Experimental Study on Flotation Desilication of a High Iron Bauxite in Southwest China

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Abstract

A bauxite mine in southwestern China is a high-iron bauxite ore. The alumina content and the mass ratio of alumina to silica (A/S) of the ore are relatively low. It is not possible to directly produce alumina economically and efficiently. Therefore, flotation desilication technology is needed to improve the alumina content of the ore, reduce the silica content and improve the ore quality. For the raw ore with an alumina content of 47.82 % and an A/S of 4.66, through the study of the fineness, the type of regulator, the amount of collectors and the closed-circuit test, the alumina content of the concentrate is 52.5 %, and the A/S is 8.37. The concentrate obtained is suitable for the production of alumina by the Bayer process.

Keywords: High-iron bauxite, Flotation desilication, Alumina.

1. Introduction

The bauxite resources in China are mainly diasporic ore. With the rapid development of domestic aluminum industry, the amount of domestic bauxite resources has decreased sharply. More particularly, high quality bauxite resources are insufficient [1]. The ore presents the characteristics of high alumina, high silica and low alumina to silica ratio, which is not suitable for the economic production of alumina by the Bayer process. With the depletion of resources, the mineral processing techniques used in the Bayer process will have a great influence on the development of alumina technology at home and abroad [2,3]. In recent years, the import volume of bauxite has been increasing gradually. In 2020, the import volume of bauxite in China was 120.25 million tons, and the domestic output will be 75 million tons [4,5]. The gap of bauxite is large, so the study of impurity removal and quality improvement of domestic low-quality bauxite can alleviate the tension of domestic ore supply. This paper mainly studies the removal of impurities from high iron bauxite and the improvement of ore quality. The concentrate obtained is suitable for the production of alumina by the Bayer process.

2. Analysis of Raw Ore Sample used in Testing

Chemical multi-element and phase analysis was carried out on the raw ore test sample, representative of the deposit mining area. The analysis results are shown in Table 1 and Table 2.

Table 1. Chemical multi-element analysis results of raw ore (%).

Element	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	K_2O	Na_2O	CaO	MgO
Content	48.09	10.48	22.73	3.67	0.21	0.047	0.18	0.12

Table 2. Phase analysis results (%).

Mineral	Diaspore	Boehmite	Kaolinite	Illite	Hematite	Goethite	Anatase	Rutile
Content	42	4	20.5	2	10	15	3.2	0.5

According to the data in Table 1 and Table 2, the Al_2O_3 content in the raw ore is 48.09 %, the SiO_2 content is 10.48 %, the Fe_2O_3 content is 22.73 %, and the A/S is 4.59. The useful minerals in the ore are diaspore and boehmite, the gangue silica minerals are kaolinite and illite, the iron minerals are hematite and goethite, and the titanium minerals are rutile and anatase.

3. Testing Results and Discussion

3.1 Raw Ore Particle Size Composition Analysis

In order to investigate the selective crushing of the ore, the particle size composition of the raw ore crushed to -3mm was analyzed, and the analysis results were shown in Table 3.

Table 3. Analysis of the particle size composition of raw ore.

Grain grade (µm)	Yield (%)	Al_2O_3 (%)	SiO_2 (%)	A/S	Al_2O_3 distribution rate (%)
+500	47.20	48.59	9.88	4.92	48.06
-500 ~ +150	25.10	47.97	10.41	4.61	25.23
-150 ~ +75	8.10	47.34	10.75	4.40	8.04
-75 ~ +38	5.38	47.03	10.79	4.36	5.30
-38 ~ +23	3.88	47.81	10.41	4.59	3.89
-23	10.34	43.75	15.88	2.76	9.48
Total	100.00	47.72	10.77	4.43	100.00

According to the data in Table 3, it can be seen that the raw ore presents certain selective fragmentation in particle size distribution. Coarse-grained ores have high alumina content, low silica content and higher A/S, while fine-grained ores have low alumina content and high silica content and lower A/S.

3.2 Grinding Fineness Test

The effect of grinding fineness on flotation index was investigated. Grinding fineness testing was carried out on the raw ore. The test process is shown in Figure 1, and the test results are shown in Table 4.

2. A representative sample of raw ore with an alumina content of 47.82 % and an A/S of 4.66 was tested and a grinding fineness of 95.17 % passing 75 µm was selected for monomer dissociation without sliming. During test sodium hexametaphosphate was used as a regulator, along with a collector dosage of 1400 g/t. Through the "one roughing, one cleaning and one scavenging test process, an alumina concentrate with a yield of 77.29 %, an A/S of 8.37, and an Al_2O_3 recovery rate of 84.86 % can be obtained.
3. The beneficiation tests of the ore demonstrated the impurity content of the alumina production feed can be effectively reduced, enabling the economic benefit of alumina production to be improved. After flotation desilication, the A/S of the ore is increased from 4.59 to 8.37, which reduces the alkali consumption of 53.7 kg/t of alumina produced. At the same time, the output rate of red mud per ton of raw ore dropped by about 0.19 t. the results provide better technical guidance for the efficient production and utilization of this type of bauxite.

5. Reference

1. An Pengyu, Analysis and suggestions on the prospect of bauxite supply overseas investment for chinese enterprises [J]. *China Resources Comprehensive Utilization*, 2018(12):76-81,86.
2. Ling Shishengand Liu Siqing, A review of reagents on desilication of bauxite ores by reverse flotation [J], *Conservation And Utilization Of Mineral Resources*, 2008(3):49-53.
3. Jiang Yuehua, Development of alumina production new process and new technology and its application [J], *Light Metals*, 2007, (2), 11-13.
4. Zhang Zhihua, Yang Zhuo, Huang Hongjun, et al. Experimental study on flotation and desilication of a bauxite in Yunnan [J], *Light Metals*, 2017, (12), 6-10.
5. Xie Haiyun, Jiang Yaxiong, Ye Qunjie, et al., Study on removal silicon from high alumina and silicon bauxite by sectional flotation desilication [J], *Light Metals*, 2014, (4),1-5.