

Chapter 8

Internal Flows

Abstract

This chapter examines laminar internal flows, which are defined as flows moving through confining conduits, and here are specifically limited to fully developed case, in which there is no variation of the fluid velocity in the flow direction. First, velocity profiles, shear fields, and mass flow rates are found for Newtonian fluids when driven by shear, pressure gradients, and both. An extended example of the application of these solutions to tape casting of ceramic slurries is presented. Flows in cylindrical tubes and affected by gravity are also examined. Similarly, solutions for nonNewtonian fluids flowing under shear and pressure gradients. Examples of these fluids include power-law and Bingham plastics. Finally, there is a section on flow through porous media. Rigid, packed beds of solid particles resist flows due to the shear on the large surface solid area and the form drag as the fluid moves through the bed. If the solid particles are not connected and the drag is strong enough to separate the particles from each other, but not strong enough to blow them out of the vessel, the result is a fluidized bed, which has advantages for heat and mass transfer between the solid and the fluid.