

Molded Composites for Metal Alloy Substitution

The intrinsic merit of engineered thermoplastics is their specific strength which makes them 60 percent lighter than aluminum and 80 percent lighter than steel. Hence, these fiber-reinforced thermoplastics are popular in metal substitution. The choice of reinforcing fiber and matrix resin is dependent on various factors and end use. In addition to mechanical properties such as tensile strength and stiffness and impact toughness, these composites can be tailored for thermal and electrical specifications, flammability and toxicity, and corrosion resistance.

Table 1 lists the range of nominal properties of high-temperature composites molded from carbon fiber reinforced polyethersulfone (PES), polyetherimide (PEI), and polyphenylene sulfide (PPS). These composites are highlighted for their ability in substituting for metal alloys in engineering applications.

Table 1: Molded Composites for Metal Alloy Substitution

Property	Tensile Sength (MPa)	Tensile Modulus (GPa)	Strain to Failure (%)	Flexural Strength (MPa)	Flexural Modulus (GPa)	Impact (IUN, J/m)
Nominal Range	195 - 264	32 - 42	0.5 – 1.1	252 - 360	25 - 35	534 - 775

All of the above compounds are noted for their V0 flammability rating which is important in the transportation sector such as the airlines. The inherent chemical and moisture resistance of the matrix polymer and the reinforcing carbon fiber makes these materials ideal in hot, wet and corrosive applications.

The Technical Development Center (TDC) at PlastiComp has investigated the mechanical properties of the above composites as a function of reinforcement fiber types, fiber-matrix interaction, fiber lengths, fiber weight-fractions and matrix resins characteristics. The key findings of this expanding study help tailor the mechanical behavior and response of the PlastiComp composites in various applications. Figure 1 illustrates the role of fiber weight fractions on the composite tensile properties. The scanning electron micrograph (SEM) illustrates the role of fiber-matrix interface.



PlastiComp, LLC
 Global Headquarters
 110 Galewski Drive
 Winona, Minnesota 55987 USA
 Phone: 1-507-454-4334
 E-mail: info@plasticomp.com
 www.plasticomp.com

PlastiComp, LLC
 Complet Product Division
 25 McConnon Drive
 Winona, Minnesota 55987 USA
 Phone: 1-507-474-0939

PlastiComp Europe
 PlastiComp™ Europe GmbH
 Postfach 138
 4650 AC Steenberg
 Netherlands
 Phone: +31.611.252522
 www.plasticomp.de

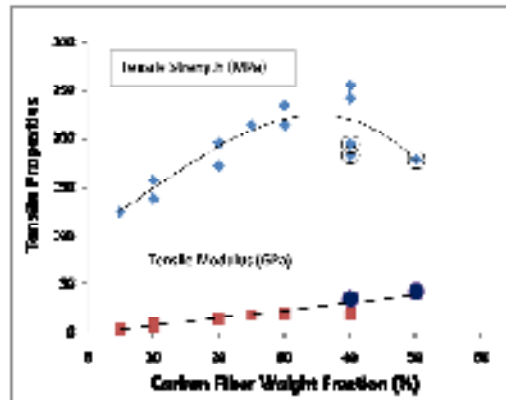


Figure 1: Tensile Properties of Composites vs. Fiber Weight Fraction. Adjacent, Scanning Electron Micrograph of the Fiber-Matrix Interface

Unlike continuous fiber placement, chopped fibers can be easily positioned in complex part geometries. In order to optimize and fully utilize the tensile properties of the fibers, it is important that the fibers are longer than a critical length of approximately 500 μm . Higher fiber lengths lead to increases in tensile properties and most significantly to the impact toughness of these materials. Increasing fiber weight fractions up to 30 to 50 weight percent leads to proportional increases in tensile properties. Beyond these fiber fractions, the fiber ends act as stress concentrators which leads to reductions in tensile properties. Thus, fiber length and fiber weight fractions can be tailored to specific requirements. Finally, composite performance is predicated by the fiber – matrix adhesion at the micromechanical level. PlastiComp has worked with several fibers and resins manufacturers in developing a comprehensive understanding of fiber tow-size effects and the role of fiber-matrix coupling agents.

The Technical Management team at PlastiComp insists that all technical advances must translate into industry-ready manufacturing methods. Together, our pultrusion **Long-Fiber Thermoplastics (LFT)** pellets and our patented **Pushtrusion™** in line molding technologies provide full parametric control on all aspects of reinforcement fibers and matrix resins. PlastiComp technologies cover injection and compression molded compounds. The engineering staff at PlastiComp utilizes **Mold Flow Analysis** and **Finite Element Methods** in designing, prototyping and specifying manufacturing methods for engineering composite parts.