

## 3.082 - Composites

Although the word "composites" can have many meanings, here we refer to materials employing thermosetting polymeric matrices (polyesters or epoxies) reinforced with short or continuous fibers. The fibers are typically much stronger and stiffer than the matrix polymer, and are usually glass, carbon, or aramid. Since the distribution and orientation of the fibers can be controlled by the processor, the material can be nonuniform and anisotropic. This allows the material to be optimized for particular applications.

Composites can be processed in a number of ways, but a convenient technique involves purchasing "prepreg" - sheets of uncured resin preimpregnated with unidirectionally-oriented fibers. The processor then creates a structure by stacking up sheets so as to obtain the desired number and orientation of fibers, and then curing the resin by applying an appropriate cycle of temperature and pressure.

Due to the flexibility of fabrication and the superior physical properties that can be obtained from these materials, they are naturals for sporting applications (where costs are often borne willingly by zealous fans). Typical projects might consider golf club shafts, pool cues, skateboards - the possibilities are numerous.

### **Reference Material:**

- D. Roylance, *Mechanics of Materials*, J. Wiley & Sons, 1996. (3.11 text)
- N. McCrum, et al, *Principles of Polymer Engineering*, Oxford Science Publications, Oxford, 1997. (3.064 text)
- D. Hull and T. Clyne, *An Introduction to Composite Materials*, Cambridge University Press, Cambridge, 1996.
- J. Gillham, "Curing," *Encyclopedia of Polymer Science and Technology*, J. Wiley & Sons, 1986. (Hayden library reference)