A USEFUL METHOD FOR THE DETERMINATION OF MAJOR MINERAL COMPONENTS IN SPRUCE PINE FELDSPAR ORE AND DETERMINATION OF RECOVERABLE FELDSPAR
IHR Project Nos. 1 & 19

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Lab No. 3112 - Book 230

by
Immo H. Redeker

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 K₂O, Na₂O, CaO, Al₂O₃. Usually Fe₂O₃, SiO₂ 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 K₂O, Na₂O, CaO, Al₂O₃, and Fe₂O₃. 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 Na₂O content of the head sample by 8.47 to obtain the soda feldspar content.
   \[ 5.06 \times 8.47 = 42.86\% \text{ soda feldspar} \]

2. **Potash Feldspar Content:**
   a) Obtain the soda to potash ratio by dividing the Na₂O content of the flotation feldspar product by the K₂O content of the flotation feldspar product.
   \[ 7.17/4.21 = 1.703 \]
   b) Divide the Na₂O content of the head feed by the Na₂O/K₂O ratio obtained from the flotation feldspar product. This gives the part of the K₂O content in the head feed available for potash feldspar.
   \[ 4.21/1.703 = 2.47\% \text{ K}_2\text{O for } K\text{-spar} \]
   c) The available potash content for feldspar is multiplied by 5.92 to obtain the potash feldspar content.
   \[ 2.47 \times 5.92 = 14.62\% \text{ potash feldspar} \]

3. **The Muscovite Mica Content:**
   a) Subtract 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.
   \[ 3.36 - 2.47 = 0.89\% \text{ K}_2\text{O for mica} \]
   b) The potash content available for muscovite mica is multiplied by 8.47 to obtain the muscovite mica content.
   \[ 0.89 \times 8.47 = 6.65\% \text{ muscovite mica} \]
4. **Lime Feldspar Content:** Multiply the CaO content of the head sample by 4.975 to obtain the lime feldspar content

\[ 1.30 \times 4.975 = 6.47\% \text{ lime feldspar} \]

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\(_2\)O\(_3\) content of above determined minerals, Na-, K-, Ca-spar and muscovite, is determined by multiplying the respective mineral percentage with the respective Al\(_2\)O\(_3\) content.

\[
\begin{align*}
\text{a - 1} & \quad \text{Multiply potash feldspar content by 0.183} \\
\text{a - 2} & \quad \text{" soda " " " 0.194} \\
\text{a - 3} & \quad \text{" lime " " " 0.366} \\
\text{a - 4} & \quad \text{" muscovite " " " 0.384} \\
\end{align*}
\]

\[
\begin{align*}
\text{a - 1} & \quad 14.62 \times 0.183 = 2.675\% \text{ Al}_2\text{O}_3 \\
\text{a - 2} & \quad 42.86 \times 0.194 = 8.715\% \text{ Al}_2\text{O}_3 \\
\text{a - 3} & \quad 6.47 \times 0.366 = 2.368\% \text{ Al}_2\text{O}_3 \\
\text{a - 4} & \quad 6.65 \times 0.384 = 2.554\% \text{ Al}_2\text{O}_3 \\
\end{align*}
\]

b) Add all four Al\(_2\)O\(_3\) contents and subtract from the Al\(_2\)O\(_3\) content in the head sample. This gives the Al\(_2\)O\(_3\) content available for kaolinite if any kaolinite is in the ore.

\[ 15.43 - 15.91 = -0.49\% \text{ Al}_2\text{O}_3 \]

No Al\(_2\)O\(_3\) is available for kaolinite so no kaolinite is in the ore.

c) When Al\(_2\)O\(_3\) 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.

\[ 100.00 - 70.60 = 29.40\% \text{ quartz} \]

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.
# Table 1

## ORE DRESSING TEST DATA

<table>
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<th>Lab. No.</th>
<th>3112</th>
<th>Test No.</th>
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<td>Immo H. Redeker</td>
<td>Date</td>
<td>10-29-70</td>
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<td>Object of Test</td>
<td>Feldspar Ore Flotation Test</td>
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<table>
<thead>
<tr>
<th></th>
<th>%Wt.</th>
<th>%K₂O</th>
<th>%Na₂O</th>
<th>%CaO</th>
<th>%Fe₂O₃</th>
<th>%Al₂O₃</th>
<th>Z.L.</th>
<th>Na₂O/K₂O</th>
<th>% Spar</th>
<th>Rec.</th>
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<td>+35 M. Mica</td>
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<tr>
<td>Slimes</td>
<td>6.8</td>
<td></td>
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<tr>
<td>Mica Float.</td>
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<tr>
<td>Iron Float.</td>
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<tr>
<td>Spar</td>
<td>55.6</td>
<td>4.21</td>
<td>7.17</td>
<td>1.30</td>
<td>0.056</td>
<td>19.64</td>
<td>0.10</td>
<td>1.71</td>
<td>92.2</td>
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<tr>
<td>Quartz</td>
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<td>0.71</td>
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<td>0.034</td>
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**Head Analysis**

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<td>3.36</td>
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### Conditions

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<th>Process</th>
<th>Time</th>
<th>% Solids</th>
<th>pH</th>
<th>H₂SO₄</th>
<th>AR-T</th>
<th>Fuel Oil</th>
<th>H-25</th>
<th>M-70</th>
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<td>-</td>
<td>1.4</td>
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### Remarks:

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

** H-25 - Hunt Chemical, Hunticol-25

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

