A USEFUL METHOD FOR THE DETERMINATION OF MAJOR MINERAL COMPONENTS IN SPRUCE PINE FELDSPAR ORE AND DETERMINATION OF RECOVERABLE FELDSPAR

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INTRODUCTION

During the Spruce Pine Feldspar Tailings Project (1, 2, 3), a useful and practical method to determine the feldspar, quartz, mica and kaolinite contents of feldspar tailings samples was developed which can also be used to determine the mineral content of the Spruce Pine feldspar ore. The method employs a combination of chemical analysis and flotation test work. The recoverable feldspar, quartz and mica content, and the grade of the products can be obtained from the test results if the flotation test work is conducted under guidance of an experienced mineral engineer familiar with plant practice.

TEST PROCEDURE

The ore to be investigated is crushed and ground to flotation size of minus 28 mesh. A head sample is split out for chemical analysis of K_2O, Na_2O, CaO, Al_2O_3. Usually Fe_2O_3, SiO_2 and ignition loss are also determined but not required in this procedure. The sample is then treated by Laboratory flotation test procedures employing mica flotation, iron mineral flotation and feldspar-quartz flotation separation after desliming on 400 mesh. The feldspar and quartz products are assayed for K_2O, Na_2O, CaO, Al_2O_3, and Fe_2O_3. An example of head analysis and feldspar flotation test is given in Table 1.

The following calculations are made to determine the major mineral content.

1. Soda Feldspar Content: Multiply the Na_2O content of the head sample by 8.47 to obtain the soda feldspar content.

   5.06 x 8.47 = 42.86% soda feldspar

2. Potash Feldspar Content: a) Obtain the soda to potash ratio by dividing the Na_2O content of the flotation feldspar product by the K_2O content of the flotation feldspar product.

   7.17/4.21 = 1.703

   b) Divide the Na_2O content of the head feed by the Na_2O/K_2O ratio obtained from the flotation feldspar product. This gives the part of the K_2O content in the head feed available for potash feldspar.

   4.21/1.703 = 2.47% K_2O for K-spar

   c) The available potash content for feldspar is multiplied by 5.92 to obtain the potash feldspar content.

   2.47 x 5.92 = 14.62% potash feldspar

3. The Muscovite Mica Content: a) Substract the available potash content for potash feldspar (2b) from the total potash content in the head sample to obtain the potash content available for muscovite mica.

   3.36 - 2.47 = 0.89% K_2O for mica

   b) The potash content available for muscovite mica is multiplied by 8.47 to obtain the muscovite mica content.

   0.89 x 8.47 = 6.65% muscovite mica

4. Lime Feldspar Content: Multiply the CaO content of the head sample by 4.975 to obtain the lime feldspar content

1.30 x 4.975 = 6.47% lime feldspar

In Steps 1, 2, 3 and 4, the soda, potash, lime spar content, and the muscovite content are determined.

5. Kaolinite Content: a) In order to determine the kaolinite content, the total Al_2O_3 content of above determined minerals, Na-, K-, Ca-spar and muscovite, is determined by multiplying the respective mineral percentage with the respective Al_2O_3 content.

a - 1 Multiply potash feldspar content by 0.183

a - 2 " soda " " " 0.194

a - 3 " lime " " " 0.366

a - 4 " muscovite " " " 0.384

a - 1 14.62 x 0.183 = 2.675% Al_2O_3

a - 2 42.86 x 0.194 = 8.715% Al_2O_3

a - 3 6.47 x 0.366 = 2.368% Al_2O_3

a - 4 6.65 x 0.384 = 2.554% Al_2O_3

b) Add all four Al_2O_3 contents and subtract from the Al_2O_3 content in the head sample. This gives the Al_2O_3 content available for kaolinite if any kaolinite is in the ore.

15.43 - 15.91 = -0.49% Al_2O_3

No Al_2O_3 is available for kaolinite so no kaolinite is in the ore.

c) When Al_2O_3 is available it is multiplied by 2.525 to obtain the kaolinite content.

6. Quartz: The rest of the ore material is usually quartz with minor amounts of iron minerals such as garnet and tourmaline. The iron minerals are estimated under the binocular microscope.

100.00 - 70.60 = 29.40% quartz

The mineral content of the ore in the example on Table 1 is:

potash feldspar	14.6
soda feldspar	42.9
lime feldspar	6.5
total feldspar	64.0
mica	6.7
kaolinite	none
quartz	28.8
iron minerals	0.5

From the feldspar flotation test it can be concluded that 56 percent of the ore can be recovered in a low-iron feldspar concentrate containing 92.2 percent feldspar. The overall feldspar recovery is 80 percent which is quite good if considered that 7 percent of the ore is lost in the minus 400 mesh slimes, and some feldspar reports in the mica flotation product and in the iron-minerals flotation product.

NORTH CAROLINA STATE MINERALS RESEARCH LABORATORY

Table 1

ORE DRESSING TEST DATA

Lab. No. 3112 Test No. 103

Operator Immo H. Redeker Date 10-29-70

Object of Test Feldspar Ore Flotation Test

	%Wt.	$\%K_2O$	$\%Na_2O$	%CaO	$\%Fe_2O_3$	$\%Al_2O_3$	%I.L.	Na_2O/K_2O	% Spar in Spar	Rec. Spar
+35 M. Mica	1.2									
Slimes	6.8									
Mica Float.	6.2									
Iron Float.	1.4									
Spar	55.6	4.21	7.17	1.30	0.056	19.64	0.10	1.71	92.2	80.0
Quartz	28.8	0.36	0.71	tr.	0.034	0.44	0.06	-		
Total	100.0									
Head Analysis		3.36	5.06	0.91	0.42	15.43	0.40			

Conditions				Reagents (lbs per ton)					
Process	Time	% Solids	pH	H_2SO_4	AR-T*	Fuel Oil	H-25**	M-70***	HF
Grind to -28 M.									
Deslime on 400 M.									
Mica Cond.	5	60	4.1	3.5	0.15	0.17	0.05	-	-
Mica Float.									
Iron Cond.	5	70	4.2	3.5	-	0.33	0.10	0.70	-
Iron Float.									
Spar Cond.	5	60	3.8	-	0.25	-	-	-	1.4
Spar Float.									

Remarks:

* AR-T - Armour Tallow Amine Acetate, Armac-T

** H-25 - Hunt Chemical, Huntico1-25

*** M-70 - Mineral Oil Refining Co., Morco-70

REFERENCES

1. "North Carolina Feldspar Flotation and Solutions to Waste Disposal Problems" by Immo H. Redeker. Preprint 70-H-83, Annual Meeting of AIME - Denver, Colorado, Feb. 15-19, 1970

2. "How to Make Money on Minerals Reclaimed from Tailings" by Immo H. Redeker. Mining Engineering, July 1970, pg. 113-114

3. "Conservation of Nonmetallic Minerals through Improved Processing" by Immo H. Redeker. Preprint 69-H-56, Annual Meeting of AIME - Washington, D. C., Feb. 16-20, 1969