United States Patent Office 3,028,008 Patented Apr. 3, 1962

3,028,008

SEPARATION OF SPODUMENE AND BERYL BY FLOTATION

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No Drawing. Filed July 27, 1960, Ser. No. 45,770
9 Claims. (Cl. 209—167)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention herein described and claimed may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of royalties thereon or therefor.

This invention relates to the beneficiation of spodumene and beryllium ores and has as its object the isolation of spodumene from beryl. A further object is the development of a process for obtaining spodumene concentrates of high purity from beryl. A still further object is the isolation by flotation of the spodumene present in certain pegmatites, with a minimum loss of beryl in the resulting concentrated spodumene product. A still further object is the isolation of a high purity beryl concentrate.

Spodumene and beryllium ores normally occur in pegmatites associated with such minerals as quartz, feldspar, mica, tourmaline, apatite, and cassiterite.

Spodumene is the major source of lithium salts that are used in greases, ceramics, glass, dry cell and alkaline storage batteries, welding and brazing fluxes, as a desiccant in air conditioning systems, and several direct applications in defense activities. Beryl is the source of beryllium metal that is used in beryllium-copper alloys. It is also used for X-ray windows and as a moderator and reflector material in nuclear reactors. Beryllium oxide is used in crucibles, refractory supports, radiation shields, and special glasses.

This invention provides a method by which spodumene and beryl can be concentrated from the associated gangue minerals regardless of their varying proportions or surface alterations.

As a result of extended research and experimentation, we have discovered a method of isolating spodumene from beryl by employing lignin sulfonate and sodium fluoride to retard beryl, while floating spodumene with oleic acid in a pulp with a pH range of 6.5 to 9.0. It has been demonstrated that effective separation of spodumene and beryl can also be achieved by using either starch or quebracho or sodium sulfide partly, or in some instances completely, to replace the lignin sulfonate and/or sodium fluoride. Starch, sodium sulfide, and quebracho are organic dispersants that apparently have the same general dispersing and retarding effect as sodium fluoride and lignin sulfonate.

The lignin sulfonate that we prefer to utilize as a beryl depressant is a magnesium lignin sulfonate derived from the by-product of the sulfite process of paper making, commonly known as a "sulfite liquor." These liquors, separated as waste from the cellulose pulp, contain soluble salts of the lignin sulfonic acids resulting from the decomposition of the wood by the acid solutions used in the pulping process. The liquid forms of lignin sulfonate as frequently marketed contain about 50 percent water. However, the reagent may also be obtained in powdered form.

The mechanism of the retarding action of the lignin sulfonate in our method of spodumene flotation has not been definitely determined and this invention is not limited to any theory of action. It seems probable, however, that the lignin sulfonate coats the surfaces of the beryl and gangue minerals so as to prevent their attachment to

the bubbles in froth flotation. It is assumed that the spodumene particles in the pulp exhibit less tendency than the beryl particles to become coated by the lignin sulfonate, and the spodumene particles are not thus made nonfloatable.

The addition of sodium fluoride when using lignin sulfonate enabled a more rapid and complete flotation of the spodumene and more effective retardation of the beryl. The mechanism by which the fluorides accomplish these beneficial effects is not definitely known and no limitation to any particular theory of action is intended in the description of the process. It seems likely, however, that one of the important functions of the fluoride is to complex or precipitate soluble salts in the pulp which would otherwise impair selectivity of the separation. The fluorides are effective slime dispersants and may aid flotation by assisting in proper removal and dispersion of slime coatings on the mineral surfaces. The lignin sulfonate and sodium fluoride serve the two-fold purpose of dispersing the pulp and retarding the beryl and gangue minerals.

The mechanism of the action of starch, quebracho and sodium sulfide in our method of spodumene flotation has not been definitely determined and this invention is not limited to any theory of action. Quebracho, and sodium sulfide are powerful dispersants and probably have the same dispersing and retarding effect as lignin sulfonate and sodium fluoride. The action of the starch is not clearly defined.

The fatty acid collecting agents have been found suitable for the flotation of spodumene from beryl in the practice of this invention. Generally, oleic acid was found to be the most effective collecting agent.

The quantities of the various reagents utilized in the practice of this invention are subject to considerable variation, and optimum quantities are best determined by experimentation for any particular ore or product treated. Purity and yield of separated products are reliable guides for reagent adjustment. An excess of collecting agent under the conditions of trial tends to float additional beryl and gangue minerals with the spodumene in the roughing operation, but the beryl may be retarded in subsequent cleaners.

The invention will be further illustrated, but is not intended to be limited by the following examples of practice.

Example 1

A sample of spodumene concentrate was obtained from the Foote Mineral Co. of Kings Mountain, N.C. The spodumene concentrate was a product of a process formerly used by the Foote Mineral Co. whereby the gangue minerals were floated away from the spodumene and beryl. Analyses indicated that the product contained approximately 5.7 percent Li_2O and 0.07 percent BeO. In addition, the product contained quartz, mica, and feldspar.

In carrying out the flotation process according to this invention, the ore was first ground to a suitable size for flotation by conventional methods. On the present ore, grinding to 48-mesh yielded satisfactory liberation of the various minerals in the ore.

A 250-gram sample of the ore was ground with water to pass 48-mesh in a laboratory Abbe mill containing various size pebbles. A description of a laboratory Abbe mill may be found in a Catalog 73, published by the Abbe Engineering Co., New York. The ground charge was then transferred to a small mechanical flotation cell of standard design, and sufficient tap water added to give a pulp containing about 20 percent solids. The laboratory cell used in the test work is a cell of the mineral separation type and is described in an article by J. B. Clemmer,

and B. H. Clemmons, titled "An Improved Flotation Test Cell," Engineering and Mining Journal, volume 144, No. 3, pages 72, 73.

In this example, as well as in all that follow, the flotation tests were conducted at normal atmospheric temperature and pressure. Tests were conducted in the temperature range of 65 to 85 degrees F., and slight variations in temperature have no effect on this flotation process.

The pulp was conditioned for 5 minutes with the equivalent of 2.0 pounds of magnesium-base lignin sulfonate per ton of ore, and 2.0 pounds of sodium fluoride per ton of ore, and 0.9 pound of oleic acid per ton of ore was then added and the pulp conditioned for an additional 3 minutes. Air was then allowed to enter the cell and resulted in the formation of a compact, heavily mineralized spodumene froth. The froth was collected for 3 minutes, whereupon flotation was complete. The rougher froth was triple cleaned to further retard the gangue collected with the spodumene in the rougher operation. The cleaner tailing was combined with the rougher tailing and a scavenger concentrate floated using 0.25 pound of lignin sulfonate per ton of ore, 0.25 pound of sodium fluoride per ton of ore, and 0.3 pound of oleic acid per ton of ore. The scavenger concentrate was cleaned twice to retard any gangue that floated in the rougher operation. The combined primary and scavenger concentrates had an average analysis of 7.9 percent Li_2O, with a recovery of 94.2 percent of the total lithia content. Approximately 84 percent of the total beryllium content was retarded with the tailing.

The spodumene tailing was conditioned for 10 minutes in a pulp of 20 percent solids, with 2.5 pounds of hydrofluoric acid per ton of ore to activate the beryl. The pulp was then washed with water until the pulp was almost neutral. It was then conditioned 3 minutes with 0.3 pound of oleic acid per ton of ore. Air was allowed to enter the cell and the froth was collected for 3 minutes, whereupon flotation was completed. The rougher froth was cleaned once to retard the gangue collected with the beryl in the rougher operation. The resulting beryl concentrate contained 3.88 percent BeO, with an over-all recovery of 50 percent of the total beryl. An additional 17 percent of the beryl, present in the cleaner tailing probably would be recovered in continuous operation.

The high recovery of spodumene demonstrated the ability of lignin sulfonate and sodium fluoride in retarding beryl while floating spodumene.

The results of the test were as follows:

Product	Weight, percent	Analysis, percent		Distribution, percent	
		BeO	Li_2O	BeO	Li_2O
Spodumene concentrate	66.7	0.015	7.9	13.3	91.2
Spodumene scavenger concentrate	2.5	.096	6.9	2.9	3.0
Combined concentrate	69.2	.017	7.86	16.2	94.2
Beryl concentrate	.9	3.88	2.0	49.1	.3
Beryl middling	2.5	.49	2.1	16.8	.9
Gangue tailing	27.4	.049	.97	17.9	4.6
Composite	100.0	.073	5.78	100.0	100.0

Example 2

Example number 2 was carried out using a procedure identical to that used in Example 1, except that 1.0 pound of quebracho per ton of ore was used to replace lignin sulfonate and sodium fluoride. The use of quebracho enables recovery of approximately the same grade and slightly lower recovery of spodumene as lignin sulfonate and sodium fluoride. The resulting beryl concentrate contained only 1.49 percent BeO, however, approximately 87.4 percent of the total beryl was recovered. Results of the test indicate that quebracho is superior to lignin sulfonate and sodium fluoride in depressing beryl while floating spodumene.

The results of the test were as follows:

Product	Weight, percent	Analysis, percent		Distribution, percent	
		BeO	Li_2O	BeO	Li_2O
Spodumene concentrate	53.2	0.0083	7.8	5.5	74.0
Spodumene scavenger concentrate	5.6	.0083	7.9	.5	7.9
Combined concentrate	58.8	.0083	7.8	6.0	81.9
Beryl concentrate	4.6	1.49	3.1	87.4	2.5
Beryl middling	5.3	.055	3.5	3.3	3.3
Gangue tailing	31.3	.0091	2.2	3.3	12.3
Composite	100.0	.077	5.6	100.0	100.0

Example 3

Example number 3 was carried out using a procedure identical to that used in Example 1, except that 1.0 pound of starch per ton of ore was used to replace lignin sulfonate and sodium fluoride. The use of starch enables a yield of approximately the same grade and recovery of spodumene as does lignin sulfonate and sodium fluoride.

The beryl is more efficiently depressed while floating spodumene, and over-all recovery of beryl is higher than when using lignin sulfonate and sodium fluoride.

The results of the test were as follows:

Product	Weight, percent	Analysis, percent		Distribution, percent	
		BeO	Li_2O	BeO	Li_2O
Spodumene concentrate	44.7	0.0016	7.8	0.9	60.2
Spodumene scavenger concentrate	23.0	.0094	7.6	2.7	30.2
Combined concentrate	67.7	.0042	7.7	3.6	90.4
Beryl concentrate	2.6	2.449	3.2	79.1	1.4
Beryl middling	2.1	.085	3.0	2.2	1.1
Gangue tailing	27.6	.044	1.5	15.1	7.1
Composite	100.0	.080	5.79	100.0	100.0

Example 4

A sample of spodumene mill feed was obtained from the Foote Mineral Co. of Kings Mountain, N. C. Analyses indicated that the ore contained approximately 1.56 percent Li_2O and 0.038 percent BeO. In addition, the ore contained quartz, mica, and feldspar.

A 250-gram sample of the ore was ground to pass 48-mesh in a laboratory Abbe mill. The ground charge was then transferred to a small mechanical flotation cell, and sufficient tap water added to give a pulp containing about 20 percent solids.

The pulp was conditioned for 5 minutes with the equivalent of 2.0 pounds of lignin sulfonate per ton of ore, and 2.0 pounds of sodium fluoride per ton of ore, and 0.9 pound of oleic acid per ton of ore was then added and the pulp conditioned for an additional 3 minutes. Air was then allowed to enter the cell and resulted in the formation of a compact, heavily mineralized spodumene froth. The froth was collected for 3 minutes when flotation was completed. The rougher froth was cleaned twice to further retard the gangue collected with the froth in the rougher operation. The resulting spodumene cleaner concentrate had an average analysis of 5.9 percent Li_2O with a recovery of 77.8 percent of the total lithia content. Approximately 78.5 percent of the total beryllium content was retarded with the tailing.

The spodumene tailing was conditioned for 10 minutes in a plug of 20 percent solids, with 3.0 pounds of hydrofluoric acid per ton of ore to activate the beryl. The pulp was then washed with water until the pulp was almost neutral. The pulp was conditioned 3 minutes with 0.3 pound of oleic acid per ton of ore. Air was allowed to

enter the cell and the froth collected for 3 minutes when flotation was complete. The resulting beryl rougher concentrate contained 0.33 percent BeO, with an over-all recovery of approximately 51.0 percent of the total beryl.

The results of the test were as follows:

Product	Weight, percent	Analysis, percent		Distribution, percent	
		BeO	Li_2O	BeO	Li_2O
Spodumene concentrate	20.7	0.019	5.9	10.1	77.8
Spodumene middling	14.6	.030	1.7	11.4	15.8
Rougher concentrate	35.3	.023	4.2	21.5	93.6
Beryl concentrate	5.9	.330	.16	51.0	.6
Gangue tailing	58.8	.018	.16	27.5	5.8
Composite	100.0	.030	1.56	100.0	100.0

Example 5

A sample of spodumene mill feed was obtained from the Lincoln-National Concentrates Corporation of Lincolnton, N.C. Analyses indicated that the ore contained approximately 1.35 percent Li_2O and 0.045 percent BeO. In addition, the ore contained quartz, mica, and feldspar.

A 250-gram sample of the ore was ground to pass 48-mesh in a laboratory Abbe mill. The ground charge was then transferred to a small mechanical flotation cell, and sufficient tap water added to give a pulp containing about 20 percent solids. The pulp was conditioned for 5 minutes with the equivalent of 0.5 pound of sodium sulfide per ton of ore, and 0.96 pound of oleic acid per ton of ore was then added and the pulp conditioned for an additional 3 minutes. Air was then allowed to enter the cell and resulted in the formation of a compact, heavily minerialized spodumene froth. The froth was collected until flotation was complete. The rougher froth was cleaned twice to further retard the gangue collected with the froth in the rougher operation. The resulting spodumene concentrate had an average analysis of 6.56 percent Li_2O with a recovery of 86.8 percent of the total lithia content. Approximately 83.4 percent of the total beryllium content was retarded with the tailing.

The results of the test were as follows:

Product	Weight, percent	Analysis, percent		Distribution, percent	
		BeO	Li_2O	BeO	Li_2O
Spodumene concentrate	17.8	0.013	6.56	7.2	86.8
Spodumene middling	14.3	.030	.77	9.4	8.2
Gangue tailing	67.9	.055	.10	83.4	5.0
Composite	100.0	.044	1.34	100.0	100.0

Example 6

A sample of spodumene mill tailing was obtained from the Foote Mineral Co. of Kings Mountain, N.C. Analyses indicated that the ore contained approximately 0.43 percent Li_2O and 0.089 percent BeO. In addition, the ore contained quartz, mica, and feldspar.

In the early stages of the work numerous batch type flotation tests were made to outline the best method of recovering a bulk spodumene-beryl concentrate from the mill tailing. The details of the batch flotation work are not included, inasmuch as the results thereof are reflected in the pilot plant operations subsequently described.

Laboratory pilot plant equipment was set up at the Kings Mountain, N.C. mill of the Foote Mineral Co. to operate continuously as a miniature-scale plant treating about 150 pounds of dry feed per hour. The principal objective of the plant run was the production of a bulk beryl-spodumene product from the current commercial mill tailings; the bulk concentrate to be subjected to additional treatment for the production of marketable grade beryl and spodumene products.

In order to obtain a representative sample of the mill tailing, a 4-inch pipe was placed in the center of the tailing launder to remove a portion of the product. The pipe discharged into a sample splitter where a small portion of the tailing was cut out for feed to the pilot plant operation. The pilot plant feed flowed by gravity to a pump where water was added to maintain a pulp solids of about 30 percent. Two pounds of hydrofluoric acid per ton of ore, to clean the mineral surfaces and activate the beryl, were added to the slurry at the pump and the pulp sent to a conditioner. Conditioning time with hydrofluoric acid was about 5 minutes at a pH of 3.8. The conditioner discharge flowed by gravity to a spiral classifier where the acid was washed from the pulp. The classifier sands, admixed with sufficient water to maintain the solids at about 30 percent, were fed to a second conditioner where 0.9 pound of sodium silicate per ton of ore and 0.3 pound of sodium hydroxide per ton of ore, as conditioning agents, and 0.9 pound of oleic acid per tone of ore as collector were all added in single stage conditioning. A retention time in the conditioner of about 5 minutes was found to yield optimum results.

The conditioned feed at a pH of about 7.3, containing about 30 percent solids, was passed to the flotation cells. The flotation cells were operated to produce a rougher concentrate which was triple cleaned to further retard the gangue collected with the beryl and spodumene in the roughing operation. The middling product was recirculated back to the rougher cells for additional cleaning. The resulting concentrate had an average analysis of 1.246 percent BeO and 4.45 percent Li_2O.

The results of the pilot plant operation were as follows:

Product	Weight, percent	Analysis, percent		Distribution, percent	
		BeO	Li_2O	BeO	Li_2O
Beryl-Spodumene concentrate	6.1	1.246	4.45	87.1	65.8
Tailing	93.9	.012	.15	12.9	34.2
Composite	100.0	.087	.41	100.0	100.0

The bulk beryl-spodumene concentrate produced in laboratory pilot plant operations was subjected to additional treatment to separate the beryl and spodumene.

The bulk concentrate was conditioned with 10 pounds of sulfuric acid per ton of ore to remove the fatty acid coating, and the spent fatty acid was washed from the pulp. The pulp was then conditioned with 2.0 pounds of sulfuric acid per ton of ore and 0.2 pound of Armac CD (coco amine acetate) per ton of ore and the mica in the product floated away from the spodumene and beryl.

The mica tailing was conditioned 5 minutes with 1.5 pounds of lignin sulfonate per ton of ore, and 1.5 pounds of sodium fluoride per ton of ore, and 0.8 pound of oleic acid per ton of ore was then added and the pulp conditioned for an additional 3 minutes. A rougher spodumene concentrate was then floated and cleaned twice to retard any gangue that floated with the spodumene in the roughing operation. The resulting spodumene concentrate contained 6.6 percent Li_2O with an over-all recovery of about 83.6 percent of the total lithium. About 80 percent of the total beryl was retarded in the rougher tailing.

The spodumene tailling was conditioned 10 minutes with 2.0 pounds of hydrofluoric acid per ton of ore. After conditioning the acid was washed from the pulp. The spodumene tailing was then conditioned with 0.3 pound of sodium hydroxide and 0.48 pound of oleic acid per ton of ore for an additional 5 minutes. A rougher beryl concentrate was floated and cleaned twice to retard any gangue that floated with the beryl in the roughing operation. The resulting beryl concentrate contained 6.371 percent BeO, with an over-all recovery of about 76 percent of the total beryllium.

The results of the test were as follows:

Product	Weight, percent	Analysis, percent		Distribution, percent	
		BeO	Li_2O	BeO	Li_2O
Mica concentrate	13.1	0.277	1.89	3.3	5.6
Spodumene concentrate	55.7	.331	6.60	16.7	83.6
Beryl concentrate	13.2	6.371	2.57	76.0	7.7
Beryl middling	2.6	.914	.86	2.1	.5
Tailing	15.4	.138	.75	1.9	2.6
Composite	100.0	1.106	4.40	100.0	100.0

Example 7

A sample of the bulk beryl-spodumene pilot plant concentrate as explained in Example 6, was used for flotation testing in this example. The sample had an average analysis of 1.246 percent BeO and 4.45 percent Li_2O.

The purpose of this example was to demonstrate the efficiency of the flotation of spodumene from beryl when sodium sulfide is utilized as a conditioning agent to replace sodium fluoride and lignin sulfonate.

The bulk beryl-spodumene concentrate was conditioned with 10 pounds of sulfuric acid per ton of ore to remove the fatty acid coating and the spent acid washed from the pulp. The product was then conditioned with 2.0 pounds of sulfuric acid and 0.2 pound of Armac CD (coco amine acetate) per ton of ore and the mica floated away from the spodumene.

The mica tailing was conditioned 10 minutes with 1.0 pound of sodium sulfide per ton of ore; 0.8 pound of oleic acid per ton of ore was added, and the pulp conditioned an additional 3 minutes. A rougher spodumene concentrate was floated and cleaned twice to retard any gangue that floated in the roughing operation. The resulting concentrate contained 7.0 percent Li_2O, with an over-all recovery of 86.8 percent of the contained lithia. About 94 percent of the total beryl was retarded into the tailing.

The spodumene tailing was conditioned 10 minutes with 2.0 pounds of hydrofluoric acid per ton of ore. After conditioning the acid was washed from the pulp. The spodumene tailing was then conditioned with 0.3 pound of sodium hydroxide and 0.48 pound of oleic acid per ton of ore for an additional 5 minutes. A rougher beryl concentrate was floated and cleaned twice to retard any gangue that floated with the beryl in the roughing operation. The resulting beryl concentrate contained 7.479 percent BeO, with an over-all recovery of about 87.4 percent of the total beryllium.

The results of the test were as follows:

Product	Weight, percent	Analysis, percent		Distribution, percent	
		BeO	Li_2O	BeO	Li_2O
Mica concentrate	11.2	0.157	1.07	1.4	2.6
Spodumene concentrate	56.5	.099	7.60	4.6	86.8
Beryl concentrate	14.3	7.479	2.48	87.4	7.8
Beryl middling	8.6	.692	.76	4.8	1.4
Tailing	9.4	.231	.65	1.8	1.4
Composite	100.0	1.224	4.55	100.0	100.0

Various changes can be made in the detailed employment of the invention without departing from the scope thereof.

We claim:

1. A process for the production of high-purity spodumene concentrates and the isolation of spodumene from beryl from a mixture containing the same, which comprises the steps of comminuting the mixture to form a material of relatively finely divided state, forming a pulp of the finely divided material with aqueous liquid, filming the beryl and spodumene selectively at a pH of 6.5 to 9.0 in the presence of (1), a dispersing and retarding agent $(A+B)$, wherein A is a member of the class consisting of sodium fluoride, starch, quebracho, sodium sulfide and a mixture of sodium fluoride with a member of the class consisting of starch, quebracho and sodium sulfide; and B is a member of the class consisting of a lignin sulfonate, starch, quebracho, sodium sulfide; and a mixture of lignin sulfonate with a member of the class consisting of starch, quebracho and sodium sulfide; and (2) a fatty acid flotation agent whereby said spodumene exhibits a lesser tendency to become coated with film than the beryl, frothing the pulp with air so that the beryl is depressed and the spodumene is floated in the froth, and collecting the froth containing the spodumene.

2. In a process for the production of high-purity spodumene concentrates and the isolation of spodumene from beryl, which comprises the step of filming the beryl and spodumene selectively in a pulp at a pH of 6.5 to 9.0 in the presence of sodium fluoride, lignin sulfonate, and a fatty acid flotation agent whereby said spodumene exhibits a lesser tendency to become coated with a film than the beryl, and frothing the pulp with gas so that the beryl is depressed and the spodumene is floated in the froth.

3. In a process for the production of high-purity spodumene concentrates and the isolation of spodumene from beryl, which comprises the step of filming the beryl and spodumene selectively in a pulp at a pH of 6.5 to 9.0 in the presence of 0.5 to 4.0 pounds of sodium fluoride per ton of ore, 0.5 to 4.0 pounds of magnesium lignin sulfonate per ton of ore, and 0.5 to 1.5 pounds of fatty acid per ton of ore, whereby said spodumene exhibits a lesser tendency to become coated with a film than the beryl, and frothing the pulp so that the beryl is depressed and the spodumene is floated in the froth.

4. In a process for the production of high-purity spodumene concentrates and the isolation of spodumene from beryl, which comprises the step of filming the beryl and spodumene selectively in a pulp at a pH of 6.5 to 9.0 in the presence of quebracho, and a fatty acid flotation agent whereby said spodumene exhibits a lesser tendency to become coated with a film than the beryl, and frothing the pulp so that the beryl is depressed and the spodumene is floated in the froth.

5. In a process for the production of high-purity spodumene concentrates and the isolation of spodumene from beryl, which comprises the step of filming the beryl and spodumene selectively in a pulp at a pH of 6.5 to 9.0 in the presence of 0.5 to 2.0 pounds of quebracho per ton of ore, and 0.5 to 1.5 pounds of fatty acid per ton of ore, whereby said spodumene exhibits a lesser tendency to become coated with a film than the beryl, and frothing the pulp so that the beryl is depressed and the spodumene is floated in the froth.

6. In a process for the production of high-purity spodumene concentrates and the isolation of spodumene from beryl, which comprises the step of filming the beryl and spodumene selectively in a pulp at a pH of 6.5 to 9.0 in the presence of starch, and a fatty acid flotation agent, whereby said spodumene exhibits a lesser tendency to become coated with a film than the beryl, and frothing the pulp so that the beryl is depressed and the spodumene is floated in the froth.

7. In a process for the production of high-purity spodumene concentrates and the isolation of spodumene from beryl, which comprises the step of filming the beryl and spodumene selectively in a pulp at a pH of 6.5 to 9.0 in the presence of 0.5 to 2.0 pounds of starch per ton of ore and 0.5 to 1.5 pounds of fatty acid per ton of ore, whereby said spodumene exhibits a lesser tendency to become coated with a film than the beryl, and frothing the pulp so that the beryl is depressed and the spodumene is floated in the froth.

8. In a process for the production of high-purity spodumene concentrates and the isolation of spodumene from beryl, which comprises the step of filming the beryl and spodumene selectively in a pulp at a pH of 6.5 to 9.0 in the presence of sodium sulfide, and a fatty acid flotation

agent, whereby said spodumene exhibits a lesser tendency to become coated with a film than the beryl, and frothing the pulp so that the beryl is depressed and the spodumene is floated in the froth.

9. In a process for the production of high-purity spodumene concentrates and the isolation of spodumene from beryl, which comprises the step of filming the beryl and spodumene selectively in a pulp at a pH of 6.5 to 9.0 in the presence of 0.5 to 2.0 pounds of sodium sulfide per ton of ore and 0.5 to 1.5 pounds of fatty acid per ton of ore, whereby said spodumene exhibits a lesser tendency to become coated with a film than the beryl, and frothing the pulp so that the beryl is depressed and the spodumene is floated in the froth.

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