Why Composites?

The possibilities of traditional materials such as metals and their alloys are so exhausted that even when using the most modern techniques it may be difficult to achieve the highest material characteristics and thus higher performance parameters, the durability and reliability of the proposed structures and equipment.

The Advantages and Disadvantages of Composites

The advantage of composites as structural materials is to obtain a material of a higher strength, toughness, stiffness, but also a higher resistance to creep, corrosion, wear or fatigue compared to conventional materials. In addition, with a suitable combination of components we can also obtain a composite of specific properties (thermal, electrical, optical). The disadvantage of composite materials, in comparison with traditional materials, is its difficult workability and relatively higher price.

The Definitions of Composites

The term composite means composed, therefore it should be material that is composed of two or more components. However, this would mean that most natural and synthetic materials and alloys belong to this category. The definition should be clarified.

As composites can be considered material composed of two or more components (phases), where at least one of them is solid, reaching the properties which cannot be provided by any of the components separately or not even by their mere sum.

The properties of composites are achieved by cooperation the individual phases called the synergistic effects.

A composite, in the present context, is a multiphase material that is *artificially made,* as opposed to one that occurs or forms naturally. In addition, the constituent phases must be chemically dissimilar and separated by a distinct interface. Thus, most metallic alloys and many ceramics do not fit this definition because their multiple phases are formed as a consequence of natural phenomena.

In designing composite materials, scientists and engineers have ingeniously combined various metals, ceramics, and polymers to produce a new generation of extraordinary materials. Most composites have been created to improve combinations of mechanical characteristics such as stiffness, toughness, and

The Compositions of a Composite

The matrix Phase

The matrix combines the individual particles of reinforcement, protecting them against external influences and prevents their violation. The basic function of the matrix is to transmit the external load onto the reinforced phase. For the matrix, a good bond strength with the reinforcing phase material (i.e. perfect wettability without chemical interaction at the interface of the matrix and reinforcement) is required. Among other requirements for the matrix, a low weight is commonly included. In comparison with the reinforcement phase, a matrix has generally lower strength and greater plasticity.

The reinforcement Phase

The reinforcement phase transmits the bulk of the external loads. It is expected to have high strength and a modulus of elasticity E (E is about one order higher than that of the matrix), as well as a small deformation at a fracture with a high proportion of elastic deformation. Regarding the tensile behaviour of the composite it is given by the shape, concentration and orientation of reinforcement. The composite material properties depend upon the properties of each of its phases, their relative proportions and their geometry. Schematic representation of several geometric and spatial characteristics of particles of the dispersed phase are shown in Figure 1.

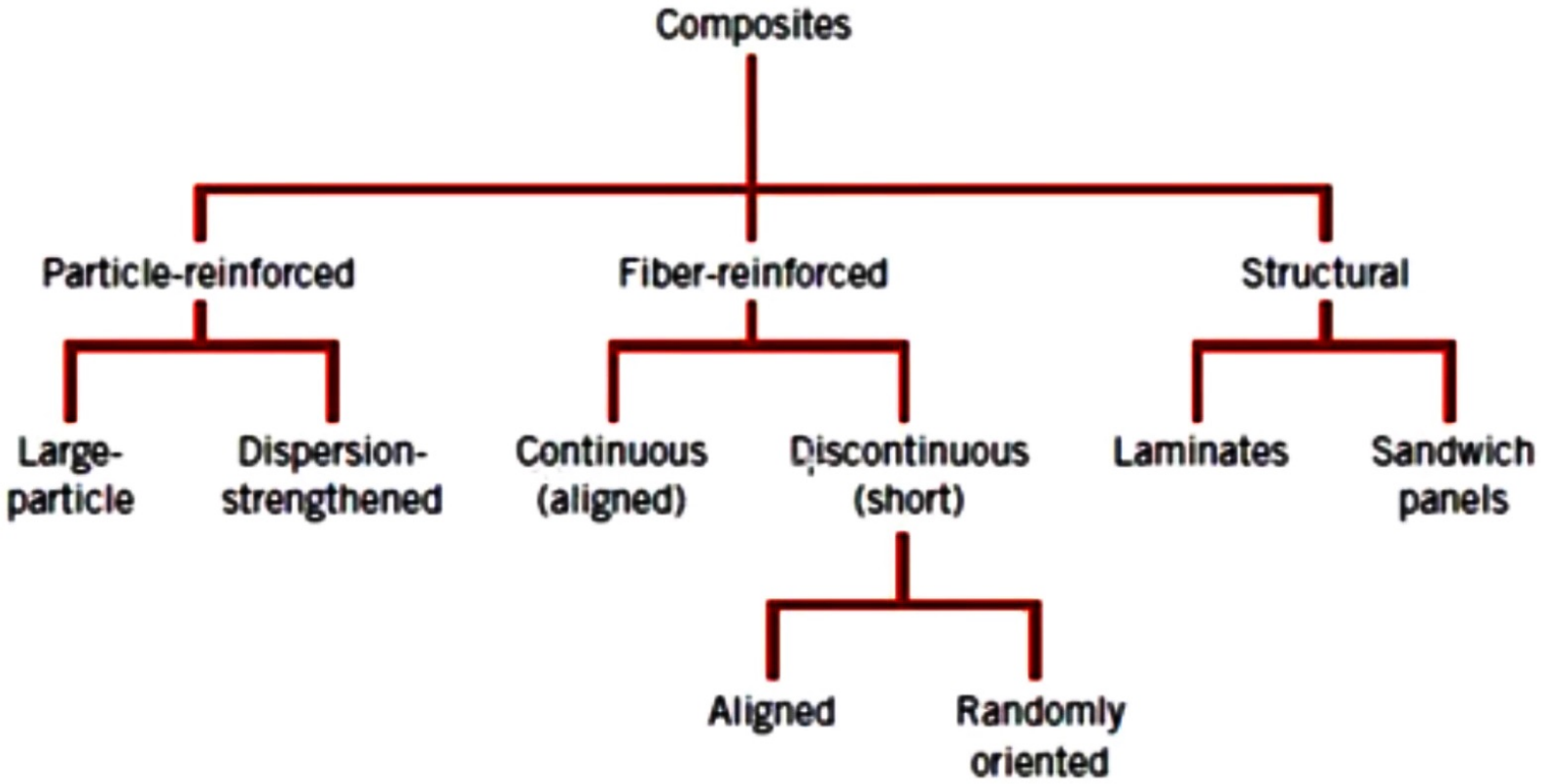

Figure 2 A classification of composite materials.

Where are composites used?

- **Automotive industry: Lighter, stronger, wear resistance, rust-free, aesthetics:**

– Car body

– Brake pads

– Drive shafts

– Fuel tanks

– Hoods (Bonnet)

– Spoilers

- **Sports: Lighter, stronger, toughness, better aesthetics, higher damping properties:**
  - Tennis
  - Bicycles
  - Badminton
  - Boats
  - Hockey
  - Golfing
  - Motorcycles …

– RV bodies

- **And many more industry sectors:**

– Biomedical industry

– Consumer goods

– Agricultural equipment

– Heavy machinery

– Computers

– Healthcare