Silicosis in mining and quarrying in South Australia

Government of South Australia

What is silica?

Silica is a common name for the compound silicon dioxide (SiO_2). 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, PM_{10}) 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).

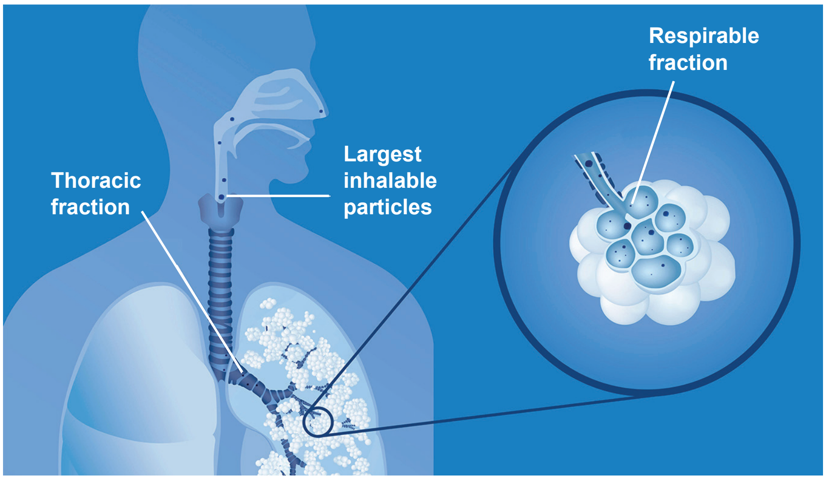

Figure 1 *Only the very smallest particles – the respirable fraction – are able to be inhaled deep into the lungs. (Courtesy of Safe Silica 2018)*

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 PM_{10} 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.

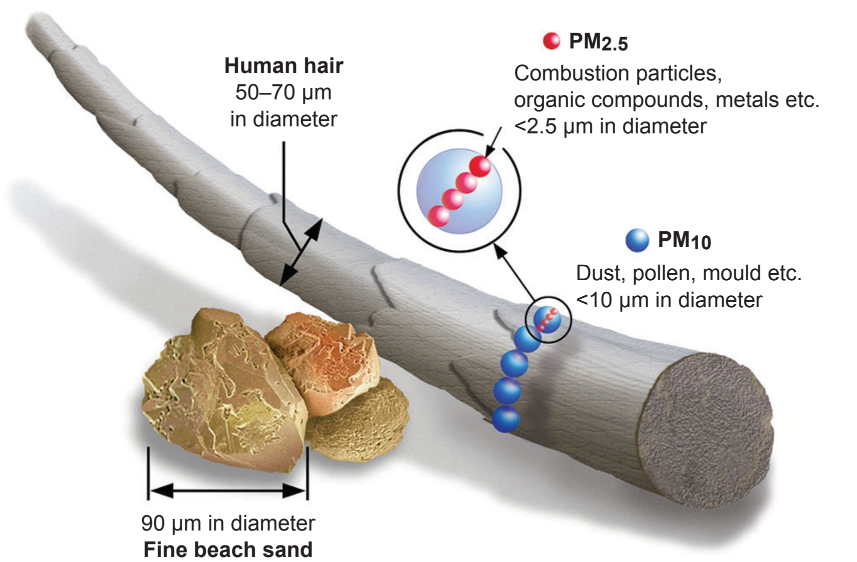

Figure 2 *Size comparisons for particulate matter (PM) particles. (Courtesy of United States Environmental Protection Agency 2018)*

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.

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

Fine crystalline silica exposure standards (limits)

Workplace exposure standards

Worker exposure to fine crystalline silica cannot exceed the exposure standard of 0.05 mg/m^3 (2020) over an 8 hour time weighted average. This standard has been reviewed by Safe Work Australia, and a national review to reduce the exposure standard is being considered. 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 (Air Quality) Policy 2016 includes a ground-level concentration criterion for fine crystalline silica. This must be taken into account (by modelling) where an activity has, or may result, in fine crystalline silica emissions being generated to demonstrate that compliance is achieved.

Regulating dust in South Australia

Legislative framework

- *Work Health and Safety Act 2012*
- Work Health and Safety Regulations 2012
- *Mining Act 1971*
- *Environment Protection Act 1993*
- Environment Protection (Air Quality) Policy 2016

Employer responsibilities and duties

Work health and safety legislation requires an employer, or person conducting a business or undertaking, to:

- Eliminate exposure to airborne contaminants or minimise the risk so far as reasonably practicable (Fig. 3).
- Conduct personal particulate exposure monitoring for workers if there is a significant risk to the worker's health because of exposure to fine crystalline silica, and ensure exposures are below exposure limits.
- Consult, so far as reasonably practicable, with workers who work in areas that present an exposure risk.
- Notify the worker if they are exposed to fine crystalline silica levels above exposure standard and introduce controls to eliminate or minimise the risk.

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 is the lead regulatory agency for mines and quarries in South Australia under the Mining Act, and is supported by the Environment Protection Authority South Australia under the Environment Protection Act. Both agencies require that operational dust management practices are adequate to minimise the risk of nuisance and public health impacts.

All mines and quarries are required to operate in accordance with lease conditions and approved programs/plans under the Mining Act.

All mines and quarries are required to comply with the general environmental duty of the Environment Protection Act. Additionally, mines and quarries conducting prescribed (set) activities of environmental significance under Schedule 1 of the Environment Protection Act are required to obtain an environmental authorisation from the Environment Protection Authority, and operate in accordance with the prescribed conditions.

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

This document has been produced by the Department for Energy and Mining in consultation with the Environment Protection Authority South Australia; SA Health; SafeWork SA; and Mining and Quarry Occupational Health and Safety Committee.

References and further reading

Australian Institute of Occupational Hygienists Inc. 2009. *Position paper on respirable crystalline silica and occupational health issues*. Australian Institute of Occupational Hygienists Inc., Melbourne. (PDF 114 KB)

Cement Concrete & Aggregates Australia 2018. *Management of respirable crystalline silica in quarries*, Workplace Health & Safety Guideline. Cement Concrete & Aggregates Australia, Sydney. (PDF 3.9 MB)

Mining and Quarrying Occupational Health and Safety Committee 2017. *Respirable crystalline silica*. Mining and Quarrying Occupational Health and Safety Committee, Adelaide, viewed 3 April 2019.

Royal Australasian College of Physicians 2019. *Frequently asked questions: accelerated silicosis*. Royal Australasian College of Physicians, Sydney, viewed 16 August 2019.

Safe Silica 2018. *Crystalline silica: the science*. Industrial Minerals Association – Europe, Brussels, viewed 3 April 2019.

SafeWork SA 2018. *Respirable crystalline silica*. SafeWork SA, Adelaide, viewed 3 April 2019.

United States Environmental Protection Agency 2018. *Particulate matter (PM) pollution*. United States Environmental Protection Agency, viewed 3 April 2019.

2023- MAQOHSC