ALUMINIUM

The principal constituents of bauxite (Al2O32H2O) which yield aluminum on a commercial scale are hydrated oxides of aluminum and iron with some silica. Some of the other aluminum ores are corundum, kaolin or china clay, and kryolite. The ore is purified by Bayer's process and is reduced to aluminum by Hall Hiroult's process in two stages.

In the first stage bauxite is converted into alumina by roasting, grinding, heating (with sodium hydrate) and filtering. Then it is agitated for several hours to precipitate the hydrate, which is separated, washed, and calcined at 1000° C. In the next stage aluminum is extracted by

electrolysis of alumina in a molten bath (Fig. 14.1) of crystolite (a fluoride of alumina and sodium). A flow diagram for extraction of aluminium is shown in Fig. Aluminum is silver white in color with a brittle metallic lustre on freshly broken surface. It is malleable, less ductile than copper but excels zinc, tin, and lead.

Aluminium is harder than tin. Aluminium is very light, soft, strong and durable, has low thermal conductivity but is a good conductor of electricity. Aluminium can be riveted and welded, but cannot be soldered. It can be tempered at 350° C. The melting point is 657° C, tensile strength is 117.2 N/mm2 in the cast form and 241.3 N/mm2 when drawn into wires. Aluminium is found to be resistant to the attack of nitric acid, dissolves slowly in concentrated

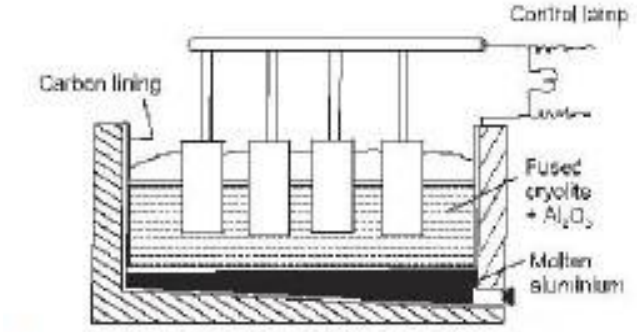

Fig. Extraction of Aluminum by Electrolysis

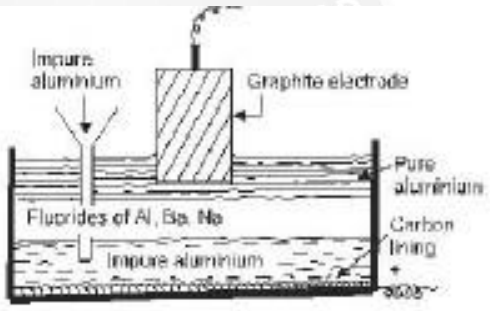

Fig. Hoope's Cell for Refining Aluminum

Fig. Flow Diagram for Extraction of Aluminum

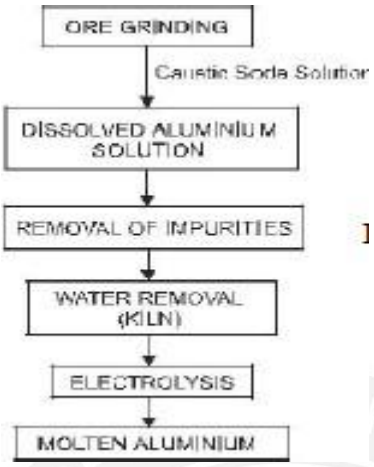

Fig. Flow Diagram for Extraction of Aluminum

ALLOY

Aluminum is commonly alloyed with copper silicon, magnesium, or zinc to improve its mechanical properties. Some aluminum alloys also contain one or more of the metals manganese, lead, nickel, chromium, titanium, and beryllium. A large part of the aluminum production is utilized in making light, stiff, corrosion-resistant alloys with these metals. Aluminum alloys may be classed as the cast alloys, which are shaped by casting and wrought alloys, which are worked into different shapes by mechanical operations. Cast alloys are generally binary alloys containing copper or silicon, and sometimes magnesium. Wrought alloys contain copper, magnesium, silicon, and manganese that form precipitation hardening alloys withaluminum. Following are some of the aluminum alloys.

Duralumin contains 3–5% copper, 0.51–1% magnesium and 0–0.07% manganese. 0.3–0.6% iron and 0.3%–0.6% silica are present as impurities. The relative density is 2.80, which is quite low as compared to that of mild steel. However, when rolled and heat treated tensile strength equals that of mild steel. Its yield point is 206.85 N/mm2. It is highly resistant to corrosion. Wire and sheets are drawn from duralumin. Duralumin may be fabricated into different structural shapes to be used for construction.

Magnesium is an alloy of aluminum and magnesium (6 per cent). It has got very good mechanical properties and is a little lighter than pure aluminum. It is easy to work, exceptionally strong, and ductile and is widely used as deoxidizers in copper smelting operations.

Aldural When a coating of aluminum is given to duralumin it is known as aldural and has better corrosion resisting properties.

Y-alloy invented during World War II contains 4 per cent copper, 20 per cent nickel and 1.5 per cent magnesium. Toughness and hardness are achieved by heating it to 500° C for six hours and then cooling it down in boiled water. Its relative density is 2.80 and resists corrosion better than duralumin. Y-alloy has good thermal conductivity and can sustain high temperature. It is used for making pistons of I.C. engines, cylinder head, connecting rod and propeller blades.

Aluminium Bronze contains less than 11 per cent of aluminium and is rather inappropriately named. It is highly ductile when aluminium is less than 7.3 per cent. As the aluminium increases,

Applications

Sandwich panels are used in those applications where high structural rigidity and low weight is required. An evident example of use of sandwich panels is aircraft where mechanical performance and weight saving is essential. Other applications include packaging (e.g. fluted

polypropylene boards of polypropylene honeycomb boards), transportation and automotive as well as building & construction. ACP is mainly used for external and internal architectural cladding or partitions,

false ceilings, signage, machine coverings, container construction etc. Applications of ACP are not limited to external building cladding, but can also be used in any form of cladding such as partitions, false ceilings etc. ACP is also widely used within the signage industry as an alternative to heavier, more expensive substrates. Epcot's Spaceship Earth is an example of the use of ACP in architecture. It is a geodesic sphere composed of 11,324 ACP tiles.

ACP has been used as a light-weight but very sturdy material in construction, particularly for transient structures like trade show booths and similar temporary elements. It has recently also been adopted as a backing material for mounting fine art photography, often with an acrylic finish using

processes like Dia sec or other face mounting techniques. ACP material has been used in famous structures as Spaceship Earth, VanDusen Botanical Garden, the Leipzig branch of the German National Library.

These structures made optimal use of ACP through its cost, durability and efficiency. Its flexibility, low weight and easy forming and processing allow for innovative design with increased rigidity and durability.

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