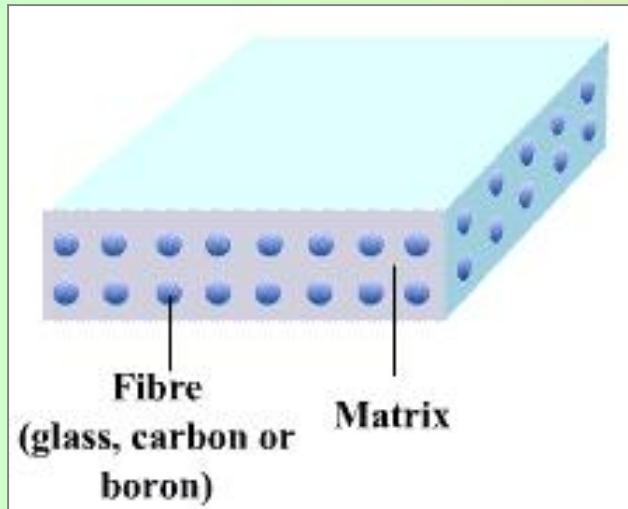


Composite Materials



What is a composite?

Composite materials are formed by combining two or more materials that have quite different properties.

The different materials work together to give the composite unique properties.

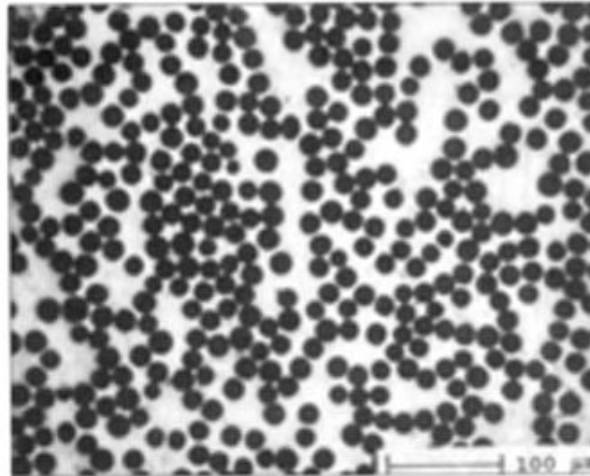
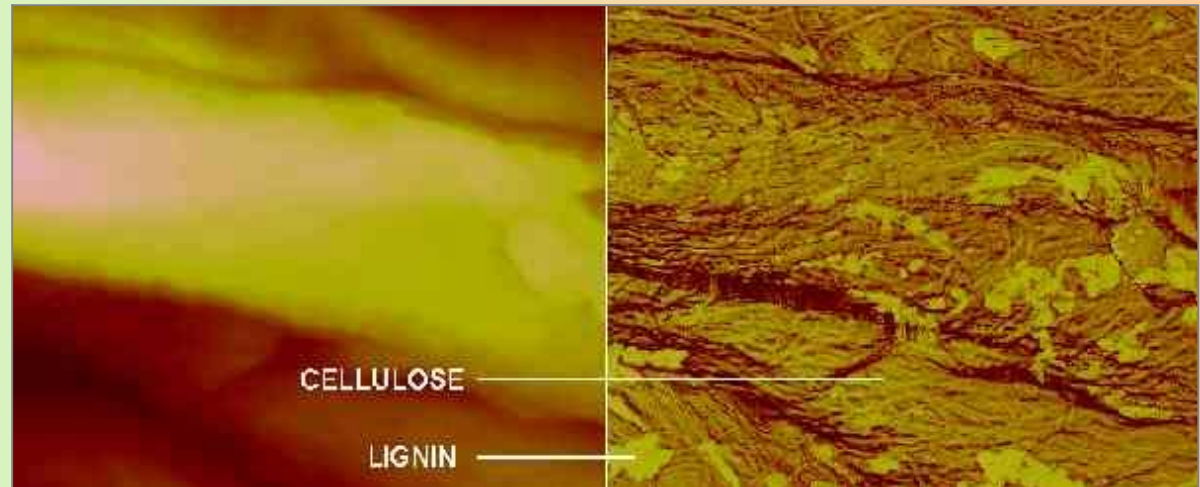
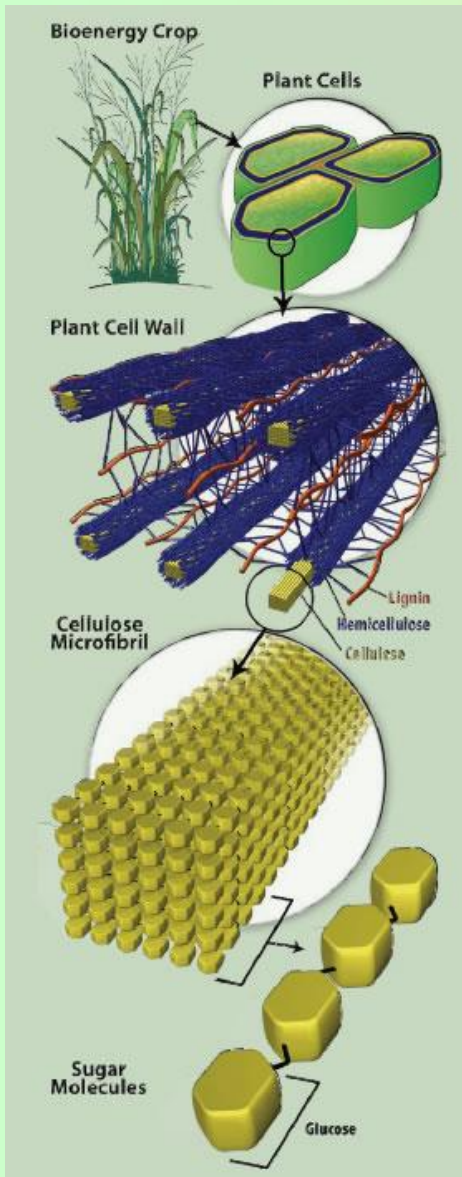


Fig. 1 Photomicrograph of the transverse plane of a composite containing SiC fibers in the matrix of Aluminum alloy. (After James P. Shaffer, et al., 1995)

Composite Materials

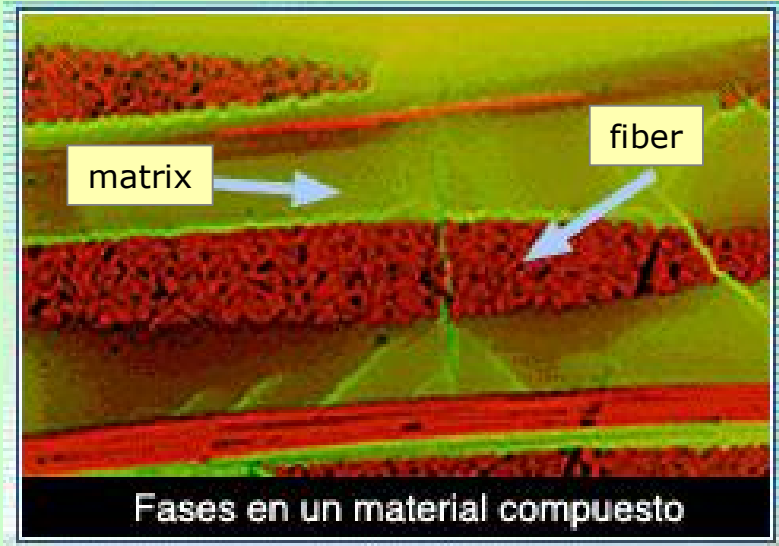
What is a composite?

Composites exist in nature. A piece of wood is a composite, with long fibres of cellulose (a very complex form of starch) held together by a much weaker substance called lignin.



<http://www.asmicro.com/Gallery/pulp.jpg>

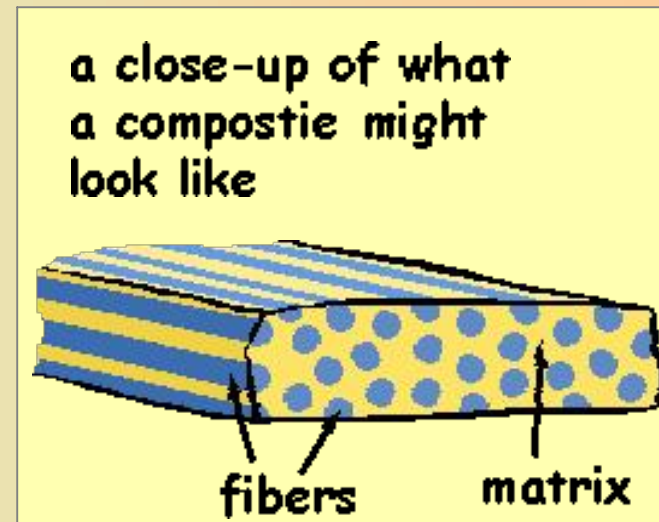
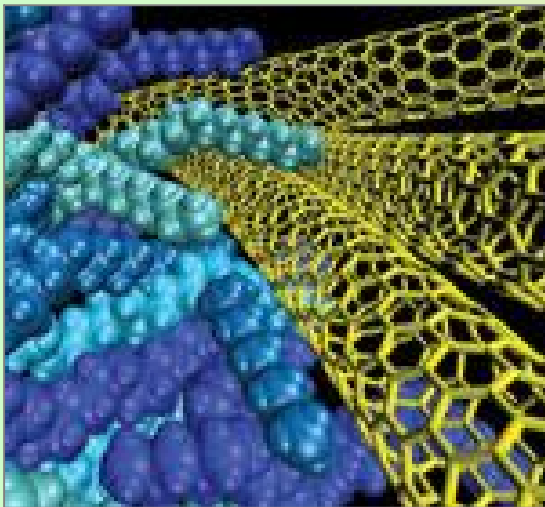
Composite Materials



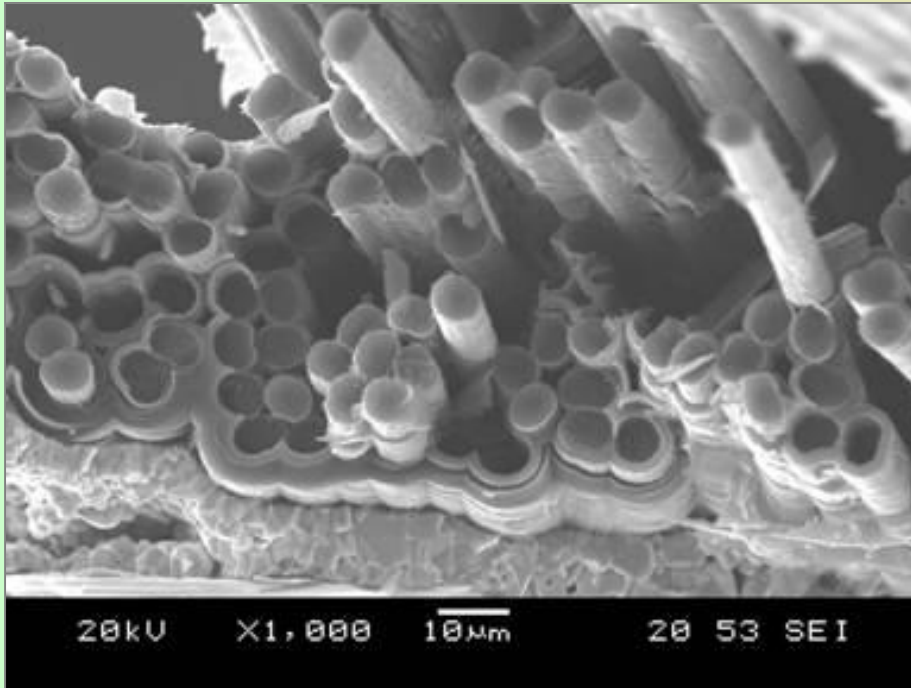
Composition

Most composites are made up of just two materials.

One material (the matrix or binder) surrounds and binds together a cluster of fibres or fragments of a much stronger material (the reinforcement)



Composite Materials



http://www.ultramet.com/images/fiber_interface_scanning_01.jpg

Composition: the matrix

For the matrix, many modern composites use **thermosetting** or **thermosoftening** plastics (also called resins).

The use of plastics in the matrix explains the name 'reinforced plastics' commonly given to composites.

The plastics are polymers that hold the reinforcement together and help to determine the physical properties of the end product.

Composite Materials

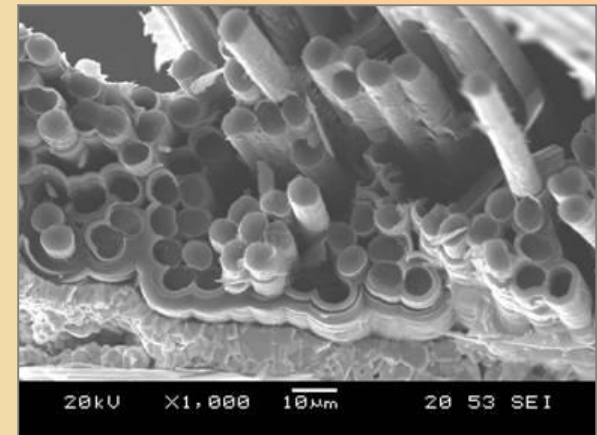
Composition: the reinforcement

Although glass fibres are by far the most common reinforcement, many advanced composites now use fine fibres of pure carbon.

Carbon fibres are much stronger than glass fibres, but are also more expensive to produce. Carbon fibre composites are light as well as strong.

They are used in aircraft structures and in sporting goods (such as golf clubs), and increasingly are used instead of metals to repair or replace damaged bones. Even stronger (and more costly) than carbon fibres are threads of boron.

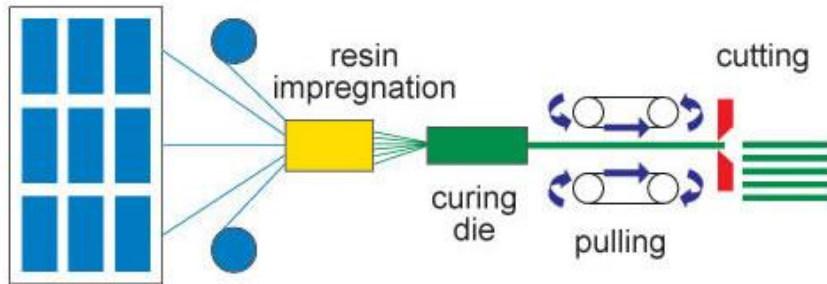
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Composite Materials

Pultrusion

rovings & mat
reinforcement



<http://www.ocvreinforcements.com/images/photos/pultrusion-large.jpg>



<http://www.yamunapower.com/images/pultrusion1.jpg>

The manufacturing process

Making an object from a composite material usually involves some form of mould. The reinforcing material is first placed in the mould and then semi-liquid matrix material is sprayed or pumped in to form the object.

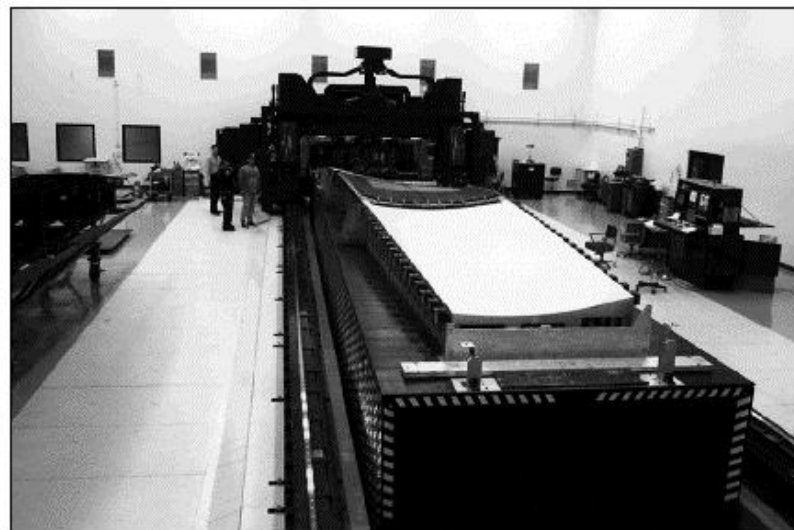
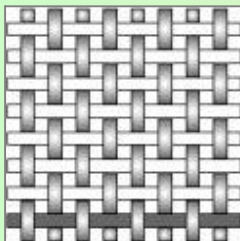
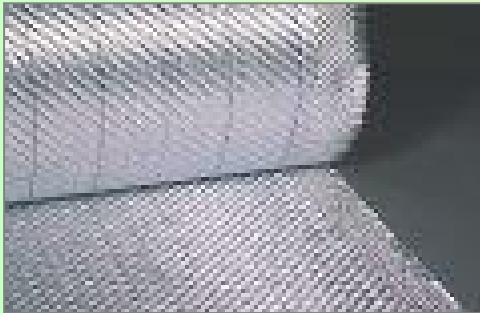
The moulding process is often done by hand, but automatic processing by machines is becoming more common. One of the new methods is called pultrusion. This process is ideal for manufacturing products that are straight and have a constant cross section, such as bridge beams.

Composite Materials

The manufacturing process

In many thin structures with complex shapes, such as curved panels, the composite structure is built up by applying sheets of woven fibre reinforcement, saturated with the plastic matrix material, over an appropriately shaped base mould.

When the panel has been built to an appropriate thickness, the matrix material is then cured.



NASA's Advanced Stitching Machine is located at the Marvin B. Dow Stitched Composites Development Center--a new Boeing facility that will produce low-cost composite wing structures.

Composite Materials



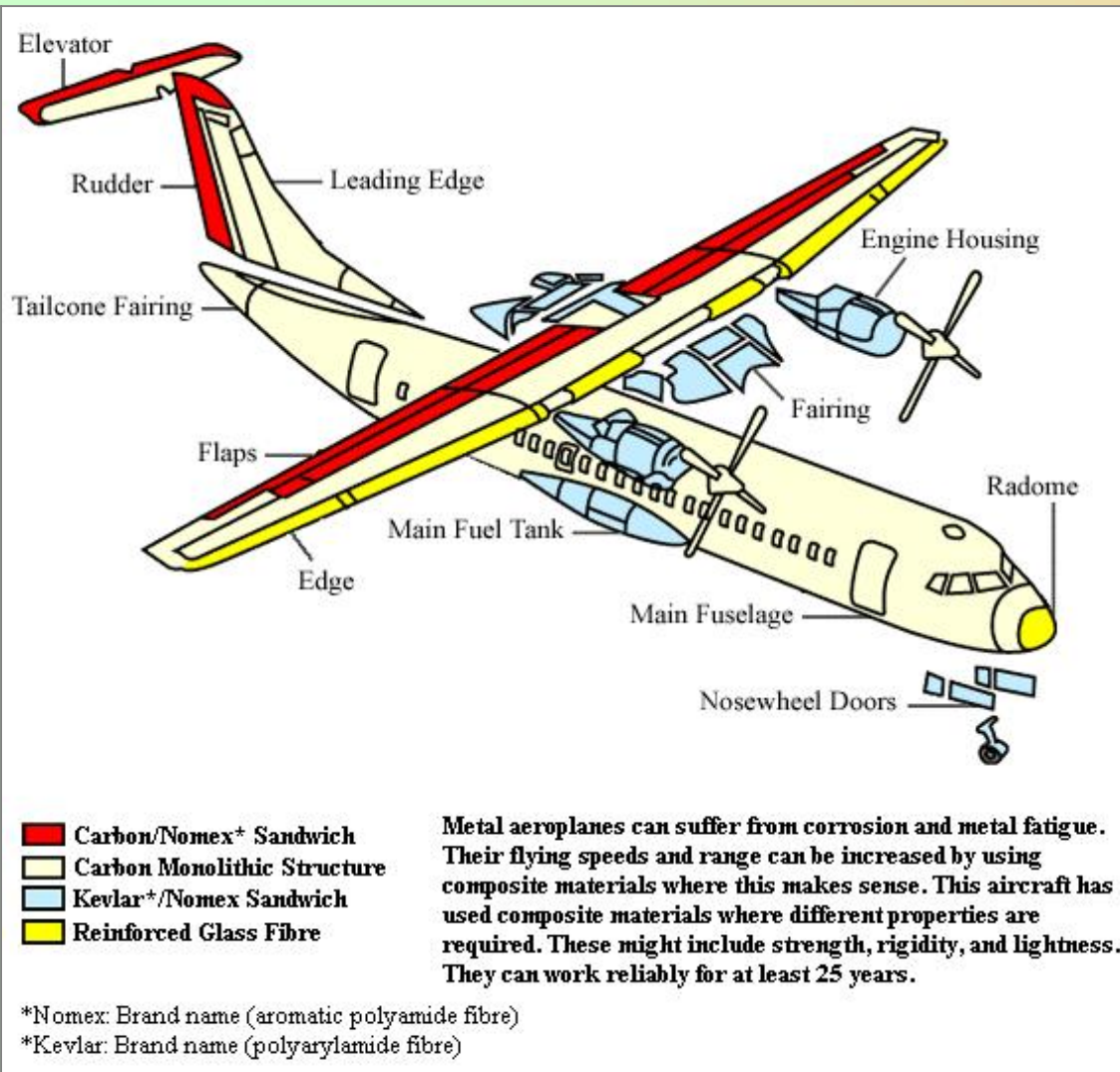
<http://www.advancedwest.net/images/adwest-home-collage.jpg>

Uses

The greatest advantage of composite materials is strength and stiffness combined with lightness.

By choosing an appropriate combination of reinforcement and matrix material, manufacturers can produce properties that exactly fit the requirements for a particular structure for a particular purpose.

Composite Materials



Uses

Modern aviation, both military and civil, is a prime example. It would be much less efficient without composites.

It is common now to find wing and tail sections, propellers and rotor blades made from advanced composites, along with much of the internal structure and fittings.

Composite Materials



http://www.plasmor.fr/images/banque-images/qui_sommes_nous/strat1.JPG



http://www.plasmor.fr/images/banque-images/qui_sommes_nous/demoulage5.JPG

Uses

The right composites also stand up well to heat and corrosion.

This makes them ideal for use in products that are exposed to extreme environments such as boats, chemical-handling equipment and spacecraft.

Another advantage of composite materials is that they provide design flexibility. Composites can be moulded into complex shapes - a great asset when producing something like a surfboard or a boat hull.

The downside of composites is usually the cost.