

Miscibility of Poly(neopentyl Glycol Adipate)/Chlorinated Polymer Blends

Many polyesters have been found to be miscible with chlorinated polymers. Polycaprolactone is the most widely studied polyester and has been found to be miscible with poly(vinyl chloride),¹ poly(epichlorohydrin),² chlorinated polyether,³ chlorinated polyethylene,⁴ chlorinated polypropylene,⁵ and poly(chlorostyrene).⁵ The formation of these miscible blends has been attributed to the specific interaction between polymer molecules via hydrogen bonding⁶ or dipole-dipole C=O ... Cl—C interaction.^{4,5} We wish to report two miscible blends involving poly(neopentyl glycol adipate), a polyester, and two chlorinated polymers, namely poly(vinyl chloride) and poly(epichlorohydrin).

EXPERIMENTAL

The poly(neopentyl glycol adipate) (PDPA) used was Rucoflex S-1065-55 supplied by Hooker Chemical Corp. The PDPA has an intrinsic viscosity of 0.084 dL/g in benzene at 25°C.

The poly(vinyl chloride) (PVC) used was QYSJ-5 supplied by Union Carbide. The PVC has an intrinsic viscosity of 0.820 dL/g in tetrahydrofuran at 25°C, which corresponds to an \bar{M}_w of 71,500 based on the relation⁷ $[\eta] = 15.0 \times 10^{-5} \bar{M}_w^{0.77}$.

The poly(epichlorohydrin) (PECH) used was Hydrin 100 supplied by B. F. Goodrich. The intrinsic viscosity of the polymer is 2.85 dL/g in toluene at 25°C. The PDPA/PVC blends were prepared by solution casting from 2-butanone, followed by drying in a vacuum oven at 100°C for 24 h. To stabilize the PVC against degradation during heating, a stabilizer, Vanstay 6053, was added in the amount of 5% by weight of PVC. The PDPA/PECH blends were prepared by solution casting from toluene, followed by drying in a vacuum oven at 110°C for 48 h.

The glass transition temperature T_g of the polymer was measured with a Perkin-Elmer DSC-2 differential scanning calorimeter, using a heating rate of 10°C/min.

The blends were examined for cloud points using procedures described previously.⁸

RESULTS AND DISCUSSION

All the PDPA/PVC blends were transparent and showed one T_g . The T_g -composition curve of the blends is shown in Figure 1. The optical clarity of the blends and the existence of one composition dependent T_g are evidence that PDPA is miscible with PVC. All the blends remained transparent

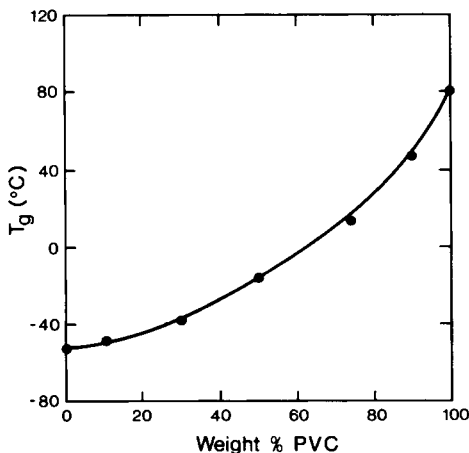


Fig. 1. T_g -composition relationship for PVC—PDPA blends.

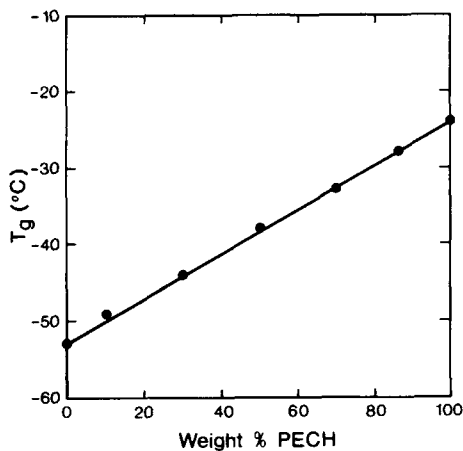


Fig. 2. T_g -composition relationship for PECH—PDPA blends.

when heated up to 220°C. Further heating led to discoloration caused by thermal degradation of the polymers.

The PDPA/PECH blends were also transparent and showed only one T_g . The T_g -composition curve of the blends is shown in Figure 2. Once again, the optical clarity and the existence of a single composition dependent T_g demonstrate that PDPA is miscible with PECH. No cloud points were observed up to 250–260°C, where discoloration began to appear.

The T_g -composition relationship for blends can often be represented by the Gordon-Taylor equation^{4,5}

$$T_g = \frac{w_1 T_{g1} + k w_2 T_{g2}}{w_1 + k w_2} \quad (1)$$

where w_i = mass fraction of component i , T_{gi} = its pure component glass transition, and k = a constant. Equation (1) can be rearranged to the form

$$T_g = T_{g1} + \frac{k w_2}{w_1} (T_{g2} - T_g) \quad (2)$$

The T_g -composition dependence for the PECH—PDPA system is linear, as shown in Figure 2, which

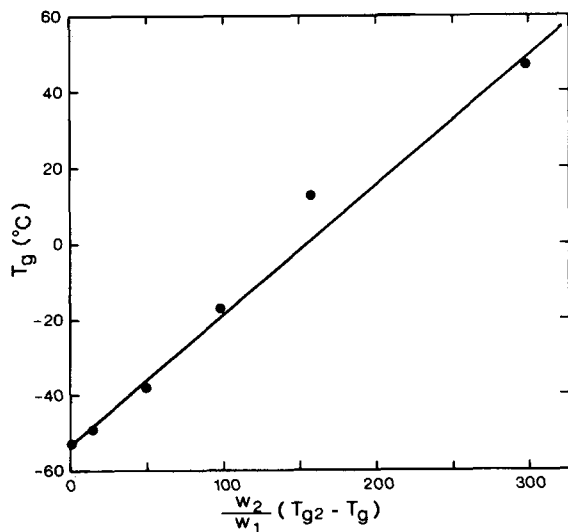


Fig. 3. Gordon-Taylor plot for PDPA—PVC blend system.

implies that $k = 1$. However, for the system PVC—PDPA, the T_g curve is concave upwards, as seen in Figure 1. Replotting the latter data in accordance with eq. 2 gives a linear relationship as shown in Fig. 3, and a value of $k = 0.34$ may be deduced. Prud'homme et al.^{4,5} have suggested that the value of k observed is indicative of the strength of interaction between components in the blend, but no fundamental basis for this connection has been presented.

Acknowledgment is made to the donors of the Petroleum Research Fund, administered by the American Chemical Society, for their support of this research.

References

1. J. V. Koleske and R. D. Lundberg, *J. Polym. Sci., A-2*, **7**, 795 (1969).
2. G. L. Brode and J. V. Koleske, *J. Macromol. Sci., Chem., A*, **6**, 1109 (1972).
3. J. V. Koleske in *Polymer Blends*, D. R. Paul and S. Newman, Eds., Academic, New York, 1978, Chap. 22.
4. G. Belorgey and R. E. Prud'homme, to appear.
5. D. Allard and R. E. Prud'homme, to appear.
6. O. Olabisi, *Macromolecules*, **8**, 316 (1975).
7. M. Bohdanecký, K. Solc, P. Kratochvil, K. Kolinsky, M. Ryska, and D. Lim, *J. Polym. Sci., A-2*, **5**, 343 (1967).
8. R. E. Bernstein, C. A. Cruz, D. R. Paul, and J. W. Barlow, *Macromolecules*, **10**, 682 (1977).

S. H. GOH*
D. R. PAUL
J. W. BARLOW

Department of Chemical Engineering
The University of Texas
Austin, Texas 78712

Received June 29, 1981
Accepted August 5, 1981

* On leave from: Department of Chemistry, National University of Singapore, Singapore 1025.