MICROWAVE CALORIMETRY COUPLED WITH DIELECTRIC MEASUREMENTS AND NEAR INFRARED SPECTROSCOPY: A POWERFUL TOOL FOR UNDERSTANDING MICROWAVE-INDUCED REACTIONS

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There is much discussion in the literature regarding the nature of the reactions that take place during microwave heating and how these compare with the processes that occur during conventional heating. It is often difficult to compare data obtained when reactions are carried out using the heating methods since it is difficult to exactly reproduce conditions. There are a number of standard analytical techniques available for following reactions during conventional heating. One of the most common is differential scanning calorimetry. With this it is possible to measure the energy of reactions and to obtain kinetic parameters such as activation energy. It does not give any specific chemical information but this can be obtained by alternative methods such as infrared spectroscopy.

In this work we have developed a microwave calorimeter that enables the same measurements as differential scanning calorimetry, but with microwave heating instead of conventional heating. Furthermore a near infrared fiber optic probe has been developed that allows near infrared spectra to be obtained simultaneously during conventional or microwave calorimetry. The development of these techniques allows simultaneous kinetic and spectroscopic measurements to be made under either conventional or microwave heating. These techniques have been used to explore the reactions in a number of commercial epoxy resin systems and examples of these will be presented. Furthermore the microwave method also permits measurement of the dielectric properties simultaneously with the calorimetry.