

AA25 - Process Innovation and Technology Progress of Bayer-Sintering Series Method

Zhimin Yang

Professor

Zhengzhou non-ferrous metals research institute Co., Ltd. of CHALCO, Zhengzhou, China

Corresponding author: zyy_ymz@rilm.com.cn

Abstract



This article discusses innovation in the Bayer-sintering in series production of alumina technology, including new dry sintering technology, elimination of green liquor desilication and its downstream processes, joint processing of unpolished sinter extraction liquor with Bayer slurry, shortening of the sintering process. At the same time, the technical progress of High iron Red mud mix sintering and improving A/S of pregnant liquor was analyzed on the example of taking Shanxi bauxite whose A/S is 3.01, with the consumption figures of the new series method are compared with that of the Bayer process. The bauxite consumption of the new series method is lower by 26.42 %, the caustic consumption is lower by 84.07 %, and the process energy consumption is 15.35 GJ/ t-Al₂O₃, which is only 23.12 % higher than that of the Bayer process. The new series method will be an economical method to produce alumina by using low grade diasporic bauxite, and it has obvious effect on reducing the consumption of gibbsitic bauxite.

Keywords: Bayer-sintering series method, bauxite consumption, caustic consumption, process energy consumption, low grade bauxite.

1. Bauxite Resources in China

China's alumina production has increased more than tenfold since 2003. In 2019, the global alumina production is about 125960 kt, and China's alumina production is 72474 kt, with China accounting for 57.54 % of the global output. The major issue for Aluminium industry in China is a serious shortage of bauxite resources. According to the 2017 China land and mineral resources statistics bulletin of the Marine resources, by the end of 2017 China's bauxite resource identified as 5.01 billion tons, which shows duration of operation security is only 26 years. The reserve base is 1.01 billion tons, with security duration of only 6.8 years. Followed by resource depletion, alumina production enterprises in China are not only faced with the problem of scares bauxite resources.

More than 50 % bauxite reserves in our country are in Shanxi and Henan provinces. The A/S ratio > 5 bauxite is almost exhausted. Some of the alumina plants are using bauxite grade which has dropped to A/S < 4 or even as low as 3.8. This fact not only affects the supply of ore but is of high economic concern. China imported 687.6 million tons of foreign bauxite in 2017, and 826.2 million tons in 2018, accounting for more than 60 % of China's bauxite consumption in the same period.

At present, China's bauxite resources are facing the following problems: on the one hand, the only low-grade diasporic bauxite in China cannot be effectively used; on the other hand, there is a large quantity of imported bauxite. The fundamental reason why A/S < 4 low grade diasporic bauxite cannot be utilized effectively in China is that no ideal method to produce alumina by using the low-grade bauxite economically has been found at present. A large mass of imported ore is not only associated with high freight cost, but also has lower alumina concentration leading to relatively high bauxite consumption.

2. A Method for Producing Alumina from Low-Grade Bauxite

There are many methods to produce alumina by using low-grade bauxite, including Flotation-Bayer process, Bayer process and Sintering process, etc. These methods do not have technical bottlenecks, but their technical and economic differences are great. The Bayer process using lower grade bauxite, in which A/S has been down to < 4 , that some alumina manufacturers use, leads to the ore loss and alkali consumption increase. The material flows increase leading to higher capital costs and the process, technical and economic indicators deteriorate badly.

Table 1 lists several ways in which alumina can be produced from low-grade bauxite.

Table 1. Comparison of various methods.

Methods	Suitable for bauxite grade	Advantages	Disadvantage
Flotation-Bayer	$A/S > 3.5$	The efficiency of Bayer method is improved; Process energy consumption is low.	The process is complex; Low alumina recovery; The lower the ore A/S is, the worse the economy will be
(Bayer-Sintering) Series process	$A/S > 2.6$	High alumina recovery and low alkali consumption; Sintering method has a small proportion.	The process is complex.
Soda-Lime Sintering process	unlimited	High alumina recovery, low alkali consumption and high whiteness; High carbon decomposition rate; Red mud has hydraulic properties.	Energy consumption is on the high side.

3. Innovation and Technical Progress of New Series Process for Alumina Production

In recent years, Zhengzhou non-ferrous metal research institute Co., Ltd. of CHALCO participates in "innovative series method of alumina production technology and equipment research projects" sinter dry sintering process and equipment technology research "project in soda-lime sintering, and the series method has made the important technological innovation and technological progress, formed a new series method. In the sintering process of the new series method, the processes such as desilication of the green liquor, carbonation decomposition of sodium aluminate liquor and evaporation are removed, and joint processing of unpolished sinter extraction liquor with Bayer slurry, thus greatly shortening the sintering process. The key techniques of sintering in the new series method include low A/S red mud mix sintering with high iron content, clinker dry sintering and green liquor desilication. At present, the new series method has more than ten years of successful experience in industrial practice. Thus, the energy consumption of alumina production by the traditional series method has been significantly reduced.

3.1 High Iron Content of Low Charge A/S Red Mud Formula

Low A/S of high iron red mud refers to Bayer red mud with $A/S < 1.5$ and $Fe_2O_3 > 10wt\%$, and its ingredients are obviously different from ordinary red mud mix sintering.

5. Conclusions

In view of the current shortage and serious dilution of bauxite resources in China, it is necessary to adopt a more economical method to produce alumina by using low-grade diaspore bauxite, while it is necessary to reduce the bauxite consumption of gibbsitic bauxite.

The new series method developed in China has formed the key technologies such as Low A/S of high iron red mud is sintered into kiln by dry method and joint processing of unpolished sinter extraction liquor with Bayer slurry desilication, which is of great significance for the economic utilization of low grade diaspore bauxite to produce alumina and to reduce the bauxite consumption of gibbsitic bauxite.

Taking Shanxi bauxite whose A/S is 3.01 as an example, the consumption index of the new series method is compared with that of the Bayer method. The bauxite consumption of the new series method is lower by 26.42 %, the caustic consumption is lower by 84.07 %, and the process energy consumption is 15.35 GJ/ t-Al₂O₃, which is only 23.12 % higher than that of the Bayer method.

6. References

1. Hong Wang, Jingsong Wang, Jiang Liu and Qingguo Xue, Experimental research on comprehensive utilization of the high iron red mud based on direct reduction and melting by RHF iron bead technology, *Journal of Light Metals*, 2013, No. 1, 19-22.
2. Zhimin Yang, The improved Bayer process - red mud sintering method can be used economically to produce alumina from low-grade bauxite, *Catalogue of China Aluminum Industry Environmental Protection Technology Development Forum*, Zhengzhou, China, 19- 21October 2019, 114-116.