STUDY OF THE MECHANISM OF PET CREPE TEXTURING AND PROPERTIES OF ITS FABRIC

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1. INTRODUCTION

'Crepe' is the word for all those yarns having a particular effect which gives the fabric a rough touch, a good anti-crease surface and a very appreciated handling. Conventionnal crepe yarn first associated with the processing of natural silk, are now produced from polyester fiber through a high twist level, followed by steam setting. Today, the new crepe yarn from polyester fiber is produced by a new process which combines two-for-one twisting and texturizing operations in one step. This process greatly reduces production costs and improves crepe yarn and its fabric qualities including the silk effect, anti-crease surface and handling. This paper first deals with the process and technology, and relates the mechanism of PET crepe texturing, then the craping effect, light feeling, shape feeling, and mechanical properties of its fabric have been measured, compared and analysed. The results show that the fabric made of PET crepe textured (or stretch crepe) possesses light soft, better craping effect, bulkiness and mechanical properties are close to that of silk crepe.

2. THE MECHANISM OF THE PROCESS OF PET CREPE TEXTURING

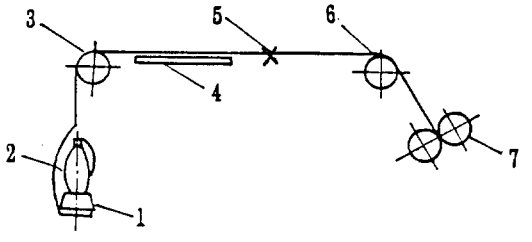


Fig. 1 The Process of PET Crepe Texturing
1. two-for-one twisting spindle 2. bobbin 3. feed roller 4. heater
5. false twister 6. take off roller 7. take-up

The process of PET crepe texturing is shown in Fig. 1. The filament yarn is taken out from bobbin, and twisted by two-for-one twisting spindle, then the twist of filament yarn before entering the feed roller is:

$$T' = \frac{2n'}{v}$$

where n' — rotations of two-for-one twisting spindle
v — velocity of filament yarn
while entering the heat-setting zone, the filament yarn with twist T' is again twisted by high rotating of false twister, the twist of false twister is:

$$T'' = \frac{n''}{v}$$

where n''— rotations of false twister
Therefore the twist of filament yarn in the heat-setting zone is:

$$T = T' + T'' = \frac{2n'}{v} + \frac{n''}{v}$$

When the filament yarn with twist T goes through the false twister, the twist T''of false twister is untwisted, the remains of filament yarn is twist T'. Whether the twist T' heat-setting or not, and filament yarn false-twist-texturing or not depend on the twist value and direction by spindle and false twister.

(1). The same twist direction by spindle and false twister, the twist of filament yarn in the heat-setting zone $T = \frac{2n'}{v} + \frac{n''}{v}$ is heated, when going through the false twister, the twist T'' of filament yarn in the untwisted zone is untwisted. Then the filament yarn with T'' twist is false twist texturing and the filament yarn with T' also is heated setting. Thus the filament yarn from take off roller likes false twist texturing yarn with twist T' which is heat-setting. This yarn is called the stretch crepe yarn and the morphology of stretch crepe is in Fig. 2.

Fig. 2 The Morphology of Stretch Crepe

The shape of filaments consists of crimp shape by false twist texturing and helical spring by twist and heat-setting.

(2). The twist direction by spindle and false twister is opposite, the twist ($\frac{2n'}{v} - \frac{n''}{v}$) of filament yarn in heat-setting zone is heated. They are two cases :

(a) When $\frac{2n'}{v} < \frac{n''}{v}$, the filament yarn with ($\frac{n''}{v} - \frac{2n'}{v}$) is false twist textured, then the filament yarn from take off roller likes the false twist ($\frac{n''}{v} - \frac{2n'}{v}$) texturing yarn with twist $\frac{2n'}{v}$ but without heat-setting.

(b) When $\frac{2n'}{v} > \frac{n^*}{v}$, the twist ($\frac{2n'}{v} - \frac{n^*}{v}$) is heated setting, then the filament yarn goes through the false twister and filament yarn is twisted with $\frac{n^*}{v}$. Thus the filament yarn from take-off roller possesses the twist ($\frac{2n'}{v} - \frac{n^*}{v}$) with heat-setting and twist $\frac{n^*}{v}$ without heat-setting. In this case it does not form the false-twist textured yarn.

Recently, one step technology for stretch crepe chooses the same twist direction by spindle and false twister, thus the crepe produced by one step technology likes the false twist textured yarn with twist and heat setting.

The function of twist by spindle in one step technology includes:

(1) to produce torsion and form crepe effect after finishing;

(2) to change the arrangement and force between filaments and form the special nice and cool;

(3) to form the tilt of filaments on the surface of the fabric and produce the special light;

The fuction of heat-setting in one step technology includes:

(1) to heat-setting for false twist texturing;

(2) to heat-setting for the twist $\frac{2n'}{v}$;

(3) to reduce the thermal shrinkage of filament yarn.

According to the mechaniam of one step technology, it possesses following characteristic:

(1) twist, heat-setting and false twist — three steps merges into one step, thus reduce technological process;

(2) good crepe effect, to decrease the twist and increase production;

(3) good elasticity, high bulkiness and easy to alkali treatment;

(4) lower torsion and to improve the weaving process;

(5) the fabric made of stretch crepe possesses better hanging, flexibility and light.

3. THE PROPERTIES OF FABRIC MADE OF PET STRETCH CREPE

3.1 Crepe technology and fabric specification:

Table 1. Crepe technology and fabric specification

No.	Crepe Technology	Materials		Weft (twist/m)		Density (threads/cm)		Fabric Weight (g/m^2)
		warp	weft	real	false	warp	weft	
1	High twist	PET 50D/24F	PET 75D/66F	2700		52.4	44.5	68.14
2	One step technology	PET 50D/24F	PET 75D/66f	500	2900	54.0	44.8	58.79
3	One step technology	PET 50D/24F	PET 75D/66F	700	3300	53.8	42.5	60.10
4	One step technology	PET 50D/24F	PET 75D/66F	900	2700	53.6	42.9	59.34
5	High twist	silk 20/22D×2		2300		61.3	38.4	66.60

3.2 The light feeling of fabric

This paper has measured the light feeling by Light Instrument of variable angle for two dimensions (UGV-4D made in Japan), which is:

(1). Light curve of variable angle for two dimensions in the 180° ;

(2). Constrast light G_{TB}: it indicates the evenness of reflected light from fabric surface;

$$G_{TB}= \frac{I_{max}}{I'_{max}} \times 100\%$$

where I_{max} — measured value of maximum reflected light

I'_{max} — theoretial value of maximum reflected light

(3). Polarized light G_P: it indicates "the intrinsic" of reflected light from fabric surface;

$$G_P = \frac{I_{\perp} - I_{\parallel}}{I_{\perp} + I_{\parallel}}$$

where $I_{\perp}$ — polarized light of perpendicular to reflected plane

$I_{\parallel}$ — polarized light of parallel to reflected plane

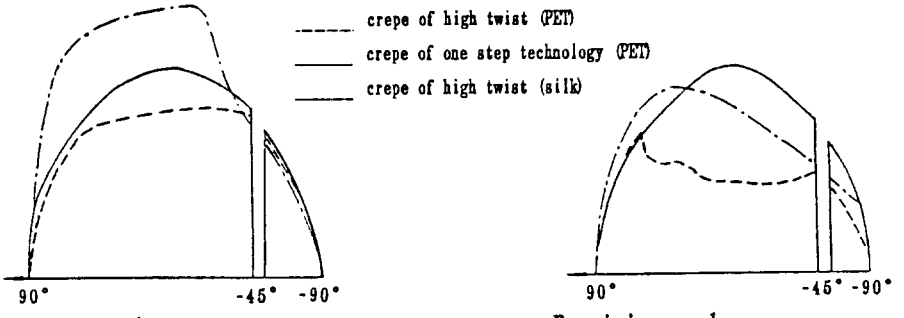


Fig. 3. Light Curve of Variable Angle for Two Dimensions

Table 2. Contrast light and polarized light

Sample	G_{TB}	G_P
Crepe of high twist (PET)	1.183	0.077
Crepe of one step technology (PET)	1.141	0.089
Crepe of high Twist (silk)	1.080	0.175

From Table 2 and Fig. 3 it shows that for silk crepe light is high and uniform distribution for light curve of variable angle for two dimensions, and contrast light is low, soft, and polarized light is high. For crepe of high twist (PET), light curve is ununiform distribution, there is a peak at light curve, the contrast light is higher,

not soft, the polarized light is lower. For crepe of one step technology (PET), contrast light, polarized light are all situated between that of crepe of high twist (silk) and that of crepe high twist (PET), are close to that of crepe of high twist (silk).

3.3 The Shape feeling of Fabric

(1). Hanging contrast A

$$A = \frac{A_D - A_d}{A_F - A_d} \times 100\%$$

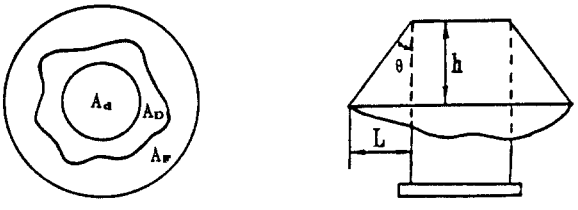


Fig. 4. Schematic diagram of hanging instrument

(2). Convex strips of hanging λ: it can indicate the creasability under the dead weight of fabric.

(3). Hanging angle θ:

$$\theta = \tan^{-1}\frac{L}{h}$$

Table 3. Hanging constant, convex strips of hanging and hanging angle

Sample	Hanging constant (%)	Convex strips of hanging (λ)	Hanging angle (°)
1	19.3	5	66.98
2	21.3	6	55.63
3	22.6	6	52.64
4	22.1	6	50.46
5	21.1	6	44.00

From Table 3, it shows that, the fabric is soft for silk crepe, rigid for PET crepe. And for crepe of one step technology (PET), the shape feeling is close to that of silk crepe.

3.4. Mechanical properties of fabric

Table 4. indicates again that the crepe of one step technology (PET) is softer than crepe of high twist (PET).

Table 4. Instantaneous and slow elastic angle, bending and shear rigidity of crepe

No.	Instantaneous elastic angle (°)	Slow elastic angle (°)	Bending rigidity ($g \cdot cm^2/cm$)	Shear rigidity (g/cm)
1	128.2	141.0	0.0275	0.278
2	130.6	144.8	0.0063	0.393
3	132.2	143.6	0.0073	0.420
4	142.0	154.0	0.0097	0.470
5	137.0	149.0	0.0125	0.303

3.5. Craping effect of fabric

Craping rete $B = \frac{\Delta l}{L^2} \times 100\%$

$$\Delta l = (L^1 - L^2) - (l^1 - l^2)$$

where L^1 — width after weaving

L^2 — width after finishing

l^1 — weft lenth of heat-setting

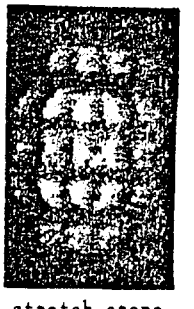
l^2 — original weft lenth

Laser diffraction diagram can indicate strong or weak of the craping effect. Table 5 and Fig. 5. show that the craping effect of crepe of one step technology (PET) is stronger than that of crepe of high twist (PET).

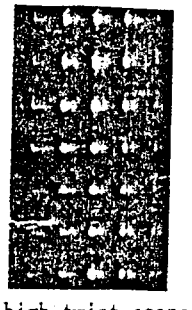
Table 5 Craping rete (%)

Crepe of one step technology (PET)	15.81
Crepe of high twist (PET)	13.64

silk crepe



stretch crepe



high twist crepe

Fig. 5. Laser diffraction diagram

3.6. Fuzzy pattern classification analyse and discussion

According to the measured light feeling, shape feeling, mechanical properties and craping effect of fabric, we have engaged in fuzzy pattern classification analyse and obtained classify diagram of sample branch which is shown in Fig. 6.

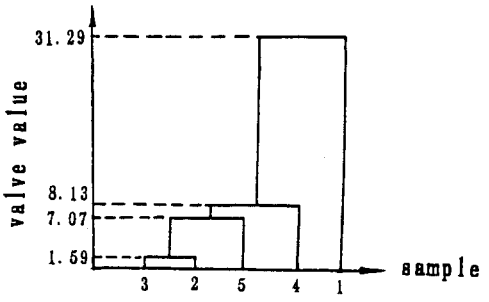


Fig. 6. Classify diagram of sample branch

From the classify diagram of branch, we can get:

(1). When valve value is 1.59, sample 3 and 2 are the same class, and are all stretch crepe;

(2). When valve value is 7.09, sample 3, 2 and 5 are the same class. When valve value is 8.13, sample 3, 2, 5 and 4 are the same class. It indicates that the light feeling, shape feeling, mechanical properties and craping effect of stretch crepe are close to that of silk crepe, and sample 4 and 5 are more close to each other.

(3). The light feeling, shape feeling, mechanical properties and craping effect of high twist crepe (PET) and silk crepe are more different.

REFERENCES (omitted)