

Morphology, Rheology, and Mechanical Properties of LCP-Polystyrene Blends

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INTRODUCTION

Over the last decade research on liquid crystalline polymers (LCPs) and their blends has increased significantly because of their higher orientability caused by the lower viscosity¹. Especially, blends of LCPs with thermoplastic materials have attracted much attentions due to the potentials of formation of the fibrillar structure in the matrix of the thermoplastics leading to the higher mechanical properties²⁻³. But this process is not so easy, and depends upon many parameters such as the composition of the blend, the viscosity ratio, processing temperature, the type of the flow field during the process, etc⁴. In this study, the blends of polystyrene(PS), a typical commodity polymer, and two different LCPs were investigated. Also to improve the adhesion between the components of blends, two LCPs were modified and their properties were observed.

EXPERIMENTALS

Two LCPs were used in this study. The first LCP is known commercially as Vectra A950(from Hoechst Celanese Corporation) and is believed to be composed of 75 mol% 4-hydroxy benzoic acid (HBA) and 25 mol% 2-hydroxy-6-naphthoic acid(HNA). The second LCP is known as RODRUN LC-5000(from Unitika Co.), reported to be composed of 20 mol% PET and 80 mol% HBA. The thermoplastic used was PS(HF-2660, $M_w = 240,000$, from Cheil Industries Inc.). All polymers were completely dried under vacuum before blending. Blends of the LCPs with PS were prepared on the Mini-Max injection molder(Model CS-183 MMX, Custom Scientific Instruments Inc.) at 290°C, mixing for about 5 min. The rheological properties of the blends and their components were determined on a Rheometrics Mechanical Spectrometer(RMS 800). The morphology was investigated with scanning electron microscope (SEM, JEOL JSM-35). The mechanical properties of the molded dumbbell type specimens were measured on a tensile tester with a cross-head speed of 1 mm/min.

RESULTS AND DISCUSSION

The plots of the complex viscosity as a function of shear rate for unblended components and PS/Vectra A950 blends at 290°C are shown in Fig.1. The viscosity curves of the blends containing up to 20 % Vectra A950 reflect the viscosity-shear rate characteristics of the PS but those for the higher LCP compositions are typical of that of the pure LCP in that shear thinning is observed. However, the viscosities of the pure PS and blends lie below those of the LCP, which makes the formation of the fibrillar structure difficult. So RODRUN has the higher potential of the formation of the highly oriented structure because of the lower viscosity than Vectra A950. Fig.2 shows the fracture microstructure of pure Vectra A950 and 10 % Vectra A950/PS blend. As can be seen in Fig.2a, the pure Vectra A950 shows the highly oriented structure but in the case of the blend the LCP phase, in spite of their high orientability, forms the spherical domains(Fig.2b). This is, as mentioned above, attributed to the higher viscosity of Vectra A950. Also it can be seen from Fig.2b that the adhesion between the components is very poor. And the improvement of the interfacial adhesion as well as the formation of the oriented structure is studied.

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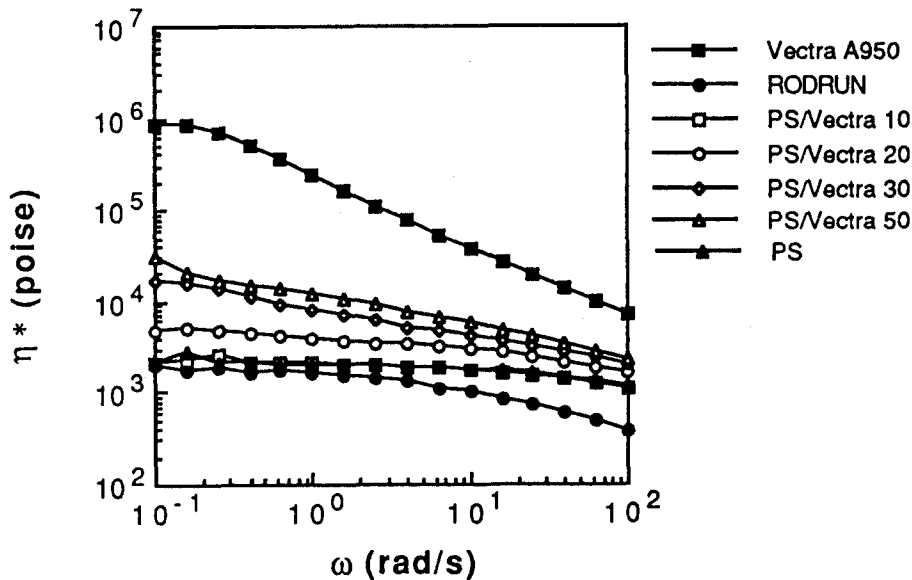


Fig.1. Shear rate dependence of the viscosity of LCPs, PS, and their blends.

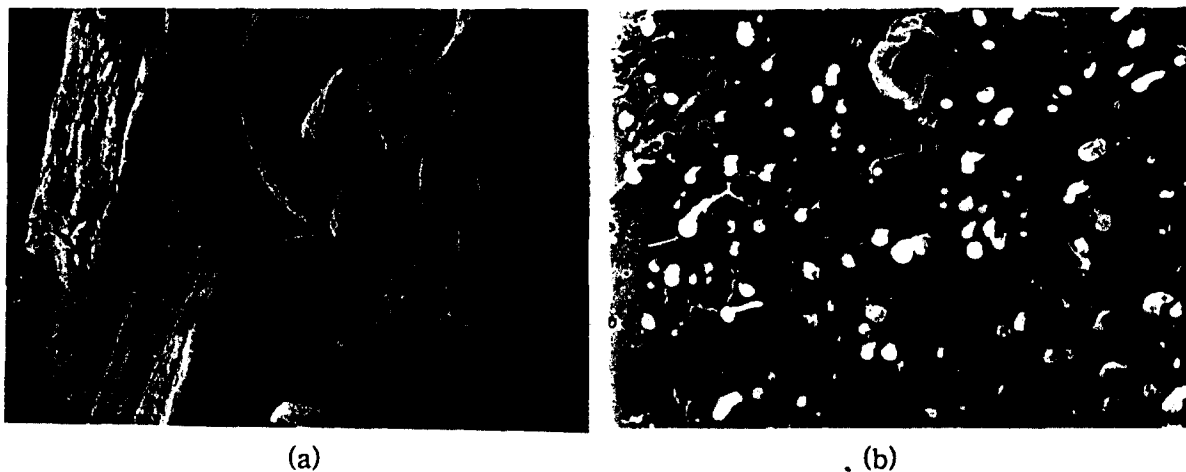


Fig.2. Scanning electron micrographs of the fracture surface of Vectra A950(a) and 10 % Vectra A950/PS blend(b).