

# THERMAL DECOMPOSITION STUDY OF SOME POLYMERIC MULTICOMPONENT SYSTEMS BASED ON AROMATIC POLYURETHANE AND EPOXY RESIN NETWORK

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The aim of this study is to follow the thermal stability of some semi-interpenetrating polymer networks (SIPNs) obtained from an aromatic polyurethane (PU) with linear structure and a crosslinked epoxy network (ERN) based on bisphenol A. Studies of thermal stability were carried out by coupled techniques thermogravimetry-Fourier transform infrared spectroscopy and thermogravimetry-mass spectroscopy. Samples were heated in inert atmosphere, at temperatures between 40°C and 600°C in dynamic heating conditions. Four different heating rates (5, 10, 15 and 20 K min<sup>-1</sup>) have been applied in the study. The volatile products evolved during thermal degradation have been identified. The kinetic parameters for thermal decomposition reaction were established using the isoconversional methods. Figure 1 shows a SIPN structure which was obtained by inclusion of linear polyurethane in the cross-linked epoxy resin.



**Figure 1.** SIPN structure which was obtained by inclusion of linear polyurethane in the cross-linked epoxy resin: (a) polyurethane; (b) epoxy resin based on bisphenol A

The composition of the SIPNs synthesized from polyurethane and epoxy resin is: 5%, 10%, 15%, 20% and 40% ERN.

The thermal stability of the polymeric systems is very important because it determines the upper service temperature and the environmental conditions under which they can be employed. Therefore, a systematic thermal degradation study of the SIPN systems was conducted by thermogravimetric analysis at different heating rates in N<sub>2</sub>. Since the thermal stability is related to both the initial degradation temperature and by the degradation rate of polymers, the determination of kinetic parameters associated with the degradation process is a very interesting topic in these polymeric systems. The results obtained provide useful information in defining of suitable processing conditions for applications and draw a correlation between thermal stability and structure of SIPNs.

The thermograms exhibit lower thermal stability compared to the crude components. The thermal stability of the samples decreases with ERN content increase. This behavior is generally specific for alloys or blends of polymers. Thermograms displacement to higher temperatures was observed with increasing of heating rates from 5K min<sup>-1</sup> to 20K min<sup>-1</sup> for SIPN samples. The PU sample exhibits a melting peak around 200°C. Other three endothermic processes can be observed at the peak values of 222°C, 352°C and 415°C attributed to thermal degradation. No significant differences are observed between the melting peak intensities of SIPNs with low epoxy resin content (5%, 10%). An important decrease in the intensity of the melting peaks is presented by the other samples with higher epoxy resin content (15%, 20%). The melting process DSC signals completely disappear at samples with epoxy resin content higher than 20%. This general behavior of the melting pattern can be explained by the increase of the crosslinking density of high content epoxy resin in SIPN samples. This aspect is further confirmed by the decreasing in melting heat values from 3.63 J g<sup>-1</sup> in the PU sample up to 0.52 J g<sup>-1</sup> in SIPN-5.

**Acknowledgements:** This work was supported by a grant of the Romanian National Authority for Scientific Research, CNCS – UEFISCDI, project number PN-II-ID-PCE-2011-3-0187.