

# SPODUMENE ORE



## Specifications

Clients can accept different levels of impurities, depending on their specific use of the material. Specifications of TANCO's 7.25%, -200 Mesh, 6.8%, and Spodulite grade concentrates are as follows:

Grade	7.25% Grade	200 Mesh	6.8% Mesh	Spodulite
Li <sub>2</sub> O	7.25 ± -0.1%	7.10% ± -0.2%	6.80% min.	5.00% min.
Fe <sub>2</sub> O <sub>3</sub>	0.06% ± -0.01%	0.15% max.	0.08% max.	0.10% max.
Na <sub>2</sub> O	0.35% max.	0.30% max.	0.45% max.	0.75% max.
K <sub>2</sub> O	0.30% max.	0.60% max.	0.40% max.	0.75% max.
P <sub>2</sub> O <sub>5</sub>	0.27% max.	0.40%	0.27% max.	0.20% max.
MnO <sub>2</sub>	0.04% max.	0.06% max.	0.04% max.	0.05% max.
Al <sub>2</sub> O <sub>3</sub>	24.0% min.	25.0% min.	23.0% min.	20.0% typ.
Tyler 20 Mesh	0.0% max.			
Tyler 28 Mesh	Trace max.			
Tyler 48 Mesh	1.0% max.			
Tyler 200 Mesh	50.0% min.	10.0% max.	55.0% min.	80.0% typ.

## Production

TANCO is one of the three major suppliers of high grade Spodumene concentrates to the world market. TANCO's annual production has risen steadily since the first production in 1984, and the plant operates at close to its design capacity of 24,000 tonnes.

TANCO supplies material to all the major section of the market; the majority is shipped to plants in the US with other important markets in South Korea and various locations throughout Europe.

Spodumene can be shipped in a variety of packaging. Larger North American customers, with the appropriate facilities can have the material delivered in 90 tonne

railcars. Elsewhere the material is shipped to customers by 20 tonne container or by "piggyback" usually packed in 1 tonnes "big bags", although the packagings that can be used are container liners (one liner per container, holding all 20 tonnes), or in 25 kg paper bags. TANCO ships in bulk to their European agent, in Holland, who either packages the material in bags, or delivers it by pneumatic truck.

## Markets

Spodumene can be used either as a feedstock for the production of lithium carbonate and metal, or directly, in its mineral forms, in the glass and ceramics industries.



Since the development of the "salars" in the USA and Chile, most lithium carbonate is recovered from these sources, and little Spodumene is now used for chemical production.

Lithia is a very powerful flux, especially when used in conjunction with potash and soda feldspars. In ceramics, lithium lowers thermal expansion and decreases the firing temperature.

Possible outlets in glass manufacturing include pyroceramic ware, namely Corning Ware, borosilicate glasses, lighting glass, soda-lime container glass, foam glass insulation, and ion-exchange glass. Although the major role for lithium in glass is as a flux in order to reduce the melting temperature and thus reduce fuel costs, it may be used to alter some important properties of the glass including viscosity and thermal expansion. It is a valuable component in glasses having a low thermal expansion where its use permits the total alkali content to be kept to a minimum. Glasses containing lithia are much more fluid in the molten state than those containing proportionate amounts of sodium or potassium, and the successful use of lithia in glass-making lies in the fact that much smaller amounts are required to produce a glass of the desired physical and chemical properties. Lower viscosity and faster melting can be utilized to improve glass quality in terms of fewer defects such as unmelted or partially melted raw material grains, and more rapid removal of small bubbles. Lower viscosity can permit the glassmaker to run his forming machinery at a higher rate, or create more elaborate products such as some perfume bottles.

In frits and glazes, lithia is used to reduce the viscosity and thereby increase the fluidity of the coatings. This reduces maturing times and lowers firing temperatures. Small amounts of lithia increase gloss. Spodumene is an ideal raw material for introducing lithia into frits and glazes and, in porcelain enamels, lithia acts as a strong flux, serving to reduce firing temperature and time. Because of its low molecular weight, small percentages have a marked effect. Depending upon the compound employed, it can be used either in the smelter or in the mill. The excellent fluxing properties of lithia serve to improve the working qualities of abrasion-resistant enamels for dry-process cast iron. From 2-2.5% Li<sub>2</sub>O have been used. In dry-process enamels, the lithia must be added to the frit batch and not as a mill addition. In electrical porcelain it also is of value in producing a glaze of high strength and resistance to weathering. More recently, crystallized glazes have been developed for

coating low expansion bodies. The lowering of the thermal expansion coefficient to an almost negligible level by development of the beta Spodumene phase is the basis for pyroceramic, over-the-table ware.

In fully vitrified porcelain bodies, lithium minerals in combination with nepheline syenite or feldspar have been shown to significantly reduce firing temperatures.

### Processing

Customers specify tight impurity levels for the use of Spodumene in the glass and ceramics industries and the process for the production of Spodumene is based on removal of contaminant minerals. The schematic flowsheet of the Spodumene circuit is shown on the following page.

After crushing to -12 mm the heavy medium triflo circuit reject the feldspar from the -12 mm +0.5 mm range. Ferrosilicon and magnetite as a 70:30 mixture are used with a feed density of 2.74 kg t<sup>-1</sup> and effective density of separation of 2.65 kg t<sup>-1</sup> and Ep of 0.02. Medium loss is 200 g t<sup>-1</sup> of feed. The -0.5 mm fraction continues to the grinding circuit.

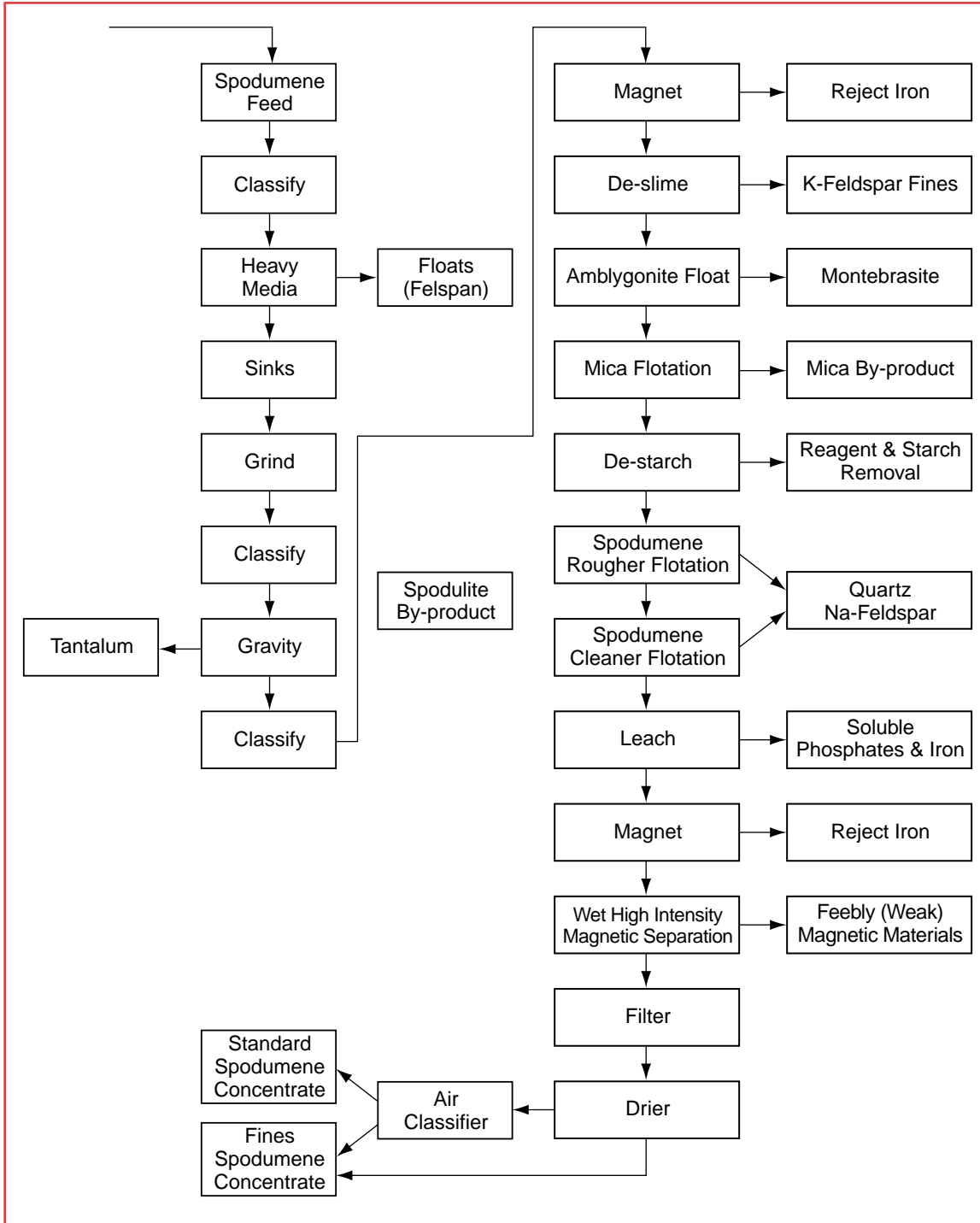
The sink product and the -0.5 mm fraction are ground in closed circuit with a 2 mm primary screen and a linatex hydrosizer with an approximate cut point of 150 um. Rougher and cleaner spirals recover coarse free Tantalum within the grinding circuit. A 5' low intensity drum magnet for removal of steel complete the grinding circuit.

The grinding circuit product is scavenged for Tantalum by two Falcon concentrators. The rubber lined overflow ball mill consumes 2 kg t<sup>-1</sup> of 75 mm balls. Tantalum from the Falcon concentrators is upgraded on a Double Deck Holman Table with the tailings and middlings returning to the grinding circuit. Coarse tantalum from the cleaner spiral is also upgraded on a single Holman Table. The Tantalum recovered from the Spodumene circuit is a valuable by-product.

Prior to the Amblygonite flotation stage, in order to control phosphate levels, the pulp is deslimed by single stage cycloning. Due to the nugget-like appearance of the Amblygonite, close control of this flotation stage is maintained using SPC based on four hourly P205 assays of the Amblygonite rougher flotation tailings. Starvation quantities of collector are used based on feed tonnage and previous tails assays. Starch is used as a depressant for Spodumene pH 9.2. A by-product called montebrasite concentrate is produced to meet market



## SPODUMENE Processing Chart



requirements. The phosphate concentrate is subjected to wet high intensity magnetic separation to remove weakly magnetic iron materials. This concentrate is pumped to a belt filter and propane fired rotary drier. The dried concentrate goes to a storage bin prior to bagging or bulk shipping to meet the customers' requirements. The failure to meet Amblygonite rougher tailings control assay levels will result in out of specification final Spodumene concentrate. Mica is then removed with a single flotation stage. This step assists in the removal of K<sub>2</sub>O from the final concentrate product.

The Mica flotation tailings are two stage cycloned to remove starch. Two conditioning stages for automatic pH control and collector addition are carried out prior to rougher flotation. The rougher concentrate goes on to two or three stages of cleaning to produce the final concentrate with the first cleaner tails being combined with the rougher concentrate for further treatment to produce low grade Spodumene concentrate (Spodulite @ 5.0% Li<sub>2</sub>O).

The cleaner concentrate is leached to remove residual reagents and soluble phosphate and iron minerals. A low-density drum magnet takes out any magnetic minerals and iron prior to treatment through a wet high intensity magnetic separator to remove weakly magnetic iron minerals and thus maintain the final concentrate Fe<sub>2</sub>O<sub>3</sub> specification level.

The WHIMS non-magnetic fraction is thickened by two stages of cycloning and stored in a holding tank prior to tonnage controlled feeding to the belt filter and propane fired rotary drier.

Final product handling is carried out by air slides and dense phase pneumatic pumping to storage bins. The final product can be shipped to the customer in 25 kg, 1,000-kg bags, or bulk, via road or rail. The concentrate is sold to markets worldwide.

Water used within the circuits is either fresh (from Bernic Lake) or re-cycled pond overflow depending on the section of the plant.

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Cabot Corporation  
Specialty Fluids  
25025 I-45 N, Suite 385  
The Woodlands, TX 77380  
1-888-CSDRILL