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Chemorheological behavior of organophilic clay-epoxy resin composites

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Abstract. Hybrid nanocomposites based upon epoxy resin and organophilic clay mixes have been intensively studied because of their better mechanical and thermal properties as compared to conventional composites. When the organoclay is added to the epoxy reactive medium it does affect the thermoset polymer chemorheological behavior. Such behavior can define the composite ultimate mechanical properties. The aim of this work is the study of chemorheological behavior by X-ray diffraction, calorimetric, dynamic mechanical and dielectric analysis of epoxy-organoclay composites.

Hybrid nanocomposites based upon epoxy resin and organophilic clay mixes have better mechanical and thermal properties as compared to conventional composites [1]-[3]. The epoxy-anhydride resins are known to interact with the modified clay filler within the reactive medium [1]. In this work, the chemorheology of reacting composites with epoxy-anhydride resin and commercial Cloisite™ clay were studied.

The epoxy system was heat treated in two stages: the first, at 85°C; and a second higher temperature stage, at 150°C. The X-ray diffraction (Fig. 1) of fully cured composites revealed the intercalation of clay platelets by the resin. The kinetics analysis revealed that at lower temperature cure obeys two-steps kinetics model, whereas at the higher temperature post cure stage obeys the order *n* model kinetics (Fig. 2 and 3, respectively). The dynamic mechanical *tan δ* curves at 85°C (Fig. 4) showed three peaks, whereas the dielectric *tan δ* curves at 85°C (Fig. 5) showed only one peak. This behavior is similar to the electrical conductivity at 150°C cure stage.

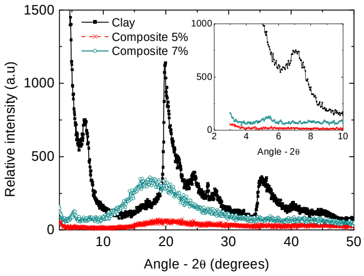

Figure 1: X-ray diffraction of cured composites at 0, 5 and 7% clay contents.

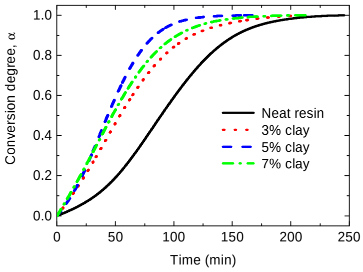

Figure 2: Conversion degree as function of clay content at 85°C cure.

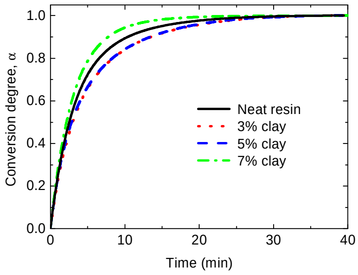

Figure 3: Conversion degree as function of clay content at 150°C post cure.

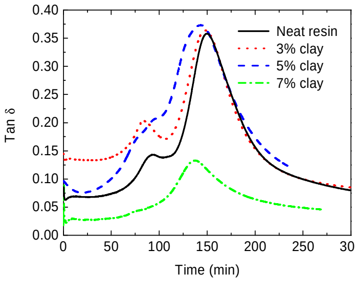

Figure 4: Mechanical *tan δ* curves as a function of clay contents at 85°C cure.

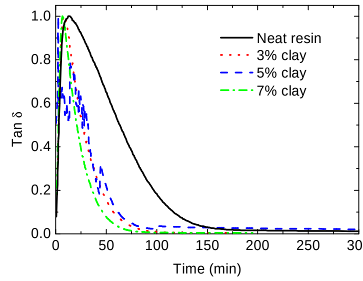

Figure 5: Dielectric *tan δ* curves as a function of clay contents at 85°C cure.

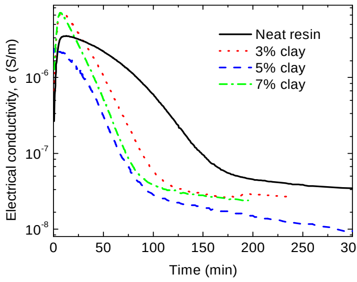

Figure 6: Electrical conductivity as a function of clay content at 150°C post cure.

References

[1] T. Lan and T. J. Pinnavaia. Chem. Mater. 6 (1994), 2216-2219.
[2] C. Zilg, R. Mülhaupt, and J. Finter. Macromol. Chem. Phys. 200 (1999), 661-670.
[3] K. Zhang et al. J. Appl. Polym. Sci. 91 (2004), 2649-2652.