

# 机织用扭妥™ 纱的应用研究

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**摘 要:** 通过在传统环锭纺细纱机上加装纺纱附件, 研制出一种生产低扭矩纱(扭妥™ 纱)的新型纺纱方法。对以该法纺制的 84 tex 纯棉扭妥™ 纱进行纱线性能的测试与分析, 并与传统环锭纱作比较。同时, 对织制的扭妥™ 牛仔布和传统环锭牛仔布进行织物性能和外观的分析和比较。

**关键词:** 扭妥™ 纱新型纺纱方法 纱线性能 牛仔布 织物表面平整度

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织物的性能如织物的歪斜、起皱、织物的尺寸稳定性和表面平整度都与纱线的残余扭矩有关<sup>[1]</sup>。因此, 研制低扭矩纱或平衡纱对改善纱线的加工性, 提高织物的外观和性能都具有重要的实际意义。目前, 已有一些方法用于降低纱线扭矩和生产平衡纱<sup>[2-3]</sup>, 如通过湿热处理, 使纱线得到定捻, 纱线扭矩可大大降低; 另外也可通过股线的二次加捻捻向与一次加捻捻向相反, 以制得扭矩平衡的纱线。但 these 方法都具有一定的局限性, 如需要增加加工工序, 从而增加成本。因此, Tao X M 等人研制出一种生产扭妥™ 纱的新型纺纱方法<sup>[4]</sup>, 并对其纱线的性能以及在机织物上的应用进行了测试与分析。

## 1 扭妥™ 纱的纺纱原理<sup>[4]</sup>

扭妥™ 纱(低扭矩纱)是由一种新型纺纱技术生产的, 它在传统的环锭纺细纱机上安装了简单的纺纱附件, 可改善成纱结构, 从而大大降低纱线扭矩。生产扭妥™ 纱的纺纱附件主要是纤维排列调整装置。扭妥™ 纱新型纺纱技术的纺纱原理是: 粗纱→牵伸→纤维排列调整装置→加捻→成纱。

首先, 将粗纱经过细纱机的牵伸装置进行牵伸, 而后进入安装于前罗拉与导纱钩之间的纤维排列调整装置, 最后经传统的钢领钢丝圈加捻和卷绕成纱。纤维排列调整装置主要是提高加捻三角区内纤维的转移和纠缠, 改善因纱线加捻而产生的纤维应力-应变分布。纱线扭矩与纱线中纤维的排列、纤维的应力-应变分布、纤维与纤维间的摩擦力以及纤维几何形状都密切相关。因此, 通过纤维排列调整装置的调节, 使成纱结构得到改善, 从而大大降低纱线扭矩。

## 2 实 验

### 2.1 材 料

纺纱试验在加装了纤维排列调整装置的 Zinser

319 环锭纺细纱机上进行, 采用 100%棉普梳粗纱纺制 84 tex 纯棉扭妥™ 纱, 并纺制相应的传统环锭纱以作性能对比。经 Uster Spinlab HVI 900 纤维多功能测试系统测定, 粗纱用棉纤维长度为 28.7 mm, 纤维马克隆尼值为 4.0, 纤维断裂强度和伸长率分别为 22 cN/tex 和 5.3%。

将纺制的 84 tex 纯棉扭妥™ 纱和相应的传统环锭纱分别做纬纱, 用 Picanol 剑杆织机织制经向异支牛仔布<sup>[5,6]</sup>。牛仔布经纱采用 84 tex 和 58 tex 靛蓝染色纯棉纱, 织物经、纬密度分别为 264 根/10 cm 和 197 根/10 cm, 织物组织采用 3/1 右斜纹。织制的织物经牛仔布常规后整理, 并经水洗整理。

### 2.2 方 法

用于测试的纱线和织物试样分别在标准大气条件下(温度 20 ℃, 相对湿度 65%)平衡 24 h 以上后进行试验。

2.2.1 纱线性能测试 纱线断裂强度和伸长率采用 Uster Tensorapid 强力仪测试, 试验拉伸速度为 5000 mm/min, 试样长度为 500 mm。纱线条干均匀度和纱线毛羽分别由 Uster II 型条干测试仪和 Zweigle G 566 纱线毛羽仪测定。

纱线残余扭矩采用自制的纱线扭矩试验仪测试, 该仪器参照 ISO 3343-1984 标准研制而成。其试验原理如下: 首先, 在一定的预张力下取 50 cm 长的纱线试样, 将纱线两端夹持, 在纱段中部加 0.02 cN/tex 的负荷, 然后将纱线两端靠近并接触, 由于纱线存在残余扭矩, 纱段会产生扭结。将该纱段放入水中一定时间以使残余扭矩充分释放, 达到平衡。最后, 计数 25 cm 长纱段内纱段的扭结数。

2.2.2 织物性能测试 经水洗整理后的织物重量按照美国利惠·斯特劳斯(Levi Strauss)牛仔布标准

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LS & CO. 21 测试<sup>[7]</sup>。织物撕破强力和断裂强力分别采用美国 ASTM D1424 (扇形摆锤法) 和 ASTM D5034 (抓样法) 进行测试。此外, 对织物表面平整度进行主观评定和比较参照美国 AATCC 124 标准<sup>[8]</sup>。

### 3 结果与分析

#### 3.1 纱线性能比较与分析

采用新型纺纱技术纺制的 84 tex 纯棉扭妥™ 纱

表 1 84 tex 纯棉扭妥™ 纱和传统环锭纱性能测试结果

试样	捻度 (捻/m)	断裂强度 (cN/tex)	断裂伸长率 (%)	纱线扭结数 (个/25 cm)	条干均匀度 (%)	纱线毛羽数 (个)
扭妥™ 纱	333	16.50	5.69	24	11.10	771
	365	16.51	5.85	28	11.56	749
	396	17.21	5.75	31	11.19	604
传统环锭纱	333	15.72	6.72	33	12.15	2008
	365	16.43	6.31	35	12.41	1638
	396	17.04	6.59	39	12.57	1249
	438	17.58	7.14	39	11.43	1049

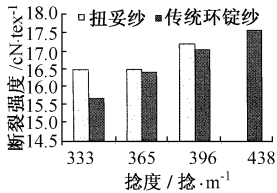


图 1 扭妥™ 纱和传统环锭纱断裂强度的比较

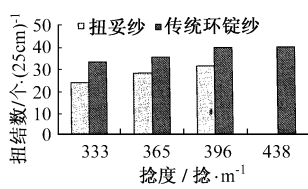


图 2 扭妥™ 纱和传统环锭纱纱线扭结数的比较

一定的情况下, 该纺纱方法对纤维的品质要求可降低。同样, 从图 2 可知, 纱线扭结数也随着纱线捻度的减小而降低。因为纱线采用较低捻度纺纱时, 纱线中纤维因加捻而产生的应力、应变小, 纱线的残余扭矩也相应降低。

从扭妥™ 纱和传统环锭纱的性能比较来看, 扭妥™ 纱虽然纱线断裂强度比捻度为 438 捻/m 的常规环锭纱略低, 但纱线扭结数比传统环锭纱大大降低。如采用捻度 333 捻/m 的扭妥™ 纱, 纱线扭结数可降

与相应的传统环锭纱的主要性能测试结果见表 1。扭妥™ 纱和传统环锭纱的性能比较见图 1 和图 2。

由表 1 和图 1 可知, 随着纱线捻度的降低, 扭妥™ 纱和传统环锭纱断裂强度都减小。这与临界捻度以下, 纱线强力与捻度的变化规律相一致。但扭妥™ 纱纺纱时, 纱中纤维转移和纠缠增加, 成纱结构更为紧密和均匀, 因此, 扭妥™ 纱断裂强度的降低程度要比传统环锭纱小。这也说明, 在纱线质量保持

低近 40%。传统环锭纱采用低捻也可在一定程度上减少纱线扭结数, 但下降程度比扭妥™ 纱小, 如采用捻度 333 捻/m 的环锭纱, 纱线扭结数只下降 15%, 同时, 纱线毛羽显著增加。而采用较低捻度纺制的扭妥™ 纱, 纱线断裂强度较高, 已能满足加工和产品要求, 并且纱线扭结数和纱线毛羽较少, 纱线条干均匀。

#### 3.2 织物性能和外观评价

以 84 tex 和 58 tex 靛蓝染色纯棉纱做经纱, 84 tex 扭妥™ 纱和传统环锭纱分别做纬纱, 织制的扭妥™ 纱牛仔布和传统环锭纱牛仔布性能测试结果见表 2。其中, 传统环锭纱牛仔布试样 1<sup>#</sup> 采用工厂常规生产的环锭纱 (438 捻/m) 做纬纱, 传统环锭纱牛仔布试样 2<sup>#</sup> 采用低捻环锭纱 (333 捻/m) 做纬纱。用数码相机摄制的扭妥™ 纱牛仔布和传统环锭纱牛仔布外观见图 3。

表 2 扭妥™ 纱牛仔布和传统环锭纱牛仔布性能测试结果

试样	织物密度 (根/10 cm)		织物面密度 (g/m <sup>2</sup> )	断裂强力 (N)		纬向断裂伸长率 (%)	撕破强力 (N)		表面平整度
	经向	纬向		经向	纬向		经向	纬向	
扭妥™ 纱牛仔布	264	197	458	978.0	751.3	9.6	82.3	62.7	较好
传统环锭 1 <sup>#</sup>	264	197	465	978.0	791.2	10.0	86.2	61.7	较差
纱牛仔布 2 <sup>#</sup>	268	197	451	986.9	746.8	9.4	89.2	53.9	较好



图 3 牛仔布外观比较

从织物性能测试结果和织物外观图片可以看出, 采用扭妥™ 纱做纬纱织制的牛仔布性能与以常规环锭纱 (438 捻/m) 做纬纱生产的牛仔布性能基本相同, 但扭妥™ 纱牛仔布的表面平整度可以显著改善。采用低捻环锭纱 (333 捻/m) 做纬纱织制的牛仔布, 虽然外观也有较大改善, 但由于纱线性能的降

# 毛纤维判别方法的改进

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摘 要: 对 Fisher 二类线性判别分析方法进行改进, 并利用改进的基于 Fisher 准则的二类非线性判别分析方法处理绵羊毛和山羊绒纤维识别指标, 并计算检验判别效果的统计量。在此基础上, 可判别未知样品纤维所属的类别。

关键词: Fisher 准则 二类非线性判别方法 毛纤维判别

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## 1 Fisher 准则的二类非线性判别分析原理<sup>1,2</sup>

判别分析包括建立判别函数、给出判别方法和对判别效果进行检验。

两组判别分析方法均基于统计上的 Fisher 准则, 即判别应使两组间区别最大, 每组内部离散性却最小, 按照 Fisher 准则来确定线性判别函数:

$$y = C_1 x_1 + \dots + C_M x_M \quad (1)$$

其中,  $C_k (k=1, 2, \dots, M)$  为待求的判别系数。

对于二类非线性判别, 则:

$$y = C_1 x'_1 + \dots + C_M x'_M \quad (2)$$

这里  $x'_i = \ln x_i$ 。

设已知  $A^*$ 、 $B^*$  两组分别有  $n_1$ 、 $n_2$  个样品,  $A^*$ 、 $B^*$  两组样品各判别指标的平均值记为  $\bar{x}'_i(A^*)$  与  $\bar{x}'_i(B^*) (i=1, 2, \dots, M^*)$ , 以  $\bar{y}(A^*) = \sum_{k=1}^{n_1} C_k X_k(A^*)$  和  $\bar{y}(B^*) = \sum_{k=1}^{n_2} C_k X_k(B^*)$  分别表示  $A^*$  和  $B^*$  组样品的“重心”, 两组间差别用  $(\bar{y}(A^*) - \bar{y}(B^*))^2$  表示,  $A^*$ 、 $B^*$  两组内部离散程度分别用  $\sum_{i=1}^{n_1} (y_i(A^*) - \bar{y}(A^*))^2$  和  $\sum_{i=1}^{n_2} (y_i(B^*) - \bar{y}(B^*))^2$  表示。

由极值原理得:

低, 织物的纬向撕破性能大大降低, 难以达到产品质量的要求。

对于重型牛仔布来说, 如果经纬纱残余扭矩较大, 织物内纤维和纱线应力不平衡, 在后整理中, 由于纤维吸湿膨胀和应力松弛收缩, 牛仔布表面会呈现凹凸不平。凸出于织物表面的经纱受到较强的洗涤和摩擦, 经纱表面的部分染料和表面纤维会丢失。最后, 在织物表面呈现明显的浅色和白色短花纹, 随机分布, 且面广, 见图 3(b)。这种布面疵点俗称“蛇仔纹”, 它严重影响牛仔布布面外观质量。该疵点与织物中经纬纱的残余扭矩密切相关。经过上浆和染色, 经纱的残余扭矩已大大降低, 因此, 降低织物中经纬纱的残余扭矩可以改善牛仔布“蛇仔纹”布面疵点, 见图 3(a)、(c)。

## 4 结 论

1. 通过在传统环锭纺细纱机上加装简单的纺纱附件, 研制出一种生产扭妥™ 纱的新型纺纱方法, 改善成纱结构。

2. 用新型纺纱方法生产的扭妥™ 纱纱线残余扭矩比传统环锭纱大大降低, 并且纱线毛羽较少, 纱线

条干均匀。

3. 扭妥™ 纱纺纱方法可提高较低品级棉纤维的可纺性, 降低原料成本, 增加经济效益。

4. 织物表面平整度与织物中经纬纱的残余扭矩有关。因此, 采用扭妥™ 纱做纬纱织制的牛仔布, “蛇仔纹”布面疵点大大减少, 织物外观质量显著提高。

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# JOURNAL OF TEXTILE RESEARCH

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## Contents

(Abstracts Inc.)

### Research Reports

#### Structure and Processing Properties of the Natural Colored Cotton

The reasons of instabilities of size, colorant and poor spinning property of the natural colored cotton has been analyzed in the respect of structure in order to offer the reference for industrial production. .... Zhang Mei *et al* (7)

#### Preparation and Mechanical Properties of Fibroin/Sericin Blended Film

The fibroin/sericin blended films were prepared with epoxides resins as cross-linking agent. The properties and structure of blended films was investigated. Results show that the blended film, which prepared by 10% fibroin and 90% sericin, PEGO 4-1 as cross-linking agent, has better physical and mechanical properties. .... Xie Ruijuan *et al* (10)

#### Study on Cross-linking Properties Between Cotton and Chitosan

Treat cotton knitted fabric with poly-carboxylic acid and chitosan as finishing agent. Study on the properties of cross-linking by the technique of Fourier Transform Infrared Spectrum and X-ray Photoelectron Spectrometry. Results show that the cross-linking takes place between cotton and chitosan in the presence of cross linking agents. .... Xu Yunhui *et al* (12)

#### Study on Surface Modification of Soybean Protein Fiber with DBD Plasma

Treat soybean protein fiber and its roving with Dielectric Barrier Discharge (DBD) technique, that can change their surface morphology significantly and increase the frictional coefficient of the soybean, thus improve the cohesion force of the soybean protein fiber in roving, at meanwhile there is no significant change in strength and elongation of soybean protein fiber. .... Wu Huijeng *et al* (15)

#### Study on Dyeing Properties of Polyester with Disperse Dyes in Supercritical Carbon Dioxide

Dynamic characteristics of PET fiber dyed with Disperse Blue C. I. 79 in supercritical carbon dioxide medium was studied. Its diffusion coefficients and the activation energy of different temperature in such situation were obtained. .... Hou Aiqin *et al* (17)

#### Research on Dyeing Properties of Coloring Material from Carthamin on Ramie and Natural Silk Fabrics

Analyze and compare the dyeing properties of carthamin and safflower yellow on ramie and natural silk. The  $K/S$  value of safflower yellow on natural silk is much higher than that on ramie and has different color eigenvalue from ramie, and the  $K/S$  value of carthamin on natural silk is close to it on ramie, but it has different color eigenvalue from ramie. Metal ions will affect the stability of carthamin. .... Yu Zhicheng (19)

#### Determination of Free Formaldehyde in Textiles by High Performance Liquid Chromatography

Set up the liquid chromatography method for determining hydrolyzed free formaldehyde in textiles. The formaldehyde in textiles is extract in water and reacted with 2,4-dinitro-phenylhydrazine. Its derivative compound can be analyzed directly without any other solvent. So the method is simple, quick and economical. The conventional syngenic chemicals have no interference. Recover ratio is 93%~103%. .... Chen Haixiang *et al* (21)

#### Numerical Simulation of Dynamic Heat-moisture Transfer within the Human-Clothing-Environment System

Establish the Stolwijk's human thermal regulatory model, take the accumulative course of perspiring into consideration, then combine the heat-moisture transfer model of fabric for numerical simulation of instantaneous status heat-moisture transfer course in human-clothing-environment system. The phenomenon that the fiber can adsorb and desorb moisture is the problem at core on study into the comfort property of clothes which is bound up with dynamic heat-moisture transfer. The effects of the thermal conductivity rate, thermal capacity as well as heat occur and release due to phase change also be taken in consideration as the model set up. Experiments show the model possess a good predictability. .... Liu Yingxi *et al* (24)

### Analysis and Investigations

#### Study on Identification of Bamboo Fiber

Based on the well-know knowledge of the elementary physical properties of bamboo fiber and viscose fiber, identify these two kinds of fiber effectively by three methods, i. e. observing fiber microstructure, measuring lignin content and the infrared spectrum, to analyze and compare bamboo fiber and viscose fiber. .... Zhang Tao *et al* (28)

#### Preparation and Property of Anti-ultraviolet Polyamide Chip

Test the nanometer  $SiO_2$  and  $TiO_2$  by TEM. After surface modification, these two nano-materials were mixed together with powdered polyamide in proportion, extruded and chipped, then made into film. Test its transparency of ultraviolet by UV-spectrophotometer and the properties of anti-ultraviolet of polyamide chip. Discuss the factors that affect the anti-ultraviolet properties of polyamide chip. .... Qian Jianhua *et al* (30)

#### Weighting Properties of Mulberry Silk after the Plasma Treatment

Stannic acid is used to characterize the voids felling capacity in silk fiber after the mulberry silk fiber was treated with low temperature oxygen plasma. Results show that the plasma treatment makes the stannic acid gel fill in the inner part of the silk easily and improves its weighting ability, which indicates the micro-voids appear in the silk. The aggregate structure of silk fiber treated with plasma changes and crystalline degree of it decrease after stannic acid weighting treatment. .... Ren Yu *et al* (32)

#### Prediction of the Quality of Worsted Yarn

Prediction of the quality of worsted yarn including the parameters such as evenness, thin place, thick place, yarn tenacity and elongation at break etc., by Multi-Layer Perceptron (MLP) and Levenberg-Marquardt (LM) algorithm. The experiment shows that there is high correlation between the predictive value and measured value of yarn quality, which indicates the MLP model and LM algorithm can be used in practical prediction of worsted yarn quality. .... Wang Kanfeng *et al* (34)

#### Study on Varying Principle of Fiber Property in Pure Cotton Card Sliver Making Process

Thirty pure card slivers were made of different components from ten Chinese medium cotton, and test with HVI 900 system. The varying principle of fiber properties in the process was investigated. It will be of reference value to cotton assorting in cotton mill. .... Zhang Hongwei (36)

#### Application of New Method Spinning Nu-Torque™ Yarn for Weaving

Put a attachment on conventional ring spinning frame, a lower torsion moment yarn (Nu-Torque™ yarn) was produced by this new spinning method. 100% cotton Nu-Torque™ yarn of linear density 84.4 tex was produced, its properties were test and compared with conventional ring spinning yarn. In addition, the fabric properties and appearance of denim weaving separately using these two yarns as weft are tested and compared. .... Hua Tao *et al* (38)

#### Improvement of Distinguishing Method for Wool Fiber

Improve the bi-class linear discriminatory analysis method base on Fisher criteria. Use improved non-linear method to treat the virtue of the sheep wool and the cashmere. Collect the distinguishing index acquired and make a statistics of discriminatory result. By this the specimen of unknown animal fiber can be distinguished. .... Shen Jinghu *et al* (40)

#### Application of Grayscale Morphology in Image Processing of Animal Fibers

The grayscale morphology in image processing technique is applied to animal fiber image. Base on experiments and the reasonable design of the process, it is