

UNITED STATES PATENT OFFICE

2,305,502

CONCENTRATION OF KYANITE

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No Drawing. Application April 9, 1941,
Serial No. 387,667

5 Claims. (Cl. 209-166)

The present invention relates to an improved process of concentrating kyanite from its ores by froth flotation.

In a co-pending patent application, assigned to the same assignee as the present application, by Nathan K. Karchmer and Charles E. Heinrichs, Serial No. 349,128, filed August 1, 1940, there is described a process of concentrating kyanite from its ores, which is characterized by a first step of conditioning an aqueous pulp of the kyanite ore in a conditioner by adding to and admixing concurrently with the pulp a higher fatty acid (such as oleic acid) and sodium silicate as cooperating agents, and the second step of subjecting this conditioned pulp in froth flotation cells to froth flotation, without the addition of further agents, to separate a concentrate of kyanite.

The present invention which may be considered an improvement on the above process is the result of the discovery that by pre-treating the kyanite ore with acid and then washing out the acid the kyanite becomes much more amenable to flotation. After such pretreatment the kyanite may be successfully concentrated by the addition to the pulp of a fatty acid as the only flotation reagent, possibly with slight amounts of pine oil or other frother at the discretion of the operator.

In certain cases it has been found that the addition of a caustic alkali and a water-immiscible oil such as fuel oil is beneficial. The addition of a soluble fluoride such as sodium fluoride has also been found to be beneficial in certain cases.

It is unnecessary to theorize about what the pretreatment with acid does to the particles of the kyanite ore, but the fact is that for some reason this acid pretreatment and subsequent washing out of the acid leaves the ore particles in such condition that the kyanite particles may be separated by flotation much more easily than is the case with ore which has not been so treated. Concentrated sulfuric acid, in the quantity hereinafter mentioned, has been found to be a satisfactory acid for use in the pre-treatment of the kyanite ore. Hydrofluoric acid has also been found effective as the pre-treatment agent. Oleic acid, in the quantity hereinafter mentioned, has been found particularly useful as a

higher fatty acid in the carrying out of this process, but any other fatty acid having at least twelve carbon atoms can be used. Caustic soda and a water-immiscible oil or a soluble fluoride may also be used in conjunction with the fatty acid, as is shown in the examples that follow.

Example 1.—In practicing the process and obtaining the excellent results hereinafter set forth, Baker Mountain kyanite ore was comminuted to suitable particle size which was mostly minus 35-mesh and was largely deslimed, the comminution being accomplished in stages so as to reduce the slimes to a minimum. The comminuted ore was then agitated in a pulp at approximately 70% solids with 3.68 lbs. per ton of ore of concentrated sulfuric acid (specific gravity 1.84) for about three minutes. After thus being pre-treated with acid, the ore was washed substantially free of acid; and in a pulp at approximately 70% solids was conditioned with oleic acid (red oil) in the amount of 0.26 lb. per ton of ore and with a frother consisting of pine tar oil (P. T. 101) in the amount of 0.14 lb. per ton of ore. The ore thus conditioned was subjected to froth flotation in a froth flotation machine with the following results:

Product	Weight	Kyanite	Quartz	Acid sol.	Kyanite recovered
	Per cent	Per cent	Per cent	Per cent	Per cent
Feed.....	100.0	33.89	64.53	1.54	100.0
Conc.....	32.3	94.55	2.65	2.80	90.1
Tail.....	67.7	4.96	94.10	0.94	9.9

From the above data, it will be noted that from ore containing 33.89% kyanite there was obtained a kyanite concentrate having a grade of 94.55% kyanite, with 90.1% recovery of the kyanite in the ore. It will also be noted that these excellent results were obtained by the use of only a small amount of fatty acid as the only flotation agent, and without any depressing agent.

Example 2.—A North Carolina kyanite ore, crushed to 35 mesh and deslimed, was agitated with 2.40 lbs. of 48% hydrofluoric acid, per ton of ore, for three minutes in a pulp of 63% solids, then washed with water to remove the acid, con-

ditioned at 63% solids with red oil, 2.24 lbs. and pine tar oil #101, 0.14 lb. per ton of ore and subjected to flotation. The concentrate was retreated in the usual way without addition of reagents. The result of the test was as follows:

Product	Weight	Kyanite	Kyanite recovered
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Feed.....	100.0		100.0
Conc.....	41.3	91.5	64.4
Mid.....	10.9	71.3	13.3
Tail.....	47.8	27.4	22.3

The products resulting from this and subsequent tests were subjected to a sink and float test, the amount of sink being a measure of the kyanite present in the sample.

Example 3.—Another sample of the same ore, crushed to 35 mesh and deslimed, was agitated at 63% solids with 4.03 lbs. of sulphuric acid per ton of ore, washed free of acid and conditioned 2 minutes in a pulp of 63% solids with:

	Pounds per ton of ore
NaOH.....	0.50
Fuel oil.....	1.74
Red oil.....	1.61
P. T. 101.....	0.14

It was then subjected to flotation as in the previous example with the following result:

Product	Weight	Kyanite	Kyanite recovered
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Feed.....	100.0		100.0
Conc.....	42.9	93.9	66.9
Mid.....	15.7	80.2	20.9
Tail.....	41.4	17.7	12.2
Combined conc. and mid.....	58.6	92.0	87.8

Example 4.—Still another sample of the same ore, crushed through 35 mesh and deslimed, was agitated with sulphuric acid, 4.05 lbs. per ton and after washing out the acid, conditioned for 2 minutes at 63% solids with:

Pounds per ton of ore

Sodium fluoride.....	1.00
Red oil.....	2.24
P. T. 101.....	0.14

The pulp was then subjected to flotation, the concentrate being retreated as before with the following result:

Product	Weight	Sink	Sink recovered
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Feed.....	100.0		100.0
Conc.....	44.9	94.7	72.5
Mid.....	10.8	74.2	13.7
Tail.....	44.3	18.3	13.8

What is claimed is:

1. A process of concentrating kyanite from its ores, which comprises comminuting the ore to suitable particle size, pre-treating the comminuted ore by agitating it in a pulp containing sulfuric acid, washing the sulfuric acid away from the ore, agitating the thus acid-treated and washed ore in a pulp containing a higher fatty acid, and subjecting the thus conditioned pulp of kyanite ore to froth flotation to separate a concentrate of kyanite.

2. A process of concentrating kyanite from its ores, which comprises comminuting the ore to suitable particle size and desliming the same, pre-treating the comminuted ore by agitating it in a pulp containing sulfuric acid, washing the acid away from the ore, agitating the thus acid-treated and washed ore in a pulp free from any depressing agent and containing oleic acid as the only flotation agent, and subjecting the thus conditioned kyanite ore to froth flotation to separate a concentrate of kyanite.

3. The process of claim 1 in which an alkali and a water-immiscible oil are used in conjunction with the higher fatty acid.

4. The process of claim 1 in which caustic soda and fuel oil are used in conjunction with the fatty acid.

5. The process of claim 1 in which sodium fluoride is added to the pulp in addition to the fatty acid.

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