Silicosis in mining and quarrying in South Australia

What is silica?
Silica is a common name for the compound silicon dioxide (SiO₂). Silica is one of the most common naturally occurring compounds in the earth’s crust and is a major component of rocks and soil where it is often found in the form of a mineral called quartz. Quartz is the second most common mineral in the earth’s crust.

Fine crystalline silica
Fine silica particles that are smaller than or equal to 10 micrometres (µm) in size (particulate matter, PM₁₀) are called respirable crystalline silica (also known as fine crystalline silica) and are able to be inhaled deep into the lungs (Mining & Quarrying Occupational Health & Safety Committee 2017; Fig. 1). Particles this small cannot be seen with the naked eye (Fig. 2).

What is silicosis?
Silicosis is a lung disease associated with occupations that involve the fracturing of rocks which contain silica minerals (quartz, cristobalite and tridymite). Silicosis is triggered when PM₁₀ containing crystalline silica enter the lungs to cause the formation of scar tissue, which reduces the lung capacity over time.

The body naturally removes large dust from the upper parts of the lung, but if there is either prolonged exposure or large exposures to very fine particles (equal to or less than 0.5 micrometres) the body’s immune system may not keep up.

At this point, fine crystalline silica dust begins to accumulate in the lungs, which can lead to serious and irreversible diseases, predominantly silicosis.

Initially silicosis may have no apparent symptoms, which may follow with development of shortness of breath, a dry cough, and a general feeling of ill health. As the disease progresses the symptoms may lead to permanent disablement and early death.

Types of silicosis
The risk and severity of lung damage varies and is dependent on the size and shape of the fine crystalline silica particles, and the concentrations and length of exposure time to freshly fractured silica dust.

Silicosis can be generally categorised in three ways:
• chronic (nodular) silicosis – classic silicosis; exposure for more than 10 years
• accelerated silicosis – exposure over 1 to 10 years but usually only 3–10; historically rare
• acute silicosis – exposure for less than 1 year (used to be less than 3 years); historically very rare.

Sources of fine crystalline silica in mines and quarries
At mine and quarry sites, a number of operational processes produce dust, such as extraction, crushing, screening and stockpiling. When weather conditions are dry, hot and windy, the risk of dust generation and transport increases.

The minerals extracted from mines and quarries vary greatly from site to site regarding the amount of silica materials present in the rock. The higher the proportion of silica in the rock, the higher the proportion of fine crystalline silica that can be expected in the total airborne particles.

Figure 1 Only the very smallest particles – the respirable fraction – are able to be inhaled deep into the lungs. (Courtesy of Safe Silica 2018)

Figure 2 Size comparisons for particulate matter (PM) particles. (Courtesy of United States Environmental Protection Agency 2018)
Although mines and quarries may have low proportions of silica in the rock, elevated exposures to any dust particles have the potential to cause adverse health effects, and the potential for dust generation is heightened by South Australia’s dry climate. Therefore, general dust exposure is a main mining hazard, and is the reason why dust management is mandated across the state.

**Fine crystalline silica exposure standards (limits)**

**Workplace exposure standards**
Worker exposure to fine crystalline silica cannot exceed the exposure standard of 0.1 milligrams per cubic metre on an 8 hour time weighted average. This standard has been reviewed by Safe Work Australia, and a national agreement has been reached to reduce the exposure standard to 0.05 milligrams per cubic metre. In addition, worker exposure to fine crystalline silica must be as low as reasonably practicable.

**Ambient air quality standards**
Fine crystalline silica exposure for the community is much lower than those encountered in the workplace. It is therefore considered that if there is effective management of the risk to workers, then the risk to the community will also be managed (Cement Concrete and Aggregates Australia 2018, p. 4).

The South Australian Environment Protection Act. Both agencies require operational dust management practices are adequate to minimise the risk of nuisance and public health impacts. All mines and quarries also have additional obligations under chapter 10 of the Work Health and Safety Regulations.

**Regulation of offsite impacts**
The Department for Energy and Mining and the Environment Protection Authority conduct site inspections of mines and quarries to review dust management practices, and where an operation presents a high risk of air quality impacts to the community, may require the operator to conduct air quality monitoring to demonstrate compliance with accepted human health standards.

Where dust is observed to be causing unacceptable offsite impacts, either through a site observation, monitoring results or a community complaint, the Department for Energy and Mining and/or Environment Protection Authority may utilise a range of enforcement tools to correct the issue.

**Acknowledgements**
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**References and further reading**


**Figure 3 Haul road watering to reduce dust from mining operations.**