Cost Comparison and Temperature Resistance

For many people, "plastic" means "cheap and breakable." But when engineers search for new ways to enhance weight savings, corrosion resistance, shock and vibration dampening and stealth they immediately turn to plastic—the only alternative material capable of meeting, and beating, the established performance levels of aluminum, brass, titanium and steel.

The name "plastic" refers to the ability to form or shape a material, or to the moldability a material adopts under forces such as pressure or heat. Engineers often use the term "polymer" when referring to plastic materials, because it more clearly describes how many (poly) chemical units (mers) form up in complex chains to create modern plastic resins. "Thermoplastics" are polymer materials that melt to a liquid when heated and form into a hard, dimensionally stable shape when cooled.

Thermoplastic polymers are created by subjecting various chemical and petroleum-based ingredients to heat and pressure in sealed vessels. Specific chemical additives control how the polymer is formed and contribute to its performance in such areas as surface hardness and flame resistance. The process of mixing base materials with chemical additives to create specific types of plastic resins is called "polymerization." The resulting plastic materials can be classified in various ways—by chemical or physical structure, by strength or thermal performance and by optical or electrical properties. Thermal properties are extremely important when selecting plastic materials for use in high-performance applications. Composite glass transition temperature (the point at which the heated material softens) will dictate whether or not the plastic is suitable for use in high-heat applications such as adjacent to an engine or other heat source. But other properties, such as its specific gravity, hardness, refractive index, dielectric strength, conductivity, chemical resistance, UV and flame resistance are also critical in deciding which recipe of resins, fibers and additives will be selected for a particular project.

The glass transition temperature, or the point at which the heated resin will soften, varies from material to material. Extremely high-heat applications, such as engine sensors, are generally considered to be ill-suited for composites.

Temperature resistance can be measured in a variety of ways: melt temperature, heat deflection temperature, glass transition temperature, and continuous use temperature. The resins that offer the highest capabilities in each of these categories are often the most expensive, but typically offer the lowest lifetime cost because of enhanced durability and strength. Two of the top thermal performers, Polyetheretherketone (PEEK) and high-temperature ETFE, are high cost materials, but exceptional performers over the long run.

Additives can be used to increase flame retardency, to improve lubricity or, in the case of pigments, simply to change the color of the final product. Again, material costs can rise with the addition of chemical compounds that contribute to improved performance. In terms of cost, thermoplastic resins can be arranged into three basic categories:

- Low cost/commodity resins with large volume market costs of less than $1.50/lb
- Medium cost/engineering resins that fall between $1.50-$3.00/lb
- High cost/high temperature resistant resins that usually cost above $3.00/lb.

Re-Designing Interconnect Systems for Composite Thermoplastics

Interconnect products made of composite materials offer significant advantages over steel or aluminum. They're lighter. They don't rust. They don't loosen under vibration. They can hide from radar. Yet the ability to design composite components that take advantage of these properties while still meeting form, fit and function requirements is no simple task.

Connector accessories, no matter the material, must thread onto the back of connectors. Intermatability with other components, whether composite or metal, is critical. Composite component design is further complicated due to the unique strengths and weakness of the material. Abrupt changes in wall thicknesses, for example, can lead to stress problems in both manufacture and use. Sharp, un-radiused angles can create stress and cause cracking. The length, shape, orientation and distribution of reinforcing fibers is also a critical concern, as is the impact of other additives, such as colorizers and flame retardants, on the behavior of the material during manufacture and use.

Interconnect systems designers continue to specify composites, despite the complications of the design and manufacturing process. The weight savings, corrosion resistance and other significant advantages of composites represent real, out-of pocket savings in fuel consumption and lifetime system maintenance for a broad range of air, sea and space applications.

Special Applications of Engineering Plastics: Flexible Tubing

Most of the products in this catalog are made from glass-filled thermoplastic resins, such as PEI (polyetherimide). These Glenair interconnect components—connectors, junction boxes, backshells and so on—are produced in an injection molding process that results in products that are known for their toughness, damage-resistance, dimensional stability and strength. But other formulas of engineering plastics, such as ETFE (ethylene tetrafluorethylene), are also widely applied by Glenair to produce a very different class of products: flexible convoluted tubing.

Unlike glass-filled thermoplastics that produce rigid parts, ETFE, FEP, and other high-temperature plastics used by Glenair in tubing fabrication produce products that are known for their folding endurance, or the number of times the material can be bent or flexed before experiencing failure. Used in wire-protection applications where a rigid, jacketed cable would experience rapid failure, flexible plastic tubing delivers outstanding performance and durability.

Glenair specializes in the manufacture of ruggedized plastic tubing for shipboard, aircraft and ground applications, and offers the world's broadest range of environmental, mechanical and EMI hardened solutions. Our recently expanded convoluted tubing and conduit manufacturing facility in Glendale is a state-of-the-art plant with every step in the tubing extrusion and finishing process centralized under one roof.