

## Safety Data Sheet: Spodumene Concentrate COARSE

**1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER**

<b>Product name</b>	<b>Spodumene Concentrate COARSE</b>
<b>Synonyms</b>	Aluminosilicates in a mixture with other naturally occurring minerals. Mineral Concentrate.
<b>Intended use</b>	Mining Industry. Concentrated lithium aluminosilicate ore (i.e. spodumene) for refining process.
<b>CAS-No.</b>	Not applicable.
<b>Supplier</b>	PILBARA MINERALS LIMITED
<b>ABN</b>	95 112 425 788
<b>Address</b>	Level 2, 88 Colin Street, West Perth, WA 6005, Australia
<b>Telephone</b>	+61 8 6266 6266
<b>Emergency Contact</b>	+61 (0)497 607 415
<b>SDS Date</b>	15 April 2021

**2. HAZARDS IDENTIFICATION****Classification of Substance according to GHS, 8<sup>th</sup> revised edition [Refer Section 15].**

NOT CLASSIFIED AS HAZARDOUS  
NOT CLASSIFIED AS DANGEROUS GOOD

Based on the composition information for the Pilbara Minerals coarse spodumene concentrate, it is not classified as hazardous to human health. The mixture rules in the GHS have been applied when considering the hazard classification of the product. Concentrations of constituents which could potentially drive a hazard classification were below the designated cut-off concentrations (9, 20).

**Hazard Classes and Categories**

None applicable

**Labelling according to GHS, 8<sup>th</sup> revised edition:**

**Substance:** Coarse Spodumene concentrate

**Hazard Pictograms**

None applicable

**Signal Word:** Not applicable

**Hazard Statements:** Not applicable

**Precautionary Statements:**

- |      |  |
|------|--|
| P260 | Do not breathe dust.                                       |
| P273 | Avoid release to the environment.                          |
| P280 | Wear protective gloves/protective clothing/eye protection. |

**Not classified as Dangerous Good** according to the Australian Dangerous Goods Code (8) for road/rail transport and the International Maritime Dangerous Goods Code (3). Refer Section 14.

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### 3. COMPOSITION / INFORMATION ON INGREDIENTS

**Recommended use:** Industrial applications.

**Appearance:** Sand-coloured coarse rock-like particulate material. It is a coarse amorphous solid ore concentrate consisting predominantly of lithium aluminosilicate (i.e. spodumene,  $[\text{LiAl}(\text{Si}_2\text{O}_6)]$ ), quartz, and other minerals and trace metals found in soil/rock that are not readily separable into the individual components. The mineralogy of the concentrate and results of elemental analysis are summarised in Table 1.

**Table 1 – Typical Composition of Pilbara Minerals Coarse Spodumene Concentrate**

Component	CAS Number	Concentration % wt/wt
Spodumene $[\text{LiAl}(\text{Si}_2\text{O}_6)]$	12068-40-5	40-50%
Muscovite $[\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{F},\text{OH})_2]$	1318-94-1	5-10%
Quartz ( $\text{SiO}_2$ )*	14808-60-7	5-10%
Albite ( $\text{NaAlSi}_3\text{O}_8$ )	12244-10-9	<5%
Other aluminosilicates (e.g. actinolite, microcline, clinocllore, amorphous material)	Various	20-30%
Moisture ( $\text{H}_2\text{O}$ )	7732-18-5	<5%
Trace Minerals (total)	Not Available	<1%
Mineralogical composition approximated from semi-quantitative XRD analysis undertaken on <20µm material (21). Elemental analysis indicated a typical concentration of 75% Si; 16% Al; 4.5% Li; 0.4% Ca; 0.4% Fe; 0.2% Mn; 0.2% P; and 1% K (5).		
* Crystalline silica (when crushed) may produce hazardous respirable dust. Based on respirable crystalline silica analyses of the coarse concentrate by X-ray diffraction, <b>Pilbara Minerals Coarse Spodumene Concentrate</b> contains <0.01% respirable crystalline silica (19, 20).		

### 4. FIRST AID MEASURES

- Ingestion:** Not a normal route of exposure due to coarse product form. Ingestion of large amounts may cause irritability of the digestive system. If swallowed, rinse mouth with water. Give plenty of water to drink. Do not make a semi-conscious or unconscious person vomit. If vomiting occurs give further water. If signs or symptoms develop, seek medical advice. *In Australia Phone 13 11 26.*
- Eye contact:** Unlikely due to product form. If contact with eyes occurs and irritation or discomfort exists, irrigate eyes gently with copious quantities of water for 15 minutes. In all cases of eye contamination, it is a sensible precaution to seek medical advice, especially if irritation persists.
- Skin contact:** If prolonged skin contact occurs wash affected skin thoroughly with soap and water.
- Inhalation:** Do not breathe dust. If excess dust is inhaled or irritation or discomfort exists, remove to fresh air. Blow nose to clear breathing passages and rinse mouth with water. Recovery should be rapid after removal from exposure. If other than minor symptoms are displayed, seek medical advice. *In Australia Phone 13 11 26.* If dust is present, it may aggravate pre-existing respiratory conditions such as bronchitis or asthma due to nuisance dust nature.
- Notes to physician:** Treat symptomatically.

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**First Aid Facilities:** Eye wash facilities and safety shower should be available close to the work area.

## 5. FIRE-FIGHTING MEASURES

**Specific hazards:** Non-combustible solid. Will not evolve toxic or flammable gases on contact with water. It is unknown if it may evolve toxic gases when heated to decomposition (likely to be >500 °C, but unknown). In such an event, evacuate area and contact emergency services. *In Australia* 000. Remain upwind and notify persons downwind of hazard.

**Extinguishing Media:** Use waterfog, foam, carbon dioxide or dry agent to cool intact containers and nearby storage areas and/or fight fire. Suppress dust. Self-contained Breathing Apparatus (SCBA) and full protective gear should be used when combating fire.

**Fire fighting further advice:** Non-combustible solid. Fire fighters should wear approved, positive pressure, self-contained breathing apparatus and full protective clothing when appropriate.

**Australian Hazchem Code:** 2Z

**Self-Heating Test:** Not classified as a Class 4.2 or 4.3 Dangerous Good (9).

## 6. ACCIDENTAL RELEASE MEASURES

Wear gloves, dust proof goggles, a particulate respirator, coveralls and boots when cleaning spills. Recover using mechanical means. Avoid generating dust (e.g. spray lightly with water). Collect and contain recoverable material for recycling or disposal.

## 7. HANDLING AND STORAGE

**Handling:** Carefully read the product label or other instructions prior to use. Safe work practices should be employed to avoid eye or skin contact and inhalation of dust. Observe good personal hygiene, including thoroughly washing hands before eating. All eating, drinking and smoking should be prohibited in work areas.

**Storage:** Avoid generating dust. Consider dust suppression techniques to control dust. Store in a cool, dry, well-ventilated area, and away from oxidising agents, acids and foodstuffs.

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

**National Workplace Exposure Standards (1):**

No value assigned for this specific material by Safe Work Australia.

Workplace Exposure Standards (WES) for elemental components are as follows (1):

Substance	CAS Number	WES in Air (mg/m <sup>3</sup> )		Biological Exposure Index (BEI)
		TWA	STEL	
Aluminium (metal dust)	7429-90-5	10		-
Silica, Crystalline - Quartz (SiO <sub>2</sub> )	14808-60-7	0.05	-	-

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**Engineering measures:** Do not breathe dust. Ensure ventilation is adequate and that air concentrations of components are controlled below quoted Exposure Standards.

**Personal Protection Equipment:** The selection of PPE is dependent on a detailed site-specific risk assessment. The risk assessment should consider the work situation, the physical form of the chemical (including the moisture & dustiness of the product), the handling methods, and environmental factors.

The product is a coarse particulate material, therefore exposure to inhalable or respirable dust from the product is considered unlikely to occur. Nevertheless, it is a good precaution to wear dust-proof goggles, coveralls, and gloves. Use with adequate ventilation. If product is dry or crushed and dust inhalation risk exists wear particulate respirator. For example, P2 (Particulate) filter respirator, meeting the requirements of AS/NZS 1715 and AS/NZS 1716. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use. Do not take working clothes home.

**Eye:** Wear safety glasses to avoid eye contact.

**Skin Protection:** Wear appropriate work clothing or coveralls and gloves to avoid prolonged direct skin contact.



## 9. PHYSICAL AND CHEMICAL PROPERTIES

**Form / Colour / Odour:** Sand-coloured coarse rock-like particulate material with minimal or no odour.

Specific Gravity (t/m <sup>3</sup> )	: N Av	Boiling Point	: N App
Vapour Density	: N App	Melting Point	: N av
Vapour Pressure	: N App	Decomp. Temp	: Likely >500°C
Flash Point	: N App	Sublimation Point	: N App
Flammability Limits	: Non Flammable	pH	: N Av
Autoignition Temp	: N Av	Viscosity	: N App
% Volatile by volume	: N App	Evaporation Rate	: N App
Solubility in water	: Poorly soluble	Corrosion	: Not corrosive to metals
Moisture content	: Typically <5%		
Self-heating	: No		
Gravimetric particle size distribution	: 0.1% <45µm, 0% 45-75 µm, 0% 75-150 µm, 0.3% 150-250 µm, 0.8% 250-355 µm, 41.1% 355-1000 µm, 57.6% >1000 µm		

(Typical values only)

N Av = Not Available

N App = Not Applicable

Solubility, based on transformation/dissolution testing results (5, 9).

Flammability, self-heating and corrosivity, based on test results (6).

Decomposition temperature based on literature values for similar minerals present in concentrate (10).

Gavimetric particle size distribution based on sieving results (5).

## 10. STABILITY AND REACTIVITY

**Stability** Stable under normal conditions of use, storage, and transportation as shipped.

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<b>Conditions to Avoid</b>	Avoid extreme heat and ignition sources.
<b>Hazardous Decomposition</b>	It is unknown if it may evolve toxic gases when heated to decomposition (likely >500°C) (10).
<b>Hazardous Polymerization</b>	Not expected to occur.

## 11. TOXICOLOGICAL INFORMATION

No toxicological studies have been undertaken with this spodumene concentrate. Experience with concentrates of this type has not resulted in reports of harmful effects to workers. The following statements are based on expert opinion considering the individual ingredients in the concentrate and the hazard classification of the whole product. Handle product in accordance with this Safety Data Sheet.

### Health hazard summary:

The product is a coarse particulate material, therefore exposure to inhalable or respirable dust from the product is considered unlikely to occur. Nevertheless, overexposure to dust from this product may be irritating to eyes and skin. Use safe work practices to avoid dust inhalation and hand to mouth transfer. The concentrate contains very small amounts (<0.01%) of respirable crystalline silica (i.e. quartz). The quartz is only respirable if product is allowed to dry out or is crushed. Chronic overexposure to respirable crystalline silica can result in silicosis. Due to the product form (i.e. it is a coarse rock-like material) and the manner in which it is transported (i.e. ~5% moisture), this hazard is considered low.

### Inhalation & eye contact:

The product is a coarse particulate material, therefore exposure to dust from the product is considered unlikely to occur. If product is crushed, dust from the product may be a slight irritant. Contact of dust with eyes may result in irritation, lacrimation, pain and redness. Over exposure to dust may result in physical irritation of the nose and throat. Chronic inhalation exposure to respirable crystalline silica may result in a debilitating lung disease called silicosis. However, due to the physical form of the product (i.e. only 0.1% of the product is within an inhalable particle size range), dust propagation is considered unlikely to occur, therefore toxicity via inhalation is also considered unlikely.

### Skin:

If the product is crushed and dust is generated, the dust may be irritating to skin if excessive contact occurs, especially in combination with sweating. This may result in irritation, redness and rash.

### Ingestion:

Low toxicity. Ingestion of large quantities of product may result in nausea, vomiting, abdominal pain and diarrhoea. Ingestion of large quantities is considered unlikely due to product form.

### Health Effects of Individual Ingredients

**Spodumene:** The lithium in spodumene is tightly bound to the crystal structure of the mineral and therefore, it is anticipated to be of very low toxicity (16). Although no toxicological data for spodumene could be found, the toxicology of a variety of other silicates indicates they are of low toxicity (17). Although some studies of occupational exposures to aluminosilicate containing clays have reported development of a chronic lung disease in some workers, this has been tied to the levels of respirable crystalline silica (i.e. quartz) in these clays (see information for quartz below) (18). The Pilbara Minerals coarse spodumene concentrate contain very small (<0.01%) amounts of respirable crystalline silica.

**Quartz Dust:** To date, there are no known adverse health effects associated with non-occupational exposure to quartz dust (13, 14). Silicosis is causally related to occupational respirable quartz exposure, and the dose-

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response assessments of the adverse health effects of quartz are based on epidemiological studies of occupational cohorts with silicosis. Although a causal association with respiratory cancer has been made from epidemiological studies of workers occupationally exposed to quartz the doses required to cause respiratory cancer are unclear (13, 14). The International Agency for Research on Cancer (IARC) evaluation of crystalline silica concluded that it is a human carcinogen (Group 1) (11, 14). The Pilbara Minerals coarse spodumene concentrate contains a tiny (<0.01%) amount of respirable crystalline silica. Therefore, dust exposure to the coarse spodumene concentrate should be minimised by avoiding crushing of the material. In its normal form, the coarse spodumene concentrate presents a negligible risk of harm to human health.

### 12. ECOLOGICAL INFORMATION

The concentrate contains metals complexed in mineral form. In a 24-hour transformation/dissolution test for hazard classification purposes, the metals were *insufficiently* soluble in seawater to trigger a hazard classification as Environmentally Hazardous. For aquatic toxicity, it is the soluble metals which may be bioavailable and potentially cause toxicity.

#### Ecotoxicity

##### General Product Information

No ecotoxicity tests have been conducted with the coarse spodumene concentrate. In a 24-hour screening dissolution test **Pilbara Minerals Coarse Spodumene Concentrate** was found to be insufficiently soluble in seawater for the purposes of aquatic toxicity classification according to the Globally Harmonised System for Classification and Labelling of Chemicals (5, 9). The concentrate is therefore NOT classifiable as an Environmentally Hazardous Substance for transport purposes.

##### Spodumene

The lithium in the coarse spodumene concentrate is tightly bound in mineral form and therefore not expected to be bioavailable to organisms in the environment. Lithium is not expected to bioaccumulate and its environmental toxicity is low (16).

### 13. DISPOSAL CONSIDERATIONS

#### Spills:

Minor spills should be collected and placed in original transport containers. In the case of a major spill, contact Pilbara Minerals (Refer Section 1 of SDS). Ensure product is sprayed with water to prevent dust generation. Wear appropriate personal protective equipment (see Section 8).

#### Disposal Instructions:

In the case of a major spill, return the material to Pilbara Minerals Limited. Reuse or recycle the material whenever possible. The material can be disposed of as non-hazardous waste.

### 14. TRANSPORT INFORMATION

#### NOT CLASSIFIED AS DANGEROUS GOOD

Pilbara Minerals Coarse Spodumene Concentrate has been evaluated under the UN Model Regulations and the International Maritime Dangerous Goods Code (9) and is NOT classified as a Dangerous Good for marine or road/rail transport.

#### Road & Rail Transport (2, 8):

UN-No: Not applicable

Proper shipping name: Coarse SPODUMENE Concentrate

Class(es): Not applicable

Packing group: Not applicable

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Hazard label(s): Not applicable

**Sea Transport:**

*International Maritime Dangerous Goods (IMDG) Code (3):*

UN-No: Not applicable

Proper shipping name: Coarse SPODUMENE Concentrate

Class(es): Not applicable

Packing group: Not applicable

Hazard label(s): Not applicable

*Revised International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V (4):*

NOT considered 'harmful to the marine environment' (9).

*International Maritime Solid Bulk Cargoes (IMSBC) Code (7, 9, 12, 15):*

Proper shipping name: SPODUMENE (UPGRADED)

Class: Not applicable

Group: A

**15. REGULATORY INFORMATION**

NOT CLASSIFIED AS HAZARDOUS according to the criteria of Safe Work Australia and the *Globally Harmonized System for Classification and Labelling of Chemicals* (GHS).

**Poisons Schedule:** Pilbara Minerals Coarse Spodumene Concentrate and lithium aluminosilicates are not scheduled poisons according to the Uniform Scheduling of Medicines and Poisons (SUSMP).

**AICS:** Individual metals and basic chemical compounds are listed on the Australian Inventory of Chemical Substances (AICS).

**16. OTHER INFORMATION****Literary references**

- (1) Safe Work AUS (2020). Hazardous Chemicals Information System. Safe Work Australia.  
<http://hcis.safeworkaustralia.gov.au/>.
- (2) UN (2019). Recommendations on the transport of dangerous goods: Model Regulations. Twenty-first revised edition. United Nations, New York and Geneva. ST/SG/AC.10.1/Rev.21
- (3) IMO (2018a). International Maritime Solid Bulk Cargoes Code, incorporating amendment 04-17 and supplement. International Maritime Organisation. Electronic edition. London.
- (4) IMO (2012). 2012 guidelines for the implementation of MARPOL Annex V. The Marine Environment Protection Committee, Annex 24, Resolution MEPC.219(63). Adopted on 2 March 2012.  
<http://www.imo.org/OurWork/Environment/PollutionPrevention/Garbage/Documents/219%2863%29.pdf>
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- (6) SGS (2018). Spodumene (Lithium Oxide) Concentrate. SGS Report No. ENV 28383 (SE 179900) (Coarse). Dated 25/07/2018.
- (7) IMO (2013). Amendments to the International Maritime Solid Bulk Cargoes (IMSBC) Code. The Maritime Safety Committee, Annex 6, Resolution MSC.354(92). Adopted on 21 June 2013.
- (8) NTC (2018). Australian Code for the Transport of Dangerous Goods by Road & Rail. Edition 7.6, 2018. Effective from September, 2018. National Transport Commission.
- (9) ToxConsult (2018). Dangerous Goods and Marine Transport Classification for Pilbara Minerals coarse spodumene concentrate. ToxConsult report ToxCR120718-TF2, dated 25<sup>th</sup> July 2018.
- (10) Becattini, V., Motmans, T., Zappone, A., Madonna, C., Haselbacher, A. and Steinfeld, A. (2017). Experimental investigation of the thermal and mechanical stability of rocks for high-temperature thermal-energy storage. Applied Energy. 203: 373-389.

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- (12) IMO (2015). Amendments to the International Maritime Solid Bulk Cargoes (IMSBC) Code (resolution MSC.393(95)). Adopted on 11 June 2015.
- (13) WHO (2000). Concise International Chemical Assessment Document No. 24 Crystalline Silica, Quartz. World Health Organisation.
- (14) IARC (1997) Silica, some silicates, coal dust and para aramid fibrils. Lyon, International Agency for Research on Cancer, pp 1-242 (IARC Monographs on the Evaluation of Carcinogenic Risk to Humans, Vol 68).
- (15) IMO (2014b). Amendments to the International Maritime Solid Bulk Cargoes (IMSBC) Code (resolution MSC.268(85)). Circular Letter No. 3488. 17 November 2014.
- (16) Aral H. and Vecchio-Sadus A. (2008). Toxicity of lithium to humans and the environment—A literature review. *Ecotoxicology and Environmental Safety* 70(3): 349-356.
- (17) CIR (2003) Cosmetic Ingredient Review. Final Report on the Safety Assessment of Aluminum Silicate, Calcium Silicate, Magnesium Aluminum Silicate, Magnesium Silicate, Magnesium Trisilicate, Sodium Magnesium Silicate, Zirconium Silicate, Attapulgite, Bentonite, Fuller's Earth, Hectorite, Kaolin, Lithium Magnesium Silicate, Lithium Magnesium Sodium Silicate, Montmorillonite, Pyrophyllite, and Zeolite. *Int J Toxicology*, 22 (Suppl. 1): 37-102.
- (18) WHO (2005) Environmental Health Criteria 231 Bentonite, Kaolin and selected clay minerals. International Programme for Chemical Safety (WHO), World Health Organisation Geneva.
- (19) Microanalysis (2018). Respirable alpha-quartz concentration analysis by x-ray diffraction (XRD) and scanning electron microscopy (SEM) using the modified SWeRF method. Sample 18\_0854\_01. Dated 06/06/2018.
- (20) Microanalysis (2019). Respirable alpha-quartz concentration analysis by x-ray diffraction (XRD) and scanning electron microscopy (SEM) using the modified SWeRF method. Sample 19\_1106\_02. Dated 5<sup>th</sup> of August 2019.
- (21) Microanalysis (2019). Semi-quantitative XRD analysis. Sample 19\_1106\_02. Dated 13<sup>th</sup> August 2019.

**Definitions:**

TWA - the Time-Weighted Average (TWA) airborne concentration over an eight-hour working day, for a five-day working week over an entire working life. According to current knowledge this concentration should neither impair the health of, nor cause undue discomfort to, nearly all workers.

STEL - Short Term Exposure Limits (STELs) are averaged over a period of 15 minutes and provide guidelines for the control of short-term exposure. STELs are important supplements to the eight-hour TWA exposure standards. STELs are generally established to minimise the risk in nearly all workers of the occurrence of: intolerable irritation, chronic or irreversible tissue change, and narcosis to an extent that could precipitate industrial accidents, provided the TWA exposure standards are not exceeded.

BEI – Biological exposure indices (BEI) are guidance values for assessing biological monitoring results. BEIs generally represent the level of determinants that are most likely to be observed in specimens collected from healthy workers who have been exposed to chemicals to the same extent as workers with inhalation exposure at the Threshold Limit Value (TLV). The BEI generally indicates a concentration below which nearly all workers should not experience adverse health effects.

Workplace Exposure Standards (WES) are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. These Exposure Standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

**Abbreviations**

IARC	International Agency for Research on Cancer
mg/m <sup>3</sup>	Milligram per cubic metre
WES	Workplace exposure standard.
TWA	Time weighted average
STEL	Short term exposure limit

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AS/NZS      Australian Standard / New Zealand Standard

Reason for Issue: New SDS.

Safety Data Sheets are updated frequently. Please ensure that you have a current copy.

**This Safety Data Sheet is maintained by Pilbara Minerals Limited in consultation with SLR Consulting Australia Pty Ltd.**

This SDS summarises at the date of issue our best knowledge of the health and safety hazard information of the product, and in particular how to safely handle and use the product in the workplace. Since Pilbara Minerals Limited cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, review this SDS in the context of how the user intends to handle and use the product in the workplace.

If clarification or further information is needed to ensure that an appropriate assessment can be made, the user should contact Pilbara Minerals Limited. Our responsibility for products sold is subject to our standard terms and conditions, a copy of which is sent to our customers and is also available upon request.

\*      \*      \*      **End of SDS**      \*      \*      \*