - ✓ Do not eat, drink or use tobacco products in dusty areas.
 - ✓ Wash hands and face before eating, drinking or smoking outside of dusty areas.
 - ✓ Park cars where they will not be contaminated with silica and other substances.

XIII. Baseline Medical Testing

In addition to workplace safety precautions, medical monitoring should be available to all workers who may be exposed to respirable crystalline silica.

Such examinations should occur before job placement or before entering the stone trade and should include an x-ray and pulmonary function test to establish a worker baseline.

Check-ups should occur at intervals not greater than 3 years.

Workers should immediately report any unusual respiratory medical problems, especially a chronic dry cough and breathing difficulties.

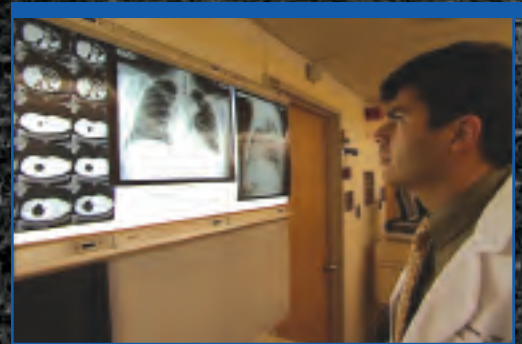
XIV. Conclusion

It cannot be said too often, or with too much emphasis: Protecting the workplace and employees from respirable crystalline silica - and eventually silicosis – should be one of the most important objectives of every company in the natural stone industry.

And the good news is - it's really a simple proposition.

There is no cure for silicosis. But with the proper equipment, training, vigilance and continual monitoring, you and your shop can be free of the dangers of the most common occupational lung disease in the world: Silicosis.

It's really is as simple as that.



Doctor analyzing x-rays

Resources

- Silicosis: Incurable, but Preventable
Marble Institute of America



- Stone Facility Safety Videos



- Occupational Safety and Health Administration (OSHA)
www.osha.gov

Photography Credits

- Levy Media Group
- Wood Dimensions, Inc./Rocksolid Stone Works
- U.S. Department of Labor
- Kevin M. Padden

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About the Marble Institute of America

For over sixty years, the Marble Institute of America (MIA) has served as the authoritative source of information regarding standards of dimension stone workmanship, practice and the suitable application of natural stone products.

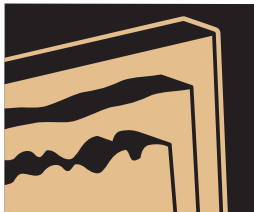
Membership in the association is worldwide and includes natural stone producers, exporters/importers, distributors/wholesalers, fabricators, finishers, installers, and industry suppliers – all committed to the highest standards of workmanship and ethics.

MIA publishes a monthly newsletter for members, markets a range of technical publications and consumer pamphlets on natural stone, sponsors business and technical meetings and seminars on industry-related topics, promotes their member companies on the MIA web site, provides educational opportunities for architects and construction specification professionals, and conducts the “Rocky” Advertising Awards and the annual Pinnacle Awards competition recognizing outstanding natural stone projects worldwide.

MIA is also a leading proponent of stone usage in the commercial and residential marketplaces. MIA produces a number of consumer educational materials on the use of natural stone and its proper care and maintenance, and hosts an informative web site for consumers as well as design and construction professionals at www.marble-institute.com.

MIA Safety Alliance with OSHA

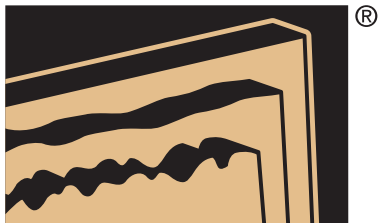
In 2005, OSHA and the MIA formed an alliance to work together to develop information to help MIA member employees and workers recognize and prevent such hazards as exposure to silica and handling slabs of stone. The alliance will also develop safety and health training and education programs and will provide expertise to develop workplace safety and health curricula on the prevention of silicosis in the stone industry.



MARBLE
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Marble Institute of America

28901 Clemens Rd. • Suite 100 • Cleveland, Ohio 44145 USA
Phone: 440-250-9222 • Fax: 440-250-9223
www.marble-institute.com



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