Concentration Machinery and Equipment in Alumina Refining

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Abstract

Demand for mineral resources continuously grows but their quality deteriorates and the cost increases because the mining companies have to turn from development of rich ore deposits to development of deposits with substandard or out-of-balance ores. Changes in material composition of bauxites cannot but adversely affect established alumina production process. Sooner or later this will necessitate making decisions to improve manufacturing. The paper presents positive results achieved and considers prospects of employing processes and apparatus initially developed to concentrate ores and non-metal materials at certain ore preparation stages, grinding, thickening and decomposition in alumina production.

Keywords: Process and apparatus, ore concentration, alumina production, improvement.

1. Introduction

Splitting of industrial production into separate branches, each with its own specifics brought into existence free-standing industrial processes and apparatus, e.g. [1, 2, 3]. Today the alumina production also has its own generally accepted basic manuals to calculate and design processes and apparatus for its implementation [4, 5]. Quality characteristics of bauxites gradually deteriorating with development of ore bodies and changes in mine development systems ultimately reduced alumina content and increased content of harmful impurities in commercial bauxites. With every year the issues of conditioning the raw materials incoming into the process get more and more pressing [6]. Meanwhile the use of the traditional pool of apparatus is not always able to provide for required economic efficiency of the process and quality of final product. The use of apparatus initially developed for chemical production or concentration of ores or non-metal materials at different stages of ore preparation, grinding, classification, thickening in alumina production makes possible in many cases to achieve required technological result.

2. New Bauxite Concentration Processes

In this context the experience accumulated by expert professionals of Pavlodar Aluminum Smelter should not be left unmentioned. Depletion of Turgay bauxite reserves in the second half of the 90s posed the problem of developing a new technology to process low grade highly sideritized bauxite from Krasnogorsk deposit. At the moment “Aluminum Kazakhstan” LLC has developed and implemented alumina production process from substandard bauxite raw materials of Kazakhstan as per sequential Bayer sintering diagram. Flow charts have been implemented, apparatus designed and manufactured made possible to increase annual alumina production capacities to 1 500 thousand tons as compared to the designed 1 034 thousand tons. The principal engineering solution in processing substandard raw material was to implement unique process flow chart to remove impurity components of bauxites by removing a part of iron sands and kaolinites [7, 8]. Vertical sizing vessels and elutriating apparatus which are the base of the flow chart are hydrosizers widely used in sand beneficiation have been modified for the process specifics.

Industrial pulsation chemical reactor adapted for hydrochemical processing of sintered material was tested at the sintering stage integrating in all stand-along equipment unit all processes stages – leaching of sintered material, thickening of solids, clarification of aluminate liquor and sand washing – reduced secondary loss and specific consumption of washing water [9, 10]. Experience of applying hydrocyclones in concentration of ores and non-metal materials formed the basis to develop at PAS the only one in the post-Soviet countries complete flow chart to classify the product hydrate in decomposition area employing battery hydrocyclones [11, 12],

Changes in material composition of bauxites create similar challenges at the alumina enterprises in Russia. Currently, high carbonate content in SUBR bauxite results in its accumulation in the manufacturing solutions. High carbonate content in solutions reduces evaporation performance, increases specific steam consumption, misbalances alkaline consumption towards more expensive caustic. Together with ETC RUSAL Alumina Directorate we made a decision to consider the possibility of concentrating the initial rock mass by air elutriation by "SEPAIR" technology. Initially developed to beneficiate coal the device demonstrated stable process characteristics and simplicity of control under varying input conditions (initial moisture content of the material including) and for other ore and non-metal materials. The process realized the principle of separating the products by density in the upward current and in the vortex chamber above the perforated belt, Figure 1.

Design of the process chamber combines conventional principles of pneumatic separation in the vertical channel and vortex technologies to separate initial material components with density pitch from 0.01 t/m3 in dry process and extract from 95% and more useful products. Actual EPM classification efficiency (average probable deviation from theoretical separation conditions) for conventional dry concentration processes, e.g. Chinese FGX ranges from 0.2 to 0.35. By the data presented by «COALTECH» (SAR) on studies of coal concentration parameters carried out in 2018 on «SEPAIR» plant the real EPM of theplant was 0.1-0.17 (depending on the size of separated material), which is practically comparable with traditional wet concentration indicators.

The aim of the work was to study the preparedness of GB-1 (ГБ-1) bauxite with extraction from it of the high quality bauxite and bauxite with CO_2 content. Tests carried out on bauxites of Bogoslovsk Aluminum Smelter at «Gormashexport» laboratory to assess preparedness by air elutriation produced the combined concentrates of the Ist, IInd and IIIrd quality with the yield of 40, 13 and 47 %, respectively. The process was found to be able to smoothly vary the quality and balance of concentrate within the framework of fractional makeup of the raw material. Studies to elaborate the process and develop an industrial flow chart for preliminary concentration of SUBR bauxites to increase the yield of calcite concentrated classes [13] are in progress.

Figure 7. Multicyclone-thickener with automatic control system. PJC Western Branch MMC «Nornickel».

Industry as a whole (this is true for the alumina industry, too) is extremely conservative. It always prefers proved processes and takes great pains in resisting innovations which has not been tested many times. Meanwhile the experience of adapting and operating concentration apparatus at chemical enterprises and in hydrometallurgy [19] allows considering the feasibility of employing in technological processes washing, classifying, crushing and other equipment well proven in the course of operation for many years under various conditions.

6. References

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