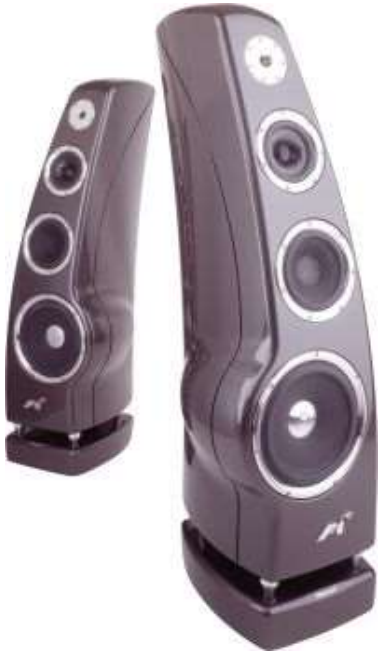


# Composite Materials

# Composite Materials

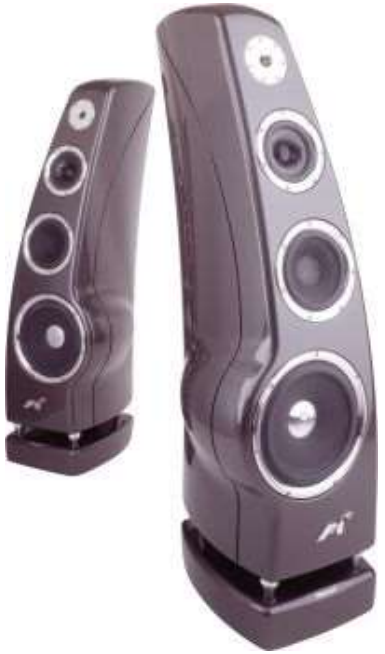
**Composite materials** (or **composites** for short) are engineered materials made from two or more constituent materials that remain separate and distinct on a macroscopic level while forming a single component.

The most primitive composite materials comprised straw and mud in the form of bricks for building construction. The most advanced examples perform routinely on spacecraft in demanding environments

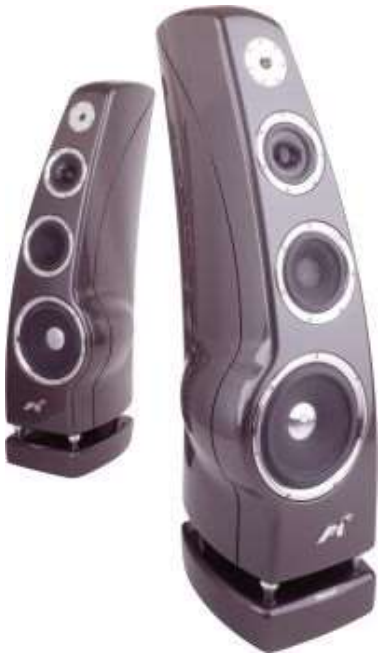
Many commercially produced composites use a polymer matrix material often called a resin or resin solution.

There are many different polymers available depending upon the starting raw ingredients. There are several broad categories, each with numerous variations. The most common categories are known as polyester, vinyl ester, epoxy, phenolic, polyimide, polyamide, and others.

The reinforcement materials are often fibers but also commonly ground minerals. Fibers are often transormed into a textile material such as a felt, fabric, knit or stitched construction.



Advanced composite materials constitute a category comprising carbon fiber reinforcement and epoxy or polyimide matrix materials. These are the aerospace grade composites and typically involve laminate molding at high temperature and pressure to achieve high performance components. These advanced composite materials feature high stiffness and/or strength to weight ratios.



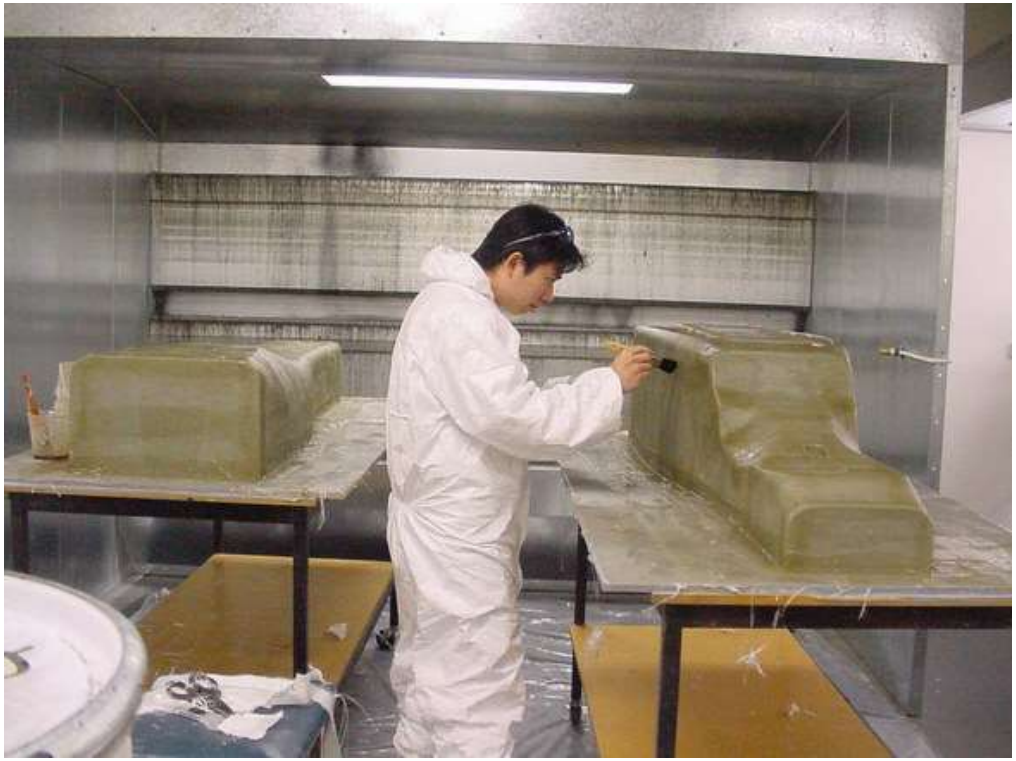
# Carbon fiber

**Carbon fiber reinforced plastic** or (**CFRP** or **CRP**), is a strong, light and very expensive composite material or fiber reinforced plastic. Similar to glass-reinforced plastic, which is sometimes simply called fiberglass, the composite material is commonly referred to by the name of its reinforcing fibers (carbon fiber)

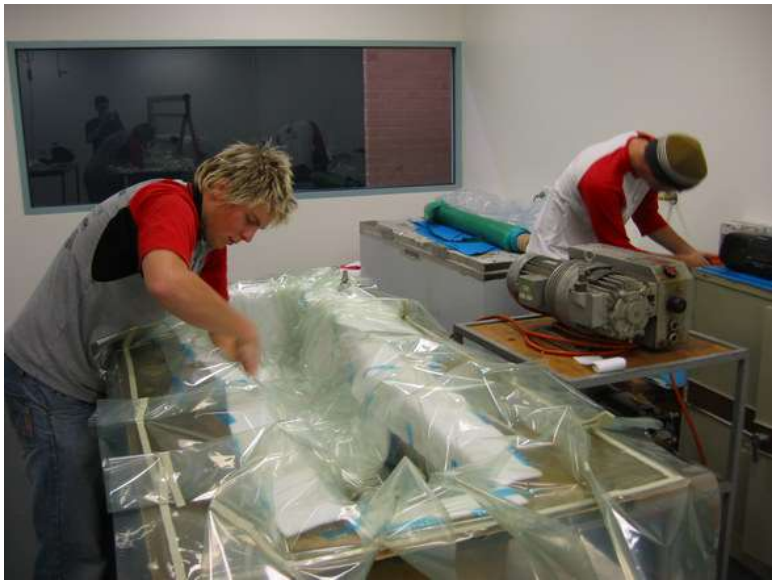
It has many applications in aerospace and automotive fields, as well as in sailboats, and notably in modern bicycles, where these qualities are of importance. It is becoming increasingly common in small consumer goods as well, such as laptop computers, tripods, fishing rods, racquet sports frames, stringed instrument bodies, and drum shells.

The material is produced by ....

• layering sheets of carbon fiber cloth into a mold in the shape of the final product. The alignment and weave of the cloth fibers is important for the strength of the resulting material.

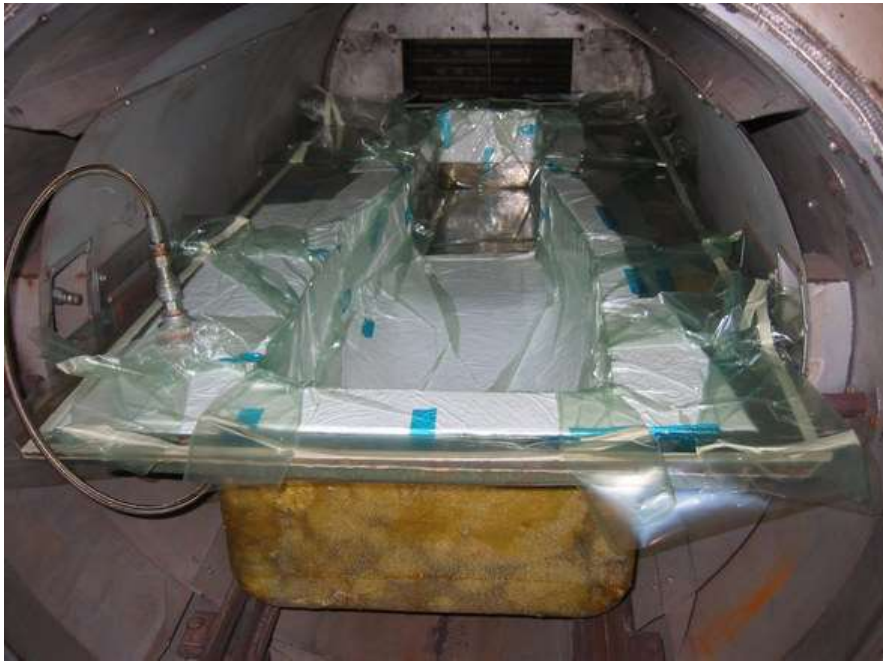


• In professional applications, all air is then evacuated from the mold,



Air bag being applied to mould

Air being evacuated from
bag surrounding mould



The mold is then filled with epoxy and is heated or air cured. The resulting stiff panel will not corrode in water and is very strong, especially for its weight. If the mold contains air, small air bubbles will be present in the material, reducing strength.

The large amount of (often manual) work required to manufacture composites therefore it limits its use in applications where a high number of complicated parts is required.

# Uses of Carbon fibre

CFRP is used extensively in automobile racing, most especially in F1 and Indycar racing. The high cost of carbon fiber is balanced out by the material's unsurpassed strength-to-weight ratio, and low weight is essential for high-performance automobile racing.

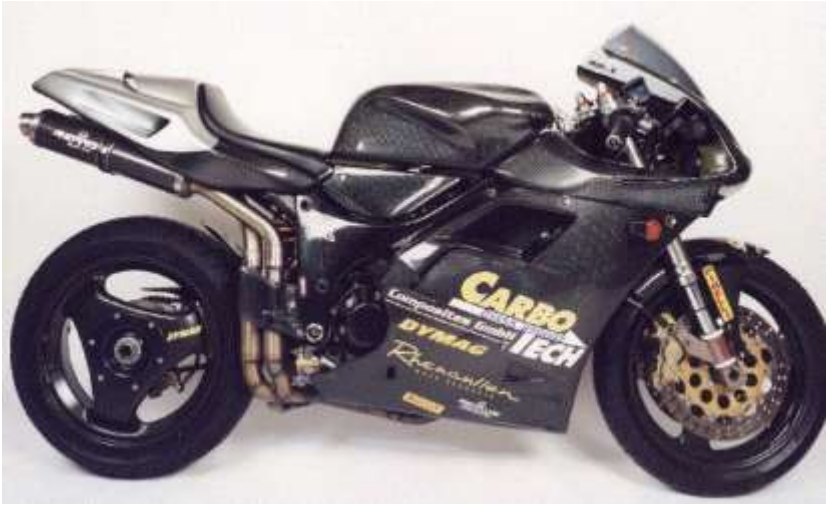
Racecar manufacturers have also developed methods to give carbon fiber pieces strength in a certain direction, making it strong in a load-bearing direction, but weak in directions where little or no load would be placed on the member.

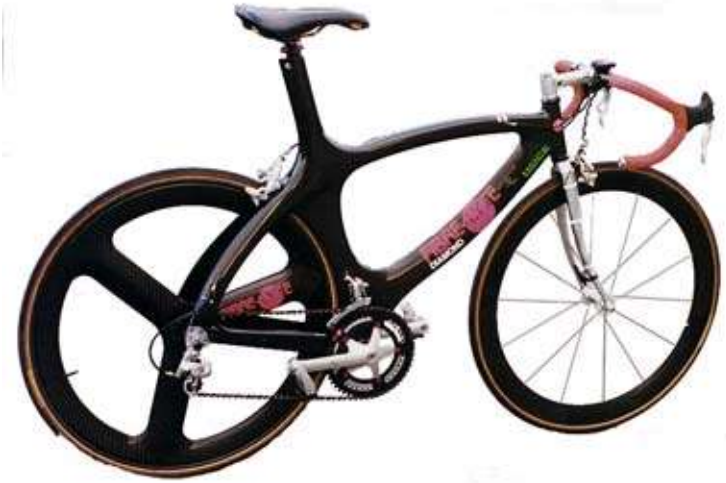
Conversely, manufacturers developed omnidirectional carbon fiber weaves that apply strength in all directions. This type of carbon fiber assembly is most widely used in the "safety cell" monocoque chassis assembly of high-performance racecars.

Several supercars over the past few decades have incorporated CFRP extensively in their manufacture, using it for their monocoque chassis as well as other components. Examples include the Koenigsegg ccR, McLaren F1, Bugatti Veyron, Bugatti EB110, Pagani Zonda, Ferrari Enzo and Porsche Carrera GT.

Until recently, the material has had limited use in mass-produced cars because of the expense involved in terms of materials, equipment, and the relatively limited pool of individuals with expertise in working with it. Recently, several mainstream vehicle manufacturers such as BMW have started to use carbon fiber technology in everyday road cars.

In addition to this many high end frames for road bikes and mountain bikes are made of carbon fibre reinforced composite. Also, many road bikes made of aluminum have carbon fibre reinforced composite seat posts, handlebars and forks for reduced weight.



# In Summary.

Carbon fibre is…

- Strong ( excellent strength to wait ratio)
- Lightweight
- Very expensive
- A composite material (two or more constituent materials that remain separate and distinct on a macroscopic level while forming a single component. In this case carbon fibre and epoxy resin
- Most commonly used in F1 and the aerospace industry, but is becoming more readily available.
- Good at resisting tension, shear, and compression,
- Designed to be impact resistant