Egyptian Aluminum-containing Raw Materials and the Prospects for its Integrated Processing to Produce Alumina and By-products

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Abstract

One of the leading alternative raw materials for the production of aluminum in the first place is consider kaolin ore and clay rocks, the world reserves of which are estimated at 20 - 25 billion tons, and their location is confined to various non bauxitic regions. A typical example of the non bauxitic region in the world that needs to be exploited its own raw material base for aluminum production is the Arab Republic of Egypt, which has capacities for aluminum production, but does not have alumina production and has to import it in significant amounts. At the same time, Egypt has significant reserves of kaolin that makes it one of the largest exporters of the upgraded and non upgraded kaolin in the Middle East and Africa. To date, a significant number of methods for the processing of kaolin and clay are known and continue to be improved, among these historical methods, the acidic technologies is in first place. Their advantages and disadvantages are well known, which gives more attentions for solving their existing problems and their industrial implementation in the near future. One of the considerable interest methods for the processing of alkali-free aluminosilicates is the technology of autoclave leaching in an environment of high modulus aluminate solutions with the precipitation of silica in the form of ferrous hydrate or sodium-calcium hydrosilicate. A high degree of development includes number of technologies based on sintering of 2 and 3 component charges, with a well-developed scheme of utilization of calcium-silicate sludge in the production of Portland cement. At the same time, the final choice is required to focus on regional conditions for the organization of a specific production, consumers of main and by-products, the possibility of further improving of the technological process with the optimization of its modes and indicators.

Keywords: Kaolin, deposits, complex processing, alumina and by-products.

1. Introduction

It is well known that aluminum production is the basis of leading industrial sectors and ensures stable growth of any national economy. Russia occupies one of the leading positions in this field, and United Company RUSAL is one of the world leaders in the production of primary aluminum. At the same time, the problem of the domestic raw material base, associated with the insufficient amount of high-quality bauxite reserves, led to the need to use alternative types of low-grade raw materials, which are used by most of the domestic companies. According to leading experts, the role of this resource will invariably increase due to the growth in global aluminum consumption and the exhaustion of high-quality bauxite reserves. In Russian such materials include the tailings of apatite-nepheline ores, the accumulated volume of which in sludge dumps of different times is more than 2 billion tons. Significant amounts of low-grade aluminum raw materials are associated with natural aluminosilicates in the composition of urtitic, rischorritic and other alkaline rocks, as well as slags, sludge and ashes of the existing industrial complex [1-4]. Alkaline aluminosilicate rocks are widely distributed not only in Russia, but also in other regions of the world. They often

occur due to the geological conditions where bauxite is absent. Such regions include the USA, Canada, Mexico, Argentina, Iran, Egypt, Spain, Bulgaria and other countries. Practically all the massifs of these rocks are characterized by their large reserves, as well as favorable mining and technical conditions that allow the use of open mining method. One of the most interesting alternative in these regions is the possibility of using alkali-free aluminosilicates, the most common types of which include kaolin ores and various clay rocks. In the historical aspect, this became the basis for the development of numerous methods for the production of alumina - acidic, alkaline, and electrothermal, some of which were implemented on an industrial scale. Recently, such raw materials have regained considerable interest from the standpoint of its regional use, which is associated with the steady demand for aluminum, alumina and by-products in the context of a significant increase in transport costs [5-8].

2. The World Reserves of Kaolin Ores and their Development

The world reserves of clay and all types of kaolin ore are estimated at 20 - 25 billion tons. The reserves of kaolin ore from this amount approximately 16 billion tons, and their consumption is quite stable and is currently at least of 60 million tons per year as shown in Figure 1.

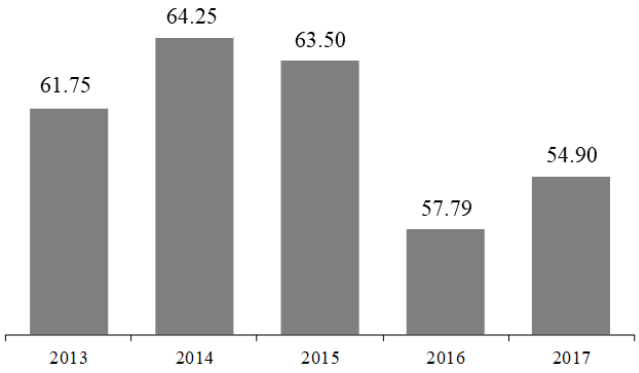

Figure 1. World production of kaolin ore, million tons per year [9].

Like other mineral resources, kaolin ore are distributed in the earth's crust and between countries unevenly enough, which puts some in a leading position and others in a disadvantageous position. Paradoxical is the fact that the share of Russia, the largest in the world, accounts for only 3 % of the world reserves of kaolin ore as shown in Figure 2 [9].

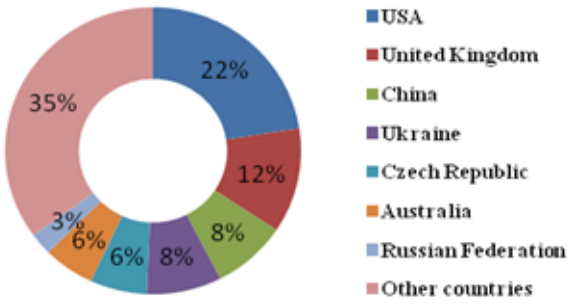

Figure 2. Distribution of kaolin reserves in the world [9].

Currently, in the countries of Soviet Union kaolin is mined in 51 fields in Russia, Ukraine, Georgia, Kazakhstan, Uzbekistan and Turkmenistan. At the same time, the total reserves of kaolin ore in this area are estimated at 1.4 billion tons, of which about 25 % are found in the Russian Federation [10]. Table. 1 shows the distribution of the proven reserves of kaolin ore and clays in the Russian Federation, which suggests the potential importance of this type of raw material for

additives as part of the charge [16]. Exploratory research allows to give quite encouraging predictions on the effectiveness of the use of activated lime materials of various nature, a limited number of alkaline aluminosilicates and carbon-containing additives.

5. Conclusion

Modern mining and processing methods of kaolin ore have an established infrastructure, are provided with raw materials and in the future can be adapted to the production of alumina and by-product based on the regional nature of this raw material resource and consumers of final products.

Regardless of the region of formation and occurrence of kaolin ores, they have nearly the same chemical and mineralogical composition with a high level of consistency as regard to the content of basic chemical elements and minerals, which indicates a high degree of completion of the geochemical kaolinitization processes of primary feldspathic minerals alumina and associated products.

Until now, the most mastered technology of processing kaolin raw materials are methods based on sintering 3 or 2 component charges with subsequent leaching of sintering, while a reasonable choice of the method of processing a particular source of raw materials is determined by the sum of its chemical and mineralogical characteristics and technical characteristics and economic condition of the region. This suggests that the sintering method of the two component limestone-kaolin mixture in the Arab Republic of Egypt is promising, utilizing the entire amount of lime-silicate sludge in the production of Portland cement.

6. Acknowledgment

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