Interaction between ethylene vinyl acetate copolymer and polyethylene

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Summary

Low density Polyethylene (LDPE) and Ethylene Vinyl Acetate (EVA) Copolymer have been processed at 170 °C for 7 minutes. Dynamic mechanical analysis shows a single composition dependent glass transition temperature of the 50:50 EVA/LDPE blend. Infrared spectra of pure EVA processed at the same condition shows splitting of >C=0 stretching band of EVA while spectra of the 50:50 EVA/LDPE blend shows a well resolved single band. Thermogravimetric analysis of the blend shows greater stability than those of the pure components. A schematic mechanism ascribing to the synergistic effect observed is proposed.

Introduction

In recent years, blends containing a judicious combination of a homopolymer with its copolymer have gained considerable attraction, particularly when the components are semicrystalline. The structural similarity between the polymers may lead to some sort of compatible composition, sometimes through the co-crystallization phenomenon (1,2).

Compatibility phenomenon between Polyethylene and Ethylene Vinyl Acetate (EVA) copolymer was studied by Kovacs and Kallo (3) through electron microscopy. Recently, a detailed study on the relation between morphology of EVA/LDPE blends and their mechanical properties, dynamic mechanical properties and electrical resistivities have been communicated (4). We have also reported the stress-strain behaviour of EVA/LDPE blends and the effect of straining and process parameters on the microstructure of the blends (5,6). Grafting of EVA on PBTP has been studied by earlier researchers (7).

Experimental

Materials used

Materials used for the investigation have the following characteristics:

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Trade name</th>
<th>Producer</th>
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<tbody>
<tr>
<td>EVA</td>
<td>PILENE 2806</td>
<td>PIL; INDIA</td>
</tr>
<tr>
<td>VA content 28%</td>
<td></td>
<td></td>
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<tr>
<td>d = 0.95 gms/c.c.</td>
<td></td>
<td></td>
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<tr>
<td>MFI = 6g/10 min.</td>
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<tr>
<td>LDPE</td>
<td>INDOThENE 20CA002</td>
<td>IPCL; INDIA</td>
</tr>
<tr>
<td>d = 0.92 gms/c.c.</td>
<td></td>
<td></td>
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<tr>
<td>MFI = 0.2g/10 min.</td>
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*Corresponding author
Preparation of the blends

Blending was carried out in a Brabender Plasticorder (PLE-330) fitted with a cam type rotor. Temperature was set at 170°C and rotor speed at 60 r.p.m. LDPE was first allowed to melt in the Plasticorder, followed by addition of EVA. Mixing carried out for about 7 minutes until the torque was stabilized. The mixed mass was then compression molded at 150°C under 10 MPa pressure.

Thermogravimetric analysis

Thermogravimetric Analysis (TGA) were carried out in a 951 Thermogravimetric Analyser fitted with Dupont Thermal Analyser-9000 in nitrogen atmosphere at a heating rate of 20°C min⁻¹.

Dynamic Mechanical Analysis (DMA)

Dynamic mechanical measurements were carried out on a dynamic mechanical analyser (Rheovibron DDV-III-EP). The experiment was performed in tension mode from -150°C to +150°C at a frequency of 3.5 Hz at 0.17% dynamic strain amplitude with a programmed heating rate of +2°C min⁻¹.

Infrared Spectrophotometric study

Infrared Spectrophotometric analysis of the blend and the pure components were performed with a Perkin-Elmer 843 model. Thin films were used for analysis. The spectral resolution was kept at 2.40 cm⁻¹ for all samples and the scan was taken at room temperature.

Results and Discussion

Figure 1 shows TGA traces of the 50/50 EVA : LDPE blend and the individual components. Both pure EVA and the 50/50 blend show a two-step decomposition. However, the second plateau is wider in the case of 50/50 blend revealing greater thermal stability of the blend compared to that of pure EVA.

![TGA curves of EVA (-- --), LDPE (---), and 50:50 EVA/LDPE blend (-----)](image)

Fig. 2 shows that the activation energy (Eₐ) of the 50:50 EVA/LDPE blend (8) calculated through Freeman Carroll's equation (9) deviates from weighted average value. This indicates the existence of some chemical interaction between the components of the blend. Similar observation have been reported by other authors (10). This may be explained by IR analysis.