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# Effect of Drawing Parameters on the evenness of C/P Blended Rovings

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## 1. INTRODUCTION

The evenness of roving is greatly important for the improvement of quality in final yarns[1]. In order to produce even rovings, all fibers would have to be uniformly distributed over the whole rovings. However, that is ruled out by the inhomogeneity of fiber materials and by the mechanical constraint. Accordingly, there are limits to the achievable fiber assembly evenness. Also, since the evenness of roving has greatly influenced on the evenness of slivers in drawing process, the optimum condition of drawing process is very important[2~4].

In drawing process, doubling and passage conditions are generally used to improve the evenness of slivers. 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 form suitable for further processing[5~8].

In this paper, we have investigated the effect of drawing parameters on the evenness of C/P blended rovings. The C/P blended rovings produced have compared experimental with theoretical evenness and established the optimum condition of drawing process, such as doubling strand, number of passage and blending conditions. In addition, we have analyzed the blending distribution of C/P blended rovings with the view point of cross-section shape in order to observe blending distribution of C/P blended rovings in each blending condition.

## 2. THEORETICAL CONSIDERATION

The limiting irregularity of blended rovings can be determined by considering fiber length, fineness and fiber extent. In this study, the limiting irregularities were calculated by two methods. The first, the limiting irregularities of 100% cotton and PET rovings 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 linear density of roving(tex). The second, since the cotton fibers are not perfectly straight in the C/P blended rovings, the limiting irregularities were calculated with consideration of fiber extent in cotton by the equation (2).

$$CV_{h-lim} = \frac{100}{\sqrt{nh}}\sqrt{1+0.0004(CV_d^2+CV_h^2)} \qquad (2)$$

Where, h is fiber extent of cotton, $CV_d$ is coefficient of variation of cotton diameter(%) and $CV_h$ is coefficient of variation of cotton fiber extent(%). While, the limiting irregularities of blended slivers were calculated by using the roving size corresponding the percentage of particular fiber component in blended rovings. The limiting irregularity of blended rovings was calculated by the equation (3).

$$T_K = \frac{T_G \cdot P_K}{100} \qquad (3)$$

Where, $T_K$ is roving size for each particular fiber component(tex), $T_G$ is linear density of the blended rovings, $P_K$ is percentage of the fiber components to the overall roving and K is index of particular fiber components. Finally, the limiting irregularity of blended rovings($CV_{lim}$, $CV_{h-lim}$)

was calculated according to the equation (4).

$$CV_{lim} = \frac{\sqrt{\sum_{n=1}^{k} (CV_{n\,lim} \cdot T_n)^2}}{T_G} \qquad (4)$$

Where, $CV_{n\,lim}$ is limiting irregularity of each component to the overall rovings(%)

## 3. EXPERIMENTAL

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. The C/P blended slivers were manufactured by a pilot drawing machine(Daiwa-Kika Co. Ltd). The drawing parameters have included numbers of doubling strand, passage of drawing and blending conditions. All samples were manufactured by roving machine(Max-Rover, Howa Machinery Co. Ltd). Table Ⅰ shows manufacturing conditions of C/P blended rovings.

The unevenness of C/P blended rovings was measured on a USTER® TESTER 4(Zellweger Uster Ltd.). The surface and cross-section structures of the rovings were observed on a image analysis.

Table Ⅰ The manufacturing conditions of C/P blended rovings

| Feed sliver type | C/P blended slivers |
|---|---|
| Blending ratio | C/P: 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($P_4$)<br>Doubling strand: 4($D_1$), 6($D_2$), 8($D_3$) |
| Twist density(twist/inch) | • C/P(100/0, 75/25): 1.84<br>• C/P(50/50) : 1.47<br>• C/P(25/75, 0/100): 0.95 |
| Back draft | 1.34 |
| Total draft | 8.02 |

## 4. RESULTS AND DISCUSSION

### 4.1 Limiting irregularity

Figure 1 shows the effect of doubling strand and number of passage on the limiting irregularity($CV_{h\text{-}lim}$) of C/P blended rovings. The limiting irregularity($CV_{h\text{-}lim}$) of C/P blended rovings decreased as the doubling strand and number of passage have increased. Because the linear density of C/P blended rovings increased with increasing doubling strand and number of passage. The limiting irregularities($CV_{h\text{-}lim}$) of $D_2$ and $D_3$ rovings have decreased 0.16% and 0.28%, respectively with increasing doubling strand.

Figure 2 indicates the effect of doubling strand on limiting irregularity of C/P blended rovings with 2 passages. It shows the trend that the limiting irregularity of C/P blended rovings has decreased due to the increasing of roving size of C/P blended rovings with increasing doubling strand. The decreasing rate of $CV_{lim}$ and $CV_{h\text{-}lim}$ also shows similar trend, but the limiting irregularity($CV_{h\text{-}lim}$) with regard to the fiber extent of cotton shows higher value than $CV_{lim}$ as doubling strand increases. This is due to the fiber extent of the cotton fibers.

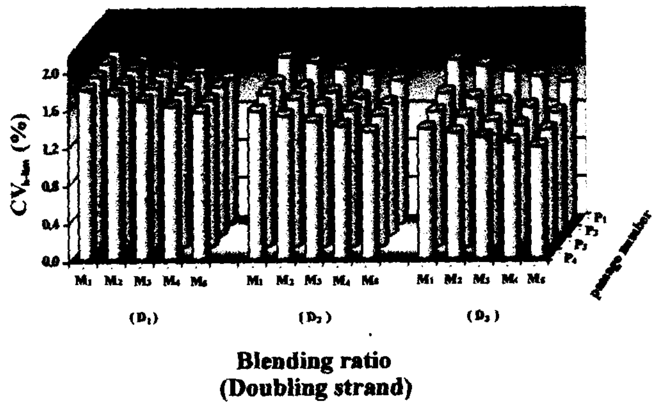



Figure 1. Effect of doubling strand and number of passage on limiting irregularity($CV_{h\text{-}lim}$) of C/P blended rovings.

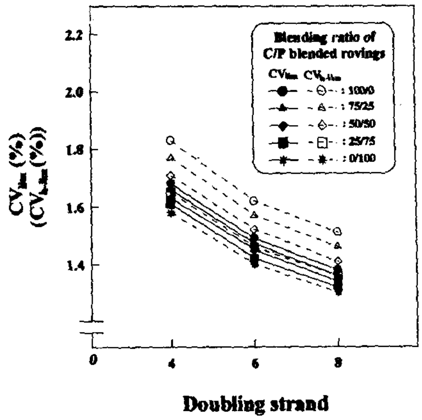



Figure 2. Effect of doubling strand on limiting irregularity of C/P blended rovings.(passage number: 2)

## 4.2 Actual irregularity

Figure 3 shows the effect of doubling strand and number of passage on evenness of C/P blended rovings. The general trend find out that the evenness of C/P blended rovings increases as doubling strand is increased, because rovings have more even structure by doubling. The evenness of C/P blended rovings also increased with increasing number of passage. It is considered that the evenness of C/P blended rovings has increased by parallelizing the fibers due to separation of fibers and decreasing of hook and nep formation in the roving. Thus, the evenness of $D_2$ and $D_3$ rovings has increased 0.8% and 1.2%, respectively with increasing doubling strand and increased about 1.7% with increasing number of passage.

Figure 4 shows the effect of doubling strand on evenness of C/P blended slivers and rovings with 2 passages. The evenness of C/P blended rovings has decreased about 3.7% compared with the evenness of C/P blended slivers with increasing doubling strand. The reason is that C/P blended rovings become more fine further drawing processes.

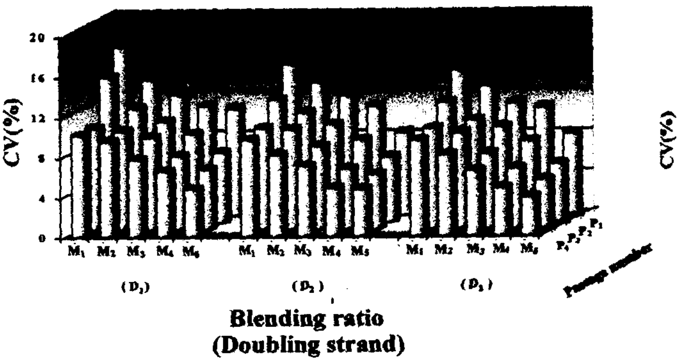



Figure 3. Effect of doubling strand and number of passage on evenness of C/P blended rovings.

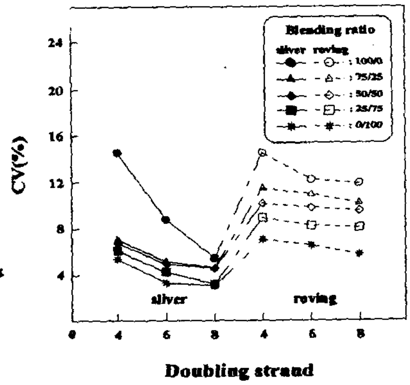
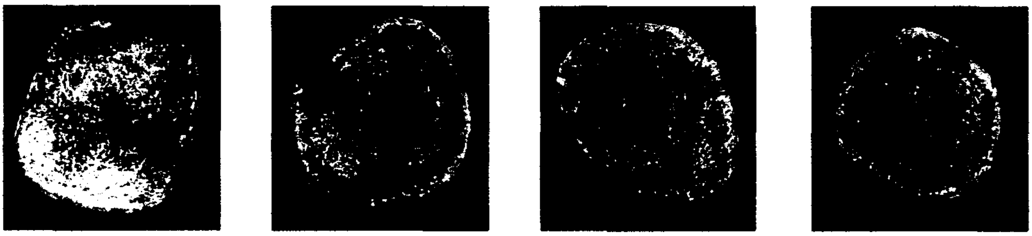



Figure 4. Effect of doubling strand on unevenness of C/P blended sliver and rovings. (passage number: 2)

### 4.3 Blending distribution of cross-section shape

Figure 5 shows photographs for the cross-sectional shape of $D_1M_3$ rovings with different passage conditions. The cross-sectional shape of $P_1$ roving shows bicomponent structure, which was separated cotton and PET fibers. $P_2$ roving was more blending than $P_1$ roving due to the partially parallelization of fibers. However, the blended rovings consist of sectional blended distribution at cross-sectional shape. While, the sectional distribution of C/P blended rovings was decreased by increasing the regular arrangement of fibers at $P_3$ roving. Cotton and PET roving($P_4$) was randomly distributed and so led to homogeneous blending.



(a) (b) (c) (d)

Figure 5. Photographs for the cross-section of $D_1M_3$ rovings with different passages.
(a) $D_1M_3P_1$, (b) $D_1M_3P_2$, (c) $D_1M_3P_3$, (d) $D_1M_3P_4$

## 5. CONCLUSION

We have investigated the effect of drawing parameters on the evenness of C/P blended rovings, and also determined the optimum condition of doubling, passage of drawing and blending distribution. From this study, the following results can be obtained:

1. The limiting irregularities of $D_2$ and $D_3$ rovings have decreased 0.16% and 0.28%, respectively with increasing doubling strand and decreased about 0.16% with increasing number of passage.
2. The evennesses of $D_2$ and $D_3$ rovings have increased 0.8% and 1.2%, respectively with increasing doubling strand and decreased about 1.7% with increasing number of passage.
3. The evenness of C/P blended rovings has decreased 3.7% compared with the evenness of C/P blended slivers as doubling strands increased.
4. The blending distribution in the cross-sectional shape of C/P blended rovings was led to be homogeneous with increasing number of passage due to the regular arrangement of cotton and PET fibers.

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