The Desulfurization Desilication Study on Technology of Low Grade High-Sulfur Bauxite in Western Henan

Jianqiang Zhang[1], Du Wuxing[2], Ma Junwei1[3] and Wei Zhaobin[4]
1. Assistant Director
2. Engineer
3. Senior engineer
4. Engineer
Institute of Comprehensive Utilization of Resources,
Zhengzhou Non-ferrous Metal Research Institute Co. Ltd of CHALCO, Zhengzhou, China
Corresponding author: 50125241@qq.com

Abstract

Research and development on desulfurization and desilication technology for low grade, high sulfur bauxite in Western Henan has been undertaken to solve the problem of low mass ratio of alumina to silica (A/S) in concentrate when only desulfurization is performed, and high sulfur content in concentrate when only desilication is performed. Low grade, high sulfur bauxite with a sulphur (S) content of 1.21 %, alumina (Al_2O_3) content of 58.09 % and A/S of 4.43, can be improved to produce a bauxite concentrate at a production rate of 76.55 %, with S of 0.15 %, Al_2O_3 content of 65.25 %, A/S of 9.02 and a sulphur concentrate with S content of 23.27 %, and yield of 4.60 %. This is achieved by "one roughing, one selection and two sweeping" stages of desulphurizing flotation, that is followed by "one roughing, two selection and one sweeping" stage of desilication flotation. These results demonstrate that effective utilization of low grade, high sulfur bauxite is possible, and that efficient utilization will provide support to the economy.

Keywords: Low grade bauxite, High-sulfur bauxite, Desulfurization desilication, Economic support.

1. Introduction

With the rapid increase of alumina production capacity in China, domestic bauxite resources are becoming increasingly scarce, and low grade, fine and difficult to process bauxites are becoming increasingly prominent. As a result, new challenges are being faced by bauxite beneficiation technology and beneficiation equipment performance.

With the decrease of bauxite resources and reduction in quality, the particle size of useful minerals are getting finer and finer. In addition, the symbiotic relationship with gangue minerals is becoming more and more complicated, making it difficult to improve the quality of desired minerals while reducing impurities, leading to an increase in production costs and decrease in process index [1-6].

There are a large number of low-grade, high-sulfur bauxite deposits in western Henan. With reserves of more than 60 million tonnes, the typical sulfur content is about 1.2 - 2.0 %, and the ratio of aluminum to silica (A/S) is around 4.5 - 5.0. The use of desulfurization flotation alone cannot deliver a high A/S concentrate, and the sulfur content of the flotation concentrate is above 0.8 % and cannot meet the alumina production requirements. In order to develop and utilize this resource economically and rationally, this paper studies combining desulfurization and desilication technology for use with low-grade and high-sulfur bauxite in western Henan.

2. Research on the Properties of Ore

Multi-element analysis, X-diffraction analysis and phase composition analysis of low-grade and high-sulfur bauxite ore from western Henan were carried out to understand the nature of the ore and provide mineralogical guidance for subsequent experiments. The analysis results are shown in Table 1, Figure 1, and Table 2.

According to the analysis results, it can be seen that the Al_2O_3 content in the raw ore is 58.09 %, with SiO_2 content of 13.10 %, A/S content of 4.43, and the harmful impurity S content of 1.21 %, confirming the sample as low-grade and high-sulfur bauxite ore. The useful minerals in the ore are mainly diaspore, the gangue minerals are mainly illite, kaolinite, chlorite, calcite, etc., and the sulfur-containing minerals are mainly pyrite.

The bauxite ore must be beneficiated before it can be used for alumina smelting. Flotation desulfurization can be used to reduce the content of harmful impurities S, and flotation desilicication to increase the A/S of the ore to meet the requirements of alumina smelting [7-9].

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

Al_2O_3	SiO_2	Fe_2O_3	TiO_2	K_2O	Na_2O	CaO	MgO	S	C	LOI
58.09	13.10	7.05	2.76	1.88	0.05	0.67	0.37	1.21	1.19	14.73

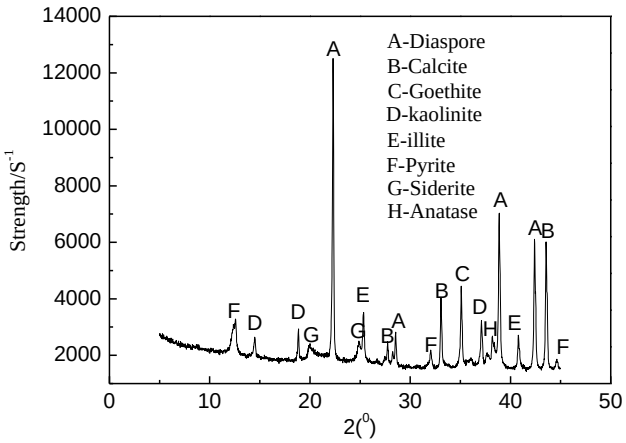

Figure 1. XRD pattern of raw ore.

Table 2 The original mineral phase analysis results (%).

Mineral	**Diaspore**	**llite**	**Kaolinite**	**Chlorite**	**Pyrite**	**Anatase**
Content	54.50	18.00	10.63	6.58	2.20	2.23
Mineral	**Rutile**	**Calcite**	**Siderite**	**Dolomite**	**Quartz**	**Gypsum**
Content	0.50	1.00	0.75	0.23	0.10	0.10

According to the results in Table 4 for the closed circuit test of the complete process, the raw ore is desulfurized by flotation using "one roughing, one selection and two sweeping" stages. The desulfurized concentrate is desilicated by flotation using "one roughing, two selection and one sweeping" stage. After treatment, bauxite concentrate with a yield of 76.55 %, S content of 0.15 %, Al_2O_3 content of 65.25 %, A/S of 9.02 and sulfur concentrate with S content of 23.27 % and yield of 4.60 % were obtained. The results indicated that improved flotation indexes could be obtained, and the S content of bauxite concentrate is able to meet the requirements of alumina smelting.

4. Conclusion

1. According to the study of the nature of the raw ore sourced from western Henan, the Al_2O_3 content was 58.09 %, the SiO_2 content was 13.10 %, A/S of 4.43, and the harmful S content of 1.21 %. This is classified as a medium-low grade and high-sulfur bauxite. The useful minerals in the ore are mainly diasporic alumina mineralogy which is accompanied by sulfur-bearing minerals that are mainly pyrite.
2. The bauxite must be beneficiated before it can be used for alumina smelting. Flotation desulfurization can reduce S content which is a harmful process impurity and flotation desilication can increase ore A/S, and when combined can meet the ore quality requirements of alumina smelting.
3. Through comparison tests for the types of desiliconization collectors, it was found that the self-made desilication collector, BKS has strong collecting ability and selectivity.
4. Closed circuit testing using preferred test conditions confirmed the low-grade and high-sulfur bauxite in western Henan may be desulfurized by "one roughing, one selection and two sweeping" stages of flotation, and the desulfurized bauxite concentrate may be desilicated through "one roughing, two selection and one sweeping" flotation stages.
5. Closed circuit test results indicated that the ore can be improved such that a bauxite concentrate with yield of 76.55 %, S content of 0.14 %, Al_2O_3 content of 64.25 %, A/S of 8.02 can be generated alongside a sulfur concentrate with S content of 23.27 %, yield of 4.60 %. Better flotation indexes were obtained, which provided technical reference for economic and efficient utilization of low-grade and high-sulfur bauxite resources.

5. References

1. Wuxing Du, Huixin Dai, Deping Zhai, The research status and progress of high silica bauxite dressing desilication [J] *Light Metals*, 2016, 11:8-13.
2. Licong Zheng, et. al. Review on desulfurization of high-sulfur bauxite, [J] *Materials Review*, 2017, 5:84-93.
3. Lulu Han, Lei Li, Wei Chen, Research on the status quo and sustainable development trends of bauxite resources exploration and development, [J] *Resource Information and Engineering*, 2017, 1:39-40.
4. Jiancheng Sun, Analysis of the development trend of my country's alumina industry, [J] *China Nonferrous Metals*, 2018, 20:42-43.
5. Shiyu Wang, et. al. Research status and development trend of high-sulfur and high-silicon bauxite, [J] *Light Metals*, 2018, 12:1-4.
6. Guobin Yang, Zhouwei Zhang, Lirong Chen. Desulfurization and desiliconization experiment by flotation on a high sulfur and high silica bauxite ore from guizhou province, [J] *Modern Mining*, 2015, 8:56-58.
7. Tianxia Li, Research on high efficiency and low consumption separation technology of a bauxite containing sulfur, [J] *Metal Mine*, 2017, 12:67-71.
8. Jieqiang Zhou, et. al. Research on synchronous desulphurization and desilication of low grade high-sulfur bauxite by reverse flotation, [J] *Metal Mine*, 2018, 505, 7:128-131.

9. Xin Guo, Peihe Wei, Yingzhong Tin, An experimental study on deep desulfurization of high sulfur bauxite under coal in henan province, [J] *Journal of Kunming University of Science and Technology (Natural Science)*, 2020, 2:1-8.
10. Qian Zhang, et. al. Experimental research on quality optimization of ball mills in kalatonk copper-nickel ore, [J] *Multipurpose Utilization of Mineral Resources*, 2020, No.224, 04:105-110.