Composites in Aviation

TASK 2. Read the text below and check your answers from TASK 1.

a) How would you define the term ‘composite material’?
b) What do you know about the history of composites in aviation?
c) What do you think is the greatest advantage of composite materials?
d) Do composite materials have any disadvantages? What might they be?

Composite Construction

History

The use of composites in aircraft construction can be dated to World War II aircraft when soft fiberglass insulation was used in B-29 fuselages. By the late 1950s, European high performance sailplane manufacturers were using fiberglass as primary structures. In 1965, the FAA type certified the first all-fiberglass aircraft in the normal category, a Swiss sailplane called a Diamant HBV. Four years later, the FAA certified a four-seat, single-engine Windecker Eagle in the normal category. By 2005, over 35 percent of new aircraft were constructed of composite materials.

Composite is a broad term and can mean materials such as fiberglass, carbon fiber cloth, Kevlar™ cloth, and mixtures of all of the above. Composite construction offers two advantages: extremely smooth skins and the ability to easily form complex curved or streamlined structures.

TASK 2. Read the text below and check your answers from TASK 1.

a) What is matrix and what is its main function in a composite?
b) What is the most common type of matrix used in aviation today and why?
c) What are the most common types of reinforcing fibers used in aircraft construction nowadays and why?
d) Do these reinforcing fibers have any disadvantages? If so, what are they?

Composite Materials in Aircraft

Composite materials are fiber-reinforced matrix systems. The matrix is the “glue” used to hold the fibers together and, when cured, gives the part its shape, but the fibers carry most of the load. There are many different types of fibers and matrix systems.

In aircraft, the most common matrix is epoxy resin, which is a type of thermosetting plastic. Compared to other choices such as polyester resin, epoxy is stronger and has good high-temperature properties. There are many different types of epoxies available with a wide range of structural properties, cure times and temperatures, and costs.

The most common reinforcing fibers used in aircraft construction are fiberglass and carbon fiber. Fiberglass has good tensile and compressive strength, good impact resistance, is easy to work with, and is relatively inexpensive and readily available. Its main disadvantage is that it is somewhat heavy, and it is difficult to make a fiberglass load-carrying structure lighter than a well designed equivalent aluminum structure.

Carbon fiber is generally stronger in tensile and compressive strength than fiberglass and has much higher bending stiffness. It is also considerably lighter than fiberglass. However, it is relatively poor in impact resistance; the fibers are brittle and tend to shatter under sharp impact. This can be greatly improved with a “toughened” epoxy resin system, as used in the Boeing 787 horizontal and vertical stabilizers. Carbon fiber is more expensive than fiberglass, but the price has dropped due to innovations driven by the B-2 program in the 1980s and Boeing 777 work in the 1990s. Very well-designed carbon fiber structures can be significantly lighter than an equivalent aluminum structure, sometimes by 30 percent or so.