

CONCENTRATION OF SOUTH CAROLINA SILLIMANITE

December 1966 Progress Report  
 Minerals Research Laboratory  
 Lab. No. 3068 - Book 216, p. 3-24  
 by  
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Introduction

Professor Gilbert C. Robinson of Clemson University asked the Asheville Laboratory to concentrate sillimanite from a South Carolina ore to see if refractory grade or whiteware grade sillimanite could be obtained. About 50 pounds of the ore was received at the Asheville Laboratory in large pieces. The material as received had the following analysis:

Ore Analysis

Al <sub>2</sub> O <sub>3</sub>	30.9 %
SiO <sub>2</sub>	65.6 %
K <sub>2</sub> O	0.73%
Na <sub>2</sub> O	0.20%
Fe <sub>2</sub> O <sub>3</sub>	0.34%
Ign. Loss	1.96%

The ore contains between 40 and 45 percent sillimanite.

Flotation Test Work

The ore was crushed in the laboratory jaw crusher and then the roll-crusher and flotation samples were split out. The flotation samples were ground in the eight by nine-inch laboratory rod mill for different time periods. The ground material was deslimed and conditioned for flotation. By varying the grind and reagents, attempts were made to obtain a high grade concentrate. The hydrofluoric acid-amine system and the sulfonated petroleum oil-acid system were employed. In a few tests attempts were made to remove sericite mica with amine in an acid circuit before sillimanite concentration. The better test results are presented on the following table.

Flotation Test Results

Test	% Wt. of Head	%Al <sub>2</sub> O <sub>3</sub>	%SiO <sub>2</sub>	%K <sub>2</sub> O	%Na <sub>2</sub> O	%Fe <sub>2</sub> O <sub>3</sub>	Ign.Loss	Remarks
1	36.4	42.0	53.0	1.85	0.36	0.70	1.96	HF-amine, coarse grind
2	20.2	41.2	54.0	1.62	0.36	0.55	2.06	HF-amine, moderate grind
5	10.7	41.4	57.6	0.34	0.18	0.62	-	HF-sulfonate, mod. grind
10	26.7	41.4	55.7	1.28	0.28	0.42	-	HF-amine, fine grind
11	16.8	41.8	55.2	1.87	1.87	0.42	-	HF-amine, fine grind
7	31.5	33.6	66.2	0.28	0.12	0.51	-	HF-amine, mica float, moderate grind
12	14.3	43.7	54.1	-	-	-	0.99	HF-amine, mica float, extremely fine grind

Only 25 to 30 percent of the head feed could be recovered in products containing only 41 to 42 percent  $Al_2O_3$ . The fairly high  $K_2O$  and  $Na_2O$  content and the ignition loss of the concentrates suggest that the concentrate is a mixture of unliberated sillimanite, quartz and sericite. In order to get an idea about the size of liberation, heavy liquid separations of sized fractions were made at specific gravity of 2.96. The sinks were analyzed. The following table shows the results.

Heavy Liquid Separation Results

Size Fraction Tyler Mesh	Sinks % Weight	Assay of Sinks				
		$Al_2O_3$	$SiO_2$	$K_2O$	$Na_2O$	$Fe_2O_3$
-65+100	13	50.5	47.2	0.35	0.18	0.52
-150+200	16	54.7	44.2	0.10	0.09	0.74
-325+400	35	58.7	40.0	0.07	0.08	0.82

Even in the minus 325 plus 400 mesh fraction only 35 percent by weight reports in the sinks which contain 58.7 percent  $Al_2O_3$ . It is very doubtful that an economical amount of high grade sillimanite with the desired 59 to 62 percent  $Al_2O_3$  can be produced. In flotation test 12 the ore was ground to minus 200 mesh. Even with the low weight recovery of only 14.3 percent, an alumina content of only 43.7 percent was obtained in the concentrate.

Microscopic work supports the finding that quartz is finely interlocked in this sample, a fibrolite-type, sillimanite quartz rock.