

Process Description In the pultrusion of thermosetting resin composites, the steady-state reaction process is initiated by the application of heat to the chemically active material. The purpose of this description has been to define the pultrusion process with respect to thermosetting resin systems, highlight the most important process variables, indicate the complex interdependence among these variables which renders an intuitive grasp of the process almost impossible to attain, and, thus, emphasize the need for analytical definition of process variable interactions in order to gain insight into the process[3]. Pressures can be associated with the viscosity of the resin, the volumetric ratios of fiber and resin, the coefficient of thermal expansion of the materials, the cross-sectional geometry of the cavity, the length of die over which there is material contact, the coefficients of friction of the die with respect to the liquid, gel, and solid, and the degree of shrinkage of the solid. Reinforcing material is assembled and oriented to enter the die in the configuration necessary for the development of the desired mechanical properties of the produced structural member. It is desirable for this reaction to occur under sufficient pressure to ensure composite integrity and to minimize internal porosity that can occur from vapor pressures within the reacting material. The pressure at the material-die interface is a measurement of normal surface forces which, combined with the appropriate coefficients of friction, yield a measurement of frictional force, or resistance to pull. Once the process is in progress, the pulling force must be regulated to ensure that the line speed does not vary, since fluctuations thereof translate directly into variations in cure conditions. At the point at which the chemical reaction is initiated, the change in viscosity is reversed, and the viscosity rapidly increases through the stages of gelation and final cure. Precise control of the thermal and chemical phenomena occurring within the die is of utmost importance.