# Properties of PP/EVA Blend and Blend Fiber

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## 1. INTRODUCTION

Blending of imcompatible polymers for achieving properties suited to particular applications is gaining importance. The binary blend of isotatic polypropylene (PP) and ethylene-vinyl acetate copolymer (EVA) seems suitable for various applications owing to the modification of properties of PP by incorporation of EVA. This paper describes a study of thermal, rheological and morphological properties of binary blend of isotatic propylene (PP) and ethylene-vinyl acetate copolymer (EVA) at varying blend ratios (from 0 to 9wt% EVA content). Measurements made on a capillary rheometer ay three different temperatures (180, 200, and 220℃) in a shear stress are presented and discussed for the effects of blend composition. Morphology of the blend studied through scanning electron microscope is discussed in terms of variation of blend composition.

Also, PP/EVA polymer blends (EVA varying from 0 to 9wt%) were melt spun into fiber. Their mechanical properties were studied.

## 2. EXPERIMENTAL

### Materials

The isotatic PP used was M-88OZ (MFI = 25), a product of YUKONG Ltd. The EVA containing 38 wt% vinyl acetate (VA) was EVA (MFI = 2), a product of HONAM Petrochemical Corporation Ltd.

### Preparation of Blends and Blend fibers

PP/EVA blends was prepared by melt-miximg the component polymers, in the requisite ratios, in a single-screw extruder (Bestro BM-1820) at a screw speed of 30 rpm and the temperature range of 200-220℃ from the first zone to the die. The extrudate was cooled in water and cut into chips from the die and used for rheological measurements. The blend composition range studied was 0-9wt% EVA content. Since this type of blend is generally used for fiber formation of PP, higher EVA contents were not studied. Before melt-spinning, the chips of blend were dried separately in a vacuum drier for 4h at 80℃. The chips were spun into fibers using a melt spinning units. During the spinning operation, 3 different spinning velocities were used: 500; 700; 1000 m/min. The temperature was controlled at 2 different zones during the spinning of blends: 210℃ and the head temperature 220℃.

### Measurement

A differential scanning calorimeter, DSC (DSC 2010), was used for the thermal analysis. Samples weighed 10±0.5 mg. The scanning rate was 10℃/min for heating from 30℃ to 220℃. Rheological measurements were carried out on a pistion-type capillary rheometer. The capillary was a circular cross section (diameter 1㎜) and length/diameter ratio was 16. Morphology of the freeze-fractured extrudate cross sections were studied using a scanning electron microscope (S-4100) of Hitachi Instrument Ltd. Mechanical properties of as-spun blend fibers were determined at room temperature using an Instron (4301) tensile tester, equipped with a 10N load cell. The gauge length was 40㎜.

## 3. RESULTS AND DISCUSSION

### Flow Curves

The flow curves, shear stress vs. shear rate plots, of the PP/EVA blend at various compositions, at 180℃ are shown in figure 1. All the flow curves are quite linear in the studied range of the shear rate. The flow curve of PP falls distinctively away from those of the blend, in high shear rate regions.

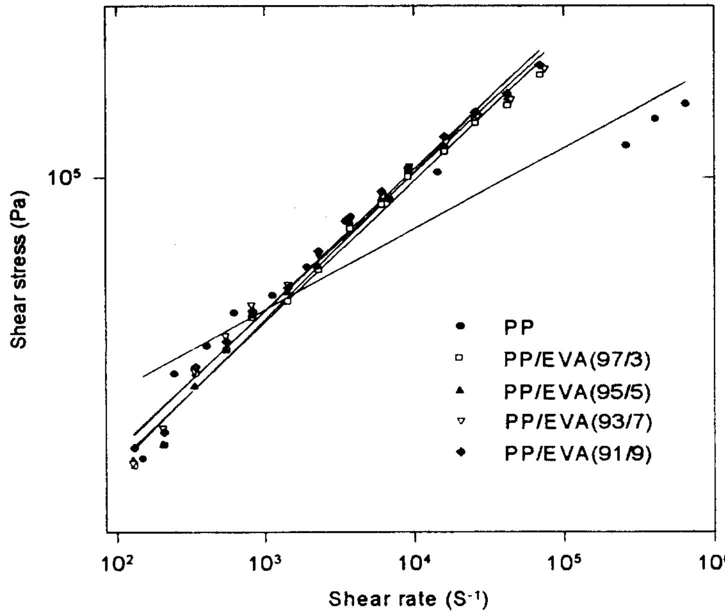
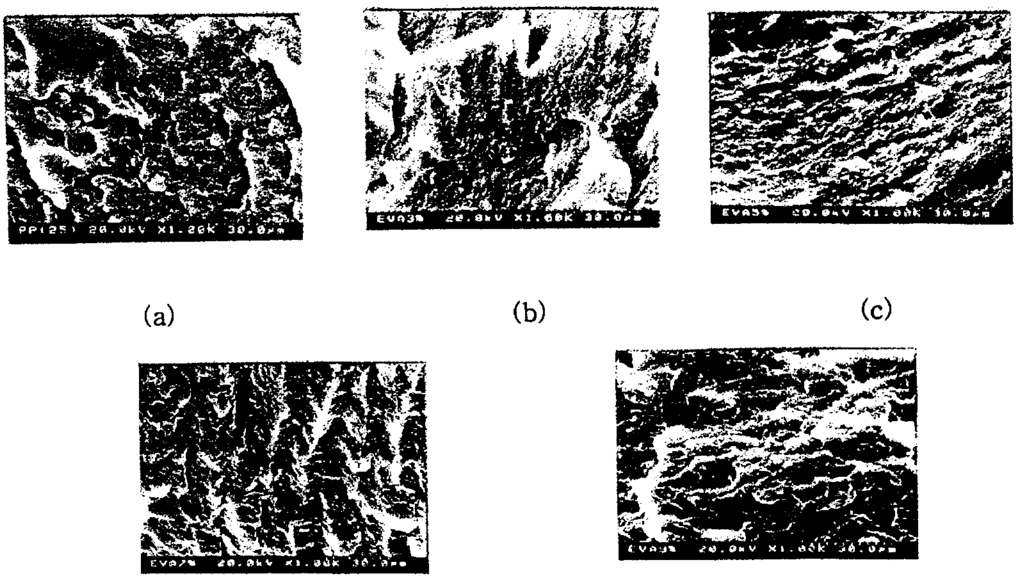



Figure 1 Variation of shear stress with shear rate of PP and PP/EVA blend at 18O℃.

### Morphological studies

Scanning electron micrographs of fracture surfaces of the chips of PP/EVA blends were examined. Figure 2a shows the pure PP breaks in a brittle manner. Figure 2b. to e show that there are many small particles dispersed over the entire cross section and show that there are many small particles dispersed over the entire cross section and the fractures are still brittle nature.



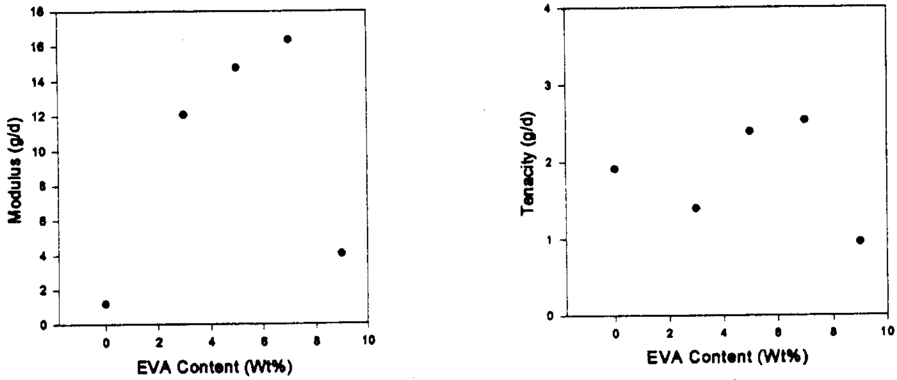
(a) (b) (c)

(d) (e)

Figure 2 Scanning electron micrographs of fractured PP/EVA chips: (a) 100/0; (b) 97/3; (c) 95/5; (d) 93/7; (e) 91/9.

**Tensile testing**

Instron tester was employed to measure tenacity, % elongation, and modulus of as-spun PP and blend fibers. Figure 3 shows modulus and tenacity of the blends both increase almost linearly with increased EVA content except EVA 9wt%. The highest modulus obtained on these blend fibers was 16.3(g/d) at the spinning condition 500m/min.




(a) (b)

Figure 3 Variation of modulus and tenacity at a constant spinning velocity (500m/min) of the PP/EVA as-spun blend fiber.

## 4. CONCLUSION

From the above, we can conclude that the addition of EVA to PP fibers can, in small amounts, have a beneficial effect on the rheological properties of the PP, without significantly depressing the mechanical properties. The fractured surface of blends seems to the brittle fracture and EVA particles well dispersed over the entire cross section.

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