

Production process

Tags: aluminium, barrier function, recycling, lightweighting, corrosion resistance, properties

Aluminium can be produced via two different routes: primary aluminium production from ore and recycling aluminium from process scrap and used aluminium products.

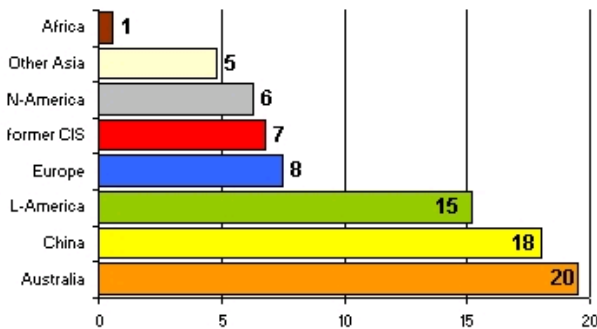
The production of primary aluminium consists of three steps: bauxite mining, alumina production and electrolysis. The last two mentioned will be described hereafter, bauxite mining is covered in the section Environment, Ecology & Recycling.

Alumina production

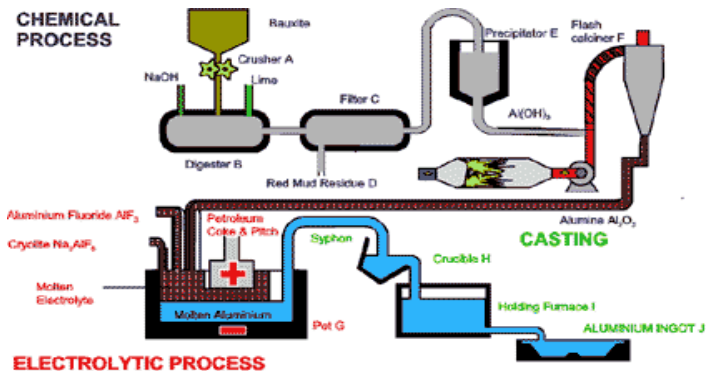
Bauxite has to be processed into pure aluminium oxide (alumina) before it can be converted to aluminium by electrolysis. This is achieved through the use of the Bayer chemical process in alumina refineries. The aluminium oxide is released from the other substances in bauxite in a caustic soda solution, which is filtered to remove all insoluble particles. The aluminium hydroxide is then precipitated from the soda solution, washed and dried while the soda solution is recycled. After calcination, the end-product, aluminium oxide (Al_2O_3), is a fine grained white powder.

Four tonnes of bauxite are required to produce two tonnes of alumina which in turn produces one tonne of aluminium at the primary smelter. In 1998, 45 million tonnes of alumina were produced world-wide.

The main production areas are:



Alumina refineries are often located near to bauxite mines for logistics reasons.



Electrolysis



Aluminium primary smelting and casting

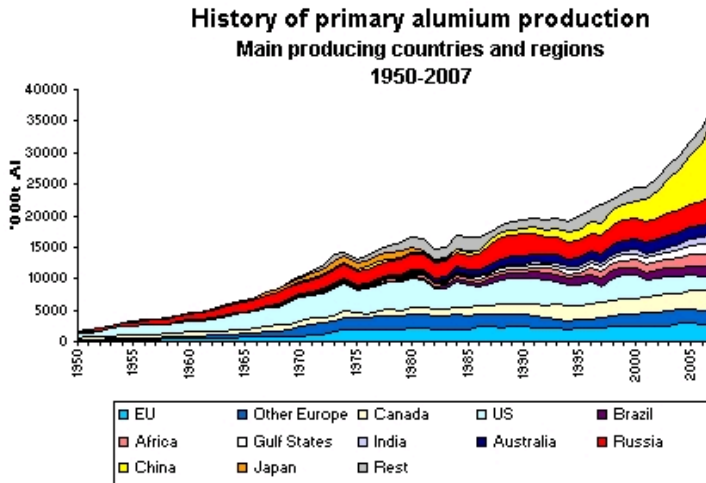
Primary aluminium is produced in reduction plants (or "smelters"), where pure aluminium is extracted from alumina by the Hall-Hroult process. The reduction of alumina into liquid aluminium is operated at around 950 degrees Celsius in a fluorinated bath under high intensity electrical current. This process takes place in electrolytic cells (or "pots"), where carbon cathodes form the bottom of the pot and act as the negative electrode. Anodes (positive electrodes) are held at the top of the pot and are consumed during the process when they react with the oxygen coming from the alumina. There are two types of anodes currently in use. All potlines built since the early 1970s use the prebake anode technology, where the anodes,

manufactured from a mixture of petroleum coke and coal tar pitch (acting as a binder), are pre-baked in separate anode plants. In the Soederberg technology, the carbonaceous mixture is fed directly into the top part of the pot, where self-baking anodes are produced using the heat released by the electrolytic process.

At regular intervals, molten aluminium tapped from the pots is transported to the cast house where it is alloyed in holding furnaces by the addition of other metals (according to the users needs), cleaned of oxides and gases, and then cast into ingots. These can take the form of extrusion billets, for extruded products, or rolling ingots, for rolled products, depending on the way it is to be further processed.

Aluminium mould castings are produced by foundries which use this technique to manufacture shaped components.

World-wide trends in production are shown in the following graph. Aluminium output has increased by a factor of 13 since 1950, making aluminium the most widely used non-ferrous metal. In 1998, world-wide production of primary aluminium was about 22.7 million tonnes per year for an installed capacity of 24.8 million tonnes.



Source: EAA, AA, JAA, ABAL, Alcan, Metallstatistik

Very recently China developed its aluminium production very rapidly, and it is the biggest producer in the world with almost 13 million tonnes of production.

The other main production areas are North America (6 million tonnes), Europe (5 million tonnes), former Cis (5 million tonnes), Africa, Australia, Brazil, India, and the Middle East. In Europe the main producing countries are Germany, France, Spain, UK and Norway. The primary smelting industry in Iceland is also expanding. World-wide, production plants are mainly located where suitable electrical energy resources are available.