폴리프로필렌의 친수화 개질(III)

- blend fiber의 제조 및 그 특성 -

임상규, 문병화, 김광일, 손태원, 윤원식, 이은우*
*영남대학교 섬유학부, *영남전문대학 섬유과*

1. INTRODUCTION

In fiber technology, two or more polymers may formed into a product of being combinations of individual material characteristics or new ones by two different routes, which are referred to blending.

The first is the more well-developed concept of fiber-fiber blending in which conventional synthetic or natural fibers are mixed. These fibers, which are referred to as fiber blends. For example, two types of fibers can be blended into a yarn, or more than one yarn, each composed of a single fiber type, can be wovwn or knitted into a fabric.

On the other hand, when the polymer-polymer blends comprise the individual filaments, they are referred to as blend fiber. This concept is rapidly developing as an approach for new fiber products and problem solving for existing products. As a result, much of the technology for the blend fibers lies in polymer processing, which shifts upstream the demand for expertise in the conversion of resources to products.[1]

The modification of polymeric materials is an important field of research for various applications such as the dyeability of textiles, the improvement of adhesion for packing industry, and the elaboration of membranes with specific properties. Because of its growing commercial applications, polypropylene(PP) fibers have attracted particular attention. Our work was focused on the improvement of the hydrophilicity of industrial PP fibers toward some polar fibers like polyester and polyamide.

However, most of the published studies dealing with PP films not PP fibers.

In this study, Morphlogical, thermal, mechanical behavior were carred out for blend fibers of polypropylene, PP, and poly(ethylene-co-vinyl alcohol), EVOH, with epoxy. The effects of severial processing parameters such as EVOH content and draw ratio on blend fiber morphology and physical properties suggest that morphology of the EVOH phase dictates to a large extent the densities of these blend fibers.

2. EXPERIMENTAL

2.1 Materials

The polypropylene, PP, was YUKON(melt flow index = 25dl/10min). The poly (ethylene-co-vinyl alcohol), EVOH, was Japan Synthesis Chemistry, Soarnol ET3825 (melt flow index = 25dl/10min). The poly(bisphenol A-epichlorohyd rin), Epoxy was Aldeich chemical Co(Epoxide E.W. 2300~3800).

2.2 Materials Processing

Before melt spinning, the PP, EVOH, Epoxy were mixed in a Brabenedr twin extruder at 220℃ for 15 mins.

Details of blend fiber formation conditions are listed below in Table 1.

Table 1. Details of blend fiber formation conditions

fiber formation conditions	
Blend resin temperature at spinnert(℃)	220℃
Number of holes in spinneret	6
Spinneret hole size(㎜)	0.3
Winding speed(m/min)	1000~1600

As-spun blend fibers were drawn on a Laboratory stretcher. Samples 10 ㎝ length were drawn simultaneously at a rate of 1.5㎝/min at room temperature. Draw ratios used were 2, 3, and 4.

2.3 Mechanical Testing

Mechanical testing of drawn blend fibers were determined at room temperature using an Istron (4301) tensile tester, equipped with a 10 N load cell. The gauge length was 40 ㎜. All the tensile properties to be presented are the average of at least five tests.

Densities of blend fibers were measured using an isopropyl alcohol/water density gradient column maintained at 23℃.

2.4 Morphology

Samples for scanning electron microscopy were prepared as below. As-spun blend fiber and drawn blend fiber were treated in dimethyl sulfoxide(a selective solvent for EVOH) in an ultrasonic bath for 2hr and rinsed in distilled water for 2min. The surfaces of these fibers were than coated with gold and observed in an SEM. Scanning electron microscopy was done using a Philips 501SEM.

2.5 Differential Scanning Calorimetry

Differential Scanning Calorimetry (DSC) was performed using a Perkin-Elmer DSC7 and a Perkin-Elmer thermal analysis system. A heating rate of 20℃/min was used in all tests.

3. RESULTS AND DISCUSSION

3.1 Physical and Mechanical Properties of blend fiber

As shown in Fig.1, the density of PP and blend fibers increase with the increase of the draw ratio. Considerable difference between PP/EVOH(9Wt%) blend fiber and PP/EVOH(9Wt%)/Epoxy(1Wt%) blend fiber exist.

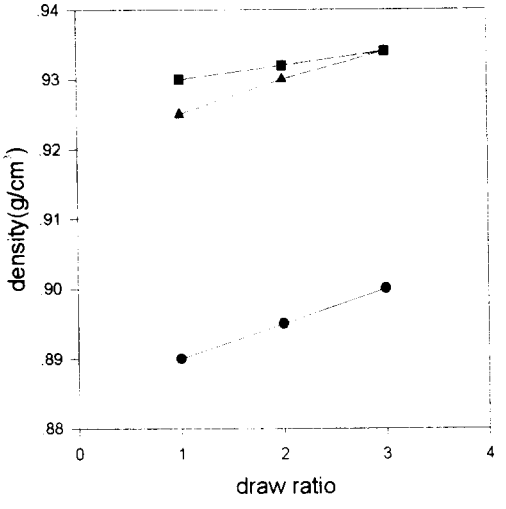
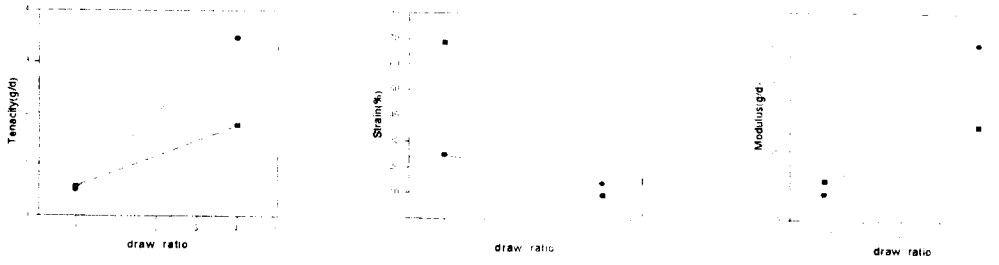


Fig.1 Dependence of density on the draw ratio of blend fiber(● ; PP fiber, ▲ ; PP/EVOH(9%)/Epoxy(1%) blend fiber, ■ ; PP/EVOH (9%) blend fiber)

Fig. 2a shows the relationship between modulus and draw ratio for blend fiber. For each blend fiber, modulus increased with draw ratio. the highest modulus obtained on these blend fibers was 51.1(g/d).



(a) (b) (c)

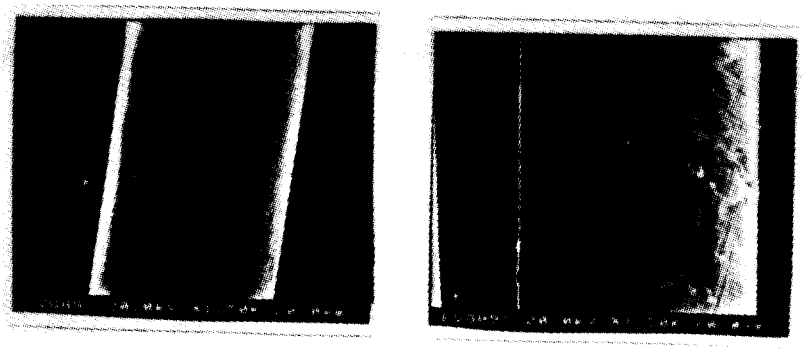
Fig.2 Dependence of Tenacity, Strain, Modulus on the draw ratio of blend fiber(● ; PP/EVOH(9%)/Epoxy(1%) blend fiber, ■ ; PP/EVOH (9%) blend fiber)

3.2 Morphology

SEM micrographs for PP/EVOH blend fibers, PP/EVOH/Epoxy blend fibers, specimens prepared from different draw ratios., are shown in Fig.3.

PP/EVOH as-spun blend fiber exhibited smooth surface without any clear defect. When the fiber was highly drawn a streak structure was developed supposedly due to the formation of PP crystals across the fiber axis. The unique morphology of the fiber surface means that small amount of EVOH incorporates into the amorphous region of PP in the draw fiber with minute and even distribution of the separate EVOH phases.

With the inclusion of additive amount of Epoxy(1Wt%) in the PP/EVOH blend, the separated phase between PP and EVOH were considerably adhered even though the streak structure was well defined.



(a) (b)

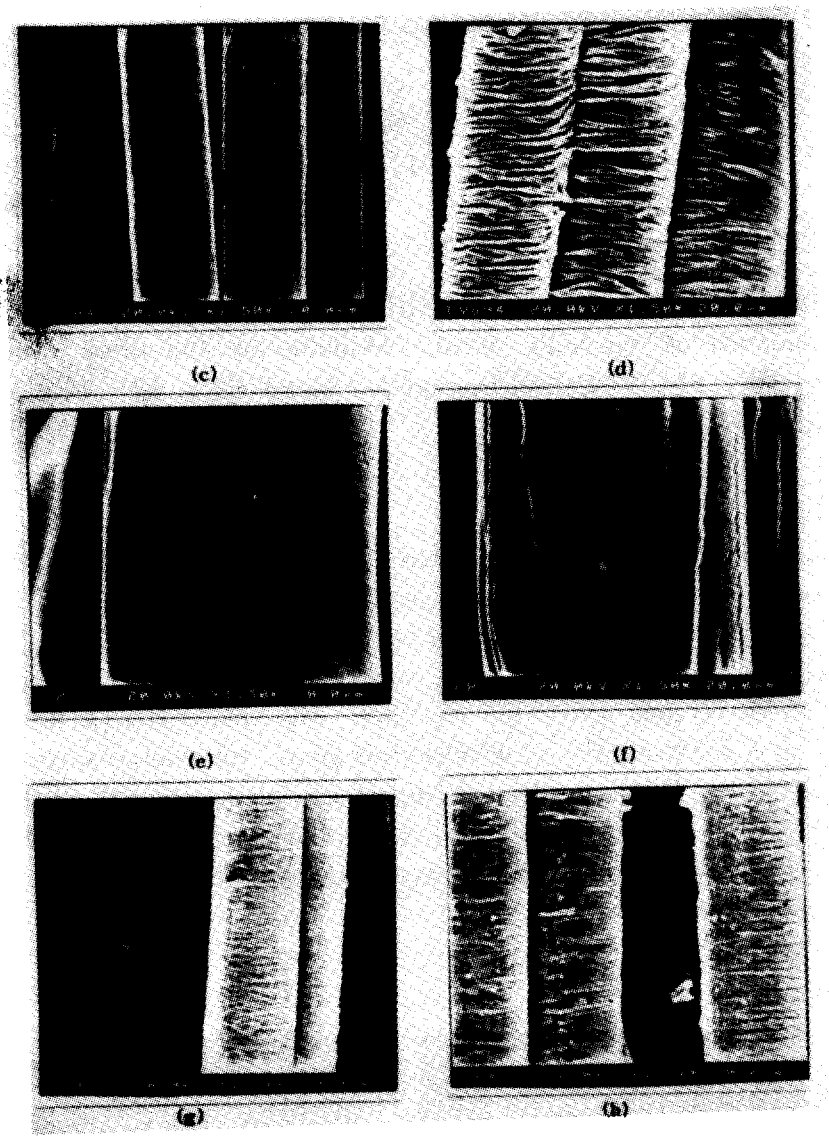


Fig. 3 Scanning electron micrographs of the surface of blend fibers; a) PP/9% EVOH as-spun blend fiber, b) Dimethyl sulfoxide treated PP/9% EVOH as-spun blend fiber, c) PP/9% EVOH drawn blend fiber(draw ratio 4), d) Dimethyl sulfoxide treated PP/9% EVOH drawn blend fiber(draw ratio 4), e) PP/9% EVOH/1% Epoxy as-spun blend fiber, f) Dimethyl sulfoxide treated PP/9% EVOH/1% Epoxy as-spun blend fiber, g) PP/9% EVOH/1% Epoxy drawn blend fiber(draw ratio 4), h) Dimethyl sulfoxide treated PP/9% EVOH/1% Epoxy drawn blend fiber(draw ratio 4).

4. CONCLUSION

Polypropylene/Poly(ethylene-co-vinyl alcohol)(9Wt%) and Polypropylene Poly(ethylene -co-vinyl alcohol)(9Wt%)/Epoxy(1Wt%) blend fibers were prepared by melt spinning and then drawn simultaneously at room temperature. It was found that, PP/EVOH as-spun blend fiber exhiblted smooth surface without any clear defect but the fiber was highly drawn a streak structure was developed. It is supposedly due to the formation of PP crystals across the fiber axis.

The unique morphology of the fiber surface means that small amount of EVOH incorporates into the amorphous region of PP in the draw fiber with minute and even distribution of the separate EVOH phases.

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