PROCESS OF OBTAINING HIGH SILICON KAOLIN FROM LOCAL RAW MATERIALS AND OBTAINING ALUMINUM OXIDE FROM IT

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ANNOTATION

There are sources of raw materials in the form of kaolin clays, alunite rocks, low-grade bauxites and coal ash. The richest deposits of kaolin clay, suitable for processing aluminum raw materials, are located in the territory of the city of Angren, their total reserves amount to more than one billion tons. This stone can be mined in open pit. The average thickness of mineral deposits is 30-40 m. In the production of aluminum, it is necessary to deiron acid solutions of aluminum and convert purified solutions into aluminum oxide, use or process their solutions, and develop an effective technology for obtaining aluminum oxide from raw materials containing aluminum with a high silicon content.

Key words: *kaolin, aluminum oxide, thermal treatment, clay soil, diffraction, regeneration.*

INTRODUCTION

При производстве алюминия необходимо обезжелезивание кислых растворов алюминия и преобразование очищенных растворов в оксид алюминия, использование или переработка их растворов, а также разработка эффективной технологии получения оксида алюминия из сырья, содержащего алюминий с высоким содержанием кремния.

Currently, with the depletion of aluminum-rich raw materials, the need for high-quality bauxite raw materials for the aluminum industry worldwide is increasing every year. At the same time, there are low-quality aluminum raw materials - high-silicon bauxite, kaolin clay, alunite rocks, nepheline and other ores. Aluminum oxide is not produced in the republic, but there are raw materials in the form of low-aluminum kaolin clays, alunite rocks, low-quality bauxite, and coal ash. However, there is no effective technology for their processing. In the conditions of a severe shortage of aluminum, obtaining aluminum compounds by recycling aluminum raw materials is currently the basis of scientific research. It is necessary to justify the following scientific solutions in the development of processing technology of aluminum-containing raw materials on a global scale: Studying the processes of processing low-quality, high-silicon aluminum raw materials by alkaline and acidic methods, including the stages of preliminary heat treatment, separation of raw materials, deironing of acidic solutions of aluminum, and the conversion of purified solutions into aluminum oxide, using or processing of solutions, high-silicon content it is necessary to develop an effective technology for obtaining aluminum oxide from raw materials containing aluminum.

RESEARCH METHODS

Aluminum oxide is a raw material for the aluminum industry, and high-quality raw materials that are not available in Uzbekistan are used for its production. There are sources of raw materials in the form of kaolin clays, alunite rocks, low-grade bauxites and coal ash. The richest deposits of kaolin clay, suitable for processing aluminum raw materials, are located in the territory of the city of Angren, their total reserves amount to more than one billion tons. This stone can be mined in open pit. The average thickness of mineral deposits is 30-40 m. There are the following methods of aluminum production: Alkaline and electrolytic methods of obtaining clay soil are currently not used in Uzbekistan. The nitric acid method is preferable to acid processing methods, because no waste is produced during its production. The demand for aluminum is very high, and the lack of an optimal technology for processing kaolin clays is one of the most urgent issues of the problem of obtaining aluminumToday, the exploitation of new deposits of mineral raw materials in the republic and their use in production creates the possibility of achieving high results.

RESEARCH OUTCOMES AND DISCUSSIONS

The development of a complex technology for the processing of kaolinite clays of the Angren mine into aluminum oxide and nitric acid of circulating solutions for various types of liquid nitrogen fertilizers is of great importance for the economy of the republic. Based on our research, the reserves in Angren are very suitable for the decomposition of kaolin clay on the basis of nitric acid to obtain alumina.

It is necessary to transfer aluminum to a solution with a mineral acid or alkaline method. There is no information on the production of aluminum oxide on an experimental or industrial scale, the influence of the composition of raw materials on the technological indicators of production, and the processing of circulating solutions after the separation of aluminum compounds. Among the listed methods, acidic methods of aluminum production are optimal for the conditions of our country. Therefore, our research is aimed at extracting aluminum oxide from the Angren mine by decomposing kaolin clays with nitric acid. Samples of kaolin clay from Angren mine were selected for the study, which contain: SiO_2 - 54.30%; Al_2O_3 - 23.50%; Fe_2O_3 - 0.47%; K_2O - 0.38%; It was found that there are 0.30% CaO substances. As a result of the inspection, it was found that the degree of burning affects the process. Since burning has a significant effect on the process of obtaining aluminum oxide, the effect of heat treatment in the temperature range of 400-800°C for 1 hour was studied, and the calcination temperature was 400-500°C. Kaolin clay components of Angren mine almost unaffected by changes in composition. From 600°C, an increase in the main components of kaolin clays was observed. The most stable chemical composition of the main components is observed at the flame temperature of 600-700°C. A further increase in temperature to 800°C leads to an increase of SiO_2 to 58.14% and Al_2O_3 to 25.16%. The composition of other components is kept almost at the same level.

Studies have been carried out on the extraction of aluminum from the calcined kaolinite clays of the Angren mine, which show that as the duration of the burning process increases, the rate of aluminum extraction increases with increasing temperature. At a temperature of 600-700°C and a process duration of 2 hours, the extraction rate is 90.94-93.29%. Increasing the firing time to more than 2 hours has almost no effect on the level of aluminum extraction. An increase in temperature to 800-1000°C causes a decrease in the extraction rate of aluminum to 10.12% and iron to 6.79%. The optimal firing temperature for maximum extraction of aluminum from kaolin clays is 600-700°C. X-ray diffraction results were obtained from the original to establish the phase composition of the samples. Kaolin clays were fired at 650°C and 800°C.

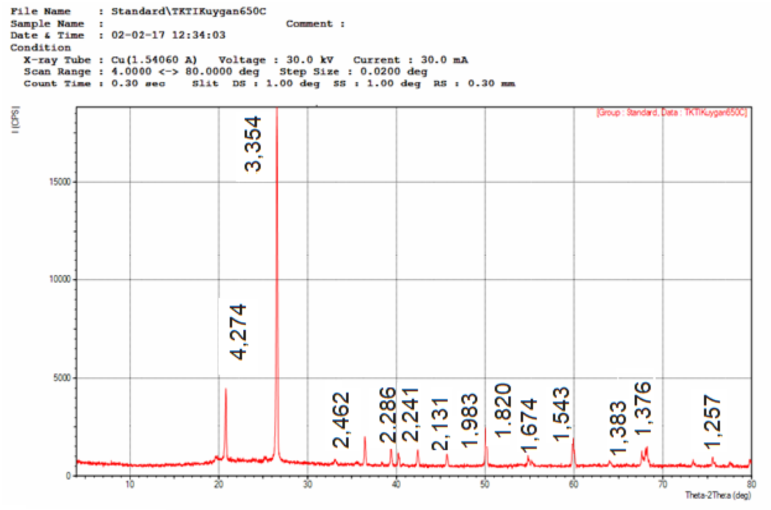

Fig. 1 X-ray diffraction image of kaolin from Angren mine at 650 °C.

The result of the analysis showed that in the initial kaolin burning, kaolinite-specific 7.224 Å of 3,585 Å peaks disappear in X-ray diffraction and a peak at 1.257 Å corresponding to $Al_2Si_2O_7$ appears. It follows that structural water is separated from kaolinite in the process of mining, and the change in the crystal structure occurs with the transition of metakaolinite to the acid-soluble form $Al_2Si_2O_7$ according to the reaction of refractory kaolinite.$Al_2Si_2O_5 \rightarrow 3Al_2Si_2O_7 + 2H_2O$

When burned at a temperature above 900°C, mullite $3Al_2O_3•2SiO_2$ is formed according to the reaction.$3Al_2Si_2O_7 \rightarrow 3Al_2O_3•2SiO_2$,

Figure 2 shows the change in particle settling velocity at 20°C and 60°C.

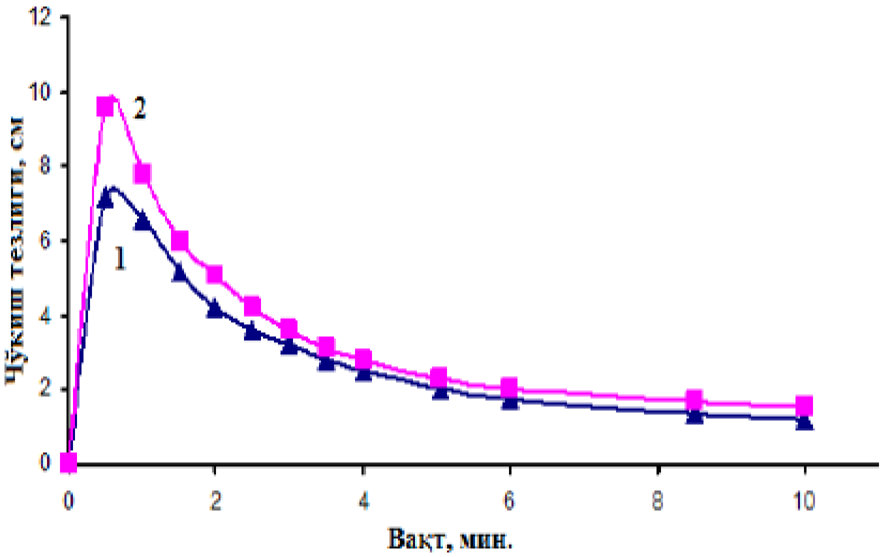

Figure 2. The effect of the duration of the clarification process on the sinking rate

As a result of this reaction, the developed technological solutions for the acidic processing of high-silicon aluminum raw materials insoluble in mineral acids are at the level of laboratory research, and only in 2016, in China, the production of aluminum oxide from the ash of thermal power plants was launched for the first time in the hydrochloric acid method. Acidic methods have certain advantages over alkaline methods, which allow relatively easy separation of silicon from aluminum oxide at the beginning of the production cycle. The process does not require the use of limestone and soda water. Despite the advantages mentioned above, the acidic method has its own disadvantages: the complexity of deep cleaning of solutions from iron and other impurities, the complexity of acid regeneration, the use of acid-resistant equipment is required.

Nitric acid method is a promising way to obtain metallurgical grades of aluminum oxide. The effectiveness of the method is mainly based on a complete study of the raw materials, purification of the separated solutions from impurities, and scientific work is being carried out on the issues of dependence on the desired physical properties of aluminum oxide.

CONCLUSION

The dependence of the sedimentation rate on the duration of the process was studied. The maximum sedimentation of particles was observed in the first minutes of clarification, followed by a gradual decrease in speed. As the temperature increases from 20°C to 60°C, the deposition rate increases, which is explained by the decrease in the density and viscosity of the solutions. The effect of temperature on the rate of filtration of solutions formed by nitric acid decomposition of kaolin was studied in the temperature range from 20°C to 60°C. On the basis of aluminum raw materials, the methods of decomposition of kaolin raw materials with mineral acid, standards, pauses, sinking speeds and other scientific researches were carried out in the world, in the republic, on obtaining aluminum compounds.

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