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Effect of Drawing Conditions on Characteristics of C/P Blended Slivers

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1. INTRODUCTION

The characteristics of the Cotton/Polyester(C/P) blended slivers produced by drawing process have greatly influenced on the structure and properties of final yarns.[1] Especially, since the unevenness of slivers is decreased greatly with passage of drawing, the optimum condition of drawing process is very important to improve the quality of yarns. In drawing process, the two major objectives are the combining of several slivers and the drafting of them. By doubling, the variations along the length of individual slivers are partially averaged out. By drafting, the fiber alignment is improved and the strand is brought back to a form suitable for further processing.[2~6] Thus doubling and passage of drawing are generally used to improve the evenness of slivers.

In this paper, we have investigated the effect of drawing conditions on unevenness of C/P blended slivers processed by a pilot drawing machine. Through statistical method, we have compared experimental unevenness with theoretical unevenness and established the optimum condition of drawing process, such as sliver strand, passage of drawing and blending conditions. In addition, we have analyzed the blending behavior of C/P blended slivers with the view point of longitudinal and cross-section directions in order to observe blending behavior of C/P blended slivers in each blending condition.

2. EXPERIMENTAL

2.1 Sliver manufacture and method

For this study, we used 100% cotton carded sliver(30mm, 4.0micronaire) and 100% polyester carded sliver(38mm, 1.25d) in order to produce C/P blended slivers. In addition, 3% black polyester was used as tracer fibers to investigate the characteristics of yarn for further study. All sample slivers were manufactured by a pilot drawing machine(Daiwa-Kika Co. Ltd). The drawing conditions have included numbers of sliver strand and passage of drawing to observe unevenness and blending behavior of C/P blended slivers, as shown in Table Ⅰ.

The unevevnness of C/P blended slivers was measured on a USTER® TESTER 3(Zellweger Uster Ltd.). The surface and cross-section structures of the sliver were observed on a computer scanner system and an optical microscopy. Also, C/P blended slivers were selectively dyed with Sumifx Supra Red 3BF®(150%) to identify the cotton fibers.

Table Ⅰ The manufacturing conditions of C/P blended slivers

Raw sliver	Cotton(C), Polyester(P)
Blending ratio	P/C: 100/0(M_1), 75/25(M_2), 50/50(M_3), 25/75(M_4), 0/100(M_5)
Draft condition	Passage number: 1(P_1), 2(P_2), 3(P_3), 4(P_4) Doubling strand: 4(D_1), 6(D_2), 8(D_3)

2.2 Doubling strand

The blending ratios of C/P blended slivers are presented in Table Ⅱ with different sliver strands. For 75/25 and 25/75 blended slivers, one end of cotton sliver was drafted in together with one end of PET sliver with draft ratio of 2. And then, the produced sliver was produced with four ends(or two ends) of cotton slivers and two(or four ends) ends of PET slivers.

Table Ⅱ Sliver numbers for blending ratio of C/P blended slivers

		Doubling strand		
		4	6	8
Blending ratio	100/0	C(4)/P(0)	C(6)/P(0)	C(8)/P(0)
	75/25	C(3)/P(1)	C(4.5)/P(1.5)	C(6)/P(2)
	50/50	C(2)/P(2)	C(3)/P(3)	C(4)/P(4)
	25/75	C(1)/P(3)	C(1.5)/P(4.5)	C(2)/P(6)
	0/100	C(0)/P(4)	C(0)/P(6)	C(0)/P(8)

( ): Number of sliver strand

3. RESULTS AND DISCUSSION

3.1 Limiting irregularity

The limiting irregularity of the blended slivers can be determined by using Martindale's equations.[7] In this experiment, the limiting irregularities of 100% cotton and PET slivers were calculated by the equation (1), respectively.

$$CV_{lim} = \frac{100}{\sqrt{n}} = 100\sqrt{\frac{T_F}{T}}\ (\%) \qquad (1)$$

Where, n is mean number of fibers in the cross-section, T_F is fiber fineness(tex) and T is count of the sliver(tex). While, the limiting irregularities of blended slivers were calculated by using the sliver count corresponding the percentage of particular fiber component in the blended slivers. The limiting irregularity of blended slivers was calculated by the equation (2).

$$T_K = \frac{T_G \cdot P_K}{100} \qquad (2)$$

Where, T_K is sliver count for each particular fiber component(tex), T_G is the count of the blended slivers, P_K is percentage of the fiber components to the overall sliver and K is index of particular fiber components. Finally, the limiting irregularity of the blended slivers(CV_{lim}) was calculated according to the equation (3).

$$CV_{lim} = \frac{\sqrt{(CV_{C\ lim} \cdot T_C)^2 + (CV_{P\ lim} \cdot T_P)^2}}{T_G} \qquad (3)$$

Where, $CV_{C\ lim}$ and $CV_{P\ lim}$ are limiting irregularity of the cotton and PET component in the blended slivers, respectively and T_C and T_P are sliver count of the cotton and PET component in the blended slivers, respectively.

Figure 1 shows the effect of doubling strand and passage number on the limiting irregularity of C/P blended slivers. The limiting irregularity of C/P blended slivers was decreased as the doubling strand and passage number increase. That is due to the count of C/P blended slivers increased by increasing doubling strand and passage number, thus the limiting irregularity of D_2 and D_3 slivers has decreased 0.06% and 0.10% respectively than the limiting irregularity of D_1 slivers with increasing of doubling strand. The limiting irregularities of D_2 and D_3 slivers has decreased each 0.06% and 0.10% as passage number has increased.

Figure 2 indicates the effect of doubling strand on limiting irregularity of C/P blended slivers at 2 passage. It shows the trend that the limiting irregularity of C/P blended slivers has decreased due to the increasing of sliver count of C/P blended slivers with increasing doubling strand.

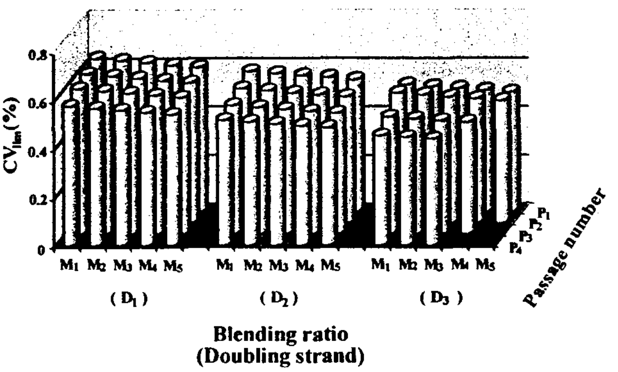

Figure 1. Effect of doubling strand and passage number on limiting irregularity of C/P blended slivers.

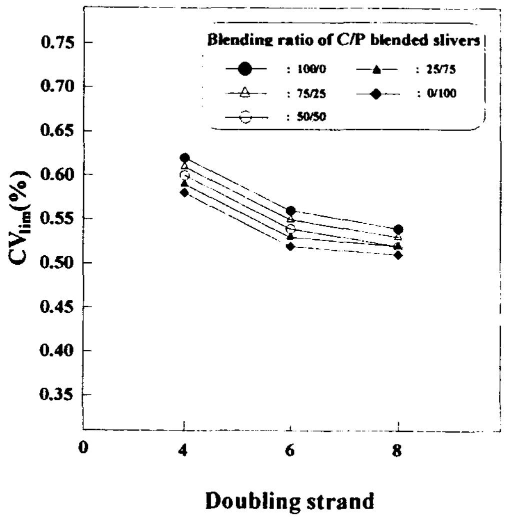

Figure 2. Effect of doubling strand on limiting irregularity of C/P blended slivers.(passage number : 2)

3.2 Actual irregularity

Figure 3 shows the effect of doubling strand and passage number on unevenness of C/P blended slivers. It shows the trend that the unevenness of C/P blended slivers decreases as doubling strand increases, because thin and thick places of slivers were distributed by doubling and so compensated each other. The unevenness of C/P blended slivers also decreased with increasing passage number. It is considered that the unevenness of C/P blended slivers has decreased by parallelizing the fibers due to separation of fibers and decreasing of hook and nep formation in the sliver. Thus, unevenness of the D_2 and D_3 slivers has decreased 2.51% and 3.13% respectively than the unevenness of D_1 slivers as doubling strand increases. The unevenness of the D_2 and D_3 slivers has decreased each 2.51% and 3.12%, respectively with increasing passage number.

Figure 4 shows the effect of doubling strand on unevenness of C/P blended slivers at 2 passage. It is considered that the unevenness of C/P blended slivers decreased as doubling strand increases due to the averaging effect of slivers.

3.3 Blending behavior(longitudinal view)

The blending behavior for the longitudinal direction of C/P blended slivers is shown in Figure 5. In case of the P_1 and P_2 slivers, the blended slivers have bicomponent structures with cotton and PET slivers which were separated each other. Thus, the blended sliver shows stripes in the longitudinal direction. While, stripes were compensated by parallelizing fibers and decreasing hook and nep formations in P_3 sliver. And so, the blending behavior of C/P blended slivers shows homogeneous in P_4 sliver.

Figure 6 shows photographs for the longitudinal direction of D_1M_3 slivers with different passage condition. From this, we could know that the sectional blending behavior in longitudinal direction of C/P blended sliver as changed into homogeneous mixture as passage number increases.

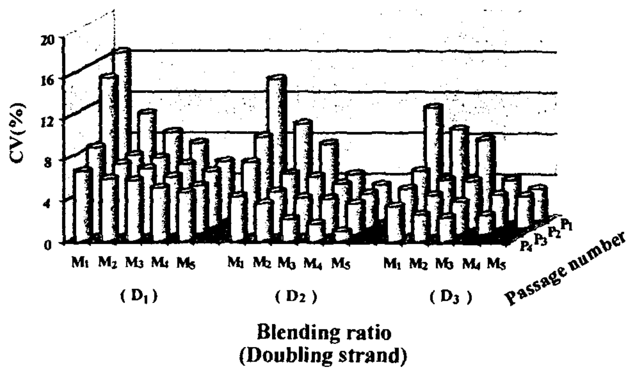

Figure 3. Effect of doubling strand and passage number on unevenness of C/P blended slivers.

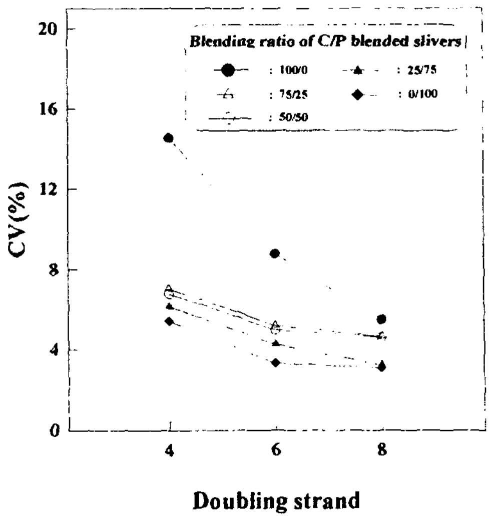

Figure 4. Effect of doubling strand on unevenness of C/P blended slivers.(passage number: 2)

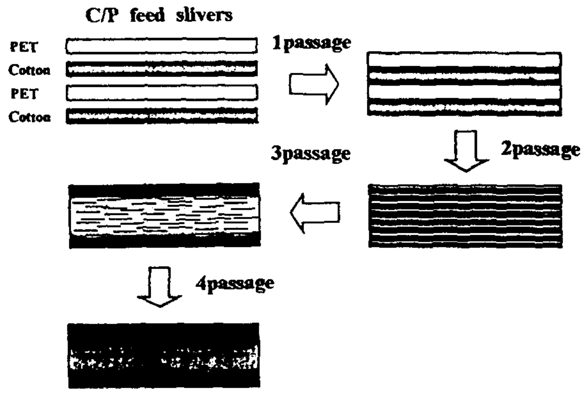

Figure 5. The blending behavior for the longitudinal view of C/P blended slivers.

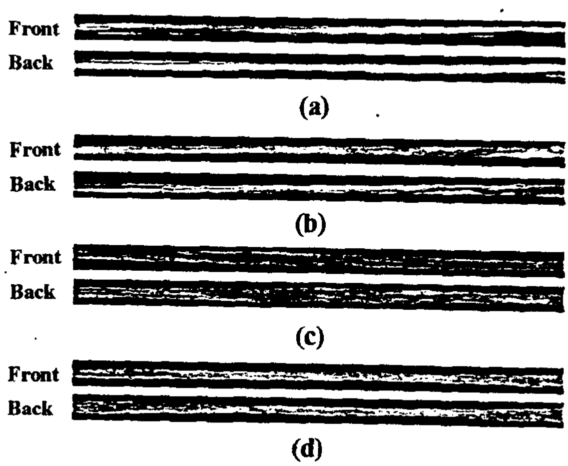

Figure 6. Photographs for the longitudinal view of D_1M_3 slivers with different passage condition.(a)$D_1M_3P_1$, (b)$D_1M_3P_2$, (c)$D_1M_3P_3$, (d)$D_1M_3P_4$.

3.4 Blending behavior(cross-section view)

Figure 7 shows the blending behavior for the cross-sectional view of C/P blended slivers. The cross-sectional view of P_1 sliver shows bicomponent structure, which was separated cotton and PET fibers. P_2 sliver was more blending than P_1 sliver due to the partially parallelization of fibers. However, the blended slivers consist of sectional blended distribution at the cross-sectional view. While, the sectional blended distribution of C/P blended slivers was decreased by increasing the regular arrangement of fibers at P_3 sliver. Cotton and PET fibers in P_4 sliver were randomly distributed and so led to homogeneous blending.

Figure 8 shows photographs for the cross-sectional view of D_1M_3 slivers with passage condition. Observing the photographs of each condition, we could found that the blending behavior in cross-sectional view of C/P blended slivers was led to homogeneous blend by increasing the regular arrangement of cotton and PET fibers as passage number increases.

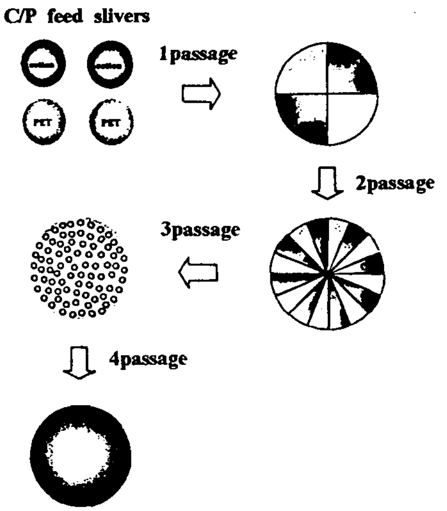

Figure 7. The blending behavior for the cross -sectional view of C/P blended slivers.

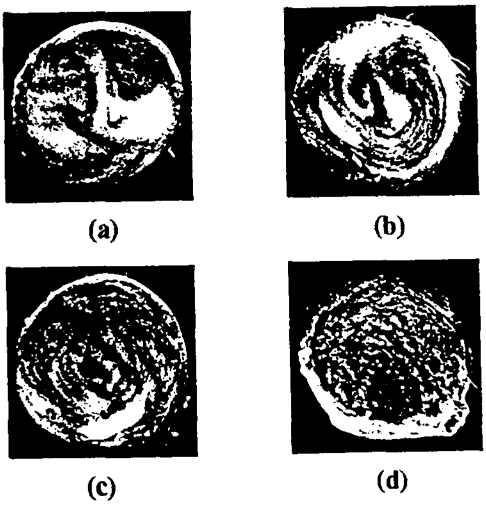

Figure 8. Photographs for the cross-section of D_1M_3 slivers with passage condition.(a)$D_1M_3P_1$, (b)$D_1M_3P_2$, (c)$D_1M_3P_3$,(d)$D_1M_3P_4$.

4. CONCLUSION

We have investigated the effect of drawing conditions on the unevenness of C/P blended slivers manufactured by a pilot drawing machine, and also determined the optimum condition of doubling, passage of drawing and blending behavior. From this study, the following results can be obtained:

1. The limiting irregularities of D_2 and D_3 slivers has decreased 0.06% and 0.10% respectively than the limiting irregularity of D_1 slivers. The limiting irregularities of D_2 and D_3 slivers has decreased each 0.06% and 0.01% with increasing of passage number.
2. The unevennesses of D_2 and D_3 slivers has decreased 2.51% and 3.13% respectively than the unevenness of D_1 slivers as doubling strands increased. The unevennesses of D_2 and D_3 slivers has decreased each 2.51% and 3.12% with increasing passage number.
3. The sectional blending behavior in longitudinal direction of C/P blended slivers was changed into homogeneous blending with increasing of passage number.

4. The blending behavior in the cross-sectional view of C/P blended slivers was led to be homogeneous with increasing the regular arrangement of cotton and PET fibers as passage number has increased.

REFERENCES

1. G. Grover and P.R. Lord, J. Tex. Ins., 83(4), 560～572(1992)
2. P.R. Lord, M. Govindaraj, J. Rust and S. Peyamian, J. Tex. Ins., 83(3), 399～406(1992)
3. P.R. Lord and M. Govindaraj, J. Tex. Ins., 81(2), 195～206(1990)
4. S.N. Djiev, Tex. Res. J., 64(8), 449～456(1994)
5. P.R. Lord, Tex. Res. J., 171～183(1987)
6. N.A.G. Johnson, J. Tex. Ins., 2, 69～79(1981)
7. J.G. Martindale, J. Tex. Ins., 135～144(1945)