

BX06 - Industrial experimental study on desulfurization of high-sulfur bauxite under coal mines

Jianqiang Zhang^{1,5}, Junwei Ma^{2,6}, Huanhuan Su^{3,7} and Zhanyun Zhang^{4,8}

1. Assistant director of Institute for comprehensive utilization of resources

2. Senior engineer

3. Engineer

4. Engineer

Zhengzhou Non-ferrous Metals Research Institute Co. Ltd of CHALCO, Zhengzhou, China

5. Assistant director of Institute for comprehensive utilization of resources

6. Senior engineer

7. Engineer

8. Engineer

National Aluminum Smelting Engineering Technology Research Center, Zhengzhou, China

Corresponding author: 50125241@qq.com

Abstract

DOWNLOAD
FULL PAPER



The high-sulfur bauxite under the coal mines in Henan Province was used as raw material. The grinding fineness, pH value and collector dosage on its desulfurization performance, and industrial flotation desulfurization process were studied. The best flotation desulfurization conditions were grinding fineness of 75 %, pH of 8.5, and collector of 600 g/t. “One coarse, one cleaning and one sweep” closed-circuit flotation was established as the industrial flotation desulfurization process. After the closed-circuit test, the sulfur content of aluminum concentrate with the yield of 93 % was 0.23%, and the sulfur removal rate was 83.16 %, and the sulfur content of tailings (sulfur concentrate) was 15.09 %.

Key words: High-sulfur bauxite under coal mines, flotation, desulfurization.

1. Introduction

The bauxite resources in China are relatively necessitous compared to huge consumption. With the rapid development of the world's alumina production industry, over 50 % of the world's alumina production capacity is concentrated in China. So, in the face of the soaring demand for bauxite resources, China will bear huge pressure [1 - 6]. According to the U.S. Geological Survey's annual reserves and production data, China's bauxite resources have a static recoverable life of only 14 years, far behind the global 102 years [7 - 8]. In order to ensure the further development of China's alumina production industry, it has become very urgent to explore and find new areas of bauxite. In recent years, many fine bauxite deposits have been found in North China coalfields. In Henan Province, from 300 meters to 500 meters below the coal seam, bauxite reserves of 300 million tons can be found [9 - 10], however, this part of bauxite has high sulfur content and cannot be directly used in alumina production. Therefore, solving the problem of high sulfur in coal seam bauxite will be of great significance for expanding the source of bauxite and ensuring the safety of the Chinese aluminum industry.

2. Raw Ore

2.1 Multi-Element Analysis

The ore samples used in the laboratory represented the high-sulfur bauxite under the coal mines in Henan Province. The chemical composition of the ore sample was analyzed. A typical result is shown in Table 1.

Table 1. The main chemical components (%).

element	Al₂O₃	SiO₂	Fe₂O₃	TiO₂	K₂O	Na₂O
content	63.46	12.35	2.46	2.96	1.10	0.025
element	CaO	MgO	S	C	LOI	
content	0.81	0.25	1.21	1.80	13.40	

It can be seen from Table 1 that aluminum in the ore exists in the form of alumina with a high content of about 64 %, silica content was relatively low at 12.35 %, and the alumina-silica ratio was 5.14. However, the ore contain elevated sulfur, reaching 1.21 %, which belongs to a high-sulfur bauxite ore. Desulfurization experiments needed to be conducted on the ore sample to see if it could become useful for processing.

2.2. Process Mineralogy

2.2.1. Mineral Composition

The mineral composition of the raw ore is shown in Table 2. The valence analysis of sulfur is shown in Table 3. The X-ray diffraction analysis is shown in Figure 1.

Table 2. Analysis results of phase composition (%).

Phase	Diaspore	Pyroxene	Kaolinite	Chlorite	Illite
content	65.00	5.5	5.0	3.0	10.5
Phase	Pyrite	Calcite	Anatase	Rutile	Quartz
content	2.4	1.4	2.0	1.0	1

Table 3. Valence analysis results of sulfur (%).

Total sulfur	Sulfur content in sulfate	S²⁻
1.21	0.07	1.14

It can be seen from Table 2 and Figure 1, the diaspore is the main aluminum mineral, and the sulfur existed mainly in the form of pyrite. In order to obtain a low-grade sulfur product, flotation desulfurization experiments needed to be performed. Studies had shown that bauxite with 2 % sulfur can be desulfurized by flotation to obtain concentrates with sulfur content below 0.41% [11].

The flotation desulfurization process of the high-sulfur bauxite was based on the flotation differences among pyrite, diaspore, and aluminosilicate minerals. Xanthate was used to remove pyrite from bauxite via reverse flotation.

amount of collector used was 1000 g/t. The industrial desulfurization flotation process adopts "one coarse, one fine, one sweep" flotation, and the process of returning the middle ore to the rough flotation can obtain the aluminum concentrate with sulfur content of 0.23 %, and the concentrate yield of 93 %. The sulfur removal rate was 83.16 %, and the sulfur content of the tailings (sulfur concentrate) was 15.09 %.

6. References

1. Lin, Zhao., It is difficult to significantly reduce the dependence of aluminum resources on the outside, *N. Economic Reference*, 2013.
2. Changkai, Li., Investigation Desulfurization Efficiency of High-Sulfur Bauxite. *Central South University Press*, 2011.
3. Wenkang Xie, et al., Study of the Flotation Desulfurization of High Sulfur Bauxite in Henan. *J. Nonferrous Metals (Mineral Processing Section)*, 2017, 4-5.
4. Shaofeng Ren et al., Research on High Sulfur Bauxite for Scale-up Continuous Test of Desulfurization and Desilication, *J. Nonferrous Metals (Mineral Processing Section)*, 2017, 2.
5. Lulu Liu, Study of Desulfurization and Desiliconization Process of High Sulfur Bauxite by Step Flotation, Zhengzhou: *Zhengzhou University Press*, 2017, 13-15.
6. Bin Xu, Development strategy of bauxite industry in China under new circumstances, *J. Metal Mine*, 2018, 472 (02): 9-11.
7. Xi-feng Chen, Exploration and sustainable development suggestions for China's bauxite resource. *Resources & Industries*, 2016, 18 (3).
8. Xinda Mo, Global bauxite resources distribution and trade status, *J. World Nonferrous Metals*, 2013, 10, 61-62.
9. Jingjing Su, Changchun Zhang, Exploitative current situation and recommendation of bauxite under coal mines in Henan Province, *J. Conservation and Utilization of Mineral Resources*, 2012, 3, 55-58.
10. Shan Wei, Fazhou Zhang, Henan aluminum under coal mining assembly survey makes major breakthrough in Shaanxi County, *J. Resource Guide: Administrative Comprehensive Edition*. 2012, 10, 34-34.
11. Yan Xie, Study on the necessity and feasibility of bauxite ore dressing. *J. Metallic Ore Dressing Abroad*, 1991, 21, 69-76.