

The Aluminium Process

Bauxite Mining



Bauxite is a reddish clay that consists of aluminium oxide (alumina), silica, iron oxides, and titanium dioxide. It is refined through the Bayer chemical process to produce alumina. About two tons of Bauxite are required to produce one ton of alumina.

The leading producers of Bauxite are Australia, China, Brazil, India, and Guinea. In the GCC, the Kingdom of Saudi Arabia has its own bauxite mines, while the UAE imports Bauxite to supply its alumina refinery in Al Taweelah.

Alumina Refining



Alumina, or aluminium oxide (Al_2O_3), is a chemical compound consisting of aluminium and oxygen atoms. When extracted from Bauxite, alumina appears as a white powder that resembles table salt or granular sugar.

The process begins with crushing, washing, and drying the Bauxite, then dissolving it in caustic soda at high temperatures. The mixture is filtered to remove impurities (red mud).

The remaining solution, containing alumina, is transferred to tanks called precipitators, where aluminium hydroxide seeds are added to promote the precipitation of aluminium hydroxide crystals at the bottom of the tank and are subsequently removed and washed to remove any remaining caustic soda, then heated to remove excess water.

Aluminium Production

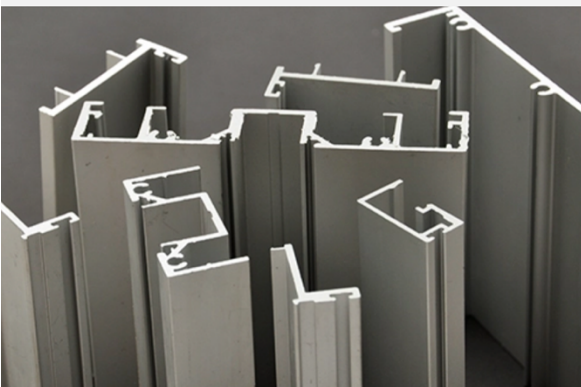


In the Hall-Héroult process, alumina is dissolved in a molten cryolite bath with a carbon-lined steel cell as the cathode. Carbon anodes are inserted at the top of the bath, and an electric current is passed through the anodes and the bath.

As a result of electrolysis, oxygen atoms separate from the alumina and combine with the carbon anode, leaving molten Aluminium at the bottom of the pot. This molten Aluminium is periodically siphoned off and transferred to a holding furnace for casting into ingots.

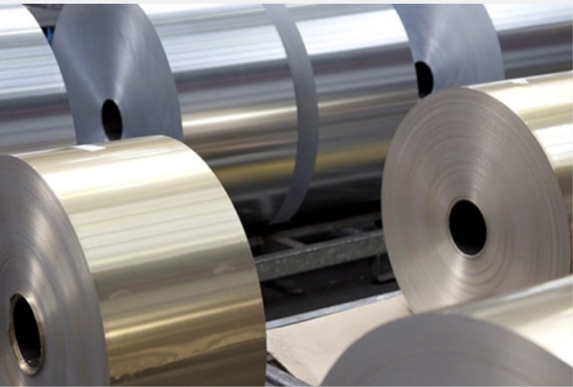
Approximately two tons of alumina are required to produce one ton of Aluminium.

Extruding



Aluminium can be extruded to create complex shapes and profiles. The extrusion process involves heating the Aluminium to approximately 500 degrees Celsius and forcing it through a die under high pressure.

After extrusion, the materials undergo fabrication and finishing to become usable components for commercial and residential buildings, including window and door frames, prefabricated structures, roofing, exterior cladding, curtain walls, and shop fronts. Extrusions are crucial in the transportation industry, airframes, road and rail vehicles, and marine applications.



Rolling

Aluminium can be processed into plates, sheets, or thin foils as thin as human hair by rolling it.

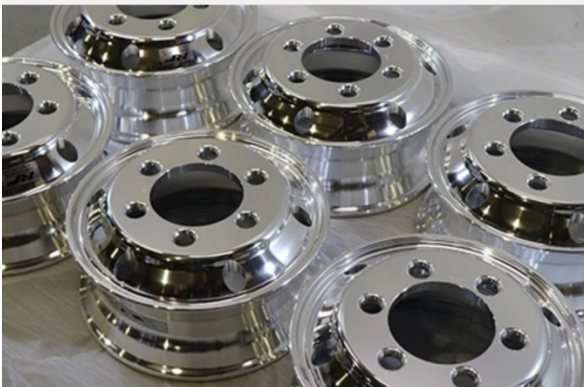
This process changes the metal's characteristics, making it less brittle and more ductile. Rolled aluminium products are commonly used in various applications, including home appliances, packaging, transportation, construction, and many others.



Cable & Rods

Aluminium rods and bars are produced through extrusion, rolling, coiling, and drawing from molten Aluminium. These processes elongate the Aluminium into circular or bar-shaped pieces that can be machined for different applications such as rivets, nails, screws, and bolts. Aluminium wire is commonly used in electrical transmission applications because of its superior conductivity and corrosion resistance.

Aluminium rods, bars, and wire production begins by heating a long square ingot, which is progressively reduced in cross-section as it passes through a series of rolls. The resulting material is coiled, and if intended to become wire, it is pulled through increasingly smaller dies. Electrical conductors are created by stranding several cables together into a single piece.

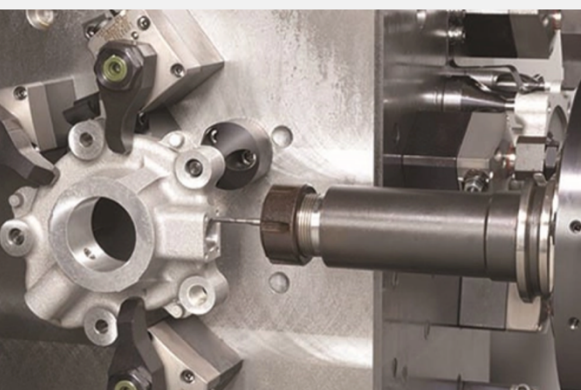


Forging

Forging is a manufacturing process in which metal is shaped by applying high pressure through pressing, pounding, or squeezing.

There are three main types of forging processes:

1. Open-die forging: Ideal for larger aluminium components.
2. Closed-die forging: Suitable for more intricate designs and tighter tolerances.
3. Ring-rolled forging: Used to create high-strength, ring-shaped products.



Casting

Casting is the original and most commonly used method for shaping Aluminium into products.

In this process, molten Aluminium is poured into a mould to create the desired shape. The three primary casting methods are die casting, permanent mould, and sand casting.

The automotive industry is the largest market for aluminium casting, with cast products accounting for over half of the Aluminium used in cars.



Powder

Aluminium powder and its flake and paste forms can be produced by blowing gas under pressure into molten Aluminium.

This process creates droplets of various sizes. These aluminium products are used in multiple applications, including explosives, rocket fuel, metallurgy, chemicals, links, and solar cells.