

Sampling of Road Patching Crew for Crystalline Silica

On September 23, 2009 City of Kamloops employees working on a road resurfacing (patch) crew were sampled for respirable crystalline silica (including alpha quartz and cristobalite.) Sampling was conducted by Occupational Hygiene Officer Geoff Thomson of WorkSafeBC.

Silica

Silica is the second most common mineral on earth and makes up nearly all of what we call “sand” and “rock.” Silica exists in many forms—one of these, “crystalline” silica (including quartz), is the most abundant and poses the greatest concern for human health.

Some common materials that contain silica include:

- Rock and sand
- Topsoil and fill
- Concrete, cement, and mortar
- Masonry, brick, and tile
- Granite, sandstone, and slate
- Asphalt (containing rock and stone)
- Fibrous-cement board containing silica

Silica is so common that many workplace activities that create dust can expose workers to airborne silica. In British Columbia, the Occupational Health and Safety Regulation has established occupational exposure limits (OELs) for five different forms of silica; three of these are amorphous, and two are crystalline (quartz and cristobalite). The form most likely to cause serious problems for worker health is quartz.

Health Effects

Crystalline silica dust can cause a disabling, sometimes fatal disease called silicosis. The fine particles are deposited in the lungs, causing thickening and scarring of the lung tissue. The scar tissue restricts the lungs’ ability to extract oxygen from the air. This damage is permanent, but symptoms of the disease may not appear for many years.

A worker may develop any of three types of silicosis, depending on the concentrations of silica dust and the duration of exposure:

- Chronic silicosis—develops after 10 or more years of exposure to crystalline silica at relatively low concentrations

- Accelerated silicosis—develops 5 to 10 years after initial exposure to crystalline silica at high concentrations
- Acute silicosis—develops within a few weeks, or 4 to 5 years, after exposure to very high concentrations of crystalline silica

Initially, workers with silicosis may have no symptoms; however, as the disease progresses, a worker may experience:

- Shortness of breath
- Severe cough
- Weakness

These symptoms can worsen over time and lead to death.

Exposure to silica has also been linked to other diseases, including bronchitis, tuberculosis, and lung cancer.

Exposure Monitoring

The Occupational Health and Safety Regulation lists an occupational exposure limit (OEL) for respirable crystalline silica (including quartz) of 0.025 milligrams per cubic metre (mg/m³). This is a concentration to which nearly all workers could be exposed for eight hours a day, five days a week, without adverse health effects. However, as a suspected carcinogen, crystalline silica is also an ALARA substance, and exposures must be reduced to levels as low as reasonably achievable below the OEL.

Studies show that when work tasks involving the drilling, chipping, grinding, cutting, and sawing of concrete and concrete products are conducted without using effective dust controls, workers are exposed to airborne silica concentrations at levels far above the OEL.

Method

Personal breathing zone samples were taken for 5 workers on the patch crew. Air samples were taken using SKC Aluminum Cyclone (2.5 L/min) with a pre-weighed Polyvinyl Chloride Filter. Air was drawn through the media using SKC PCXR4 Universal sample pumps calibrated with a Bios DryCal DC Lite Primary Flow Meter. Samples were analyzed by an independent accredited laboratory using X-ray Diffraction for crystalline silica.

Results

Sample ID	Position	Concentration	EL
P8162	Milling Machine operator	0.03 mg/m ³ (adjusted for 8 hr shift = 0.016 mg/m ³)	0.025 mg/m ³
P8160	Milling Machine assist	0.07 mg/m ³ (adjusted for 8 hr shift = 0.04 mg/m ³)	0.025 mg/m ³
P8181	Dump Truck driver	< LOD	0.025 mg/m ³
P8157	Labourer patch crew	< LOD	0.025 mg/m ³
P8165*	Labourer patch crew	< LOD	0.025 mg/m ³

LOD = < 10 micrograms/sample

* operated sweeper

No Crystalline Silica in the cristobalite form was detected for any sample. For the two positions where crystalline quartz was detected, the concentration was presented both for actual sample time and also adjusted for an 8 hour shift. For the adjusted sample concentrations, it was assumed that remaining tasks in the shift had no exposure to crystalline silica.

The sampling results indicate potential for exposure to respirable crystalline quartz silica above the Occupational Exposure Limit of 0.025 mg/m³. The milling machine operator sample is in excess of 50% of the OEL and the Milling machine assistant sample is in excess of the Occupational Exposure Limit. Both of the workers in these positions were wearing half-facepiece air purifying respirators with P100 cartridges during this work. A properly fitted respirator of this type will provide a protection factor of 10 to a cleanly shaven worker. The workers in the Milling Machine Operator and Milling Machine Assist positions had actual exposure that were likely less than 50% of the exposure limit.

While the results of this sampling are not valid statistically, they do indicate the potential for overexposure to respirable crystalline quartz silica. This substance is designated by WorkSafeBC as a carcinogen and so exposure to it must be kept as low as reasonably achievable. Workers operating the milling machine and assisting with the operation must be included in the employer's Silica exposure control plan. Engineering controls such as the water provided to the resurfacing drum of the machine must continue to be used to lower worker exposure as low as possible. It may be possible to improve the efficiency of engineering controls to further decrease exposure.

Information in this and other studies indicate exposure to respirable crystalline silica are typically less than 10 times the exposure limit for operating an asphalt milling machine (1). Until further exposure monitoring can be done to determine statistically typical exposures for this type of work, workers must wear at minimum a properly fit tested half-facepiece air purifying respirators with P100 cartridges during this work. As the labourer

operating the sweeper did not operate the device for extended periods it is recommended that workers using the sweeper in the future wear a respirator and consider using water for dust suppression if possible.

(1) Linch, Kenneth D. "Respirable Concrete Dust – Silicosis Hazard in the Construction Industry" *Applied Occupational and Environmental Hygiene*. Vol. 17(3): 209-221, 2002.