Preparation and Characterization of Novel Polybenzoxazine-Polyester Composite

Amit Balsing Rajput* and Narendra Nath Ghosh
Birla Institute of Technology and Science- Pilani, Goa Campus
Zuarinagar, Goa 403726, India

INTRODUCTION

Polybenzoxazine is a newly developed addition polymerized phenolic system, having a wide range of interesting properties and the capability to overcome several shortcomings associated with conventional novolac and resole type phenolic resins. These materials exhibit (i) near-zero volumetric change upon curing, (ii) low water absorption, (iii) for some polybenzoxazine Tg is much higher than cure temperature, (iv) high char yield, (v) no strong acid catalysts required for curing, and (vi) no toxic by-product release during curing. The molecular structure of polybenzoxazine offers enormous design flexibility, which allows tailoring the properties of the cured materials for a wide range of applications. Though, benzoxazine based materials possess several advantages, they have not yet become very attractive to the industries. Some of the disadvantages associated with pure polybenzoxazine are (i) high curing temperature (~200^{0}C or higher), (ii) difficulty in processing and (iii) poor mechanical strength[1].

In this paper, we have reported the preparation of blends consisting of polybenzoxazine and unsaturated polyester. We have chosen unsaturated polyester as one of the components of the blends because (i) it is cheap and commercially available, (ii) possesses low viscosity, which helps in processing and (iii) polybenzoxazine can form hydrogen bonding with the carbonyl group of polyester. This hydrogen bond can play a critical role in improving the mechanical properties of polybenzoxazine based blends.

EXPERIMENTAL AND RESULTS

Benzoxazine (bis (3-phenyl-3, 4–dihydro-2H-1, 3-benzoxazinyl) isopropane) (BA-a) was synthesized using a solventless method by reacting bisphenol-A, aniline and paraformaldehyde. Blends of polybenzoxazine (PB) and polyester (PER), having several compositions, were prepared by using a solution blending method, where acetone was used as solvent.We have prepared the polybenzoxazine (BA-a)- polyester (PER) blends with various compositions by using a solution blending method.

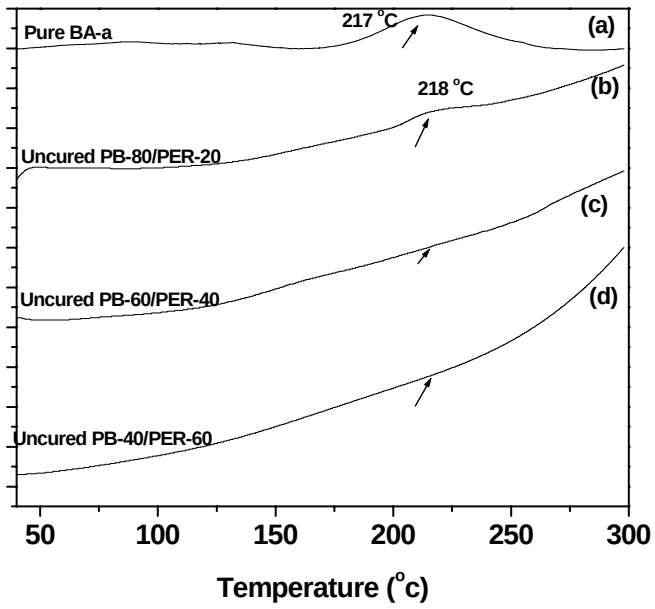


Figure 1. DSC of (a) BA-a without BPO, (b) BA-a with BPO, (c) PER with BPO.

Thermal stability of the cured blends and cure temperature was investigated by using Thermogravimetric and Differential Scanning calorimetric analysis . FTIR spectroscopy was used to understand the presence of hydrogen bonding in the blends. Hardness of the blends was determined by using Barcol Hardness testing.

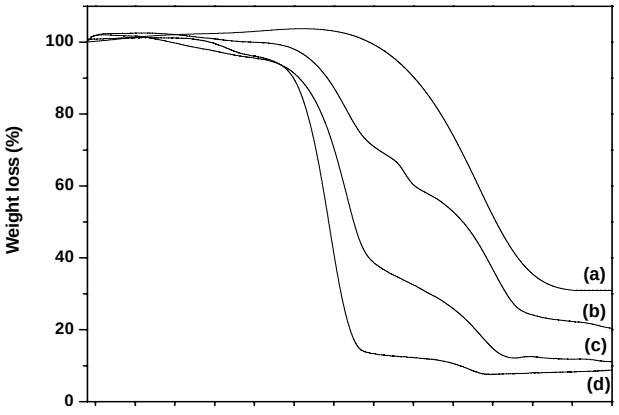


Figure 3. TGA of cured samples (a) PB-100/PER-0 (pure cured PB), (b) PB-80/PER-20, (c) PB-20/PER-80, (d) PB-0/PER-100 (Pure cured PER).

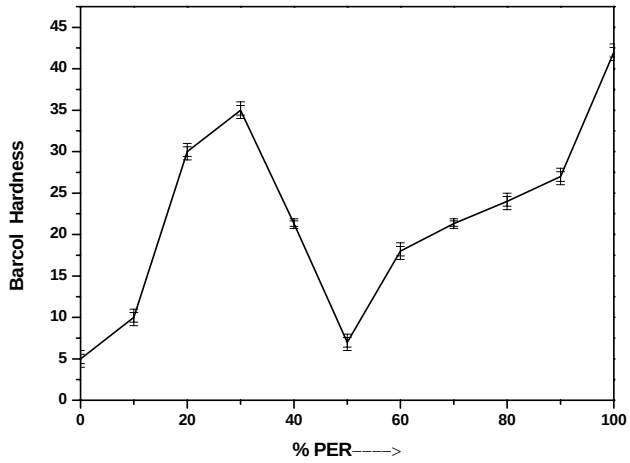
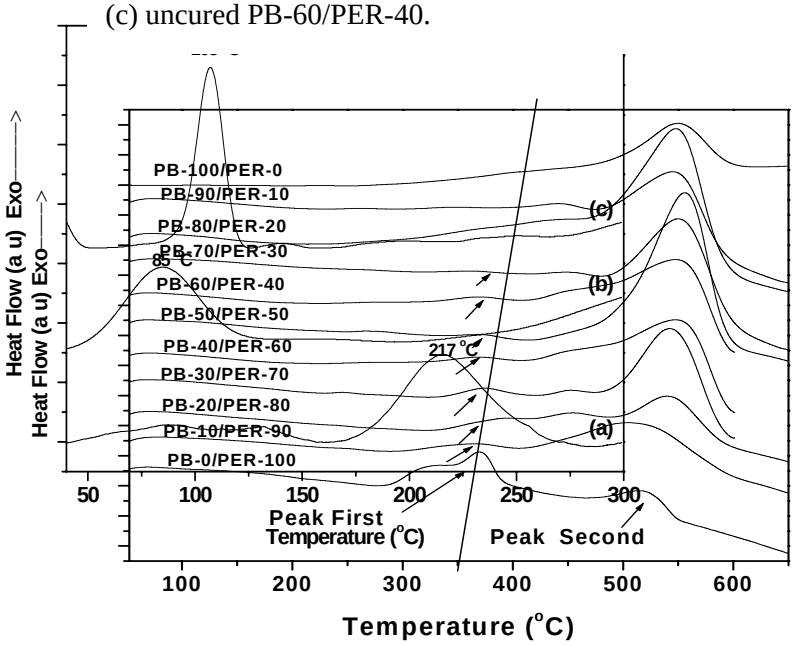


Figure 5. Hardness of the blends.

Figure 2. DSC of (a) BA-a, (b) uncured PB-80/PER-20, (c) uncured PB-60/PER-40.



CONCLUSIONS

The important observations of this investigation are (i) thermal stability of the blends increased with increasing amount of polybenzoxazine in the composition, (ii) blends having 70wt% polybenzoxazine and 30wt% polyester resin possesses highest hardness with comparatively good thermal stability (T_i= 274^{0}C and char yield = 21 %). (iii) Comparatively high thermal stability, easy processibility and good mechanical property make these materials suitable candidate for various applications.

Figure 4. DTA thermograms of cured blends showing the effect of PB concentration on the thermal degradation of

Reference

1) Ghosh, N. N. et. al. (2007): Prog. Polym. Sci. **32**, 1344- 1391.