Experimental Study on Efficient Recovery of High-Grade Sulfide Ore

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Abstract: A gold mine is a typical broken zone altered rock type gold deposit, with some high grade primary sulfide ore at 20~30m from the surface, and the ore grade is about 5g/t. To understand the nature of the ore, performed the process mineralogy testing and analysis. The occurrence state of the gold mineral is very good, Most gold is bare gold, It is conducive to the enrichment and recovery; To determine the best selection process and parameters, Conducted experimental studies including Nelson reselection and flotation, Finally determined to adopt the Nielsen reselection-heavy tail flotation process, Au grade 42.15g/t, Au recovery rate of 48.92%; Reconcentration tailings after one rough selection, two sweeps, two selection, Au grade 38.26g/t, The grade of Au of tailings is 0.16g/t; The combined Au recovery rate of reselection + flotation was 97.39%, The concentrate quality and recovery indexes are all good, The benefits are considerable.

1 Introduction

Erosion rock gold deposit refers to the gold deposit found in the altered rock of yellow iron serinite and yellow iron serinite granitic fracture rock, which is an important type of gold mine in China [1-2]. A gold mine in Jiaodong, Shandong province belongs to a typical altered rock type gold deposit [3-5], and some primary sulfide ore with gold grade of about 5g/t exists near the surface. The mine has a 3000t/d concentrator, which adopts the three-section closed-circuit crushing, two-section grinding classification, one coarse and two sweeping and one selection process. In order to realize the efficient recovery of the ore, determine the best selection process parameters, and provide technical support for the optimization and transformation of the processing process, the experimental research is conducted [6-7].

2 Design of test scheme

2.1 Nature of ore

The main metal minerals in the ore are pyrite, chalcopyrite, galena, sphellite, magnetite, cuprite, hematite, magnetite, etc.; gold minerals include natural gold, silver, and a small amount of associated silver minerals; gangue minerals include quartz, cloud cloud, kaolinite, sericite, clinite, mela, etc. The results of the multielement analysis of the raw ore are shown in Table 1.

<table>
<thead>
<tr>
<th>Elements name</th>
<th>Au (g/t)</th>
<th>Ag (g/t)</th>
<th>Cu</th>
<th>Pb</th>
<th>Zn</th>
<th>Fe</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>content (%)</td>
<td>5.3</td>
<td>6.70</td>
<td>0.03</td>
<td>0.05</td>
<td>0.05</td>
<td>5.43</td>
<td>4.50</td>
</tr>
</tbody>
</table>

The occurrence of gold is in the form of monomer gold, split gold, continuous gold, wrapped gold, and the main gold minerals are quartz, pyrite, etc. The particle size of gold minerals is mainly fine particles, with the range of about 70um~5um. Gold minerals mostly exist in the form of fissure gold, intergranular gold, continuous gold, monomer gold, and a small amount of coated gold. The occurrence state of gold minerals is very good, and the vast majority of gold is bare gold, which is conducive to enrichment and recovery.

2.2. Experimental method

According to the occurrence status of gold, the method of reselection + flotation test is selected [8-10]. KC-MD3 Nielsen concentrator is selected. Nielsen concentrator is a new type of redressing equipment, which can effectively recover coarse grain gold and have a good recovery effect on fine grain gold. After regrinding with XMQ-250100 ball mill, the flotation test was carried out in the laboratory XFD hanging tank flotation machine.
and the collector and foaming agent were added successively, and the coarse selection was scraped for 3min, and the sweep was scraped for 4min each.

3. Test results and discussion

3.1 Nelson reélection exploratory trial

Under the conditions, 50% -0.074mm, G value 60g, water supply 3.5 L/min and 500g/min. The test results are shown in Table 2.

<table>
<thead>
<tr>
<th>product name</th>
<th>productivity (%)</th>
<th>Au grade (g/t)</th>
<th>Au percent recovery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>gravity concentrate</td>
<td>0.071</td>
<td>591.67</td>
<td>7.97</td>
</tr>
<tr>
<td>Reselected mine</td>
<td>6.949</td>
<td>30.58</td>
<td>40.10</td>
</tr>
<tr>
<td>gravity tailings</td>
<td>92.980</td>
<td>2.96</td>
<td>51.93</td>
</tr>
</tbody>
</table>

The test results show that the Nielsen concentrator obtains the coarse sand Au grade 36.29g/t, the Au grade 591.67g/t after washing, the recovery rate of Au reaches 48.07%, the enrichment degree and recovery index of Au concentration Au are high, and the recovery effect is good.

3.2 Nelson reélection + heavy tail flotation exploration test

Nielsen reélection + heavy tail flotation exploration test was conducted on the basis of Nielsen reélection exploration test, keeping the conditions of Nielsen reélection test unchanged. The reélection tailings flotation exploration test was conducted under the condition of pulp PH value 7.5, the dosage of isoperyl sodium yellow drug 150g/t, the dosage of foaming agent 2#oil 30g/t, and the test process. The test results are shown in Table 3.

<table>
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<tr>
<td>Reselected mine</td>
<td>6.949</td>
<td>30.58</td>
<td>40.06</td>
</tr>
<tr>
<td>flotation concentrate</td>
<td>8.63</td>
<td>29.89</td>
<td>48.66</td>
</tr>
<tr>
<td>cleaner tailings</td>
<td>3.19</td>
<td>0.98</td>
<td>0.59</td>
</tr>
<tr>
<td>Float mine 1</td>
<td>3.42</td>
<td>1.14</td>
<td>0.74</td>
</tr>
<tr>
<td>Flotation in mine 2</td>
<td>2.40</td>
<td>0.65</td>
<td>0.29</td>
</tr>
<tr>
<td>flotation tailings</td>
<td>75.33</td>
<td>0.12</td>
<td>1.70</td>
</tr>
</tbody>
</table>

The test results show that the heavy-floating process is 0.12g/t and Au, and the recovery rate is more than 96%. It can better realize the recovery of Au minerals and test the flotation conditions.

3.3 Test of redressing tailings conditions

3.3.1 Grinding fineness test

Under the condition of grinding fineness-0.074mm, 60%, 65%, 70% and 75%, and the variable of 50%, 55%, the PH value is 7.5, the amount of isopentyl sodium yellow drug is 150g/t, and the amount of 30g/t. The test results are shown in Figure 1.

The test results show that with the improvement of grinding fineness, the Au recovery increases and then remains stable, and the concentrate Au grade becomes stable. After the flotation concentration of-0.074mm content exceeds 55%, the combination of Au recovery, the optimal flotation fineness is-0.074mm content 55%.

3.3.2 Capture dosage test

Under the condition of 80g/t, the amount of 100g/t, 100 g/t, 120g/t, 150g/t and 180g/t, the amount is 30g/t. The test results are shown in Figure 2.
According to the test results, with the increase of the collector dosage, the Au recovery rate gradually increases, and the concentrate Au grade increases first and then decreases. The suitable dosage of isopentyl sodium yellow ore is 120g/t, the Au recovery rate can reach 97.62%, the concentrate Au grade 21.06g/t, the increase of Au recovery rate is not large, and the Au grade of concentrate Au is significantly reduced. Therefore, the best dosage of isovaleryl sodium yellow drug is 120g/t.

3.3.3 Flotation time test

In the flotation fineness-0.074mm content of 55%, the dose of isoperyl sodium yellow medicine 120g/t, the PH value of mineral pulp 7.5, the amount of foaming agent 2#oil 30g/t, the test process, the test results are shown in Figure 3.

According to the test results, with the increase of flotation time, the Au recovery rate gradually increases and the concentrate Au grade gradually decreases; when the flotation time is 11min, the Au recovery rate can reach 97.76%, the concentrate Au grade 16.38g/t, and the Au recovery rate is not increased, so the flotation time is 11min.

3.3.4 Flotation-based concentration test

With the concentration of the mineral concentrate as the variable, under the conditions of 30%, 35%, 40%, 45%, 50% and 55%, the content of 55%-0.074mm, the amount of isoperyl sodium yellow drug is 120g/t, the PH value of the pulp is 7.5, and the amount of 30g/t foaming agent 2#. The test results are shown in Figure 4.

According to the test results, with the increase of flotation concentration, the Au recovery increases and the concentrate Au grade is significantly reduced; at 40%, the Au recovery can reach 97.28% and the concentrate Au grade 22.56g/t. If the flotation concentration increases little, the concentrate Au grade is significantly reduced.
reduced; so the selected flotation concentration is 40%.

3.4 Closed-circuit test

The best selection process parameters obtained from the flotation condition test are: flotation fineness-0.074mm content 55%, the amount of isoperyl sodium yellow drug 120g/t, slurry concentration 40%, flotation time 11min, PH value 7.5, oil amount of foaming agent 2#30g/t. On this basis, the closed circuit test of heavy-floating process was conducted. The test results are shown in Table 4.

**Table 4. Closed circuit test results of heavy-floating process**

| Product name | Productivity (g/t) | Au grade (g/t) | Au percent recovery (%) | Accumulative total (%)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>gravity concentrate</td>
<td>42.1</td>
<td>6.18</td>
<td>48.92</td>
<td>5</td>
</tr>
<tr>
<td>flotation concentrate</td>
<td>38.2</td>
<td>6.75</td>
<td>48.47</td>
<td>97.39</td>
</tr>
<tr>
<td>flotation tailings</td>
<td>0.16</td>
<td>87.07</td>
<td>2.61</td>
<td>100.00</td>
</tr>
</tbody>
</table>

The test results show that under the condition of heavy-floating process with the concentration of 0.074mm, the Au recovery of Au concentration is 48.92%. After one rough dressing, two sweeps and one selection, the Au grade is 38.26g/t, and the Au grade is 0.16g/t; the comprehensive Au recovery rate of reselection + flotation is 97.39%, with good concentrate quality and recovery indexes, and the test index is relatively ideal.

4 Conclusion

(1) The average Au grade of the altered rock gold ore is 5.36g/t, and silver grade is 8.70g/t; the main gold minerals are quartz and pyrite, S content is 4.50%; gold minerals include natural gold and silver gold; gold minerals mainly range from about 70um~5um; gold minerals are in the form of split gold, intergranular gold, continuous gold and single gold, and a small amount of wrapped gold.

(2) Combined heavy-flotation process, 55% in grinding fineness-0.074mm, Reated concentrate containing Au grade 42.15g/t, The recovery rate of Au can reach 48.92%; The redressing tailings after one rough dressing, two sweeps, one selection, Under the conditions that the dosage of isopentyl sodium is 120g/t, the slurry concentration of 40%, the flotation time of 11min, the PH value of 7.5, and the amount of foaming agent 2#oil is 30g/t, Au grade 38.26g/t, Flotation tailings containing an Au grade of 0.16g/t; The comprehensive Au recovery rate of reselection + flotation was 97.39%.

(3) Through the experimental study of this paper, the best process and parameters for the recovery of gold-containing high-grade sulfide ore are obtained, which provides technical support for the efficient recovery of the ore, and provides reference for the recovery of gold-containing high-grade sulfide ore in other gold mines.

**References**