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Promising Methods for Red Mud Processing

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Abstract

Modern methods red mud processing are considered. A method for extracting macro-components from red mud using calcium additives is proposed.

Keywords: red mud, processing, leaching, calcium oxide

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Bauxite ores are a valuable source of nonferrous, scattered, rare and rare–earth metals. Wastes and middlings of bauxite processing to alumina are a unique technogenic concentrate of the above metals, which surpasses the potential of natural deposits. The production of aluminum from bauxite ores is accompanied by the formation of a large amount of waste in the form of red mud (RM). In the production of one ton of commercial aluminum by the Bayer process, 1.5 t of red mud is formed. Its chemical composition is determined by the composition and properties of leached bauxites, as well as by the duration and conditions of storage in slurry tanks. It is universally recognized nowadays that the problems of environmental protection and environmental abuse can be solved by creating modern non-waste industries.

Considering the peculiarities of the chemical composition (high content of iron and aluminum oxides) and a high dispersity of RM (the amount of 5 μm fraction is as much as 80%), of practical interest are the methods for red mud utilization providing the maximal conversion of components into commercial products.

These requirements are met to the utmost in the processes providing for pyrometallurgical treatment of red mud with the production of metal and sludge. One of the versions of thise processes can be direct production of cast iron and high–alumina slags (clinkers) on the basis of red mud. Another technology offers a more complex process including the separation of red mud into magnetic and nonmagnetic fractions to produse of iron–containing concentrate (for the production of cast iron), silicaalumina product (for the production of cement) and rare-metal concentrate (for scandium recovery) [1–3]. However, a critical deterrent to the use of red mud in ferrous metallurgy is the

concentration of alkali, sulfur and moisture in RM, since these impurities negatively affect the quality of products.

A fundamentally different technology for RM utilization is the production of iron-oxide pigments for the manufacture of paints, lacquers, ceramics, construction materials etc. [4]. Before calcination, red mud is draded into sizes, and fractions to 0.02 mm and additionally from 0.02 to 0.045 mm are selected. These fractions are calcined in a controlled oxygen deficient atmosphere in the temperature interval from 500 to 1000°C. Depending on the calcination temperature, this method allows red, black, grey or brown pigments to be produced.

The hydrochemical methods for RM processing provide selective extraction of micro-components. They include acid leaching of RM: among them hydrochloric, these are nitric and sulfuric acid methods. These technologies make it possible to selectively extract into solution such valuable components as scandium, lanthanide- group metals and other rare metals [1].

The considered methods for RM processing include technologies for additional extraction of alumina from RM since it contains a large amount of aluminum. Such methods allow up to 90% of alumina to be extracted from RM, hawever, the problem of integrated utilization of RM has not been solved yet [5, 6].

For additional extraction of alumina from RM we propose high–temperature autoclave leaching of RM.

In this work we report the results into the investigation of the effect of calciumcontaining additives on the degree of aluminum extraction into solution during autoclave leaching of residues of the Bogoslovskii aluminum plant(BAP). Red mud from BAP sludge depositories of the with the composition, wt.%: Al_2O_3– 10.32, Fe_2O_3–47.82, SiO_2–5.35, TiO_2–0.67, CaO–12.87, Na_2O–0.94, was used for the experiment, and surface-carbonized lime (SCL) in the amount to 10 wt.calcium–containing additive.

The experiments were carried out in a Parr 4560 laboratory autoclave at 250°C for 2.5 h while constant mechanical stirring at a rate of 100 rev/min. Using SCL as an active additive, allows the degree of alumina leaching into solution to be to 90%. Besides, the produced aluminate solutions were characterized by a high alumina to silica ratio (to 950). This makes it possible to use SCL in the process of additional leaching of RM for additional extraction of alumina.

The developed to date technologies for bauxite processing do not provide integrated utilization of feedstock, are limited to extraction of one target component and create large-tonnage technogenic dumps, which, in turn, leads to environmental and techno-economic problems. The most promising methods for red mud processing and selective extaction of valuable components are hydrometallurgical methods, which provide a

high level of extraction of target component, are low–waste and have a relatively low production cost.

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