

Dust Management



Introduction...

Most employers and employees are aware that dusts in quarries can be a serious health hazard. As such, the CMPA as the peak representative body has developed this document to assist its members in managing the hazard of dusts in the quarry.

Summary of Key Areas:

- Risk Management
- Dust Hazards
- Calculating Exposure Levels
- Monitoring Exposure Levels
- Health Monitoring
- Risk Controls
- Management Plans
- Related and Emerging Issues

Exposure Standards

Dusts not otherwise classified

For all other dusts, the **inhalable** fraction has an exposure limit of 10mg/m³ TWA on the condition it is both of inherently low toxicity and free from toxic impurities (e.g. no asbestos content and less than 1% silica).

Crystalline Free Silica

According to the Australian Safety & Compensation Council (formerly the National Occupational Health & Safety Commission), the exposure standard for crystalline silica is 0.1mg/m³ TWA.

Dust Control at Work



Stockpile minimisation



Water cart suppressing dust on roads



Mobile plant climate control



Plant automation

Construction Material Processors Association

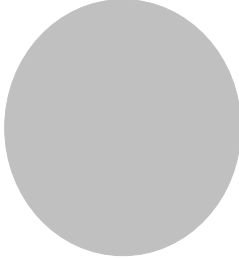
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Dust Hazards



“Both the volume of dust and the type of dust present sites with hazards”

Risk Management

Risk Identification

The first stage is to analyse a material sample in order to confirm crystalline silica content (it is important to ensure analysis is performed for crystalline silica and not total silica). If it is not present, silica will not be an issue when working with that resource. General dust (dusts not otherwise classified) may still need to be monitored.

Risk Assessment

Working through the site systematically, identify situations and jobs where exposure to dust occurs and document accordingly.

Where detectable concentrations of crystalline silica have been confirmed, there is a need to assess the actual risk to employees from exposure to airborne respirable crystalline silica. This is performed through assessment of airborne crystalline silica and comparison of the result to the exposure standard.

When the standard is clearly exceeded, it indicates that there needs to be better controls in place, and high level health monitoring undertaken.

Results below the standard indicate that the controls in place are effective. That said, there is always a potential for improvement.

Similarly, where health monitoring indicates that there have been negative changes, there is a need to re-address this risk. Support may be sought from the company’s hygienist or doctor.

All that said, there is no reason why there needs to be a blanket rule for the whole site. It would not be unusual for weighbridge operators to have less exposure than crusher operators and therefore a lower level of health monitoring and controls in place.

Risk Review

Check effectiveness of controls regularly and ensure they have not contributed to other hazards. For instance, irrigation over a screen causing a slippery top step on a ladder. Reviews must be in consultation with operators.

Inhalable Dust

Inhalable dust is made up of all dust sizes that can deposit throughout the respiratory tract. It can include larger particles that deposit in the upper airways (nose and throat), smaller particles that can penetrate the upper airways and deposit in the lungs (thoracic fraction) and finer particles that can penetrate the alveolar region or gas exchange region (respirable fraction).

Health Effects

Dust may cause irritation and inflammation of the eyes, and aggravate pre-existing conditions. Repeated heavy contact to the skin may cause drying of the skin and can result in dermatitis, typically to the hands. Repeated exposure to the fine dust may result in increased nasal and respiratory secretions and coughing. Inflammation of the lining tissue of the respiratory system may follow repeated, high level exposures increasing the risk of bronchitis and pneumonia.

Exposure Standards

For all general dusts, the **inhalable** fraction has an exposure limit of 10mg/m³ on the condition it is both of inherently low toxicity and free from toxic impurities (e.g. no asbestos content and less than 1% silica).

Qualitative & Quantitative Measurement

Sampling for inhalable dust is performed by an occupational hygienist according to AS 3640 – 2004, “*Workplace Atmospheres – Method for Sampling and Gravimetric Determination of Inhalable Dust*”. Sampling devices used for inhalable dust are the UKAEA 7 hole sampler and the IOM dust sampler. These devices act as filter holders and are connected via tubing to the pump. Following sampling, gravimetric and/or chemical analysis of the filter can be performed on the filter sample.

Dust Hazards

Identifying which dusts are present and understanding what the dusts can do are important first steps

Crystalline Silica

Crystalline silica (silicon dioxide or SiO₂), also known as free silica, is a basic component of soil, sand, granite and many other minerals. Quartz is the most common form of crystalline silica. Cristobalite and tridymite are two other forms of crystalline silica. All three forms may become respirable size particles when workers chip, cut, drill or grind objects that contain crystalline silica. That is, the more recent the break, the higher the risk.

Analysis of various samples from CMPA sites throughout Victoria indicates the following approximate percentage of crystalline silica:

- Basalt < 1.0%
- Scoria 0.5 - 2.0%
- Clay 20 - 30%
- Granite 25 - 40%
- Hornfels 35 - 60%
- Siltstone 45%
- Sandstone > 80%
- Sand > 90%

Variations from the above percentages will occur depending on the source of the material.

Respirable particles are the hazardous component. Respirable particles are very small and are able to get deep into the lungs. That is, the particles commonly have diameters of approximately 10 micrometres (1 micrometre is 1 millionth of a metre).

Health Effects

Prolonged exposure to respirable crystalline silica may, in some cases, cause silicosis in various forms:

- Chronic / classic silicosis: After 15 - 20 years moderate to low exposure
- Accelerated silicosis: After 5 - 10 years high exposure
- Acute silicosis: Between a few months - 2 years following extremely high concentrations

Other health effects include increased risk of pulmonary tuberculosis and chronic obstructive respiratory disease.

Crystalline silica has been classified by the International Agency for Research on Cancer as carcinogenic to humans, however the research on this is inconclusive and the ASCC has not classified it as a carcinogen.

It has been shown in numerous studies that smoking will increase the risk to those exposed.

Exposure Standards

According to the Australian Safety & Compensation Council (formerly the National Occupational Health & Safety Commission), the exposure standard for crystalline silica is 0.1mg/m³. This amount was gazetted on 8 December 2004.

Environmental Limits

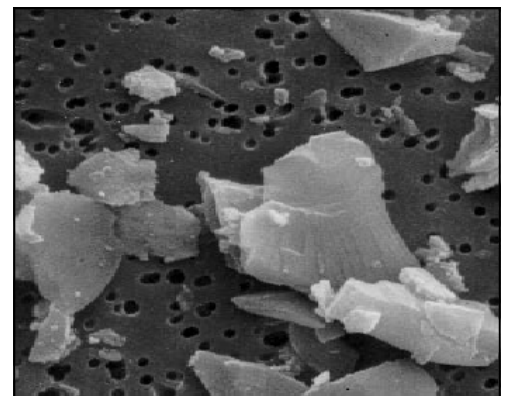
In addition, consideration must be given to exposure levels for crystalline free silica to the general public. The current draft EPA document 'Protocol for Environmental Management - Mining & Extractive Industries' sets a level of 3 micrograms per cubic metre measured as an annual average.

Qualitative & Quantitative Measurement

It is necessary to establish if there is quartz within the material being processed. A simple yes/no answer can usually be obtained from your geologist.

To establish the presence and percentage of crystalline silica, a sample would need to be tested using X-Ray Diffraction.

This percentage however, will generally not have a clear relationship to the exposure to employees. It can however be used in the development of the MSDS and could be referred to when considering processing methods.



Detailed microscopic view of silica particles on a filter. (Scanning electron micrograph by William Jones, Ph.D.)

Calculating Exposure Levels

Exposure levels are used to establish how/when over-exposure is occurring

This discussion uses the crystalline silica exposure standard as an example, however the inhalable dust standard also applies.

The exposure standard of 0.1 mg/m³ refers to the airborne concentrations of respirable crystalline silica in the breathing zone of the employee, determined by "personal sampling". The 0.1 mg/m³ exposure standard for respirable crystalline silica is defined as an 8 hour time weighted average that represents an airborne concentration which, according to current knowledge, should neither impair the health of, nor cause undue discomfort to, nearly all workers. The exposure standard is based on an 8 hour working day, 5 day working week, over an entire working life.

If you are working more than 40 hours a week the TWA will need to be adjusted using an equation as follows:

$$\text{Adjusted exposure standard} = 0.1 \text{ mg/m}^3 \times \frac{8 \times (24 - \text{length of work shift})}{16 \times \text{length of work shift}}$$

For example, If you work 10 hour shifts, five days per week:

$$\text{Adjusted exposure standard (10 hr shift)} = 0.1 \text{ mg/m}^3 \times \frac{8 \times (24 - 10)}{16 \times 10} = 0.07 \text{ mg/m}^3$$

Accordingly, by maintaining exposures below the occupational exposure standard, the health risks associated with crystalline silica are minimised.

How this is Measured

The assessment of worker exposures involves the use of a personal dust monitoring device which is worn by selected workers (i.e. a pump, a cyclone containing a pre-weighed membrane filter and tubing).

The pump which is set at a specific flow rate by the occupational hygienist draws air into the cyclone. The design of the cyclone causes the larger particles to be separated whilst the smaller airborne particles are trapped on the membrane filter that the air is forced to pass through.

At the conclusion of the day the membrane filter is reweighed and the amount of total dust on the filter is established.

Monitoring is in accordance with AS 2985 – 2004 "Workplace Atmospheres – Methods for Sampling & Gravimetric Determination of Respirable Dust". The analysis of the crystalline silica content of the collected samples is performed by a process known as X-Ray Diffraction. This process identifies how much crystalline silica is present on the filter, excluding all other types of dust. (See diagram on left).

The weight of detected crystalline silica, sampling time and pump flow rate are manipulated through a series of calculations to provide a time weighted average airborne concentration to compare to the occupational exposure standard.

Limitations of Measurements

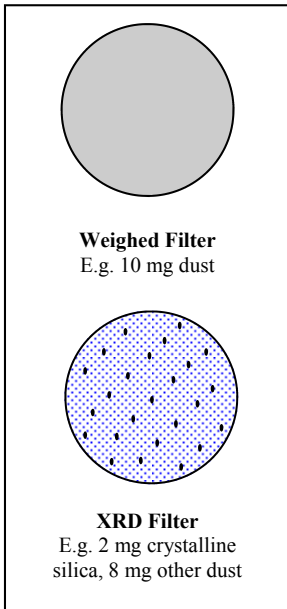
This measurement will not show you:

- Where/when peak readings occurred
- If the filter was deliberately manipulated
- If any PPE controls were in place

Static Monitoring

In addition to "personal monitoring", an assessment of risk may also incorporate the measurement of airborne respirable dust / crystalline silica concentrations at fixed locations (static monitoring).

Static monitoring is a means to check the effectiveness of implemented controls or identify high risk areas. Results should be tabled separately as they do not reflect personal exposures, and are not legally required. Hygienists may utilise measuring tools such as a Dust Trak (a device with a light scattering optical sensor) in order to assess total respirable dust concentrations.



Monitoring Exposure Levels

Protocol for Dust Monitoring - Booking

Accordingly when booking monitoring to occur it is important to clarify:

- That the person monitoring is competent (i.e. an occupational hygienist)
- Where and who is to be monitored
- When and what time you want this to occur (ideally the majority of the shift)
- Who is to help with the placement of static monitoring devices

Also keep detailed written records of:

- What and where tasks were undertaken, what precautions (PPE) were taken
- Weather conditions for that day and a period preceding the day of testing (this may include wind speed and direction, rain and humidity)
- Details of any irregular tasks undertaken

Protocol for Monitoring - Testing

When wearing the instrument an employee should:

- Only undertake tasks within the job requirements
- Not enter restricted areas without taking proper precautions

- Not pass the monitoring device to another employee (as personal monitoring takes into account times when exposure is really low)

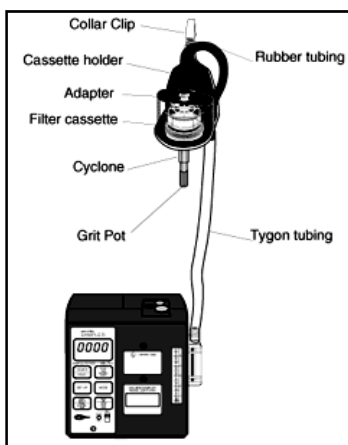
It is essential that these measurements are conducted in similar weather conditions if results are to be compared over time. Alternatively, testing may occur in different conditions to see if compliance is consistent. This can be set by the site, however should take into account on-site work practices, any past measurements and any incidents that have occurred.

The results should be presented as per the WorkSafe document, "Occupational Hygiene Reports".

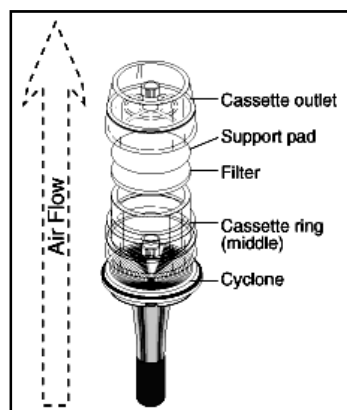
How to Use Results

The results from monitoring will become an important tool for the site. Use these when establishing the frequency of such testing, when establishing a medical monitoring plan, and in the ranking and therefore implementation of control measures.

The results must be made readily available to employees so that they too can take ownership of their health.



Sampling Train



Filter assembly with Cyclone

Health Monitoring

Sites are able to require employees to participate in medical examinations if this is advertised at employment. This may include:

1. When engaging a new employee (to establish baseline data and ensure fitness for work),
2. On a periodic basis (to monitor for changes), and
3. At the conclusion of employment (to establish end-point data).

During these investigations, the following is recommended by the CMPA's medical monitoring tools.

Testing Frequency

Frequency of health monitoring in regards to crystalline silica exposure will be determined by the results of personal dust exposure levels.

For example, those who are potentially exposed to high levels of silica, health monitoring should include more frequent spirometry and medical examinations than those with low silica exposure.

In all cases, if there are significant changes, further medical investigations should be conducted and controls reviewed.

Permission to Test

It is therefore essential that prior to employing someone, it is made known to them that the work environment is a silica resource and that medical monitoring will be undertaken. This should be advised in writing and a signed copy of this kept.

Risk Controls

Silica sites in particular have public information obligations

All substances which contain elevated levels of a hazardous substance and are sold commercially must have a 'Material Safety Data Sheet' (MSDS) which identifies safe use practices and emergency response procedures, etc.

As a guide, an elevated level for crystalline silica would be more than a few percent and would give consideration to the material size and processing method.

Other substances, such as washed sand for instance, may not need an MSDS. However, it would still be good company practice to develop an MSDS and state the non-hazardous nature of the product to avoid any potential ambiguity.

An MSDS must be made available to customers at first delivery and upon request. Therefore the MSDS is often posted on a company's website.

Content of MSDS

The content of the MSDS is dictated through the document, 'National Code of Practice for the Preparation of Material Safety Data Sheets 2nd Edition' - released by ASCC's predecessor in 2003.

This document details precisely what needs to be included in an MSDS and what order it should be included in.

The document can be downloaded from the website www.ascc.gov.au by searching for "preparation of material safety data".

*“Medical
monitoring
programs can vary
between different
employees”*

Risk Controls

OHS Support in Quarries 05

Control	Examples
Elimination & Substitution	<p><i>Fine particles will always be present at extractive sites and consequently this is not normally achievable in the industry</i></p> <ul style="list-style-type: none"> • Move to a new resource! • If an additive such as sand is required, use a low silica alternative • Add additional crushing or screening capacity to create more fines if already extracting from a low silica resource
Engineering	<p>Mobile plant</p> <ul style="list-style-type: none"> • Isolate people from dust by providing climate controlled cabins (with appropriate filtration) <p>Fixed plant</p> <ul style="list-style-type: none"> • Utilise a wet processing system • Increase the use of automation on site • Install dust extraction/collection units at main discharge points (For instance, using a bag house to collect unwanted dust from the crushing process) • Install local exhaust ventilation • Install conveyor covers and skirts, enclose hoods and screen housings • Establish wash down facilities under plant that store fines underwater • Reduce fall height to stockpile through transfer chute • Install sprays within the processing system • Ensure any dust seals are effective <p>Stockpiles</p> <ul style="list-style-type: none"> • Reduce stockpile size and area of exposed face • Contain the movement of any dust by using native vegetation screens • Install sprinklers on the quarry face or stockpiles <p>Roads</p> <ul style="list-style-type: none"> • Use permanent dust control on traffic routes (i.e. irrigation, sealed roads) • Have a dedicated water truck • Cover loads prior to dispatch from site • Wash truck wheels prior to entering public road <p>Workshop and office</p> <ul style="list-style-type: none"> • Utilise air locks and negative pressure for office buildings to minimise any dust entering
Administrative	<p>Maintenance</p> <ul style="list-style-type: none"> • Reduce exposure time by limiting time in dusty environment, job rotation or shortening shifts OR Reduce the number of people exposed • Implement systems of work such as wash down policies prior to maintenance • Carry out maintenance tasks during times of low dust concentrations (i.e. when plant isn't running) and wash maintenance area down prior to performing tasks <p>Housekeeping</p> <ul style="list-style-type: none"> • Maintain a clean work environment. For instance, keep site clean and tidy, do not wear dusty overalls or shoes in mobile plant or office buildings, clean cabins regularly • Encourage good personal hygiene • Have overalls washed by industrial cleaner <p>Management</p> <ul style="list-style-type: none"> • Train those who may be exposed on the risks and preventative measures (i.e. run regular training sessions on how to manage dusts) • Develop and release MSDS for customers
PPE	<ul style="list-style-type: none"> • Respirators and dust masks with proper selection, maintenance and fitting

“Engineering controls are an essential part of managing dust on site”

These should then be ranked in terms of how much risk it will reduce compared to the suggestions practicability. An optimum is the highest risk reduction for the most practicable solution.

Dust
Management

Management Plans

Without a clear management plan, all the monitoring in the world is a waste

Once the hazards and risks are identified, and the controls selected and allocated, a due date is necessary to ensure that these are implemented. One means of keeping track of this is by using a 'Control Register'.

Risk identification, control and assessment promotes itself to continual improvement. Review what the 'norm' is and investigate ways you can improve it on a regular basis.

Means of reviewing include formal analysis, regular audits, monitoring incidents and through any suggestions or concerns raised by those on site.

Unfortunately, as with many things in life, it is not a matter of doing it once and getting it right. Rather, it is about continuously reviewing and improving.

Related & Emerging Issues

Issues in relation to dust management are continually changing. Keep this in mind when reviewing or changing plant or systems of work.

Welding Fumes

Welding produces a wide range of dangerous fumes. This includes known carcinogens such as beryllium (from aluminium and magnesium alloys), causes of metal fume fever such as cobalt, and other toxic substances such as cadmium, chromium and lead. These fumes can be both odourless and colourless.

In addition to complying with the individual exposure standards for specific contaminants, the fume concentration in the breathing zone (which is inside a welder's helmet when a helmet is worn) should not exceed 5 mg/m³ TWA.

For more information see the website www.wtia.com.au or search for "welding fumes" on the website www.ascc.gov.au.

Acknowledgements:

- Department of Primary Industries
- Victorian WorkCover Authority
- D. McKelvie, Readymix
- Bureau Veritas HSE (formerly Kilpatrick & Associates)

Disclaimer

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