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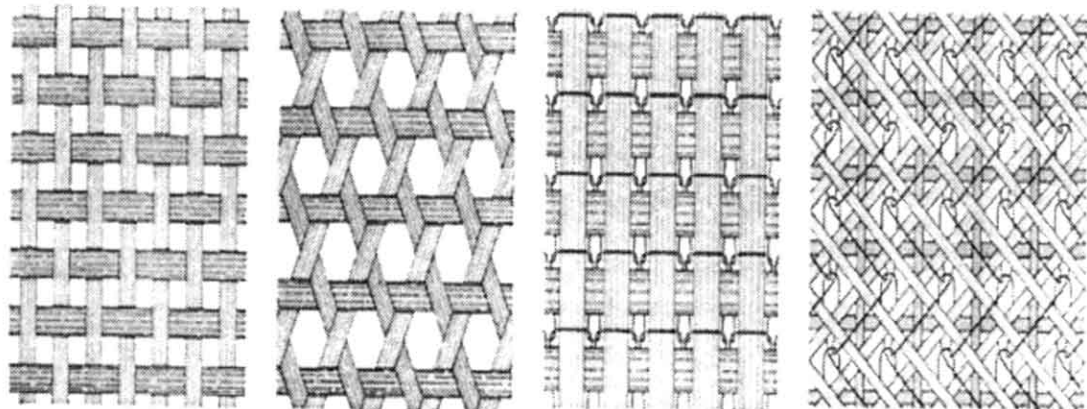
Heat Transfer During Mold Filling in Liquid Composite Manufacturing Processes

Suresh G. Advani and Kuang-Ting Hsiao

University of Delaware, Newark, Delaware

I. INTRODUCTION

To manufacture advanced polymeric composites, one has to completely impregnate the empty spaces between a stationary bed of continuous fibers with polymer resins to form an integral component. The fibers may be glass, carbon, or Kevlar, and are converted first into a fiber preform which constitutes the porous medium. Fiber preform may be a continuous fiber strand or in tows (containing from a few hundred to 48,000 individual fibers that may be either woven or stitched in various repetitive arrangements to tailor to the desired mechanical properties, as shown in Figure 1). The resin may be either a thermoplastic or a thermosett resin. Thermoplastic resins are usually very viscous, of the order of about a million times more viscous than water, and usually difficult to impregnate in the small spaces between the fibers. Thermosett resins are about 50 to 300 times more viscous than water and relatively easier to impregnate. However, thermosetts undergo an exothermic chemical reaction and cross-link and hence are difficult to recycle. There are many different ways to manufacture these composites, depending upon the type of application, the geometry of the part, and the performance desired. For an introduction to this, the reader may refer to the following composite manufacturing books (Åström 1997; Gutowski 1997; Advani 1994).

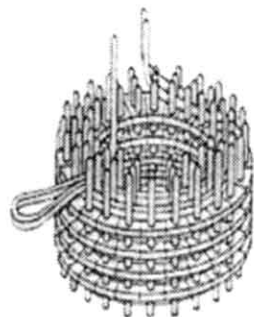


Biaxial Weave

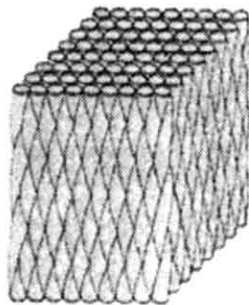
Triaxial Weave

Knit

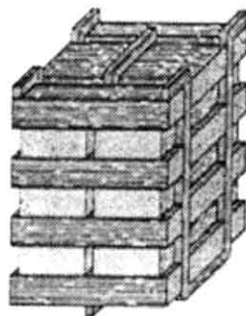
Multiaxial Multilayer Warp Knit



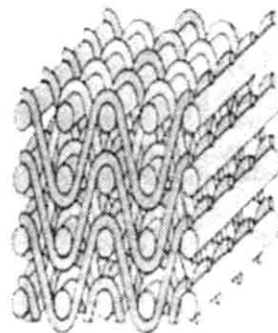
3-D Cylindrical Construction



3-D Braiding



3-D Orthogonal Fabric



Angle-Interlock Construction

Figure 1. Preform architectures.