POLYMERIC COMPOSITE MATERIALS: IN MANUFACTURING OF LIGHT WEIGHT HELICOPTERS

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ABSTRACT

Composites are materials created by combining dissimilar materials with a view to improve the properties or to create materials with desired properties Fiber reinforced plasticsare the combination of a reinforcement fiber in a thermoset polymer ,, where the reinforcement has an aspect ratio that enables the transfer of loads between fibers, and the fibers are chemically bonded to the resin matrix.

To maximize the benefits of composites it is also essential that the fibre orientation be optimally tailored to meet the strength and stiffness requirements for a particular application.That is composites can be tailored to be anisotropic (capable of carrying load in a particular direction) rather than quasisotropic (equal strength in all directions); hence, orienting the fibres in the direction of the load will optimally result in the most weight efficient structure.

Keywords: Anisotropic Resin Matrix, Thermoset Polymer, Quasiisotropic

I. INTRODUCTION

Composite material are made up of two are more constituent materials to obtain the desired properties. Filament and resin is the basic constituent of ceramic material.

WHY COMPOSITES?

Composite materials are being developed and made with two kinds of objectives:

1. To enhance the material properties and performance efficiency.
2. To design materials with combinations of desired properties.

1. Enhancement of Properties and Performance Efficiency

The first generation of composite materials which are in wide scale use today were developed with a view to create materials with high specific properties like higher specific strength and/or higher specific modulus. The specific property of materials is the ratio of the property under consideration and the specific gravity of the material. Composites with improved impact, fatigue and creep resistance were also created. All these improvements were achieved by choosing the lightweight matrices like polymers and reinforcing them with reinforcement fibres of high specific properties in specific geometrical patterns. By proper orientation of the fibres, directional properties are also achieved.

Composites made by adding 55% by volume of fibre to an epoxy matrix. Fibres are uniaxially oriented. The properties achieved in such composites are the additive properties where the property is related to that same

property of each of the components and the property achieved depends on the geometrical arrangements of the two components. Thus, properties like specific gravity, elastic modulus, strength, thermal conductivity, electrical resistance etc. lie between the respective properties of the components used for making the composites. It is also possible sometimes that the properties like impact resistance, acoustic damping, Poisson's ratio etc. can be outside the ties boundary of the properties of constituent materials.

Advantages of composite materials in aerospace industry:

1. Weight savings are significant.
2. Corrosion resistance is outstanding.
3. Impact and damage tolerance is excellent.
4. Low thermal expansion.
5. Tooling is cheaper.
6. Excellent damping feature.
7. Improved frictional resistance.
8. Material waste is reduced.
9. Design flexibility.
10. Resistance to crack propagation.
11. Rigidity enhanced by sandwich.
12. Easy to repair.
13. High dimensional stability.
14. Manufacturing and assembly simplified by part integration.
15. High torsion stiffness.
16. Material handling is easy.

II. APPLICATIONS IN AERONAUTICS:

Complete air frames for small commercial, leisure and military aircrafts, rudder, ailerons, wing panels, cowlings, flooring, floor beam, seating, interior cladding and lockers, foot trolleys, torque tubes, piping and ducting, pressure vessels, escape equipment, engine cowlings, propellers, fan and compressor blades, bypass ducts, thrust reverser systems, helicopter air frames, and under carriage components; brake components, radomes, electronic housing, flight helmets etc.

Main Rotor Blade (Glass carbon prepreg) **Hub Plate (Carbon prepreg)** **Aris Spring (Glass prepreg)**

Fig. 1: Composites Used In Manufacturing of Various Parts of Aeroplane

III. APPLICATIONS IN AEROSPACE

Heat shield panels, cylinder, nose cone, shear webs, decks, etc. great weight saving in space shuttle and space station, provide dimensional stability and low cte.

Space Shuttle

Aero Engine

IV. APPLICATIONS IN MILITARY

Rocket motors and launch tubes, equipment boxes, spall linings, Amour, helmet, gun cowlings, bridge elements, vehicles bodies and doors, radar components, motor tubes and bases, underwater weapons, gun barrels, scaling ladders, temporary building etc.

V. MANUFACTURING PROCESS

Manufacture of product consists of shaping the material in the designed product geometry and finishing it in a usable form. The manufacture of composite products differs from manufacturing with conventional materials in three ways. Firstly, the material structure of composites is also created while the product is being made which means, there is a greater responsibility on the manufacturer to ensure that the right material structure as designed must be created during the process. Secondly, there is a chemical reaction involved in the processing of thermo-set resins and this cure must be complete. Finally, composites are costly materials and therefore every effort is needed to partially offset this high cost by improved productivity. The total manufacturing process in a composite product making operation can be divided into three stages.

1. Pre processing stage
2. Processing stage
3. Post processing stage

5.1 Pre processing

The pre-processing operations are required to make the materials, machinery and moulds ready for processing to commence. Pre-processing of material has an important role in composite product manufacture. Half a dozen materials go into the preparation of composites and some chemicals are added in small quantities, the measurement of which may take long time affecting the production time. If materials are made in a ready to use form in their right proportions, it will not only save time, but also help to maintain the material proportion within the finished product. In processes in which such compounding is not possible, the resin mix with ingredients can be made separately and the reinforcement fibres can be stitched in a ready to use form. The conditioning of materials for a trouble free processing with minimum production cycle time is the major task of pre processing operations. Different processing methods require the material preparation also made differently.

5.2 Processing

Processing is the actual stage of making the product in proper geometric form. In thermo-set PMC, it involves

- Placement of reinforcements with or without resin impregnation, placement of moulding compounds or pre-pegs in proper proportion, orientation and packing.
- Shaping the product configuration
- Curing the resin into a solid material
- Releasing the moulded product from the mould.

The processing method shall ensure the following requirements

- The material composition and microstructure of the finished product shall be as per the design
- The processing operations including the heat and pressure applied shall not cause any degradation of the fibres, resins or fillers used
- There shall not be any chemical reaction with the fibre easily reproducible.
- The processing method shall maintain consistency in the quality of the product.

  3.Post curing: - It is referred as additional exposure of already cured component or tool to normally higher than the cure temperature.

VI. CONCLUSION

The processes can achieve part integrations and reduce the part counts up to 60% over the conventional metal assemblies. The carbon fibres find a major outlet in the aerospace industry. Because aerospace structures are exposed to a range of environments and temperatures, for example, oils, fuels, moisture, acids, and hot gases, the excellent corrosion resistance, characteristics of carbon/epoxy composites are of great value under such conditions. Commonly encountered damage to polymers by ultraviolet rays is maximised by properly painting the exterior of the composite, Moisture is a major damaging agent. Epoxy matrices can absorb water to as much as 1% of the composite weight, however, unlike glass fibre which is attacked by moisture, the carbon itself is unaffected by moisture.

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