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CALCINING ALUM

Sidney B. Tuwiner, Flushing, and William H. Osborn, New York, N. Y., assignors to Phelps Dodge Corporation, New York, N. Y., a corporation of New York

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This invention relates to the treatment of potash alum for the separation and recovery of the aluminum and potassium values therein, and more particularly is concerned with the recovery of relatively pure alumina suitable for reduction to aluminum by the cryolite method.

Many attempts have been made to recover alumina from potash alum which in its normal hydrated form has the chemical formula

$$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$$

The water of hydration may be driven off at temperatures below 400° C., leaving the anhydrous salt as a combined potassium aluminum sulfate. If this anhydrous salt is heated above 400° C., the aluminum sulfate component decomposes with the evolution of SO_2 and SO_3 gases, leaving a calcined product consisting of a mixture of potassium sulfate and alumina. This decomposition of the aluminum sulfate component begins to take place at a substantial rate at approximately 700° C. However, as the temperature is raised, the potassium sulfate component may become decomposed. It has been proposed to calcine the anhydrous salt to decompose just the aluminum sulfate component and then leach out with water the potassium sulfate component, leaving alumina in suspension.

This process appears to be a fairly simple one on paper but commercial operations encounter many difficult problems. It is very difficult to obtain a rapid and complete decomposition of the aluminum sulfate component without some decomposition of the potassium sulfate component. After the leaching treatment, the alumina is then contaminated by substantial amounts of K_2O combined chemically as some water-insoluble compound. In the reduction of alumina to aluminum by the standard process of electrolysis in a bath of fused cryolite, the presence of potash is said to have a detrimental effect on the electrolytic pot linings. It is important, therefore, in commercial operations to produce alumina containing no more than 0.2% K_2O.

Another difficulty in this process is the slow rate at which the aluminum sulfate component may decompose making it necessary to calcine the material for long periods of time. The physical condition of the mass being calcined is very important in this connection, and normally when the dehydrated alum is heated to around 700 to 750° C. on a large scale, it becomes pasty, which makes the material very difficult to handle and interferes with the liberation of sulfur compounds. Thus, as soon as ½ to ⅔ of the aluminum sulfate is decomposed at these temperatures, the rate at which the sulfur gases are liberated is greatly reduced and the continued decomposition of aluminum sulfate becomes very slow. Also, this pasty material cannot be satisfactorily handled in a continuous calcining furnace such as a rotary kiln.

An object of our invention is to provide a process of calcining potash alum to decompose the aluminum sulfate component without decomposing substantial quantities of the potassium sulfate component, in which fusion or the formation of a pasty mass is avoided and the decomposition of the aluminum sulfate component is accelerated.

Another object of this invention is to control the calcining of potash alum in such a manner as to eliminate SO_3 gas as it is formed and thereby accelerate decomposition of the aluminum sulfate component.

Another object of this invention is the recovery of substantially pure alumina from potash alum by calcining the salt in a continuous type furnace to produce a rapid decomposition of the aluminum sulfate component without substantial decomposition of the potassium sulfate component.

A further object of our invention is to calcine potash alum mixed with a carbonaceous or carbonizable material proportioned to react with some or all of the aluminum sulfate or the SO_3 gas given off by its decomposition.

Another object of our invention is to calcine potash alum for the production of relatively pure alumina of low potash content by controlling the nature of the gases over the product during its decomposition.

Other objects will be explained and will be apparent from the following description of our invention.

When anhydrous potash alum is heated, it normally begins to give off SO_2 and SO_3 gases at a substantial rate when a temperature of 700° C. is reached. Under normal commercial conditions, the break down of the aluminum sulfate component continues until the total aluminum sulfate reaches about 12 to 25% of the total mass of material being calcined. At this point, the material begins to become pasty and gradually melts down. When this pasty condition is reached, further decomposition of the aluminum sulfate component is very, very slow and many hours are required to complete this reaction.