COMPOSITES

A composite material is a combination of two or more materials that exhibit a significant proportion of the properties of all constituent materials.

They may be natural or synthetic.

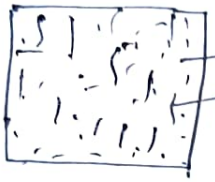
e.g. { Wood → cellulose fibres in lignin matrix
Bone → collagen fibres in mineral matrix } natural composites

e.g. Fibre glass plastic → synthetic composites

constituents of composites :-

composites consists of two phases :-

1- Matrix → forms the body of composite
2 Dispersed Phase → provide reinforcement



In Fibre glass plastic, fibre glass → reinforcement or dispersed phase
plastic → matrix phase

Matrix Phase :-

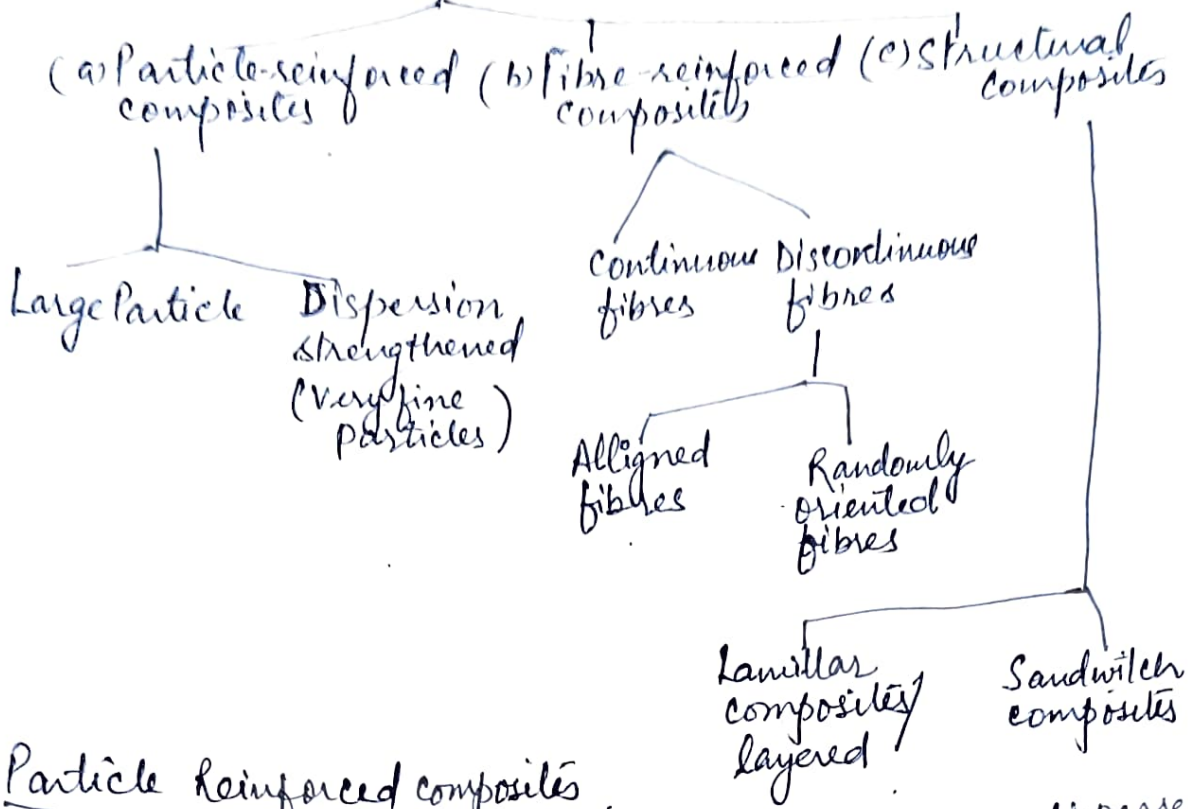
→ It binds the reinforcing material together.
→ It protects the reinforcing material from surface damage
→ Seperates the individual particles of reiforcing material.
→ Trasmits external load to the dispersed phase.
→ Prevents the propagation of brittle cracks because of its plasticity. Ex. Polymer matrix, metal matrix etc.

Dispersed Phase :-

→ It improves the strength of a matrix.
→ It must be stronger and stiffer than matrix.
→ It has high tensile strength.
Ex. glass fibres, carbon fibres, boron fibres, ceramic fibres, metallic fibres etc.

Classification of composites

(A) On the basis of Reinforcing material



(a) Particle Reinforced composites

(i) Large Particle composites → Particle size of dispersed phase is larger e.g. Carbon particles of 20-50 mm diameter are mixed in polymer matrix. This matrix is used in automobile tyres.

e.g. Cermet; → refractory carbide particles in metal matrix like tungstan carbide in Ni matrix, used as cutting tools for hardened steel.

e.g. Concrete → sand & gravel particles in cement matrix

(ii) Dispersion strengthened → They contain particles of the range 10-100 nm diameter, may be metallic/ Non-metallic.

e.g. High temp. strength of Ni alloy (matrix) is improved by adding fine particles of Thoria (ThO_3)

(b) Fibre-reinforced composites :- They contain fibres as reinforcing material. Their strength depend upon
(i) fibre length and (ii) fibre orientation.

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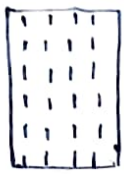
fibre length may be long → continuous fibres
or
short → discontinuous fibres

Fibres orientation may be parallel or random


Continuous — Aligned Discontinuous — Random Discontinuous

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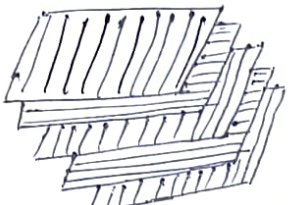
have more strength in the direction of allignment than in the other direction

have less strength than continuous but are cheaper and can adopt any shape easily.

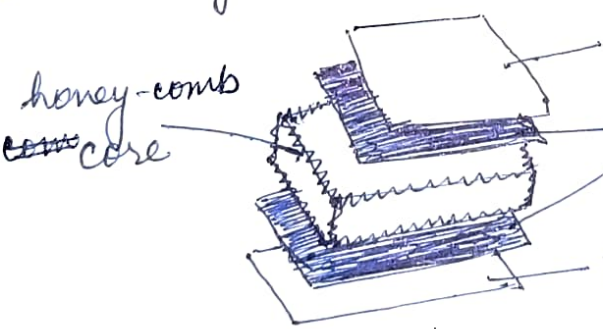
(c) Structural Reinforced composites :-

(i) Lamillar / layered :- In which two-dimensional layers of two different materials are stacked together & form composite structure. Each layer is known as lamina. e.g. Plywood, cladded metal, Plastic based laminates etc.

(ii) Sandwich Panels :- These composites consists of two strong outer sheets seperated by a less dense layer of core. The core material is of lower strength & stiffness.



Lamillar composite



Sandwitch panels are used in air. crafts for wings, walls of buildings etc. Also used in safety safety glasses.

(B) Classification on the basis of Matrix Phase

They are of following types.

(a) Polymer Matrix composites (PMC) → Polymer may be thermoplastic or thermosetting
e.g. Polyester matrix with carbon fibre reinforcement used in military helicopters etc.

(b) Metal Matrix Composites (MMC) - Metal or metal alloy = matrix with some reinforcement
e.g. Al matrix with carbon fibres used in aerospace field.

(c) Ceramic Matrix composites (CMC) - They may be reinforced by long or short fibres. Most ceramic Matrix composites are reinforced by SiC fibres due to high strength.

Advantages of composites :-

- Economic & cost effective
- Light wt
- Durable
- ~~Tailor~~ → Tailor made
- Easy to manufacture
- Excellent mechanical properties (e.g. tensile strength)
- Excellent chemical properties (e.g. corrosion resistance)
