Thermophysical Analysis of the Hardening Process of Epoxy Resin by the Hot Ball Method

Ludovit Kubicar [C, S] and Carlos Calvo Anibarro
Institute of Physics SAS, Bratislava, Slovakia

Igor Novak and Ivan Chodak
Polymer Institute SAS, Bratislava, Slovakia

The present contribution discusses the principle of the hot ball sensor for measurement of the thermal conductivity. The operation of the sensor is based on a ball that delivers heat in a stepwise regime to the surrounding material. The ball surface temperature is a measure of the thermal conductivity of the surrounding material. The construction of the hot ball sensor and its operation will be presented. The sensor is composed of two elements, namely a heater and a thermometer. Such sensor provides data on both the temperature and the thermal conductivity of the surrounding material. The effects that influence the accuracy of the thermal conductivity measurements are listed. The method is applied for monitoring of the hardening process of ChS Epoxy 513 based on epoxyacrylate resin having low-molecular weight (800) and viscosity 400 mPa. A boric fluorine compound was used as a hardener. A mixture of resin and hardener is poured into a metallic ampoule, the temperature of which was controlled by a thermostat. A polymerization controlled by cationic mechanism was responsible for hardening. Reaction between the monomers results in decrease of viscosity that causes an increase of shear modules. This mechanism is responsible for changes of the thermal conductivity. Initially a decrease of thermal conductivity was found due to homogenization of the mixture. The reaction rate depends on temperature. The temperature – time treatment influenced the final value of the thermal conductivity. The presented measuring technique can be successfully applied for analysis of polymerization process in various branches of polymer science.