R.I. 1

October, 1949

NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING

OF THE

UNIVERSITY OF NORTH CAROLINA

Minerals Research Laboratory
Asheville, North Carolina

- - - - - - - - - - -

REPORT OF INVESTIGATION 1

A NEW METHOD FOR RECOVERY OF FLAKE MICA FROM WASHING PLANT TAILINGS

(Preliminary Report)

- - - - - - - - - - -

By

Ralph Adair, W. T. McDaniel, W. R. Hudspeth

Report prepared in cooperation with the North Carolina Department of Conservation and Development, and the Tennessee Valley Authority.

INTRODUCTION

The North Carolina State College Minerals Research Laboratory, which is devoted to research and investigation on mineral dressing and the uses of non-metallic minerals of Western North Carolina and adjacent areas, is operated by the North Carolina State College in cooperation with the North Carolina Department of Conservation and Development and the Tennessee Valley Authority. There is a contractual agreement between the North Carolina State College and the Tennessee Valley Authority under which the Authority reimburses the College for expenses of personnel and supply incident to work done in its resource development program.

The laboratory attempts to maintain close contact with industry, in order to improve present practices, and to conduct basic research on mineral dressing and utilization, which would not otherwise be carried out. The programs of research carried on in the laboratory are aimed towards conserving the State's mineral resources by making possible better recoveries of desirable minerals from the deposits and the preparation of a better finished product for the manufacturer.

Mica is one of North Carolina's important mineral resources. The present report on mica is the result of work carried out in the Minerals Research Laboratory in keeping with its established policies. The report is offered to the public with the belief that it will be of value to those interested in the production and conservation of flake and ground mica.

Jasper L. Stuckey
Director

A NEW METHOD FOR RECOVERY OF FLAKE MICA FROM WASHING PLANT TAILINGS
(Preliminary Report)

By
Ralph Adair, W. T. McDaniel, W. R. Hudspeth

Three types of deposits are mined in North Carolina for flake mica, also called scrap mica, namely: alaskite, pegmatite and granite. The principal source is the weathered alaskite of the Spruce Pine district. These alaskite deposits are uaually several hundred feet in length and range up to two hundred or more feet in width. The feldspar has been weathered in place in the alaskite, and thus the mica is embedded in a mixture of kaolin, halloysite and quartz. The mixture contains from five to about eighteen percent mica, twenty-five to thirty percent quartz with the remainder principally kaolin and halloysite.

The second most important source is from the pegmatites which are of widespread occurrence in Western North Carolina. All the flake mica production from the Franklin-Sylva district is from pegmatites, which are smaller in size than the alaskite deposits but which usually contain a higher percentage of mica. The average-size pegmatite worked for flake mica is from thirty to fifty feet wide, with some exceptionally large dikes up to a hundred feet. In some of the pegmatites there are areas with a mica content up to thirty-five percent. Most of the feldspar in these pegmatites has weathered to kaolin, thus the mica is embedded in a mixture of kaolin, quartz and semi-weathered feldspar.

Recently some of the granites of the Shelby district have been mined for their flake mica content. This new source will become more important in the future as the other deposits become depleted. These granite deposits

are large and irregular in shape and contain from five to twelve percent mica. Mining is done in the highly-weathered part of the granite, in which the mica is mixed with from ten to twenty-five percent kaolin and about sixty-five percent quartz.

The recovery of flake mica in North Carolina has been accomplished by differential crushing with rolls followed by screens. Rolls and screens may be either wet or dry. The limits of recovery by this process are reached at a size of about 1/8", the mica finer than this escaping with the plant tailings which consist principally of quartz and kaolin. Jigs of various types have been used to recover a further fraction of the mica, but none of these installations has been entirely successful.

Referring particularly to the alaskite mica deposits of the Spruce Pine district, it is an established fact that the loss of minus 1/8" mica amounts to half the mica in the original ore. This fact has been recognized and deplored for some time, but up to the present no simple recovery method has been found generally applicable to these small operations. Several months ago, there was brought to the laboratory a sample of the current waste products from a typical mica recovery plant. This representative sample of minus 1/8" material, on analysis, proved to contain nineteen percent mica above 325 mesh. A preliminary test on this material, as received, over a Humphrey Spiral Concentrator showed considerable promise, although the products were quite impure. A second test was made on a crushed and screened fraction of the ore (minus 16 mesh, plus 50 mesh). This test

showed an almost perfect separation of mica from the gangue. These tests were the beginning of an extensive investigation of the use of Humphrey Spirals in the recovery of flake mica. In addition to its use for recovering this waste mica, the process is valuable as a partial or complete replacement of present washing plants.

The spiral separation of mica from quartz is based entirely on the difference in particle shape. Feed preparation to accentuate this is most important. Since mica resists grinding more than its gangue, a quick pass through a rodmill appears to be the best means of accomplishing this differential reduction. The action of the rodmill delaminates the mica without greatly reducing its mesh size. The quartz crushes readily from 1/2" to about 20 mesh, the important factor being to avoid the production of siliceous slime. Mica up to four or even three mesh is easily recovered on the spiral, providing it is thoroughly delaminated, but quartz particles larger than about 16 mesh are carried out into the mica stream and contaminate the concentrate.

On typical plant wastes of eighteen to twenty percent mica, the laboratory has consistently made recoveries of seventy percent of the mica without recirculation of the middlings. The mica content of the concentrate varies from seventy to ninety percent, the remainder of the concentrate being fine siliceous material not normally considered "grit" by the mica producers. Preliminary tests on recirculation of a large middling to the grinding unit show considerable improvement in recovery of mica. A valuable feature of the spiral in this work is that the reject or tailing contains the heavy minerals such as magnetite, garnet, and even some of the biotite.

There follows a test data sheet showing recovery, grade of mica and screen analyses of products from recent continuous test runs on the Humphrey Spiral. These tests were made in the pilot plant which consisted of an 18' x 36" rodmill, discharging to a standard five turn, 24" Humphrey Spiral. Tests were of a duration sufficient to establish equilibrium before samples were taken. The photograph on the last page illustrates graphically the type of separation made, and the distribution of the mica.

Further test work on alaskite-type waste mica is now underway to determine spiral capacities, optimum dilution in both grinding and in spiral feed, the effect of variation of the circulating load of middling to the grinding unit, optimum amount of spiral wash water, and proper spiral-feed preparation. Grinding in closed circuit with a classifier - overflow used as spiral feed - is to be investigated. Preliminary tests have shown that all types of flake-mica ore are amenable to spiral concentration and more intensive work is to be conducted on these materials in the future.

ANALYSES OF SCREEN FRACTIONS

Test 1 - Spiral Concentrate

Test Conditions: Rodmill feed rate, 467 lb/hr. dry solids;
Percent solids in rodmill, 50%;
Percent solids in spiral, 16%.

Size	% Wt. (a)	% Mica (b)	Units (ab)	Cumulative Size Fractions	% Mica in Cumulative Fraction	Recov.* (Conc.)	Recov.** (Total)
+100	60.6	96	58.2	+100	96	76.8	63.3
-100 +150	8.6	62	5.3	+150	91.8	83.8	69.1
-150 +200	12.8	57	7.3	+200	86.4	93.4	77.0
-200 +325	18.0	27.5	5.0	+325	75.8	100.0	82.4
Total (See Note)	100.0		75.8				

Additional Test Data: The mids (discarded with the tails) contained 12.5% mica and represented 3.4% of the total weight. The tailings contained 1.4% mica and represented 82.2% of the total weight.

Test 2 - Spiral Concentrate

Test Conditions: Rodmill feed rate, 607 lb/hr. dry solids;
(original feed, 451 lb/hr.; recirculated middling product, 156 lb/hr.);
Percent solids in rodmill, 38.8%;
Percent solids in spiral, 26.9%.

Size	% Wt. (a)	% Mica (b)	Units (ab)	Cumulative Size Fractions	% Mica in Cumulative Fraction	Recov.* (Conc.)	Recov.** (Total)
+100	81.7	95	77.6	+100	95	87.5	72.4
-100 +150	5.0	83	4.1	+150	94.3	92.1	76.2
-150 +200	5.0	73	3.7	+200	93.1	96.1	79.5
-200 +325	8.3	42.5	3.5	+325	88.9	100.0	82.7
Total (See Note)	100.0		88.9				

Additional Test Data: The tailings contained 2.3% mica and represented 88.0% of the total weight.

Test 3 - Spiral Concentrate

Test Conditions: Rodmill feed rate, 566 lb/hr. dry solids; original feed, 446 lb/hr.; recirculated middling product, 120 lb/hr.); Percent solids in rodmill, 40.5%; Percent solids in spiral, 15%.

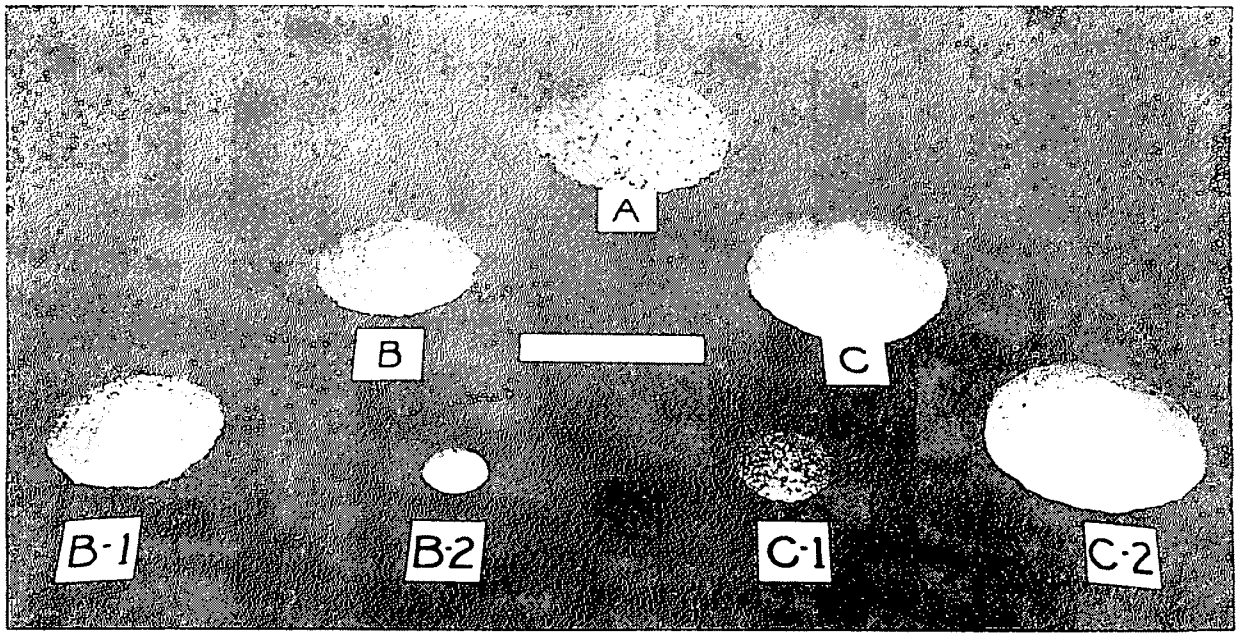
Size	% Wt. (a)	% Mica (b)	Units (ab)	Cumulative Size Fractions	% Mica in Cumulative Fraction	Recov.* (Conc.)	Recov.** (Total)
+100	65.4	97	63.4	+100	97	83.6	69.1
-100 +150	7.1	68	4.8	+150	94.1	90.0	74.3
-150 +200	11.2	50	5.6	+200	88.2	97.4	80.5
-200 +325	16.3	12.5	2.0	+325	75.8	100.0	82.6
Total (See Note)	100.0		75.8				

Additional Test Data: The tailings contained 2.3% mica and represented 84.7% of the total weight.

Note: The above tests do not take into account slime losses (-325 mesh material). The slimes, chiefly in the concentrate, contain less than 4% mica, which is not considered recoverable. Further tests are being conducted in an effort to reduce slime losses to a minimum.

* These figures represent recovery of mica based on total +325 mica content of concentrate.

** These figures represent recovery of mica based on total +325 mica content of spiral feed.



A

1000 Grams - Humphrey Spiral Head Sample
(- 1/8" Washer Plant Rejects)

B

100 Grams - Spiral Concentrate

C

900 Grams - Spiral Tailings

B-1

85 Grams - Pure Mica Contained In Spiral Concentrate

B-2

15 Grams - Sand (Quartz, Feldspar, Etc.) Contained In Spiral Concentrate

C-1

27 Grams - Pure Mica Contained In Spiral Tailings

C-2

873 Grams - Sand Contained In Spiral Tailings

DISTRIBUTION OF MICA FROM 1000 GRAMS OF WASHER PLANT REJECTS (COMPOSITE SPIRAL TESTS)