Advanced Materials Research *Online: 2012-02-10*
ISSN: 1662-8985, Vol. 460, pp 258-261
doi:10.4028/www.scientific.net/AMR.460.258

Affection of twist factor and blended ratio to the strength of soybean protein fiber blended yarn

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Key words：soybean protein fibers; twist factor; blended ratio; strength

Abstract：The soybean protein fiber is one of the green fibers. It is blended with the fine polyester. The strength of the blended yarn is tested. The relation between the strength and the twist factor and the blended ratio is analyzed. The optimum blended ratio and the critical twist factor is determined.

Preface

The soybean protein fiber is a new material in textile. Thanks to its fine denier, light specific gravity, light strength and silklike luster，it has so excellent cashmere handle, silk softness and heat resistant properties that it has been called manmade cashmere and found wide application. Now, the soybean protein fibers can be blended with silk, wool, polyester, cotton and other fibers. It can produce many kinds of fabric with special style.

In order to study the influence of twist factor of soybean protein fiber(simply called SPF) pure yarn and blending ratio of soybean protein fiber on yarn strength, 10 kinds of 18.2tex soybean protein pure yarn with different twist factor, 18.2tex soybean protein fiber fine polyester blended yarn with different blending ratio were spun, property indexes of breaking strength were tested.

Preparation of sample

Textile material and blending method.1.67dtex×38mm SPF, 1.1dtex×38mm fine polyester fibers. soybean protein fibers were chosen and then spun into soybean protein fiber pure yarn, soybean protein fiber fine polyester yarn with different blending ratio of soybean protein fiber were spun in cotton type spinning machine.

The soybean protein fibers were blended with fine polyester by the raw fiber blending method.

Spinning line.

Soybean protein fiber pure yarn.

Opening and clearing machine units→A186F carding→FA304 drawing frame(twice) →FA401 roving machine→FA502 ring machine

Soybean protein fiber fine polyester blended yarn.

SPF

Fine polyester →artificial blending→FK500 opener(double-opening units, autoleveler system)→A186F carding→FA302 drawing frame(twice)→A454E roving machine→FA514 ring machine

Specification of sample. The specification of the yarns was listed in Table 1(All of the yarns was 18.2tex and 320 twist factor).

Table 1 Specification of SPF/fine polyester blended yarn

Trail No.	Fiber content	Blending ratio/%
S_0	SPF	100
S_1	SPF/fine polyester	70/30
S_2	SPF/ fine polyester	60/40
S_3	SPF/ fine polyester	50/50
S_4	SPF/ fine polyester	40/60
S_5	SPF/ fine polyester	30/70
S_6	SPF/ fine polyester	20/80
S_7	SPF/ fine polyester	0/100

Experimental of strength and the blending ratio of yarn

According to GB/T3916-1997, the testing of breaking strength and breaking elongation of single yarns was carried out in YG061 single yarn strength tester. Testing conditions involve a 500mm effective length, 500mm/min deformation rate, and sample size of 50 yarns. Table 2 illustrates the results of tensile properties of the samples.

Table 2 Tensile properties of SPF /fine polyester blended yarn

Trail No.	Strength（cN）	Strength increasing ratio(%)	Tenacity（cN/tex）
S_0	396.0	100	21.76
S_1	420.7	106	23.12
S_2	438.4	111	24.11
S_3	541.7	137	29.76
S_4	558.9	141	30.71
S_5	553.6	140	30.42
S_6	645.9	163	35.44
S_7	690.5	174	37.94

The relation of strength and the blended ratio of soybean protein fiber fine polyester are illustrated in Fig.1.

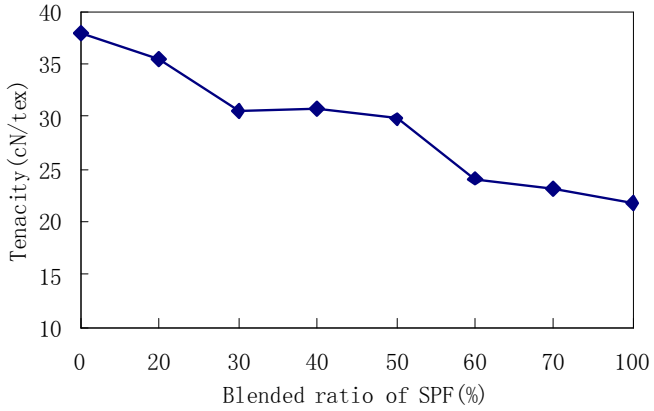

Fig.1 The tenacity and the blended ratio of SPF of SPF/fine polyester blended yarn

From Table 2 and Fig.1, we can see that yarn strength of soybean protein fiber fine polyester blended yarn is reduced by nonlinear relation with the increase of soybean protein fiber content, which is increased from 0 to 100%. The soybean protein fiber can be blended with fine polyester in any proportion according to the requirements of yarn and fabric. If the strength of yarn is more important, the blending ratio of polyester should be increased otherwise the soybean protein fiber content should be increased in order to embody the excellent properties of soybean protein fibers.

Relation of the strength of soybean protein fiber pure yarn and twist factor

The quality of the product, yield, cost, and the handling property were affected by the twist. With the increase of the twist, the output decreased and the cost increased, the friction increased among the inner structure of the fibers and the strength of the yarn increased. When the twist increased to one value, the strength of yarn reached the highest point, this twist is called critical twist and the corresponding twist factor is called critical twist factor. Different kinds of fibers have different twist factors.

18.2tex soybean protein fiber pure yarns with different twist factors were spun. The results are listed in Table 3.

Table 3 Tensile properties of soybean protein fiber pure yarn with different twist factors

Twist factor	256	299	320	341	363	384	405	469	512	598
Tenacity(cN/tex)	19.4	21.4	21.8	23.5	21.2	21.7	19.7	20.3	17.7	16.0

According to Table 3, the relation of the strength and the twist factor of soybean protein fiber pure yarn are displaced in Fig.2.

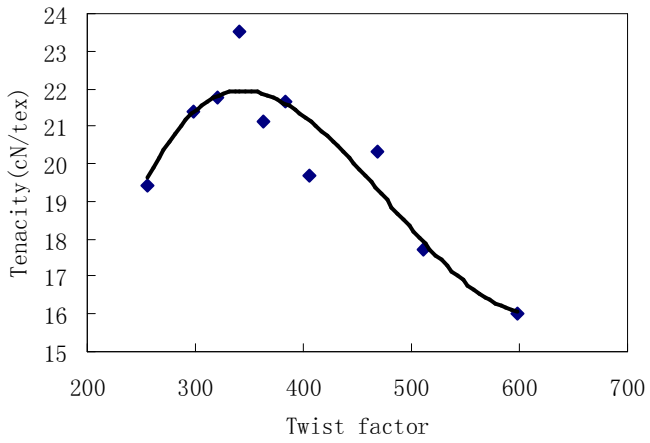

Fig.2 The tenacity and the twist factor of SPF pure yarn

The relation between the strength of soybean protein fiber pure yarn and twist factor was analyzed by regression analysis. The mathematical model of yarn strength Y_1 and twist factor X was:

$$Y_1=0.0000006X^3-0.0009X^2+0.3845X-31.849$$

Correlation coefficient $R^2=0.8539$

From above formula, we can deduce that when the twist factor is about 344.8, the strength of soybean protein fiber pure yarn is in highest value. The critical twist factor of soybean protein fiber pure yarn is 345.

Conclusions

(1) The soybean protein fiber can be blended with fine polyester in any proportion according to the requirements of yarn and fabric. If the strength of yarn is more important, the blending ratio of polyester should be increased otherwise the soybean protein fiber content should be increased in order to embody the excellent properties of soybean protein fibers.

(2) When the content of the soybean protein fiber is about 40%～50%, both the strength and the serviceability of the soybean protein fiber fine polyester blended yarn can be given consideration.

(3) The critical twist factor of 18.2tex soybean protein fiber pure yarn is 345.

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