

## **Innovations in Advanced Materials for Aircraft Interior Designs**

There has been significant growth in the aircraft interior market in recent years as airlines retrofit old planes and build new ones. And that means there are tremendous opportunities for new innovations that push the boundaries. Not only are new composite materials now being tested for their increased durability and strength, but composites are taking centre stage as the way to obtain greater weight reductions for better fuel efficiency overall. By using compounds such as commingled composites and preimpregnated continuous fiber composites, manufacturers are finding ways to slash weight while increasing both functionality and beauty.

### **Exceptional Benefits of Classic Composite Materials**

Though composites have been around for thousands of years (think adobe buildings made of mud and straw, for instance), the world of modern composites is growing fast. Modern composites usually consist of a fiber reinforcement embedded in a matrix material (usually a polymer). Today's composite innovations offer superior physical properties and performance. This is no truer than in the airline industry.

Composites offer a wide variety of advantages for use in the airline industry, not least of which are strength and light weight, as well as stability under temperature fluctuations and durability. Some of the other advantages include:

- Excellent corrosion resistance
- Exceptional environmental performance through greater durability
- Flexibility in terms of manufacturing complex shapes
- Improved vibration and damping properties
- Very low and controllable thermal expansion
- Easy repair following damage to structures
- Energy absorbing safety
- Excellent fatigue resistance (some carbon composites are fatigue-free)

Composite products offer all of these things and more, and are vastly improving as demand for better performing aircraft cabin interior materials increases.

Yet manufacturers are moving beyond classic composites, looking for ways to improve weight and durability, but also to find ways to make more sustainable materials that are recyclable and made using renewable components.

### **Preimpregnated Material for Aircraft Interior Parts**

Often considered to be an advanced form of composite, preimpregnated (or prepreg) composites contain a reinforcement material that has been pre-impregnated with a polymer or resin matrix in a controlled ratio. This provides much more control over the manufacturing process, which brings greater applicability to this type of material.

Today's prepregs are usually either thermoplastic or thermosetting. Thermoplastic prepregs are those that are made with randomly oriented chains of polymers which can be melted on heating or solidified with cooling. Thermoset polymers and resins, on the other hand, solidify by cross-linking the fibers, which makes the solidification process irreversible.

One manufacturer of thermosetting preimpregnated material for aircraft interior parts has created their product using fiber reinforcement. Their woven fabric of E-glass filament yarn is a self-adhesive resin system used for sandwich panel application. This material has an outstanding adhesion to honeycomb cores, making it ideal for aircraft construction.

It is formulated with non-halogenated resin, making it a healthier alternative. Its adjustable tackiness and retarded flow during curing, combined with long shelf and shop life, make it a very easy material with which to work.<sup>i</sup> They have several versions of this material, providing a great deal of versatility. It can be used for sidewalls, hat racks, ceilings, doors, galleys, crushed-core interior parts and panels, and more.

Another prepreg solution is based on phenolic prepreg systems that are low smoke, self-extinguishing, and self-adhesive. Phenolics are widely used in applications where fire resistance and low smoke and toxicity are of high concern, such as aircraft interiors. The low heat release and diminished toxicity allow designers to

employ exotic decorations and surface finishes without violating FAA regulations for the safety for passengers and crew.<sup>ii</sup>

### **Commingled Composites: Fiber + Polymermatrix**

Commingled composites are another up and coming technology in the world of aircraft interiors. Commingled materials are made resin-free using a polymermatrix plus some type of fiber. Several companies are applying this type of technology for use in aircraft interiors. One solution is to use siloxane substituted resin that is suitable for a variety of fibre reinforcements. This ceramic forming polymer forms a thermoset resin at low temperatures and offers a fully prepreggable formulation that generates various levels of tack. This particular material is clear to opaque and has a tailorable viscosity.<sup>iii</sup>

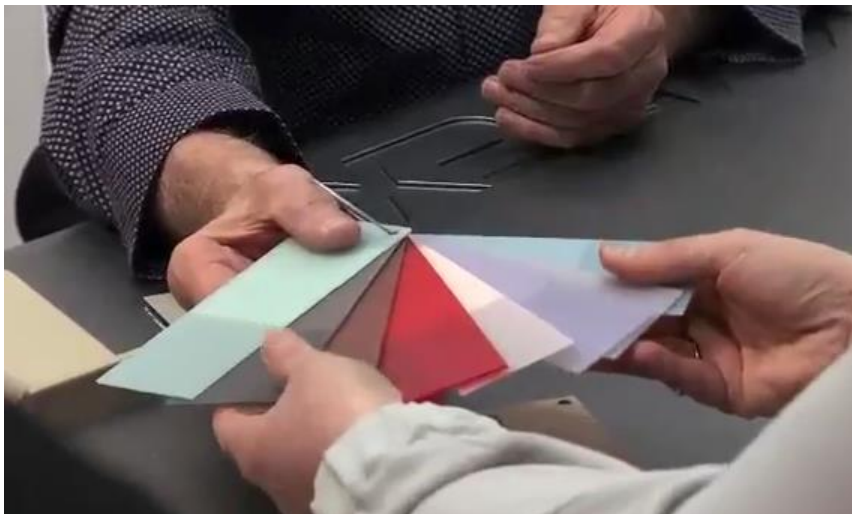
Another solution is made using a 13% mineral load of talc, but performs better than a 20% talc-filled polypropylene with a lower density. This system involves using an injection mould system that lowers pressure to allow a chemical blowing agent to expand the contents, thereby creating a foamed area within each part. This vastly reduces the weight - it weighs 7% less than other PPs and has better scratch resistance as well. Not only will this result in fuel savings, polypropylene is 100% recyclable, making it a more sustainable alternative to other duraplastic materials.

Most are already familiar with the strength capabilities of carbon and hybrid composite materials. In most applications, these materials are comparable to aluminum and steel, with high specific strengths. As such, they can handle very high loads.

What's surprising to many is that composite materials are also quite durable compared to conventional aircraft interior materials. Because of their superior specific strength and specific stiffness compared to aluminum and steel, composites

are actually better in terms of their mechanical properties.

As a result, thermoplastics are also being employed for their durability. One



Thermoplastic translucent sheets can be used for privacy screens, tray tables, and more

manufacturer is applying this material as translucent sheets that are a colourful way to create a consistent, light-friendly interior design for an aircraft that communicates the airline brand and style. These materials can be applied to cocktail tables, tray tables, privacy screens, and rolling carts. The material is much more durable than painted-over materials that quickly look worn and old. And the flame-retardant material is FAA compliant with varied surface thicknesses and textures.<sup>iv</sup>

### **Beyond Practicality to Luxurious Design and Comfort**

But beyond the practicality of products like these, many materials are now being chosen for their style as well. Increasingly, airlines are looking to design firms such as AirJet Designs to stylize their aircraft cabin interiors to reflect their brand and style. Jean-Pierre Alfano of that firm recently commented, "Jet owners want to recognize themselves in their aircraft."<sup>v</sup>

This holds true for private jet owners and large airline companies alike. In fact, many large airliners are taking lessons from private jet designers to achieve a more distinctive aircraft interior look that expresses their company's individual personality. Not only does this increase the customer's sense of quality from the airline, it begins to meet the higher expectations being expressed by discerning travellers.

But aircraft interior improvements aren't all about composite materials and beautiful designs. Comfort is also a factor when talking about customer perception of quality and luxury. That's why airlines are always trying to improve comfort for high-paying clients like those in first and business class.

[EADS Sogerma](#) is one company that specializes in seat design. Their new Ultimate



**EADS Sogerma and Lufthansa Technik's Ultimate Sleeper (aka aerosleeper)**

Sleeper, which has been created in cooperation with Lufthansa, will be the new premium class concept bed that folds out over the seat. It is being touted as one of the most luxurious seat designs on the market, and provides 80" by 42" of bed space when folded out.<sup>vi</sup>

New seat foam technologies have also received lots of attention in recent months. One such innovation is the honeycomb foam material

being used for seats in aircraft interiors. This foam is constructed with a flexible form honeycomb structure that is fusion bonded and adheres without solvents or glues. The cellular matrix is over 90% air, which makes it incredibly lightweight. Not only will this design save airlines a lot on fuel because of the reduction in weight, the foam is also 100% recyclable ... and extremely comfortable.<sup>vii</sup>

Originally designed for Navy pilots who fly F-18s, this material is now being tested in Boeing 787 and 747-8s for flight crews. A comfort study by Boeing indicated that flight crews thought this was the most comfortable of the options. An economy class seat has also been created (seat and back) which weighs only two pounds.<sup>viii</sup>

This foam technology will increase comfort *combined* with weight savings. Southwest Airlines is using these technology along with swapping out the under seat floatation devices for life vest pouches that allow designers to implement more low profile seats. These combined improvements result in about six pounds of weight reduction per seat.<sup>ix</sup> Southwest anticipates recouping their \$60 million investment within the first quarter, with annual savings of \$250 million.<sup>x</sup>

As you can see, style and sustainability are not mutually exclusive. Manufacturers and airlines are working together to tackle nearly every surface of the aircraft interior to improve not only the beauty and durability of the cabin design, but also to lighten things up so that the aircraft can fly using less fuel. These upgrades are aesthetically pleasing, and should have a profound impact on the sustainability of the airline industry. We're sure that more innovations are yet to come in the next few years.



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A student of all things green, Maryruth has a special interest in cleantech and green buildings. In recent years, Maryruth has worked as the senior editor of The Green Economy magazine, is a regular blogger for several green business ventures, and has contributed to the editorial content of not one, but two eco-living websites: [www.ecolife.com](http://www.ecolife.com) and [www.GreenYour.com](http://www.GreenYour.com). You can learn more about Maryruth's work by visiting her site, [www.jadecreative.com](http://www.jadecreative.com).

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