



## Manufacturing artificial graphite

Mersen's history began with a series of innovations associated with the manufacture of synthetic graphite. The 12th edition of Focus Mersen explains how Mersen manufactures this unique material and how its exceptional properties are used in many different applications in the industries of the present and the future and help fuel the Group's expansion.

### Brief history

Carbon and graphite exists in various different forms. Natural graphite is mined, whereas artificial graphite is produced through the graphitization of amorphous carbon, a process discovered and patented in 1893 by Charles Street, an engineer working at Le Carbone, the forerunner of the Group, which represented its first major innovation.

### The remarkable properties of graphite

The various uses of graphite derive directly from its exceptional physical properties.

Graphite is characterized by its resilience to very high temperatures and to corrosion, its thermal and electrical conductivity, its mechanical resilience, its self-lubricating properties, its suitability for machining and the length of its service life.

All these qualities make it a vital material for a whole host of industrial applications.

Before we take a closer look at them, we will first recap on the history and secrets of manufacturing synthetic graphite.

### Secrets of manufacturing graphite

#### Raw materials

- Three basic ingredients:
- > cokes, obtained through carbonization (above 1,000°C) of tar produced by distilling oil and coal,
  - > artificial graphite, which derives from the recycling of graphite materials
  - > carbon black or natural graphite, and additional ingredients: a derivative of oil and carbon used to bind the particles together.

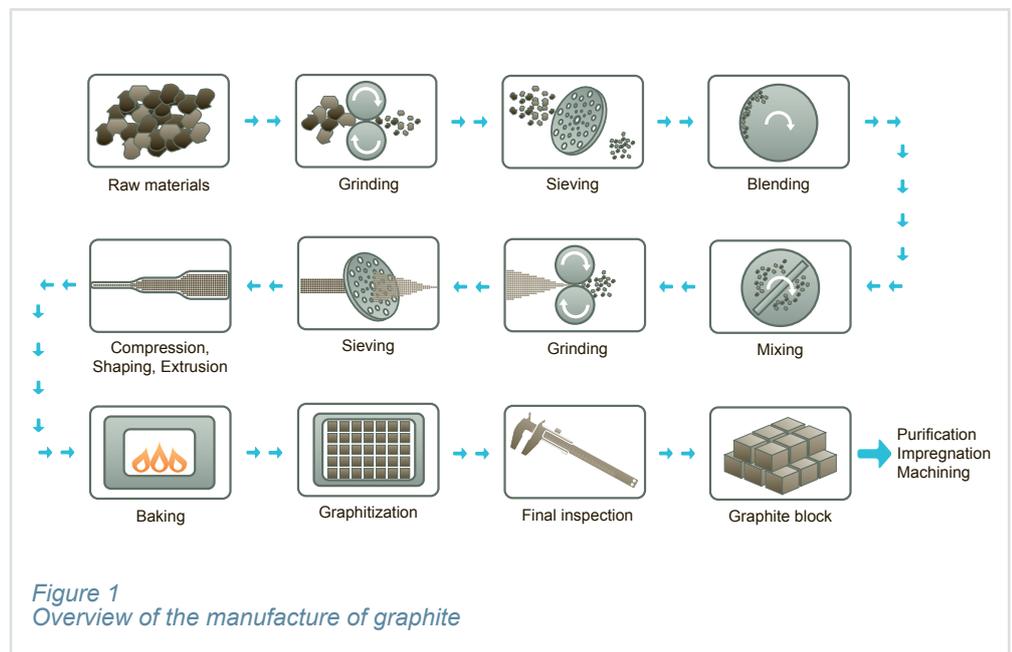


Figure 1  
Overview of the manufacture of graphite

## Manufacture (see figure 1)

After inspections to check their quality, the principal ingredients are ground up. The coke, graphite and solid binder are then loaded into a mixer that heats them up. The rise in temperature melts the binder and ultimately moistens the grains, before the gradual reduction in temperature serves to enhance the viscosity of the mix until it solidifies.

After further grinding, the mix is placed in a rubber mold to be compressed or shaped and it may be extruded into a die.

The volatile materials are then eliminated through baking. This extremely lengthy stage (1 to 2 months) takes place at a temperature of 800°C to 1,000°C.

Next comes the graphitization phase, which consists in heat-treating the blocks in an electric kiln at 3,000°C for one to three weeks. At a very high temperature, the carbon atoms realign themselves into hexagonal crystalline structures, which thus form artificial graphite. The substance's properties change. It becomes a good conductor and its resilience to oxidization improves.

The blocks are cut to the final dimensions and then undergo a series of tests (density, resilience, resistance to flexion, hardness, expansion coefficient, etc.) to safeguard its quality.

The first phase lasts for around four months in all.

Various additional purification and impregnation steps enhance the graphite's qualities and give it additional benefits for a number of industrial processes.

## Remarkable properties in highly demanding industrial environments

Based on the properties deriving from the manufacturing methods and production stages, graphite (see box) may be used in various applications, such as:

- > the manufacture of silicon, a critical component in the manufacture of solar panels,
- > the manufacture of LEDs and semiconductors,
- > highly corrosive environments, making it ideally suited for the fine chemicals and pharmaceuticals industries,
- > extremely high-temperature environments (kiln linings, glass-making, etc.),
- > mechanical structures: friction components, seamless joints, lubricating products,
- > electrical applications, notably including motor brushes,
- > rail industry, with collection strips.

## Various types of artificial graphite

There are various types of artificial graphite, and their diverse range of properties facilitates their use in a vast array of industrial applications.

- > High-quality isostatic graphite (compressed in an isostatic press) is used for solar energy applications, as well as LEDs and semiconductors, electrical discharge machining, glass industry and chemicals. Mersen is the world's co-leader of isostatic graphite.
- > Extruded graphite is used as electrodes in furnaces for the production of recycled steel.
- > Specialty extruded graphite is used in kiln equipment, heat exchangers, molds, crucibles, pods, etc.
- > Molded graphite is used to manufacture electrodes for electrical discharge machining, molds for continuous casting or sintering, etc.

## → Next issue of Focus Mersen

In a forthcoming edition of Focus Mersen, we will show how the extremely high degree of purity of Mersen's isostatic graphite and its technological innovations producing components in record-breaking dimensions can provide solutions to the new challenges facing the solar energy and electronics sectors.

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