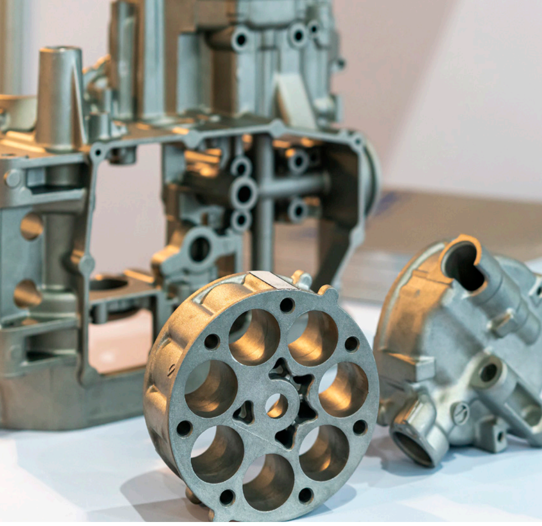
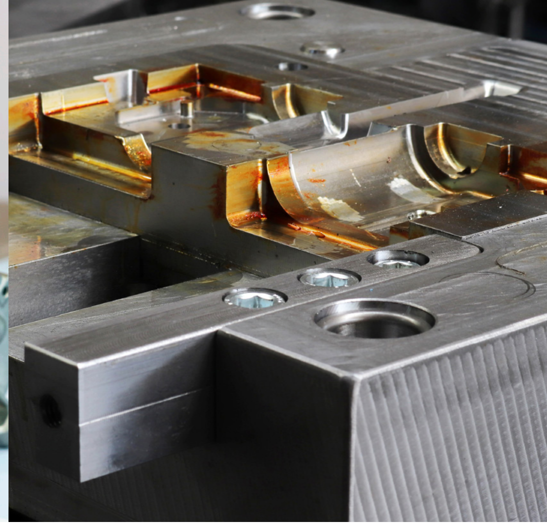
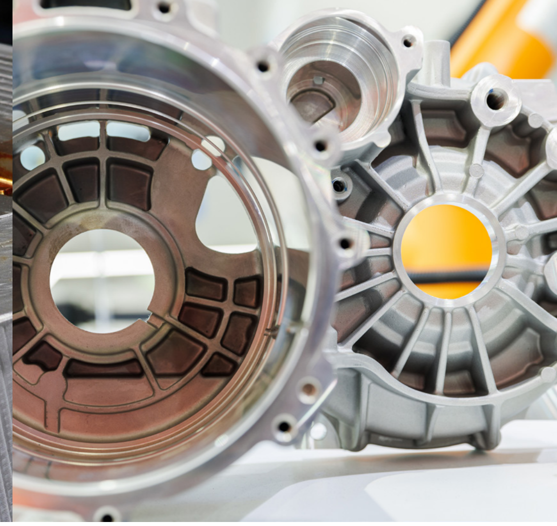




APPLICATION BULLETIN

Evaluating the Replacement of Aluminum with Long Fiber Composites

Key Factors for Making an Informed Decision

As costs and competition increase, many original equipment manufacturers (OEMs) are exploring ways to maintain profit margins. One approach is to substitute metals with reinforced thermoplastics. This not only enhances their products by reducing weight and offering inherent corrosion resistance, but also enables OEMs to consolidate parts into one economical step and use the streamlined processing method of injection molding. Evaluating a metal substitution involves two primary factors: 1) the difference in processing methodologies, and 2) the material capabilities. This bulletin will focus specifically on explaining the difference between die casting and injection molding, and highlight the differences in using long fiber reinforced thermoplastics (LFTs) versus aluminum.

PROCESSING METHODOLOGIES EXPLAINED

Die Casting - Metals

Die casting is a type of metal casting process that injects molten metal into a mold cavity under high pressure. Primary die casting materials are zinc, aluminum, and magnesium. Leveraging this process, these materials provide a strong and stiff final part with extreme temperature resistance. However, the die casting process can be complex and can require a significant amount of secondary operations such as machining, coating, and part assembly that increase production time and cost. Additionally, the lifespan for a die cast tool is limited to approximately 100,000 shots. However, this can depend on a number of factors such as metal type, part complexity, and maintenance. This can lead to higher tooling costs for high-volume programs. Furthermore, a lot of die casting is done in Asia, leading to potentially longer lead-times and higher cost for OEMs in other regions.

Injection Molding - Thermoplastics

Injection molding creates molded parts by injecting heated, molten plastic materials into a mold, which are then cooled and solidified. This method is used for various polymers, including long fiber reinforced thermoplastics (LFRT or LFT). LFTs use reinforcement fibers (e.g., glass or carbon) that are in parallel alignment and of uniform length (typically 12 mm), offering metal replacement performance. Injection molded LFTs offer designers the flexibility to build in strength and stiffness, accommodate more complex geometries, and accomplish performance objectives at a fraction of the weight of metal. This design flexibility also enables engineers to reassess assemblies and take advantage of consolidating multiple parts into one molded offering. This processing method can also streamline manufacturing steps, reduce shipping costs, and increase productivity rates. Though the upfront tooling costs can be high, the investment can yield a life expectancy of 100,000 to over 1 million cycles.

AVIENT™

MATERIAL COMPARISON

	Long Fiber Reinforced Thermoplastics	A380 Aluminum
Specific Gravity (g/cc)	1.07–1.71	2.76
Impact Strength (ft/lbs)	2.8–3.6	2.95
Tensile Strength at Yield (psi)	14000–46000	23100
Temperature Resistance	Good	Excellent
Corrosion Resistance	Inherent	Requires Coating
Secondary Operations	Limited	Extensive
Design Freedom	Extensive	Limited
Sound Dampening	Good	Poor
Color	Molded-in-Color options	Requires painting
Material Cost Per Pound	$$	$
Tooling Cost	$$	$
Total Finished Assembly Cost	$	$$

Selecting the right material for your application should include careful evaluation of the material's technical data. In addition, it is equally important to look beyond the datasheets to more fully understand the application demands, working environments, and product life expectations to use and optimize the material for your specific application.

Injection molded long fiber composites deliver comparable performance characteristics to metals and offer excellent strength-to-weight ratios. Additionally, composites are inherently corrosion-resistant and can be specifically tailored to performance requirements and cost targets. However, metals may be preferred for applications with high-temperature requirements or where production volume, assembly steps, or secondary processing needs don't warrant tooling change or investment in new equipment.

HOW SUPPLIERS CAN HELP EVALUATE MATERIAL TRANSITION

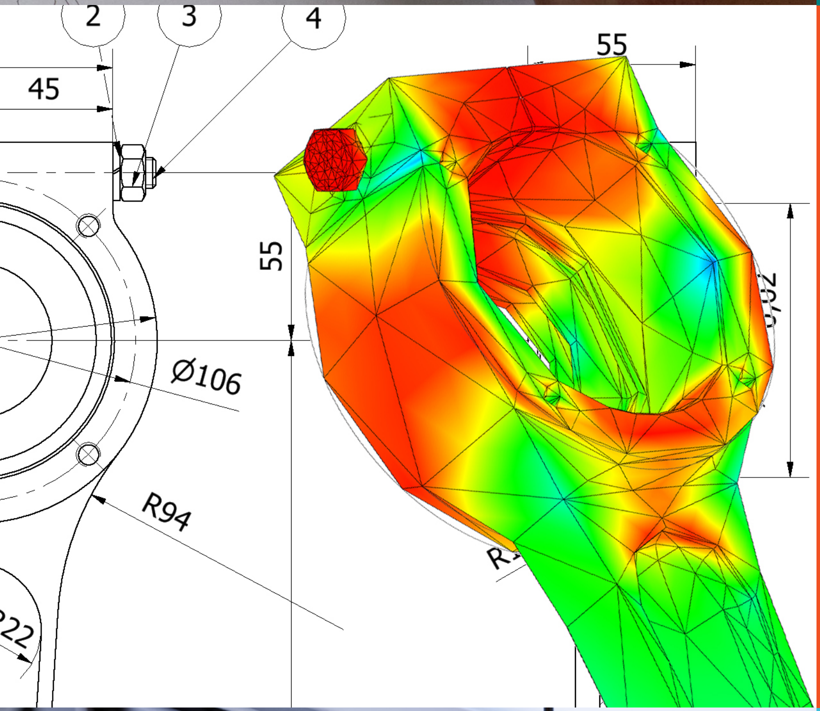
Successfully using composites goes beyond simply swapping one material for another. At Avient, our focus is helping you optimize your design, performance, and bottom line using material science and advanced technical services. Our experts act as an extension to your design and engineering teams to support your projects from start to finish. Our product development engineers use an integrated approach that considers component and tooling design, material performance, and manufacturing processes to maximize the benefits of a material change and quicken your time to market.

With global production capability and localized support to enhance your development and production processes wherever you are, our team provides you with the information you need to confidently make decisions for achieving your goals.

OUR END-TO-END SUPPORT

DESIGN SUPPORT

- Critical understanding of application requirements
- Industrial & structural/mechanical design
- Material validation & formulation



SIMULATION SUPPORT

- Computer-aided engineering (CAE)
- Onsite processing support
- Optimizing the LFT molding processes
- Troubleshooting
- Training

IN-HOUSE PROTOTYPING SUPPORT

- New program prototyping with press sizes ranging from 50 to 550 tons
- R&D material trials
- 3D printed prototypes and tooling

For more insight on metal replacement opportunities and considerations, including technical details on the structural performance of reinforced polymers, contact an expert at Avient today!

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