

2.4 Composite Materials – Types and applications

Composite Materials

A composite material may be defined as an artificially prepared or natural multiphase material that exhibits a significant properties of the both the constituent material such as high strength, stiffness and high coefficient of thermal expansion in which the chemically dissimilar phases are separated by distinct interface.

Applications of composites

- Automobiles industries: Automobile parts like components of engine, spray nozzle, mud guards, tires etc
- Aeronautical applications: structural components like wings, body & stabilizer and fuel of aircraft, rocket army missiles in military etc
- Marine applications: shaft, hulls, spars and other part of ships
- Safety equipment like helmets
- Sport equipment like tennis rockets, golf sticks, other safety equipment
- Communication Industry like preparation of antennae and electronic circuit boards

Constituents of Composites Two essential constituents of composites are

1. Matrix phase: It is the continuous body constituent (Dispersion phase) which encloses the composite and gives its bulk form. It may be polymer, metal or ceramic material.
2. Dispersed phase: It is the Structural constituent (Dispersed phase) which determines internal structure of the composite and gives its bulk form. It may be Fiber, Particulate, Flakes or Whiskers

Types of Composites Based on the dispersed phase in the given matrix of composite they are classified as

- Fiber reinforced Composite
- Particulate Composite
- Structural Composite

Fiber reinforced Composite

It is Consist of dispersed phase fiber and a continuous or dispersion phase polymer or metal or metal alloy with a bonding agent. Such composites possess high specific strength, specific modulus, stiffness, and corrosion resistance and lowers density

The mechanical characteristics of FRC depend on the following

- Properties of fiber
- Interfacial bond between fiber and matrix
- Fiber length like longer gives continuous, shorter length gives discontinuous or random. Reinforcement efficiency of continuous is higher than short fibers.
- 4.Fiber orientation and concentration ie if it is orderly orientation and continuous it is highly anisotropic or discontinuous or random orientation

Particulate Composite

The solid particulates of metal oxides or carbides of varying size and form dispersed in metal , metal alloy, ceramic or polymer liquid matrix. Particle reinforced composites are further classified into the following two types

1) Large -particulate composites

2) Dispersion strengthened composites

1) Large -particulate composites large particle composite used with all the three major types of materials, namely metals, polymer and ceramics

C. Structural composites

Structural composites are prepared by compressing the stacking of layers of fiber reinforce composites these are of two types

1. Laminated composites

2. Sandwich composites.

Laminated Composites: A Laminar composite consists of two-dimensional sheets or panels that have preferred high strength direction, successive oriented fiber reinforced layers of these are stacked and then cemented together in such a way that the orientation of the high strength varies with each successive layer

Sandwich panels: These usually consist of two strong outer sheets called faces, separated by a layer of less dense material called core which is of lower strength and lower stiffness.

Applications of Composite Material

1. Space: antenna, radar, satellite structures, solar reflectors, etc.
2. Aircraft: Aero foil surfaces, compressor blades, engine bay doors, fan blades, rotor shafts in helicopters, turbine blades, turbine shafts, wing box structures, etc.
3. Automobiles: automobile body, bumper, mudguards, door panels, dashboard, driveshaft, fuel tank, CNG cylinder, chassis, fender, etc.
4. Wind turbine blades: rotor blades, nose cone, nacelle cover, accessories for wind electric generators.
5. Sports: Skis, surfboards, windsurfing, table tennis boards, slats, and gliding wing spar, Tennis, badminton, fishing rods, golf clubs, baseball bats, hockey sticks, pole shaft, Sword, etc.