# *Selecting The Right Matrix or Resin:*

In the previous Design Tip (No. 01) we discussed the various fiber types used in composite materials. Equally important to the composite is the choice of resin or matrix material. The matrix material gives the composite its shape, protects the fibers and provides a medium through which loads are transferred from one fiber to the other. Although matrix systems can be metallics and ceramics, the focus of this Design Tip will be on the more widely used polymer matrix systems.

Polymer matrices or resins are in general categorized as Thermosets or Thermoplastics. Thermosets are resins which when activated by heat or a hardener cross-link the molecular chains, forming a rigid plastic. Thermosets are usually available in liquid form, which facilitates ease of processing using common composite structure fabrication techniques. Thermosets cannot be re-melted. Thermoplastics are solid in form, are molded by heat and are not molecularly cross-linked, thus they can be re-melted. Thermoplastics are generally more difficult to process into composite structures.

Selection of the right resin system is mainly dependant on the environment to which the composite structure will be subjected. Table 1 shows a list of typical polymer matrix systems and relative comparisons.

**Table 1**
**Matrix System Comparisons**

| | Thermosets | | | | | Thermoplastics | |
|---|---|---|---|---|---|---|---|
| **Characteristic** | **Epoxy** | **Phenolic** | **Polyester/ Vinylester** | **Cynate Ester** | **BMI** | **PEEK** | **Polyimide** |
| **Cost** | Low | Low | Lowest | Highest | High | High | High |
| **Max Temp** | 350°F | 350°F | 250°F | 700°F | 500°F | 480°F | 600°F |
| **Out Gassing** | Moderate | | | Lowest | | | |
| **Strength** | High | Low | Low | | High | High | |
| **Flame Retardancy** | High | Highest | Low | | | | |
| **Toughness** | Low | | | High | Low | Highest | High |
| **Viscosity** | Low | Low | Low | | Low | High | High |
| **Processability** | Easy | Moderate | Easy | Moderate | Moderate | Difficult | Difficult |
| **Chemical Resistance** | High | | Moderate | | | High | |
| **Moisture Absorbsion** | Moderate | | | Low | | Low | |
| **Dialectric Constant** | Low (3.0) | | | Low (2.7) | | | |

References:
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