Carbon Fiber In Aerospace Applications

Aerospace is an industry full of change and innovation. Aerospace engineers have been working to make flight safer and more sustainable, which has led to the use of carbon fiber composite materials in planes, helicopters, and even space shuttles.

Carbon fiber is a material made of carbon atoms that are arranged into long, thin crystals. The arrangement of these crystals makes carbon fiber extremely strong for it's thickness, which is less than that of a human hair. Carbon fiber combined with epoxy creates a strong, lightweight composite material that is used widely in many industries.

Advantages of Carbon Fiber in Aerospace

Carbon fiber is a unique material that can be molded with epoxy into nearly any shape, including shapes that can't be achieved with metals, or without welding several pieces together and creating weak points. Because of this, carbon fiber is a versatile material to be used in aerospace anywhere from seats to frames. But why use carbon fiber composites in aerospace? Here are some of the advantages of carbon fiber when it comes to applications in aerospace:

Lightweight: Perhaps one of the greatest advantages of carbon fiber for aerospace applications is how lightweight it is. Weight in aerospace is important because it plays a major role in fuel consumption. The lighter a plane, helicopter, or space shuttle is, the less fuel that is needed to get it into the air. Additionally, lighter planes can travel farther on less fuel, meaning

fewer or no refueling stops. Fuel consumption is an extremely important factor in costs as well as environmental consciousness.

Durable: The strength-to-weight ratio of carbon fiber is asstounding. It has a high tensile strength, meaning it's incredibly resistant to breakage under tension. In aerospace, carbon fiber components can help improve accident survivability.

Metal Hybrid Compounds: One drawback of carbon fiber in aerospace is how it is not conductive; that is, it doesn't conduct electricity. Airplanes are often subject to lightning strikes, so their outer shells need to be able to conduct electricity in order to dissipate electricity from lightning strikes and protect anyone inside the plan. Currently, carbon fiber can be embedded with conductive metal wire, foil, and mesh to help with conductivity. However, new applications involving hybrid composite materials are in development to make carbon fiber conductive without compromising other advantages.

Corrosion Resistant: When certain metals come into contact, they can corrode each other. Carbon fiber doesn't cause corrosion in contact with metals or itself. This means that using carbon fiber in aerospace can improve the longevity of metal parts.

Chemical Resistant: Carbon fiber is fairly resistant to chemical exposure as well. It won't weaken, corrode, or fall apart like other materials when exposed to strong chemicals.

Temperature Resistant: Most metals expand and contract based on the temperature of the environment they're in. In aerospace, metal parts are subject to extremely drastic temperature changes within a few minutes during take off and landing. Composites such as carbon fiber don't expand and contract as dramatically when subject to rapid temperature changes, making them more durable than metals.

Carbon Fiber Parts in Aerospace

Nowadays, different composite materials make up around 40% of modern aircraft. But where are we using carbon fiber composites in aircraft?

Carbon fiber has been used nearly everywhere in aircraft, most notably planes. For example, the Boeing 787 Dreamliner passenger plane is composed of 50% composite material by weight, with most of the composite material being carbon fiber laminate or carbon fiber sandwich. Carbon fiber materials make up the fuselage, or main body, of the plane, as well as parts of the wings and tail. Boeing points out that in addition to fuel efficiency, using carbon and other composite materials allows for less maintenance since they do not corrode or fatigue like metals do. Less maintenance means more flight time, making carbon fiber planes more profitable.

Carbon fiber is also used to replace metal parts in helicopters, such as the rotor blades and tail. It's also applied for instrument enclosures, doors, and interior components like seats. While

using carbon fiber in smaller ways might not feel like it makes much of a difference, the weight difference can add up when heavier materials are removed. Additionally, because of carbon fiber's resistance to corrosion and fatigue, using it for instrument enclosures prolongs the use of those instruments and protects them from damage.

Carbon Fiber Casting Solutions from PCMI

One barrier to carbon fiber is often its cost. However, PCMI Manufacturing offers a unique carbon fiber casting process that uses lower cost material and faster cycle rates. On average, our process creates a cost savings of 20-30% over conventional production methods.

Want to learn more about how PCMI uses carbon fiber to create innovative and complex prototype parts? Click the link below to learn more!

Learn More About Carbon Fiber