

UNITED STATES PATENT OFFICE

2,464,267

DEHYDRATING ALUMINA IN THE PRODUCTION OF ALUMINUM

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3 Claims. (Cl. 204-67)

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The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to me of any royalty thereon in accordance with the provisions of the act of April 30, 1928 (Ch. 460, 45 Stat. L. 467).

This invention relates to the manufacture of aluminum and more particularly to the reduction of aluminum ores to the metallic form by electrolysis.

Heretofore in the manufacture of metallic aluminum, purified aluminum hydrate was produced by various chemical means, then the aluminum hydrate was calcined at a very high temperature of the order of 1000 degrees to 1200 degrees centigrade in order to remove the water of hydration and to convert the aluminum hydrate to the so-called "alpha alumina" which does not again take up water from the atmosphere. Thereafter the "alpha alumina" is fed to the electrolytic cell and reduced to the metallic form by electrolysis. The conversion by high temperature calcination of aluminum hydrate to "alpha alumina" was considered necessary before addition to the molten electrolyte, in order to stabilize the alumina.

It has now been discovered however in accordance with my invention, that hydrated alumina can be distributed directly on the crusted surface of the molten electrolytic bath to cause at least partial dehydration of the feed alumina, and then the thus-dehydrated feed can be directly mixed in the molten electrolyte to cause a very rapid and substantially complete solution of the alumina feed. Thus, the slow and often incomplete solution of the formerly employed "alpha alumina" is avoided and the expensive calcination step previously thought necessary, is dispensed with.

The following example illustrates how the invention may be carried out but it is not limited thereto. Parts and percentage compositions are by weight unless otherwise indicated and temperatures are on the centigrade scale.

EXAMPLE

Alumina hydrate as prepared by a wet purification process was comminuted to pass through a one-quarter inch mesh standard Tyler screen, and air-dried for one week at an average relative atmospheric humidity of about 50%. Then the alumina hydrate was spread substantially one-half inch deep over the crust of a usual cryolite-alumina molten electrolyte of the ordinary type used in the Hall reduction cell. On

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spreading, the granules of hydrate began breaking up and in approximately one-half hour were disintegrated to a fine powder. After approximately one-half hour the crust was broken in and the powder stirred into the molten bath. There was no sputtering or evolution of steam and solution proceeded rapidly and completely. The observed temperatures are recorded in the following table:

Temperatures of bath crust and anode

Location	Temperature, Degrees C.
Anode.....	586
Anode-Crust Contact.....	422
1 inch from anode.....	386
2 inches from anode.....	361
3 inches from anode.....	372
4 inches from anode.....	335

As illustrated in the foregoing example the alumina hydrate was sufficiently dehydrated by the heat evolved during the customary electrolysis to produce a suitable feed material in only 30 minutes. However, a longer residence time for the hydrate on top of the crust formed over the electrolysis bath is entirely possible and a residence time of 2 to 4 hours also yielded a soluble product for solution in the bath.

The amount of alumina hydrate added to the crust of the electrolytic bath can be varied widely from the one-half inch described in the illustrative example and can be made of any desired depth, the limiting condition being that the weight of the alumina hydrate should not be sufficient to break the previously formed crust. In general a crust of oxidic material to support the feed is readily formed by exposing the surface of the cell to atmospheric air.

While air-dried alumina hydrate stored or dried under any of the usual conditions of atmospheric humidity, that is about 50% relative humidity on the average, has been found entirely suitable for employment in accordance with this invention, preferably the alumina hydrate is stored for several days up to a month or longer under an average relative humidity of not more than about 25% such as is found in the more arid portions of the Western United States.

From the foregoing, it is abundantly clear that a considerable saving is effected in the manufacture of metallic aluminum by this invention which obviates the necessity for calcination at very high temperatures of the alumina hydrate, such as was previously thought necessary. Fur-

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thermore, it has been observed in the practice of this invention that a very complete and rapid solution of the alumina in the molten electrolytic bath takes place which permits extended electrolysis without clogging of the cell with undissolved feed material. The waste heat of electrolysis maintains a crust surface temperature of about 300 degrees to 600 degrees centigrade, which gives a desirable temperature for feed treatment.

Various changes can be made in the detailed practice of the invention without departing from the spirit and scope thereof.

What is claimed is:

1. In the production of aluminum by electrolytic reduction of alumina dissolved in a suitable molten electrolytic bath, the steps which comprise distributing hydrated alumina feed in direct contact with the crusted surface of the heated electrolytic bath to cause substantial dehydration of such feed, and then stirring the thus dehydrated feed into the molten electrolyte whereby rapid and substantially complete solution occurs.

2. The process of claim 1 wherein the hydrated alumina feed is supported on the crusted surface of the heated electrolytic bath for at least 30 minutes before stirring into the electrolyte.

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3. The process of claim 1 wherein the crusted surface is maintained at a temperature between 300 degrees centigrade and 600 degrees centigrade.

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