Influence of pin-twist texturing on the characteristics of split-type microfine polyesters

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1. INTRODUCTION

The application of functional polyester fiber is growing very rapidly because consumers prefer to silk-like, soft, light, drapeable fabrics. For this purpose, a considerable amount of work is being done to modify the general polyester fibers. Advancements in spinning technology and improvements in the quality of polymers have made it possible to reduce the denier per filament to less than 1.0 to achieve the fineness of natural silk, its soft feel, and its luster. Microfiber polyester fibers have given a new dimension to fashion, offering consumers innovative fabrics. Texturing microfiber polyester yarns are a challenge because of the many problems faced during the process. In this paper, we have investigated the effect of draw texturing conditions not only on physical properties but on spliting ones using split-type ultrafine polyester/nylon composite filaments. The effect of process variables on the final yarn properties such as linear density and strength have been investigated. Also, visual assesment of splitting behavior was carried out by SEM photographs.

2. EXPERIMENTAL

Split type ultrafine P/N filaments were draw textured by a pin twisting method on a model 440B of ARCT Co. draw texturing machine and then all textured yarns were weaved on a water jet machine and scoured, heat-setted and dyed with a same condition, respectively. The properties of the supply yarns used are given in Table Ⅰ. The values of draw texturing variables are shown in Table Ⅱ and weaving and finishing condition are shown in Table Ⅲ. We have considered three variables, i.e., overfeed, heater temperature, twist count, and produced 15 samples with different levels of texturing variables. We measured the linear density and tensile properties of textured yarn samples by KS K 0416 and KS K 0412. By the SEM phothgraph, We investigated yarn splitting behavior of textured yarn states and fabric states after weaving and finishing.

Table 1. The properties of the supply yarns used

Property / Supply yarn	Linear density(denier)	No. of filament	Filament fineness(denier)	Tenacity (g/denier)	Extension at break(%)	Modulous (g/denier)
P/N filament	75	24	3.125 (after split 0.195)	4.539	18.46	86.45

Table Ⅱ. Values of machine variables used in experiments

Parameter	Levels
Overfeed(%)	1.7, 2.0, 2.3, 2.6, 2.9
Heater temperature(℃)	165, 170, 175, 180, 185
Twist count(T/M)	1900, 2100, 2300, 2500, 2700

Table Ⅲ. Condition of weaving and finishing used in experiments

Weaving	width:46in., No. of warp filament:7,600EA, density of weft:84EA constuction:1/3 twill
Scouring	120℃ × 30min. NaOH 1g/ℓ, scouring agent 1g/ℓ
Heat setting	170℃ × 30sec. × 44in.
dyeing	120℃ × 30min
Heat setting	165℃ × 30sec. × 44in.

3. RESULTS AND DISCUSSIONS

3.1 Linear density

Figure 1. (a), (b) and (c) show the effect of overfeed, heater temperature and twist count on linear density. With increasing overfeed, heater temperature and twist count, linear density is almost constant. Crimps produced by draw texturing are easily extended when applied loads, so linear densities of the textured yarns are similar to those of parent yarns.

3.2 Tenacity

Figure 2. (a) shows the effect of overfeed on tenacity. It shows the trend that the strength of textured yarns decreased as overfeed increased, because the yarn tension before and after the false-twisting unit decreased by increasing overfeed lead to reduction of molecular orientation. And excessive overfeed may cause filament or even yarn breakages due to friction between filament and yarn guide in the heater.

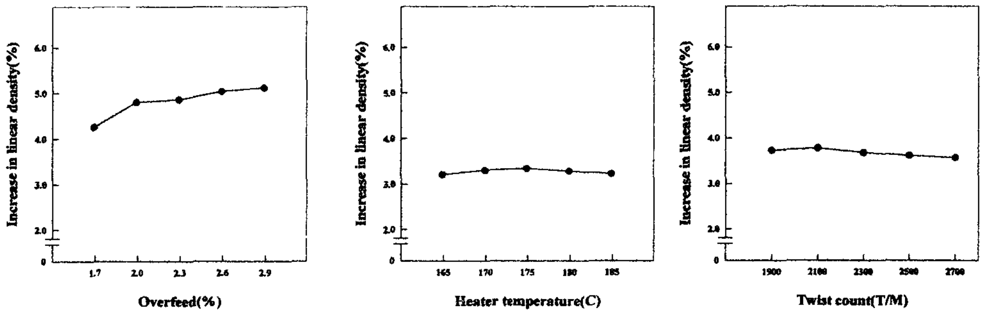
Figure 2. (b) shows that the tenacity of textured yarns is increased with increasing heater temperature. Crystalline orientation and crystal perfection increase, because smaller and imperfect crystals melt, facilitating of bigger crystals at higher temperatures. Figure 2. (c) revealed yarn tenacity increased up to 2100T/M and then decreased. As twisting levels increased, yarn tension before and after the false-twisting unit also increased and influenced on the variation of molecular orientation. But at higher twisting count, molecular degradation by excessive torsional stress might take place, and the yarn tenacity was reduced.

3.3 Breaking extension

Figure 3. (a), (b), and (c) show the effect of variables on breaking extension. By increasing overfeed, heater temperature and twist level, the helical coils are expected to reduce in diameter and also produce higher recovery force in the yarn, because the retractive power of a streched helical spring is inversely proportional to the square of its diameter. Crimp frequency also increased as a result of the diminishing diameter of the helices, because the coils increased in number as the yarn untwisted. The yarn crimp contraction and bulk will depend on the retractive power as well as crimp frequency.

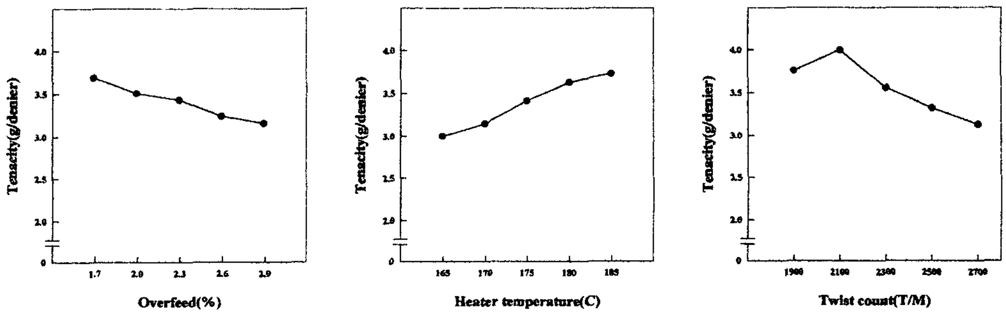
3.4 Split characteristics

Figure 4 and 5 show SEM photographs of cross-sections of yarns and fabrics produced with different overfeed, heater temperature and twist level. We see three process variables does not significantly influence on yarn split. We expect partial split in high twist level because of higher torsional deformation than by other parameters, but it does not occurs in even finished fabrics.



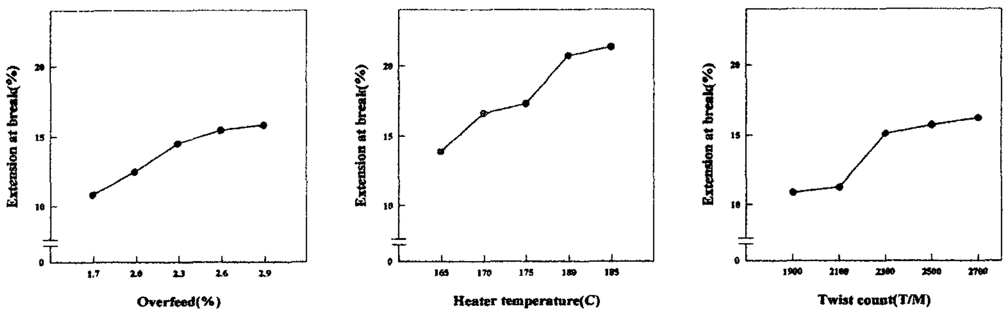
(a) (b) (c)

Figure 1. Effect of process variables on linear density



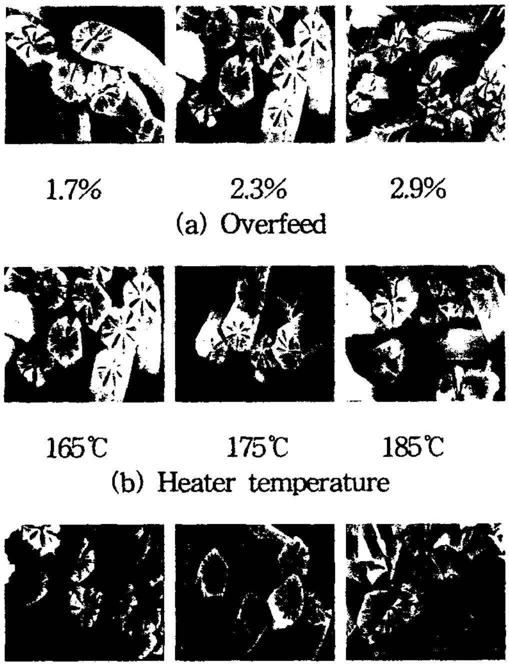
(a) (b) (c)

Figure 2. Effect of process variables on tenacity



(a) (b) (c)

Figure 3. Effect of process variables on breaking extension

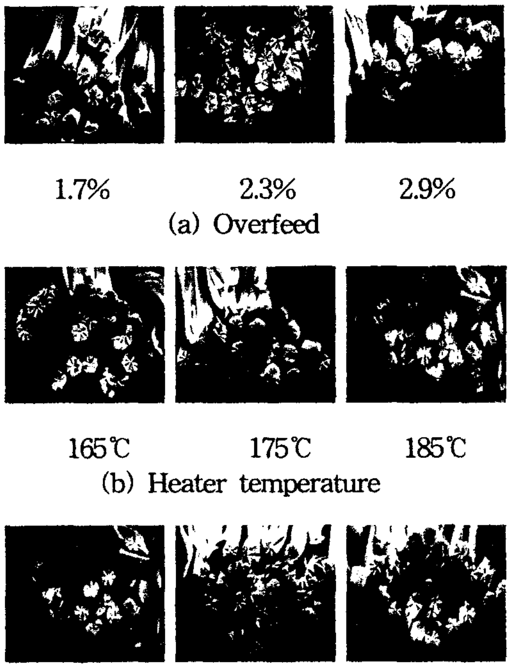


1.7% 2.3% 2.9%
(a) Overfeed

165℃ 175℃ 185℃
(b) Heater temperature

1900T/M 2300T/M 2700T/M
(c) Twist count

Figure 4. Split behavior of yarn state



1.7% 2.3% 2.9%
(a) Overfeed

165℃ 175℃ 185℃
(b) Heater temperature

1900T/M 2300T/M 2700T/M
(c) Twist count

Figure 5. Split behavior of fabric state

4. CONCLUSION

We have investigated the effect of draw texturing process on the properties and split behavior of split-type microfine polyester. The result obtained in this study are as follows

1. The linear densities of draw textured yarns are almost constant with different overfeed, heater temperature, and twist level.
2. The tenacity of textured yarns decreased with increasing overfeed and increased with increasing heater temperature, and increased up to 2100T/M and then decreased with twist level.
3. The breaking extension of textured yarn increased as overfeed, heater temperature, and twist count increased.
4. The behavior of yarn split are not affected by overfeed, heater temperature, and twist level.

References

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