Development of Technology for Carbonate Removal from North Urals Bauxite at RUSAL Krasnoturyinsk

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Abstract

Currently because of high initial carbonate content in North Urals bauxites (SUBR) the concentration of carbonates in the process alkaline aluminate liquors at Bogoslovsk aluminum smelter (BAZ) has increased. High carbonate content in the liquors reduces the efficiency of evaporation trains, increases specific steam consumption and causes the excessive consumption of expensive caustic in place of cheaper sodium carbonate. All those factors lead to the decrease of the equipment utilization factor, reduction of the evaporation trains efficiency, increase of the consumption of heating steam, and loss of the service life of heat-exchange tubes. This paper presents technical, design and process solutions that provide for efficient bauxite beneficiation with the use of SEPAIR dry concentration technology. The decrease of carbonate content in the bauxites (SUBR) will facilitate the increase of evaporation and digestion throughput, reduction of caustic consumption. Also these measures will increase the alumina production efficiency in view of both technology and cost effectiveness.

Keywords: bauxites, dry beneficiation, carbonate removal.

1. Introduction

For over 70 years North Urals deposits have been the main source of raw materials for alumina production at Urals aluminum smelters. North Urals bauxites (SUBR) are diaspore-boehmite and boehmite bauxites mainly characterized by a high content of $A1_2O_3$ (52—54 %). For a long time customers were supplied with a mixture of bauxites from different deposits that allowed maintaining A/S ratio (Al_2O_3/SiO_2) > 14 and carbon dioxide content (CO_2), i.e. the most harmful impurity of alumina production < 3.8 %. All these years these bauxites have been and still remain the bauxites of the highest grade in Russia. For bauxite mining underground (mines) method is used.

With lowering of the mining level, CO_2 content in bauxites increases. CO_2 is present in bauxites in form of calcium, iron and magnesium carbonates; and as evidenced in practice with mine development quality of SUBR bauxites gradually deteriorates in terms of both alumina content and limiting impurities. Increase of carbon dioxide mass fraction in the ore is mainly attributed to increase of mechanical dilution of the ore with limestone and lime shale of overlying bauxite that is apt to capability in course of mining; and also addition of soil lime due to challenging hypsometry (variability coefficient for sub-ore patent marks can reach 72 %).

Gradual changes in bauxite quality in course of ore mining and changes of mining methods eventually led to reduction of alumina content and increase of harmful impurities in marketable bauxites. At present high content of carbonates in SUBR bauxites causes their accumulation in process liquors. High carbonate content in the liquors reduces the efficiency of evaporation trains, increases specific steam consumption and causes the excessive consumption of expensive caustic in place of cheaper sodium carbonate.

Conditioning of raw material that is fed to the process becomes more and more urgent. Currently the most critical issue is preliminary beneficiation of GB-1 and GB-2 bauxites from the North Urals bauxite mine. Bauxite moisture does not exceed 10 %. Maximum size of bauxite particles is 250 mm. The decrease of carbonate content in the bauxites (SUBR) will facilitate the increase of evaporation and digestion throughput, reduction of caustic consumption and increase of use of calcined soda which is less expensive that will reduce heat consumption and improve the sintering capacity.

There are two options to improve the quality of SUBR bauxite while maintaining their competitive ability:

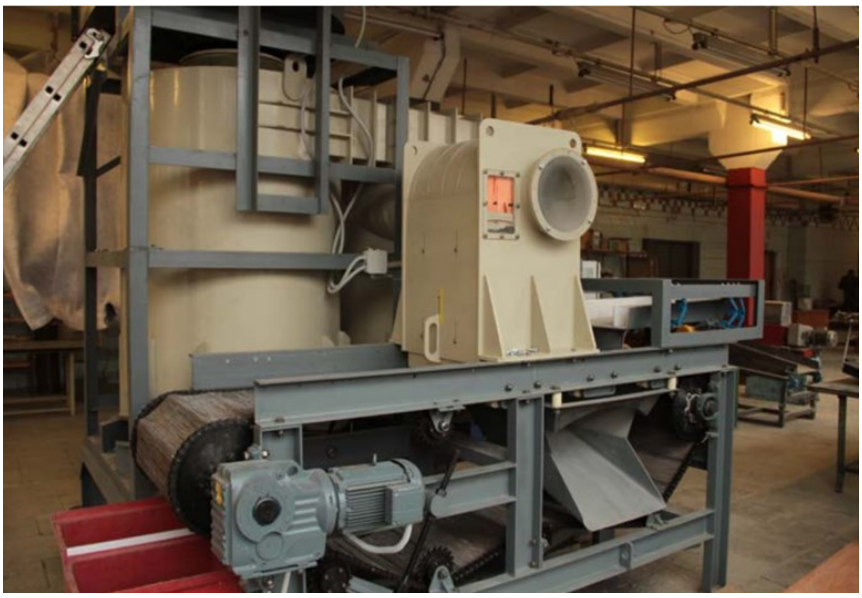
- adding bauxites of higher grades from other deposits;
- preliminary beneficiation.

Earlier in the Soviet Union and later in the Russian Federation extensive study of process flowsheets for domestic bauxite beneficiation was conducted. As a result the possibility to remove sulfides, carbonates and clay minerals from bauxites by means of flotation, gravity, radiometric concentration and during the pyrometallurgical processing was determined.

2. Experimental

Work on bauxite beneficiation was executed using SEPAIR technology. This project is aimed to study the beneficiation ability of SUBR bauxites to generate the concentrate of GB-1 bauxite quality in the end product and carbon dioxide (CO_2) content to < 4.0 %. Feed sample for the tests contained 6.6 % CO_2, 48.9 % $A1_2O_3$.

Tests were carried out using the pilot concentration plant of “GORMAShEXPORT” laboratory (Figure 1) comprising the following equipment: belt feeder, SEPAIR-1-0.5 plant.



Total estimated balance of GB-1 sample beneficiation proved the following:

- total yield of I class concentrate amounts to 64.52 % with average content of Al_2O_3 53.09 % and CO_2 4.54 %;
- total yield of II class concentrate amounts to 31.71 % with average content of Al_2O_3 43.32 % and CO_2 10.91 %;
- total process losses amounted to 3.78 %. Losses are mainly attributed to material clogging in the equipment, losses in the scrubbers, spillages, etc.

The results of the tests proved the possibility and efficiency of bauxite beneficiation using SEPAIR® dry concentration technology.

5. References

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