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Why composites for aerospace applications?

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Cobham Composites is part of the Avionics Division of Cobham plc (the Chelton Group), and operates from facilities in Shepshed, Leics. and Stevenage, Herts.. The company was formed in 1975 and has a wealth of experience in the design and manufacture of a wide range of structures. The company has 170 employees and in excess of 66,000ft^2 manufacturing space. The company designs and manufactures components for the Aerospace, Defence, Communications and Industrial markets. It is a major supplier to Rolls Royce and manufactures a wide range of structures including acoustic panels and high temperature compression moulded components.

The company manufactured the complete airframe for the Phoenix UAV unmanned aerial vehicle. It is currently under contract to manufacture the Mk32B Refuelling Hose Drum for the Lockheed Martin C130J refuelling aircraft. This is manufactured in a 3 segment composite tool as a single piece unit with a very complex hybrid lay up. Other contracts include the Typhoon radome and the Future Lynx stabilisers.

A composite material is a mixture of two or more components where the resultant performance is greater than the sum of the individual performances. The aerospace industry use mainly thermoset composites based on either carbon or glass fibres. These are normally configured in a polymer matrix configuration. This allows the strength of any given component to be maximised in a specific direction.

Carbon Fibre composites have a much higher specific strength than steel but they are relatively poor at resisting impact damage. Glass based composite materials offer better resistance to impact damage hence these are often placed on the outside surfaces of composite material based components. Composite materials as whole are very resistant to fatigue damage because individual fibres act as “crack stoppers”.

Within the aerospace industry the advantages of composites are:

1. Weight – save up to 20% on the weight of an aircraft;
2. Cost reductions;
3. Good fatigue behaviour;
4. Glass composites provide good impact resistance;
5. Able to tailor fibres to take account of stress direction.

Disadvantages are:

1. High cost of development/design for complex parts;
2. Susceptible to impact damage;
3. Validation costs high;
4. Design processes complex;
5. Lack of availability of design data;
6. Complex manufacturing processes.

World wide commercial aerospace market for composites estimated to be $51 billion p.a. Defence market estimated to be $37 billion p.a..

Commercial airlines are under increasing pressure to cut costs; 33% of airlines have not made a profit since 2004. Dominant cost factor is fuel; an A320 uses $20 million p.a. of fuel p.a.. Hence airlines demand lighter more fuel efficient aircraft. Composite materials have a significant role in meeting this requirement. They also contribute towards higher reliability and minimisation of maintenance. Of a 30% reduction in fuel burn, 11% can be provided by the use of composites, 7% by aerodynamic design to reduce drag and 17-19% by increased engine efficiency.

During the 1990s composite were used mainly on military aircraft. Civil aircraft have now caught up; the Airbus A350 structure will be 53% composite and the Boeing 787 at least 50%. Composite are also being used increasingly for aircraft engine parts.

In conclusion it may be said that composite materials are now well proven for use in both the civil and military aerospace markets and will be used increasing in the future to minimise weight, increase reliability and minimise fatigue wear. As such they will have a significant role in improving both the performance and economics of both commercial and military aircraft.