XRD ANALYSIS

CLIENT: Apex Distribution Pty Ltd

REPORT NO: AXD1124-1

DATE: 10/12/2024

NAME: Statumax (our reference: O2346)

XRD ANALYSIS

A representative portion of the tile sample was pulverised, and the powder was analysed by X-ray diffraction to determine the minerals present. XRD identifies minerals via their crystal structure. If quartz (a crystalline silica mineral) was detected in the sample, its content was determined by XRD measurements of the sample and of a pure quartz standard. If present, the quartz content was corrected by the X-ray absorbency of the sample, which was estimated from its mineralogy. This correction was similarly applied to the detection limit. This procedure was repeated for cristobalite, which is also a crystalline silica mineral, but with a different crystal structure to quartz.

MINERALOGY

The mineralogy of the sample (estimated weight %) follows. The amorphous component is the residual after all the crystalline components have been allocated percentages.

Mineral name	Composition	Relative abundance
		Statumax (O2346)
Quartz (crystalline silica)	SiO_2	0.2
Cristobalite (crystalline silica)	SiO_2	Not detected.
Calcite	$CaCO_3$	0.8
Amorphous	unknown	99

DISCUSSION

Amorphous material was the dominant component detected in the sample of Statumax. Trace quantities of quartz (crystalline silica) and calcite were also detected in the sample.

An estimated crystalline silica percentage of 0.2% was detected in the sample of Statumax. The estimated quartz and cristobalite (crystalline silica) detection limit is 0.1%.

Photograph of sample tested presented overleaf.

TESTED BY: Thomas Baggs & Michael Till[1]

[1] Ancillary XRD services within this report performed by Agon Environmental.

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Image 1: Appearance of sample as received from client.

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XRD ANALYSIS

CLIENT: Apex Distribution Pty Ltd

REPORT NO: AXD1124-1

DATE: 10/12/2024

NAME: White Shimmer (our reference: O2348)

XRD ANALYSIS

A representative portion of the tile sample was pulverised, and the powder was analysed by X-ray diffraction to determine the minerals present. XRD identifies minerals via their crystal structure. If quartz (a crystalline silica mineral) was detected in the sample, its content was determined by XRD measurements of the sample and of a pure quartz standard. If present, the quartz content was corrected by the X-ray absorbency of the sample, which was estimated from its mineralogy. This correction was similarly applied to the detection limit. This procedure was repeated for cristobalite, which is also a crystalline silica mineral, but with a different crystal structure to quartz.

MINERALOGY

The mineralogy of the sample (estimated weight %) follows. The amorphous component is the residual after all the crystalline components have been allocated percentages.

Mineral name	Composition	Relative abundance
		White Shimmer (O2348)
Quartz (crystalline silica)	SiO_2	0.5
Cristobalite (crystalline silica)	SiO_2	Not detected.
Rutile	TiO_2	0.5
Amorphous	unknown	99

DISCUSSION

Amorphous material was the dominant component detected in the sample of White Shimmer. Trace quantities of quartz (crystalline silica) and rutile were also detected in the sample.

An estimated crystalline silica percentage of 0.5% was detected in the sample of White Shimmer. The estimated quartz and cristobalite (crystalline silica) detection limit is 0.1%.

Photograph of sample tested presented overleaf.

TESTED BY: Thomas Baggs & Michael Till[1]

[1] Ancillary XRD services within this report performed by Agon Environmental.

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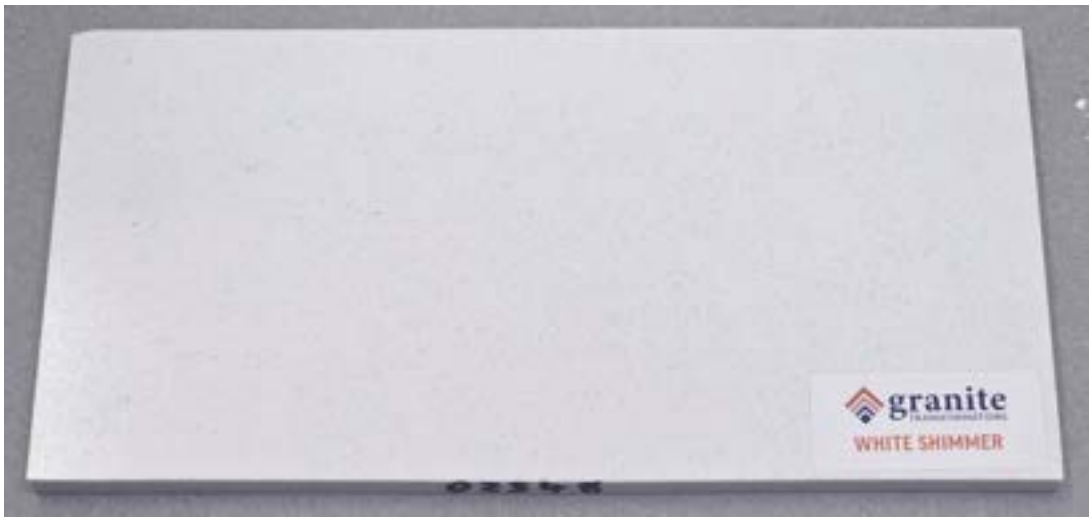

Image 1: Appearance of sample as received from client.

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XRD ANALYSIS

CLIENT: Apex Distribution Pty Ltd

REPORT NO: AXD1124-1

DATE: 10/12/2024

NAME: Sea Salt (our reference: O2347)

XRD ANALYSIS

A representative portion of the tile sample was pulverised, and the powder was analysed by X-ray diffraction to determine the minerals present. XRD identifies minerals via their crystal structure. If quartz (a crystalline silica mineral) was detected in the sample, its content was determined by XRD measurements of the sample and of a pure quartz standard. If present, the quartz content was corrected by the X-ray absorbency of the sample, which was estimated from its mineralogy. This correction was similarly applied to the detection limit. This procedure was repeated for cristobalite, which is also a crystalline silica mineral, but with a different crystal structure to quartz.

MINERALOGY

The mineralogy of the sample (estimated weight %) follows. The amorphous component is the residual after all the crystalline components have been allocated percentages.

Mineral name	Composition	Relative abundance
		Sea Salt (O2347)
Quartz (crystalline silica)	SiO_2	Not detected.
Cristobalite (crystalline silica)	SiO_2	Not detected.
Amorphous + gibbsite	Unknown + $Al(OH)_3$	100

DISCUSSION

Amorphous material and gibbsite were the dominant components detected in the sample of Sea Salt. Gibbsite was not able to be reliably differentiated from the amorphous component, and they were therefore reported together.

Crystalline silica minerals were not detected in the sample of Sea Salt. The estimated quartz and cristobalite (crystalline silica) detection limit is 0.1%.

Photograph of sample tested presented overleaf.

TESTED BY: Thomas Baggs & Michael Till[1]

[1] Ancillary XRD services within this report performed by Agon Environmental.

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Image 1: Appearance of sample as received from client.

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XRD ANALYSIS

CLIENT: Apex Distribution Pty Ltd **REPORT NO:** AXD0424-1 **DATE:** 2/5/24

NAME: Glacier Zero

XRD ANALYSIS

A representative portion of the tile sample was pulverised, and the powder analysed by X-ray diffraction to identify the minerals present. The amorphous component is the residual after all the crystalline components have been allocated percentages.

MINERALOGY

The mineralogy of the sample (estimated weight %) follows.

Mineral name	Composition	Relative abundance
		Glacier Zero
Quartz	SiO_2 (crystalline silica)	Not detected.
Amorphous	unknown	100

DISCUSSION

Amorphous material was the only component in the sample of Glacier Zero. No crystalline components were detected.

Crystalline silica as quartz was not detected in the sample of Glacier Zero. The estimated detection limit for quartz is 0.1%.

Photograph of sample tested presented overleaf.

TESTED BY: Thomas Baggs & Michael Till[1]

[1] Ancillary XRD services within this report performed by Agon Environmental.

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Image 1: Appearance of sample as received from client.

XRD ANALYSIS

CLIENT: Apex Distribution Pty Ltd

REPORT NO: AXD0824-1

DATE: 6/8/24

NAME: Misterio Zero (our reference: O2206)

XRD ANALYSIS

A representative portion of the tile sample was pulverised, and the powder was analysed by X-ray diffraction to determine the minerals present. XRD identifies minerals via their crystal structure. If quartz (a crystalline silica mineral) was detected in the sample, its content was determined by XRD measurements of the sample and of a pure quartz standard. If present, the quartz content was corrected by the X-ray absorbency of the sample, which was estimated from its mineralogy. This correction was similarly applied to the detection limit. This procedure was repeated for cristobalite, which is also a crystalline silica mineral, but with a different crystal structure to quartz.

MINERALOGY

The mineralogy of the sample (estimated weight %) follows. The amorphous component is the residual after all the crystalline components have been allocated percentages.

Mineral name	Composition	Relative abundance
		Misterio Zero (O2206)
Quartz (crystalline silica)	SiO_2	Not detected.
Cristobalite (crystalline silica)	SiO_2	Not detected.
Rutile	TiO_2	1.0
Amorphous	unknown	99.0

DISCUSSION

Amorphous material was the dominant component detected in the sample of Misterio Zero. Trace quantities of rutile were also detected in the sample.

Crystalline silica was not detected in the sample of Misterio Zero. The estimated quartz and cristobalite (crystalline silica) detection limit is 0.1%.

Photograph of sample tested presented overleaf.

TESTED BY: Thomas Baggs & Michael Till[1]

[1] Ancillary XRD services within this report performed by Agon Environmental.

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Image 1: Appearance of sample as received from client (front surface – top, back surface – bottom).

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XRD ANALYSIS

CLIENT: Apex Distribution Pty Ltd

REPORT NO: AXD0924-1

DATE: 27/9/24

NAME: Crown (our reference: O2276)

XRD ANALYSIS

A representative portion of the tile sample was pulverised, and the powder was analysed by X-ray diffraction to determine the minerals present. XRD identifies minerals via their crystal structure. If quartz (a crystalline silica mineral) was detected in the sample, its content was determined by XRD measurements of the sample and of a pure quartz standard. If present, the quartz content was corrected by the X-ray absorbency of the sample, which was estimated from its mineralogy. This correction was similarly applied to the detection limit. This procedure was repeated for cristobalite, which is also a crystalline silica mineral, but with a different crystal structure to quartz.

MINERALOGY

The mineralogy of the sample (estimated weight %) follows. The amorphous component is the residual after all the crystalline components have been allocated percentages.

Mineral name	Composition	Relative abundance
		Crown (O2276)
Quartz (crystalline silica)	SiO_2	0.2
Cristobalite (crystalline silica)	SiO_2	Not detected.
Rutile	TiO_2	0.4
Amorphous	unknown	99.4

DISCUSSION

Amorphous material was the dominant component detected in the sample of Crown. Trace quantities of quartz (crystalline silica) and rutile were also detected in the sample.

An estimated crystalline silica content of 0.2% was detected in the sample of Crown. The estimated quartz and cristobalite (crystalline silica) detection limit is 0.1%.

Photograph of sample tested presented overleaf.

TESTED BY: Thomas Baggs & Michael Till[1]

[1] Ancillary XRD services within this report performed by Agon Environmental.

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Image 1: Appearance of sample as received from client.

XRD ANALYSIS

CLIENT: Apex Distribution Pty Ltd

REPORT NO: AXD0924-1

DATE: 27/9/24

NAME: Iceberg White (our reference: O2274)

XRD ANALYSIS

A representative portion of the tile sample was pulverised, and the powder was analysed by X-ray diffraction to determine the minerals present. XRD identifies minerals via their crystal structure. If quartz (a crystalline silica mineral) was detected in the sample, its content was determined by XRD measurements of the sample and of a pure quartz standard. If present, the quartz content was corrected by the X-ray absorbency of the sample, which was estimated from its mineralogy. This correction was similarly applied to the detection limit. This procedure was repeated for cristobalite, which is also a crystalline silica mineral, but with a different crystal structure to quartz.

MINERALOGY

The mineralogy of the sample (estimated weight %) follows. The amorphous component is the residual after all the crystalline components have been allocated percentages.

Mineral name	Composition	Relative abundance
		Iceberg White (O2274)
Quartz (crystalline silica)	SiO_2	Not detected.
Cristobalite (crystalline silica)	SiO_2	Not detected.
Rutile	TiO_2	0.4
Amorphous	unknown	99.6

DISCUSSION

Amorphous material was the dominant component detected in the sample of Iceberg White. Trace quantities of rutile were also detected in the sample.

Crystalline silica was not detected in the sample of Iceberg White. The estimated quartz and cristobalite (crystalline silica) detection limit is 0.1%.

Photograph of sample tested presented overleaf.

TESTED BY: Thomas Baggs & Michael Till[1]

[1] Ancillary XRD services within this report performed by Agon Environmental.

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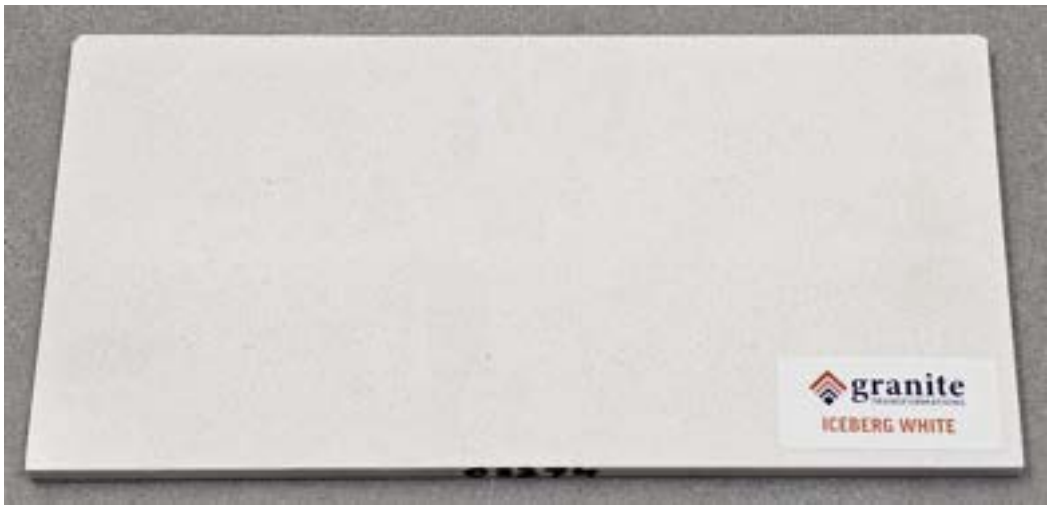

Image 1: Appearance of sample as received from client.

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XRD ANALYSIS

CLIENT: Apex Distribution Pty Ltd

REPORT NO: AXD0924-1

DATE: 27/9/24

NAME: Kaolinite (our reference: O2275)

XRD ANALYSIS

A representative portion of the tile sample was pulverised, and the powder was analysed by X-ray diffraction to determine the minerals present. XRD identifies minerals via their crystal structure. If quartz (a crystalline silica mineral) was detected in the sample, its content was determined by XRD measurements of the sample and of a pure quartz standard. If present, the quartz content was corrected by the X-ray absorbency of the sample, which was estimated from its mineralogy. This correction was similarly applied to the detection limit. This procedure was repeated for cristobalite, which is also a crystalline silica mineral, but with a different crystal structure to quartz.

MINERALOGY

The mineralogy of the sample (estimated weight %) follows. The amorphous component is the residual after all the crystalline components have been allocated percentages.

Mineral name	Composition	Relative abundance
		Kaolinite (O2275)
Quartz (crystalline silica)	SiO_2	Not detected.
Cristobalite (crystalline silica)	SiO_2	Not detected.
Rutile	TiO_2	0.1
Amorphous	unknown	99.9

DISCUSSION

Amorphous material was the dominant component detected in the sample of Kaolinite. Trace quantities of rutile were also detected in the sample.

Crystalline silica was not detected in the sample of Kaolinite. The estimated quartz and cristobalite (crystalline silica) detection limit is 0.1%.

Photograph of sample tested presented overleaf.

TESTED BY: Thomas Baggs & Michael Till[1]

[1] Ancillary XRD services within this report performed by Agon Environmental.

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Image 1: Appearance of sample as received from client.

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XRD Report – Quantitative Mineralogy of Purestone Type A Benchtop

Mark D Raven, Rong Fan and Rodrigo Gomez-Camacho
Report No: D5625D

February 2023

Phillip Herbert

Citation

Raven, M.D., Rong Fan and Gomez-Camacho, R. (2023) XRD Report – Quantitative Mineralogy of Purestone Type A Benchtop.

Copyright and disclaimer

Important disclaimer

Introduction

A single sample of Purestone Type A benchtop was submitted by Phillip Herbert for quantitative mineralogy and determination of amorphous content using X-ray diffraction (XRD) analysis.

Sample Preparation

Approximately 2g of the as received sample was ground for 10 minutes in a McCrone micronizing mill under ethanol. The resulting slurry was oven dried at 60°C then thoroughly mixed in an agate mortar and pestle before being lightly back pressed into a stainless steel sample holder for X-ray diffraction analysis.

In order to determine the amorphous content approximately 20% by weight of a well crystalline corundum standard was accurately weighed with the micronized sample then thoroughly mixed using a mortar and pestle. The mixture was lightly back pressed into a stainless steel sample holder for X-ray diffraction analysis.

X-ray Diffraction Analysis

XRD patterns were recorded with a PANalytical X'Pert Pro Multi-purpose Diffractometer using Fe filtered Co Kα radiation, automatic divergence slit, 2° anti-scatter slit and fast X'Celerator Si strip detector. The diffraction patterns were recorded from 3 to 80° in steps of 0.017° 2 theta with a 0.5 second counting time per step for an overall counting time of approximately 35 minutes.

Qualitative analysis was performed on the XRD data using in-house XPLOT and HighScore Plus (from PANalytical) search/match software. Quantitative analysis was performed on the XRD data using the commercial package TOPAS from Bruker. Amorphous content was determined using the internal standard method as describe below.

Internal Standard Method for Determining Amorphous Content

The quantitative phase analysis method of Hill and Howard (1987) results in relative phase abundance values based on the following equation:

$$W_j = \frac{S_j (ZMV)_j}{\sum_{i=1}^{n} S_i (ZMV)_i},$$

where W_j is the weight fraction of phase j, S_j is the Rietveld scale factor of phase j and $(ZMV)_j$ is the product of the unit cell mass and volume of phase j. The individual phase values are ratioed to the sum of all n phase values.

In order to determine the absolute phase abundance, an accurately weighed amount of a well crystalline standard of known composition is thoroughly mixed with the samples of interest. The weight fractions are corrected to the known weight fraction of standard added by the following equation:

$$Corr(W_j) = W_j . \frac{W_{S(weighed)}}{W_{S(measured)}},$$

Where $Corr(W_j)$ are the corrected weight fractions, $W_{s(weighed)}$ is the weight fraction of the standard added and $W_{s(measured)}$ is the weight fraction of the standard measured. The absolute weight fraction, $Asrec(W_j)$, can then be determined using:

$$Asrec(W_j) = 100. \frac{Corr(W_j)}{(100 - W_{S(weighed)})},$$

and absolute abundance is determined using:

$$Amorphous = 100 - \sum_{i=1}^{n-1} Asrec(W_i),$$

Where the sum does not include the internal standard (phase n).

Results

Results of XRD analysis of the Purestone Type A Benchtop bulk sample without (rel) and with (abs) amorphous (non-crystalline material) content by the internal standard method is shown in Table 1.

The XRD pattern for the micronized sample is shown in Figure 1.

Table 1 Quantitative XRD analysis (wt.%) of bulk micronized samples (relative and absolute abundance) before and after addition of 20% corundum internal standard

CSIRO ID	Client ID	Quartz Crystalline Silica	Gibbsite	Rutile	Amorphous Non-Crystalline Material
61644	**Purestone Type A Benchtop (rel)**	2	91	7	
61644	**Purestone Type A Benchtop (abs)**	<1	17	1	82

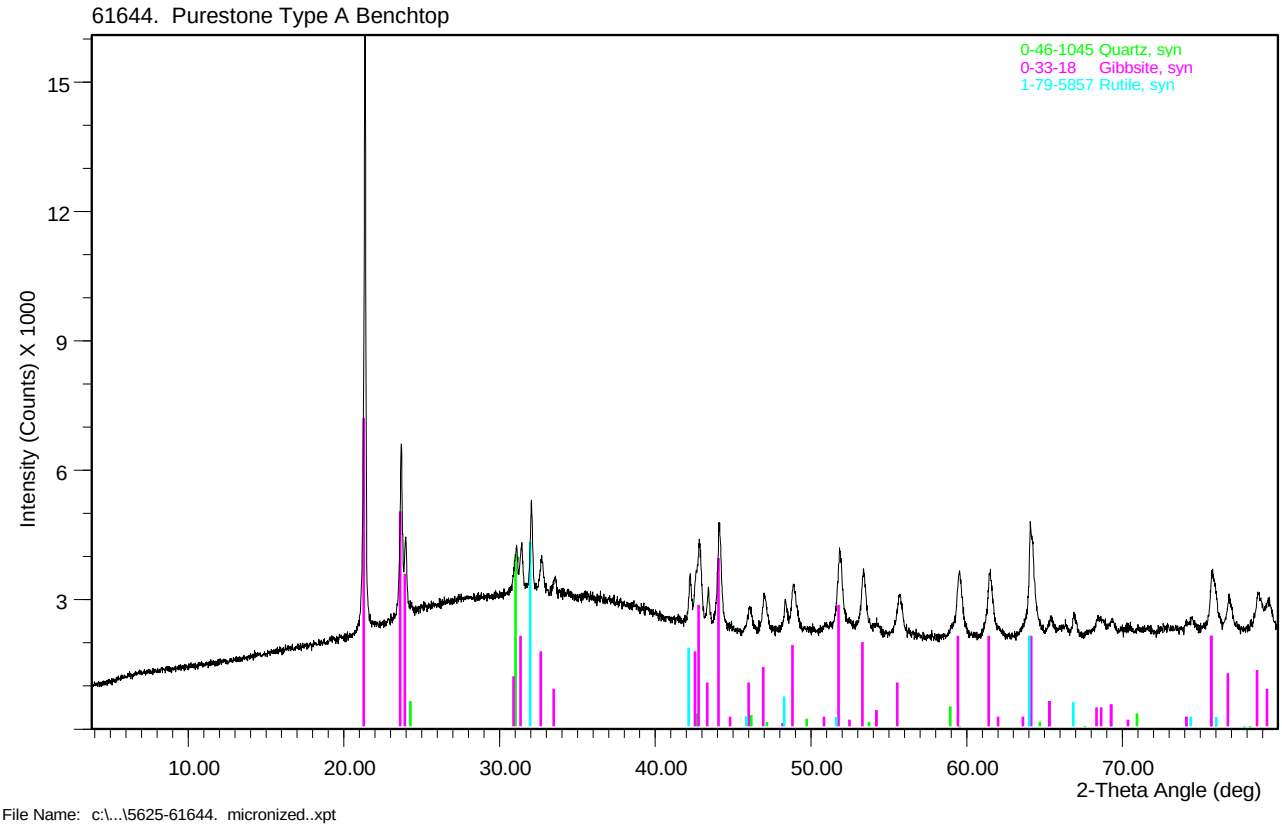

Figure 1 XRD pattern of Purestone Type A Benchtop (Co Kα radiation)

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