4.1 Fibre reinforced plastics

It is a composite material. We know that the composite materials have been developed to get improved or desired properties in them. Nowadays fiber reinforced plastics (FRP) plays an important role in the machine parts where we require high strength, high modulus, heat resistance and light weight.

The fibrous glass is used in reinforced plastics in the form of ravings, chopped strands, milled fibers, yarns, mats and woven fabrics. Most commonly used reinforcements are

(i) Random chopped strand mat, bonded together with a resinous binder (polyster).

(ii) Mat from continuos strands, deposited in a swirl pattern and loosely bonded together with a resinous binder.

(iii) Filament type thin mats.

(iv) Performs

(v) Woven fibrous glass clothes.

(vi) Parallel stranded glass fibers

(vii) Short stranded

The glass fibers having a vinyl silence-epoxy surface treatment on the fibers are used. This treatment gives best dry and wet strength. E type glass is one of the important glass fiber materials which use boric acid rather than soda ash as one of the component of the melt. Mostly polyester resin is used as plastic. Epoxy and phenolic resins are also used.

The fibers are made from synthetic textile fibers treated in such a way that the side groups are entirely removed. The carbon fiber reinforced plastics are used in aeroengines, high pressure rotor and stator blades since they can withstand higher thrusts. Silica and boron fiber reinforced plastics have high strength and low density. But these are all costlier than glass or carbon fiber reinforced plastics.

Advantages

1. It has high strength to weight ratio
2. It has low cost tooling.
3. Large shapes are possible in one piece. Since it can be fashioned more easily than a metal it is used in making complicated machine parts.
4. Excellent environment exposure resistance can be obtainable.

5. It has excellent electrical properties.
6. It has higher heat resistance.

Disadvantages

1. The material cost is so high.
2. The strengths perpendicular to fiber orientations are low.
3. It has low rate of heat transfer and dissipation.
4. It has lower flexural modulus than steel and requires higher thickness .

Fiber reinforced metal

Fiber reinforced metals (FRM) are composites, which are made up of inorganic fibers fabricate with metal.

FRM are composed of fibers (reinforcement phase) and metals (matrix phase). The following diagram exhibits the FRMs (silicon fiber reinforced in metals).

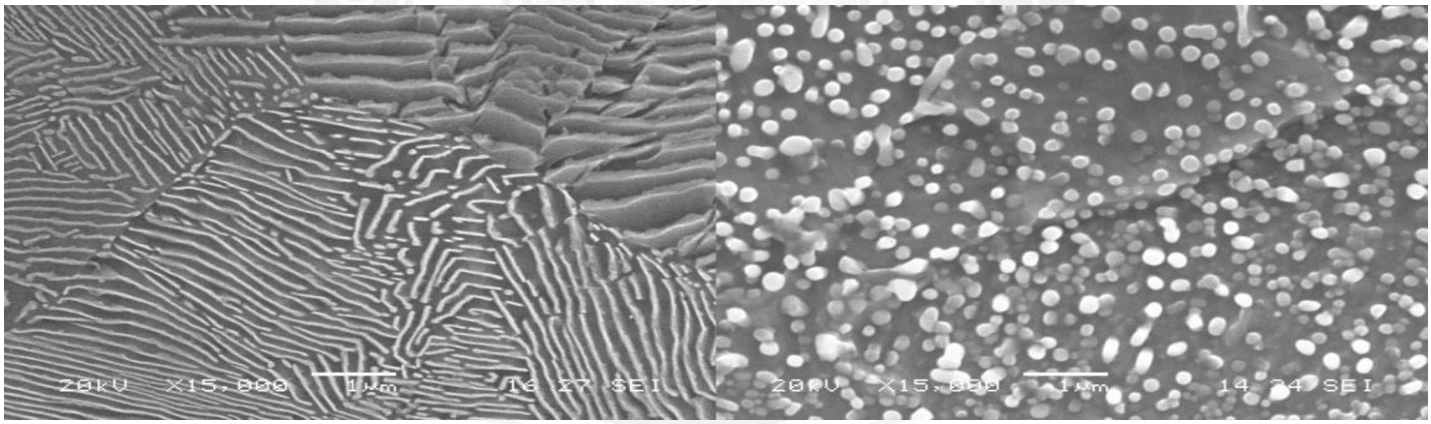

Fig:4.1.1- Fiber reinforced metal

Fabrication of FRM

The fabrication of FRM consists of joining the interfaces of both phases. Before doing the fabrication of FRM, the reinforcement fibers and the matrix materials should be choosen carefully with light weight and high strength materials.

The reinforcement fibers and the corresponding matrix metals used for fabricating FRM are given below.

S. No	Reinforcement Fibers	Matrix metals	Composite System
1.	Boron	Al and Mg	Boron System
2.	Carborundum	Al and Ti	Corborundum System
3.	Carbon	Al, Mg and Cu	Carbon System
4.	Alumina	Al and Mg	Alumina System

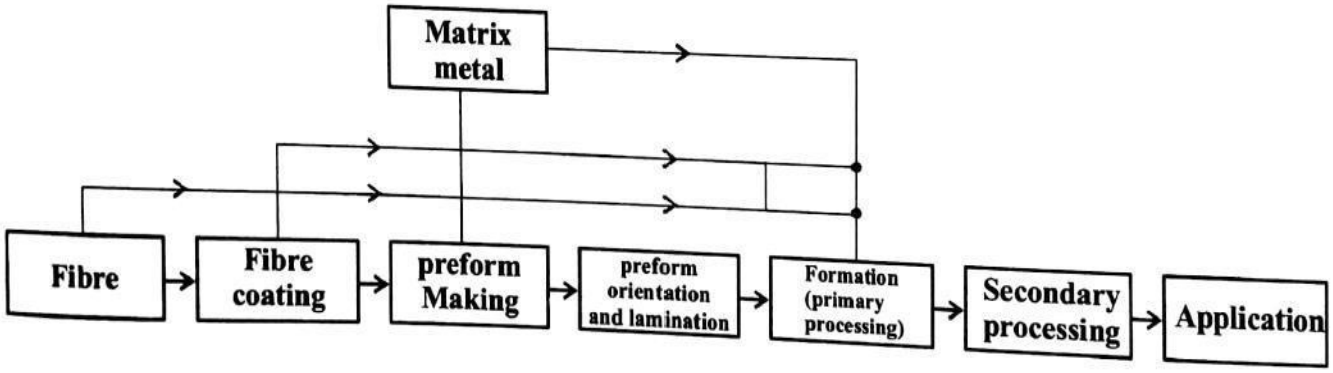

Fig:4.1.2-Matrix Process

1. Depending upon requirements, fibers are given pre-treatment such as fibre coating to improve wetting and joining ability with matrix metals and to prevent failure caused by reaction between different surfaces.
2. Then, performs are made, which are cut to the required dimensions.
3. These performs are oriented and laminated according to the design specifications of the components.
4. The next process is called forming (primary processing) in which composition and shaping is carried out.
5. At this stage the matrix metal and the reinforcement fibers are primarily processed together to form the FRM composite.
6. After forming the FRM, the secondary processing such as cutting, trimming and joining is done.

   Thus the fabrication is complete and shall be used for further applications.

Properties of FRM

i) FRM is light weight

ii) FRM has a high stiffness

iii) FRM possess high strength at high temperatures [i.e. 200 to 400 ˚C].

iv) FRM are high in inter-lamina strength and stress transmissibility between filaments and highly resistant to polyaxial and complex stress.

v) FRM are resistant to impact and superior in extreme low temperature characteristics.

vi) FRM are infiltrated by water and are not corroded by rain.

vii) They do not require any measures against lightning strike or static, nor any coating for electromagnetic shielding

Applications of FRM

i) FRM are used in constructing space machines and satellite body structures. The material system used for this are B/Al, B/Mg, C/Al, C/Mg.

ii) FRM are to make pylons, frames, beams, fans, compressor blades, fairings, wing boxes, access-doors in air crafts. The material systems used here are B/ Al, SiC/ Al.

iii) FRM are used to make truss structures in helicopters. The promising material systems used are B/ Al, SiC/ Al, Al2O3/ Al.

iv) FRM are used to make engine electric components such as motor brushes, cables, etc., C/Cu is the material systems used for these products.

v) FRM are used to make sports goods such as tennis rackets, Golf clubs, etc., the materials systems used for these are B/ Al, SiC/ Al, C/Al, Al2O3/ Al.