

Client: Carpets by Design
Job number: 19_1462
Sample: 19_1462_01
Client ID: **Miflor Dust from SPC Sample**
Date: 25/09/2019
Revision number: 0
Analysis: Respirable alpha-quartz concentration analysis by x-ray diffraction (XRD) and particle sizing by laser diffraction (PSD) using the SWeRF (calculation) method¹

Sample Preparation

The sample was supplied to Microanalysis Australia as dust from flooring cutting/sanding. The sample was tested as received.

A representative sub-sample was wet sieved at 150 μm , and the < 150 μm fraction (suspension) was thoroughly homogenized and sized by laser diffraction reporting size between 150 μm and 20 nm.

A separate sub-sample was removed, dried if necessary, and lightly ground by mortar and pestle prior to XRD analysis. As the sample was not solvent soluble, the XRD was conducted as received.

Analysis

The wet sieving was conducted using a light-flow (approximately 1 L /min) water spray jet on a 150 μm stainless steel Endecotts sieve. The < 150 μm fraction was collected in a bucket for laser diffraction analysis. Each size fraction was then oven dried at 105 °C. The dried weights of each of the fractions were noted and the fraction percentage calculated based on the original dried starting weight.

The laser diffraction size distribution analyses were conducted using a Malvern Mastersizer MS2000 calibrated using QAS3002 certified reference material and certified within specification. The analyses were conducted following ISO13320-1:2009. The calculated size fractions use an assumed density of 2.65 g/cc for the determination of equivalent spherical diameter from equivalent aerodynamic diameter.

The XRD was conducted using a Philips MPD Pro. Quantification was by the peak area integration method. Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was EVA (Bruker), which was also used to estimate the amorphous content of the material. The ICDD card set was ICDD PDF4/Minerals 2018. The X-ray source was cobalt radiation. ICDD match probabilities are reported as an indication of how well the diffraction peaks of this sample compare with currently published literature on the quoted mineral. No Rietveld refinement was conducted on the acquired spectrum unless otherwise stated.

The respirable and thoracic size fractions (as defined in ISO 7708) of quartz concentrations of the bulk were calculated by multiplying the volume percent of the respirable-only (PM₄) and thoracic-only (PM₁₀) fractions by the alpha-quartz concentration of the bulk sample.

It should be noted that the relative hardness of quartz to other minerals present may introduce heterogeneity into each size fraction composition resulting in quartz dominating in the coarser size fractions.

Summary

The size distribution of the sample by wet sieving and laser diffraction is shown below:

Client ID	Size fraction (by aerodynamic diameter) volume percent			
	Non-inhalable	Inhalable, PM100	Thoracic, PM10	Respirable, PM4
Miflor Dust from SPC Sample	91.81	8.19	0.42	0.15

Assuming all mineral phases occur at the same relative concentrations across all size intervals, a volume percent distribution equates to a mass distribution. The respirable fraction, PM₄ is therefore 0.15 wt %.

The normalised, interpreted semi-quantitative mineralogy by X-ray diffraction of the bulk sample is shown below:

Mineral phase	Concentration (wt %) of the bulk	ICDD match probability
Calcite	91	good
Dolomite	6	good
Quartz	4	good

The XRD interpretation determined the bulk sample to be approximately 43.4 wt % amorphous. The above normalised (relative) percentages represent only the crystalline fraction.

To calculate the relevant PM₄ or PM₁₀ fraction of respirable crystalline silica, the following equation is used:

$$PM_x = PSD_{(PM_x)} \times XRD_{(cs)}$$

where: PSD_(PM_x) is the percentage of material at the aerodynamic diameter PM_x;
XRD_(cs) is the absolute concentration of crystalline silica in the bulk material.

The calculated respirable (PM₄) and thoracic (PM₁₀) crystalline silica concentrations with respect to the bulk sample are shown below:

Lab number	Respirable (PM ₄) wt %			Thoracic (PM ₁₀) wt %		
	α-quartz	Cristobalite	Tridymite	α-quartz	Cristobalite	Tridymite
19_1462_01	0.003	<0.001	<0.001	0.009	<0.001	<0.001

Note: Three polymorphs of crystalline silica are scheduled as Group 1 carcinogens by IARC – quartz, cristobalite and tridymite².

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¹ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3979281/>

² <https://monographs.iarc.fr/ENG/Monographs/vol100C/mono100C-14.pdf>