NOTES

Miscibility of Poly(neopentyl Glycol Adipate) with Chlorinated Polypropylene and with Vinyl Chloride/ Vinyl Acetate Copolymers

INTRODUCTION

The study of the miscibility of polyester/chlorinated polymer blends have received considerable attention in recent years.[1-13] The formation of miscible polyester/chlorinated polymer blend is a result of one or more of the following interactions between the two polymers: dipole–dipole interaction between the carbonyl groups and C–Cl groups, hydrogen-bonding interaction between the carbonyl groups and the α-hydrogens of the chlorinated polymer and hydrogen-bonding interaction between the carbonyl groups and the β-hydrogens of the chlorinated polymer.

A polyester poly(neopentyl glycol adipate) (PDPA) was found to form miscible blends with poly(vinyl chloride),[11] poly(epichlorohydrin),[11] poly(vinylidene chloride-co-vinyl chloride),[12] chlorinated polyethylene,[13] and poly(epichlorohydrin-co-ethylene oxide).[13] This note reports the miscibility of PDPA with chlorinated polypropylene and with poly(vinyl chloride-co-vinyl acetate).

EXPERIMENTAL

The PDPA used was Rucoflex S-1065-55 supplied by Hooker Chemical Corp.; its intrinsic viscosity was 0.084 dL/g in benzene at 25°C.

The chlorinated polypropylene (CPP) was supplied by Scientific Polymer Products; its intrinsic viscosity was 0.055 dL/g in toluene at 30°C. Elemental analysis showed that the polymer contained 67% by weight of chlorine.

Two poly(vinyl chloride-co-vinyl acetate) samples containing 2% and 17% by weight of vinyl acetate, respectively, were obtained from Scientific Polymer Products; their intrinsic viscosities were 0.60 and 0.065 dL/g, respectively, in tetrahydrofuran at 30°C. The two polymers are designed as VCAC-2 and VCAC-17, respectively, in this work.

The poly(vinyl acetate) (PVAc) used was Union Carbide AYAF with an M_w of 124,000.

The PDPA/CPP blends were prepared by solution casting in toluene, followed by drying in a vacuum oven at 110°C for 30 h. The PDPA/VCAC blends and PDPA/PVAc blends were prepared by solution casting in tetrahydrofuran, followed by drying in a vacuum oven at 100°C for 30 h. For blends containing VCAC-2 and VCAC-17, a stabilizer, Advastab TM-181, was added in an amount of 5% by weight of VCAC.

The glass transition temperature (T_g) of the polymer was measured with a Perkin-Elmer DSC-1B Differential Scanning calorimeter, using a heating rate of 16°C/min. The blends were examined for cloud points using procedures described previously.[13]

RESULTS AND DISCUSSION

All the PDPA/CPP blends were transparent and showed one T_g. The T_g–composition curve of the blends is shown in Figure 1. The transparency of the blends and the existence of one composition-dependent T_g show that PDPA is miscible with CPP. All the blends remained transparent when heated up to 200°C. Further heating led to discoloration caused by thermal degradation of the polymers.

All the PDPA/VCAC-2 and PDPA/VCAC-17 blends were transparent. Each of these blends showed only one T_g as shown in Figure 2. The transparency of the blends and the existence of one composition-dependent T_g show that PDPA is miscible with VCAC-2 and with VCAC-17. All the blends remained transparent up to 240–250°C, and became yellowish at higher temperature.

On the contrary, all the PDPA/PVAc blends were nonhomogeneous. Furthermore, the blends showed two T_g close to the T_g of the pure components as shown in Figure 3. It is concluded that PDPA is immiscible with PVAc.

It is interesting to note that while PDPA is miscible with PVC[11] but immiscible with PVAc, it is miscible with vinyl chloride/vinyl acetate copolymer containing up to 17% by weight of vinyl acetate.

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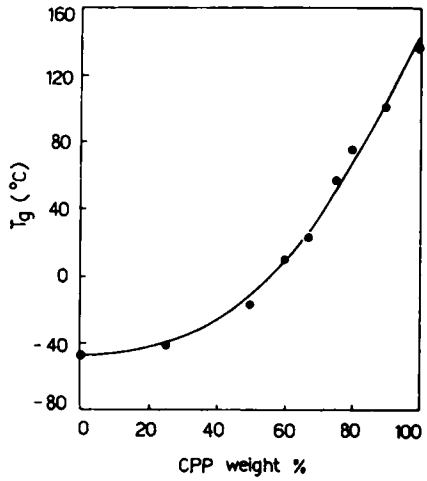

Fig. 1. T_g–composition curve for PDPA/CPP blends.

The formation of a miscible blend is a result of an exothermic heat of mixing which requires specific interaction between the two polymers. The present study shows that even when 17% of the vinyl chloride in PVC is replaced by vinyl acetate, the interaction between the copolymer and PDPA is still sufficiently strong to give an exothermic heat of mixing, resulting in the formation of a miscible blend. It is also noted that the molecular weights of PDPA, CPP, and VCAC-17 are probably in the order of a few thousand as inferred from their low intrinsic viscosities. Thus the entropy of mixing involving these low molecular weight polymers also favors the formation of a miscible blend.

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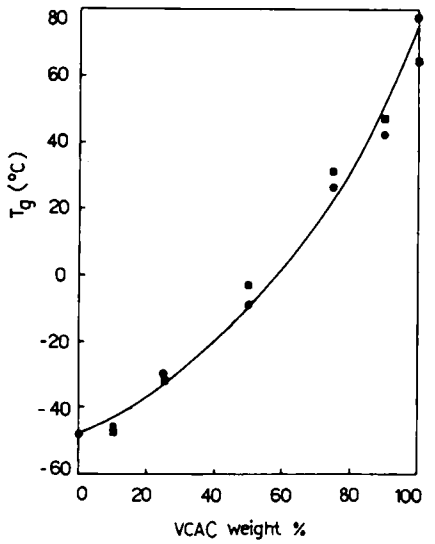

Fig. 2. T_g-composition curves for PDPA/VCAC blends: (●) PDPA/VCAC-2 blends; (■) PDPA/VCAC-17 blends.

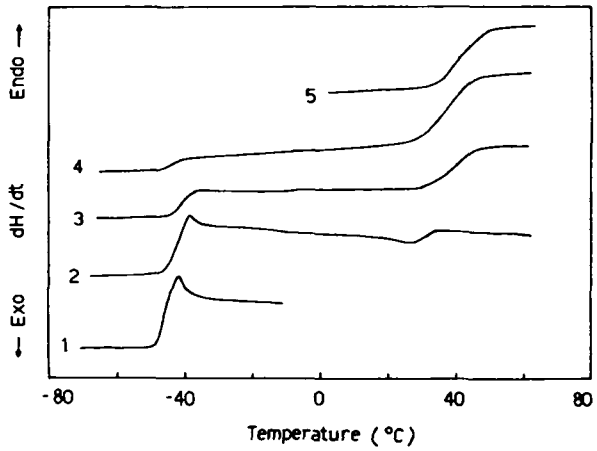

Fig. 3. DSC curves for PDPA/PVAc blends: (1) pure PDPA; (2) 25% PVAc; (3) 50% PVAc; (4) 75% PVAc; (5) pure PVAc.

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