BX04 - Research on Comprehensive Utilization of Bauxite Resources

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Abstract

A certain gibbsite-type bauxite of overseas has complex mineral structure, and the mosaic size of gibbsite minerals in it is quite fine. The Al_2O_3 content in the ore is 54.37 %, SiO_2 content is 12.80 %, and the raw ore A/S is 4.24. The ore washing test was carried out for this type of bauxite. After the raw ore was washed, the washing concentrate A/S reached 5.79, and the washing tailings A/S was 2.06. The reverse flotation desilication experiment was continued for the washing tailings, and the influence of the flotation slurry PH, flotation reagents and separation process on the desilication effect of the reverse flotation was investigated. Finally, under the technological process of "washing classification-reverse flotation desilication", by optimizing the process parameters, the test index of final concentrate A/S 5.83, final concentrate yield 87.08 %, and alumina recovery 91.46 % was obtained, which realized the efficient use of this type of bauxite resource.

Keywords: Gibbsite-type bauxite, ore washing and classification, reverse flotation desilication.

1. Introduction

With the rapid development of China's alumina industry, the availability of high-grade bauxite resources is increasingly scarce. At present, the raw ore A/S of most domestic alumina enterprises is below (4.5), resulting in a series of problems such as increased production cost of alumina and increased amount of red mud [1, 2]. In order to solve the contradiction between the rapid growth of domestic alumina demand and the relative shortage of bauxite resources, Chalco is importing gibbsitic bauxites from overseas to produce alumina. The production process is mainly based on the low-temperature Bayer method [3]. The production of alumina by this method implies that bauxite must be dissolved in caustic soda, and the alkali consumption is one of the most important factors affecting the production cost of this process [4]. With the increasing of the reactive silica mineral in the imported ore in recent years, the alkali consumption of low temperature Bayer method also increases. Kaolinite and quartz are the main effective silica mineral in the bauxite. There is a linear correlation between the content of silica minerals and the alkali consumption. In industrial practice, the correlation is as follows: for each additional 1kg of silica minerals in the ore, the alkali consumption increases for 1 kg [5]. Therefore, if silica minerals can be fully or partially removed from the bauxite, the content of reactive silica in the ore can be reduced, which will be of great significance to the production cost of the low-temperature Bayer method.

The processing technology of monohydrate bauxite has been gradually mature after nearly 50 years of development [6]. Chalco has built mineral processing plants in Shandong and Henan province and put them into production successfully. However, there are few researches on the beneficiation technology of bauxite in China. In this investigation, desilication tests are carried

out on gibbsite-type bauxite, which provides ideas for the effective utilization of this type bauxite and for reducing the production cost of the low temperature Bayer method.

2. Description of Sample

2.1 Chemical Multi-Element Analysis

Chemical multi-element analysis was carried out on the raw ore to examine the main element content of the ore, and the analysis results were shown in Table 1：

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

Element	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	K_2O	Na_2O	CaO	MgO
Content	54.37	12.80	7.25	2.94	0.019	0.049	0.059	0.068

From the analysis results in Table 1, the content of Al_2O_3, SiO_2, Fe_2O_3, and TiO_2 in the ore is 54.37 %, 12.80 %, 7.25 %, and 2.94 %, and the A/S of raw ore is 4.24. After being processed by a certain beneficiation process, the concentrate is suitable for producing alumina by Bayer process.

2.2 Mineral Composition Analysis

The X-ray diffraction analysis results of the ore sample are shown in Fig. 1, mineral composition results based on chemical analysis and X-ray diffraction analysis are shown in Table 2.

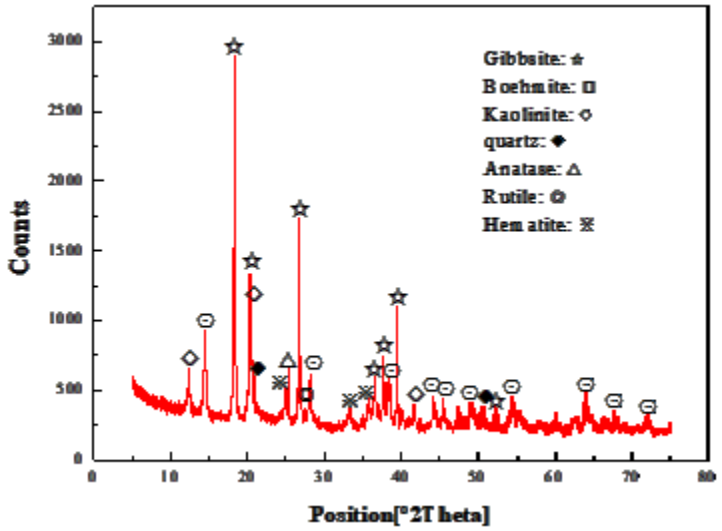

Figure 1. XRD pattern of raw ore.

Table 2. Mineral composition analysis results of ore samples (%)*.

Element	Gibbsite	Boehmite	Kaolinite	Quartz	Hematite	Rutile/Anatase
Content	53.30	18.60	9.20	8.50	7.20	2.90

*: XRD semi-quantitative analysis results

It can be seen from the XRD analysis results, the main aluminum-bearing minerals in the ore sample are gibbsite and boehmite, the main silicon-bearing minerals are kaolinite and quartz, and the others are hematite and a small amount of anatase and rutile.

3.3 Discussion

The data in Table 3 and Table 8 are integrated, and the final data are shown in Table 9:

Table 9. Test results of ore washing - flotation desilication for washing tailings.

Product	Yield %	Al_2O_3%	SiO_2 %	A/S	Recovery rate (Al_2O_3) %
Washing concentrate	74.91	55.02	9.51	5.79	77.87
Washing tailings	25.09	46.70	22.64	2.06	22.14
Flotation concentrate	12.17	59.15	9.67	6.12	13.60
Flotation tailings	12.92	34.98	34.85	1.00	8.54
Final concentrate	87.08	55.60	9.53	5.83	91.46
Final tailings	12.92	34.98	34.85	1.00	8.54
Raw ore	100.00	52.93	12.8	4.14	100.00

According to the data in the Table 9:

(1) Through the ore washing process, the aluminum concentrate with a yield of 74.91 % and A/S of 5.79 was obtained.

(2) Flotation desilication of the washed tailings was carried out to obtain the concentrate with a comprehensive yield of 12.17 %, A/S of 6.12 and the tailings with a comprehensive yield of 12.92% and A/S of 1.00 respectively.

(3) The final concentrate yield is 87.08 %, and the Al_2O_3 recovery rate is 91.46 %, realizing the comprehensive utilization of resources.

4. Conclusions

1) Through the ore washing test study, alumina concentrates with a yield of 74.91 %, and Al_2O_3 content of 55.02 % and an A/S of 5.79 are obtained.

2) Under the process of "raw ore washing - fine grain reverse flotation desilication", the yield of final concentrate is 87.08 %, Al_2O_3 content is 55.60 %, A/S is 5.83, Al_2O_3 recovery is 91.46 %. The concentrate is suitable for Bayer process to produce alumina. The new bauxite processing technology has realized the efficient utilization of bauxite resources.

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6. References

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