

## Aluminum Anode Production

Aluminum is a truly valuable metal with a dynamic future. It has an excellent combination of light weight, high strength, superior corrosion resistance and excellent electrical conductivity. It is very easy to recycle - only 5% of the energy required to make primary aluminum is required for recycling a similar quantity. And 70% of the aluminum ever produced is still in use.

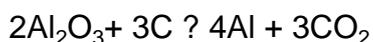
Aluminum lowers the weight of trains, planes, automobiles, structures and transmission lines, thereby increasing energy efficiency and promoting a better environment. Many consider aluminum a “green metal” for its ability to reduce vehicle fuel consumption.

Rain CII is a leading global supplier and innovator in the production of calcined petroleum coke (CPC), which is essential to the manufacture of aluminum. We know the aluminum industry and CPC’s critical role, and we supply CPC to numerous smelters around the world. Supply interruptions and inconsistent quality can disrupt aluminum smelting operations, and emerging supply and quality constraints can threaten a smelter’s very existence. Rain CII has the resources, expertise and commitment to meet these challenges and help aluminum producers take advantage of new opportunities.

**We know the challenges aluminum smelters face  
and the importance of CPC consistency.**

## The Smelting Process

Aluminum is produced electrolytically using the Hall-Heroult process. Alumina (Al<sub>2</sub>O<sub>3</sub>) powder is dissolved in a molten bath of sodium aluminum fluoride known as cryolite. The temperature of operation in modern cells is ~950-960°C. Electrical current is passed between carbon anodes and a carbon cathode in the cell, reducing alumina to aluminum metal that deposits on the cathode surface. Carbon anodes are consumed in this process, generating CO<sub>2</sub> gas. The basic chemical reaction is:



A modern electrolysis line, or “potline,” is shown above. Cells are connected in series and high-amperage DC current drives the electrolysis reaction. Modern cells operate at currents ranging from 200-500kA, but higher amperage cells are in development. Cells operate at a voltage of 3.8-4.5V; the energy required to produce 1 kg of aluminum is typically 12.5-14 DCkwhr. Aluminum smelting is energy-intensive and access to competitively-priced electric power is critical for low-cost production.

The [Aluminum Association](#) is an excellent source for information on aluminum and its many applications and benefits.

## Carbon Anode Production

Carbon anodes are essential to the production of aluminum, as described in “The Smelting Process” above.

Anodes used in the Hall-Heroult aluminum process are made from calcined petroleum coke (CPC) and coal tar pitch. Most smelters maintain an anode plant. A handful of standalone anode plants supply pre-baked anodes to smelters without plants and to those who need anodes because of production shortfalls or maintenance shutdowns.

Pre-baked carbon anodes made from CPC are used to produce aluminum. In addition to CPC and coal tar pitch, spent anodes or “butts” are used in the anode recipe. A typical breakdown is 67% CPC, 20% butts and 13% coal tar pitch. Green anodes are produced first and baked in large furnaces to a final temperature of approximately 1150°C. They are then rodded and used in electrolysis cells. Anodes are consumed in the process and must be replaced every 20-30 days, depending on the size and cell design.

CPC quality directly influences anode quality and performance. Smelters set critical quality parameters such as sulfur and trace metal impurities (vanadium, nickel, calcium, iron, silicon and sodium). CPC physical properties such as bulk density, real density and particle size are also important when making anodes. Because of its lower thermal expansion coefficient, CPC with a sponge coke structure is favored over a shot coke structure.

A modern 300kt/yr smelter produces approximately 500 anodes per day, so consistent CPC quality from shipment to shipment is very important. Many green petroleum cokes sold to the fuel market are unsuitable for making anodes due to their high impurity levels and undesirable structure.

For more information, see our [Technical Services](#) and [News & Publications pages](#).

---

Calcined petroleum coke quality directly influences anode quality and performance.

Our commitment to quality begins with careful selection of green petroleum coke from our network of supply partners.

Rain CII supplies CPC to anode producers and aluminum smelters around the world.

Providing CPC products to specification guides our quality systems from the core.