

FIBRE REINFORCED COMPOSITES - 3



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TERMINOLOGY

> Fibre Reinforced Composites are composed of fibres embedded in matrix material. Such a composite is considered to be a discontinuous fibre or short fibre composite if its properties vary with fibre length. On the other hand, when the length of the fibre is such that any further increase in length does not further increase, the elastic modulus of the composite, the composite is considered to be continuous fibre reinforced. Fibres are small in diameter and when pushed axially, they bend easily although they have very good tensile properties. These fibres must be supported to keep individual fibres from bending and buckling. Fiber Reinforced Polymer (FRP) Composites: "A matrix of polymeric material that is reinforced by fibers or other reinforcing material"

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Laminar Composites: are composed of layers of materials held together by matrix. Sandwich structures fall under this category.

Particulate Composites: are composed of particles distributed or embedded in a matrix body. The particles may be flakes or in powder form. Concrete and wood particle boards are examples of this category.

Metal Matrix Composites (MMCs): A metal matrix composite (MMC) is a type of composite material with at least two constituent parts, one being a metal. The other material may be a different metal or another material, such as a ceramic or organic compound. When at least three materials are present, it is called a hybrid composite. An MMC is complementary to a cermet.

Fiber Reinforced Composites

- Long continuous fibers whiskers, wires stronger than bulk provides high specific strength or stiffness
- > Orientation of fibers (*anisotropic*) in direction of loading fibers carry load





Fiber-Reinforced Composites





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Continuous Fiber Composite

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Chopped Fiber Composite



Short Fibre



Short Fibre





Kevlar fibers

Schematic diagram of Kevlar® 49 fiber showing the radially arranged pleated sheets





Lamina (or Ply): It is a single layer (plane or curved) of unidirectional or woven fabric in a matrix.



Laminate: Two or more unidirectional laminae or a ply stacked together at various orientations is called Laminate.

The laminae (plies) can be of various thicknesses and consists of different or same materials. Ex: (0/90/0), (0/0/0/0) = (04)



FIBRE

Fibre: A slender, elongated, threadlike object or structure.

Fibre: Fiber (American English) or Fibre (Commonwealth English, French) is a class of materials that are in discrete elongated pieces, similar to pieces of thread. Fibers are often used in the manufacture of other materials. They can be spun into thread or rope. They can be used as a component of composite materials. They can also be matted into sheets to make products such as paper or felt. Fibre: A unit of matter, either natural or man-made, which forms the basic element of fabrics. The term refers to units which can be spun into a yarn or felting and can be processed by weaving, tufting, knitting or fusion bonding.

Any of the filaments constituting the extracellular matrix of connective tissue.

> Fibre:

Any of various elongated cells or threadlike structures, especially a muscle fiber or a nerve fiber.

Role and Selection of fibers

- The points to be noted in selecting the reinforcements include compatibility with matrix material, thermal stability, density, melting temperature etc.
- The efficiency of discontinuously reinforced composites is dependent on tensile strength and density of reinforcing phases. The compatibility, density, chemical and thermal stability of the reinforcement with matrix material is important for material fabrication as well as end application.
- Also, the role of the reinforcement depends upon its type in structural Composites. In particulate and whisker reinforced Composites, the matrix are the major load bearing constituent. The role of the reinforcement is to strengthen and stiffen the composite through prevention of matrix deformation by mechanical restraint.

- In continuous fiber reinforced Composites, the reinforcement is the principal loadbearing constituent.
- The metallic matrix serves to hold the reinforcing fibers together and transfer as well as distribute the load.
- Discontinuous fiber reinforced Composites display characteristics between those of continuous fiber and particulate reinforced composites.
- Typically, the addition of reinforcement increases the strength, stiffness and temperature capability while reducing the thermal expansion coefficient of the resulting MMC. When combined with a metallic matrix of higher density, the reinforcement also serves to reduce the density of the composite, thus enhancing properties such as specific strength.



