# Effect of Abnormal Degree of Fiber Cross-section on the Moisture-Transfer and Dry-fast Properties of Knitted Fabric

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***Abstract:*** With the help of electronic microscope and scanning electronic microscope, profiled polyester fibers with cross section shapes like "Y", "＋" and "C" were analyzed individually. Four kinds of single and double-faced knitted fabrics with different structures and density were manufactured with the profiled polyester fibers, and their wicking height, water retention and drying efficiency were investigated individually. It was found that the more abnormal the fiber cross section is, the better is the moisture-transfer and fast drying properties of its fabrics.

***Keywords***: Profiled fiber, abnormal degree of the fiber cross sections, wicking property, water retention, drying efficiency.

## 1. Introduction

There are two ways to develop moisture-transfer and quick drying fibers. One method is designing the abnormal die-spinning nozzle to make the fiber have a grooved structure, and designing many pores in the textile fiber wall, thus moisture may transfer along the trench and the pore. The other method is adding hydrophilic substance to the spinning solution, this method may increase hydrophility of the textile fiber, but simultaneously also increases its water-retention property, which makes its quick drying property worse and can't bear water washing. Meanwhile, durability becomes bad as well. Therefore it can not satisfy the demands in both sportswear' moisture-transfer and quick drying. Because of the above mentioned reasons , at present, the hot issue in this study concentrates on developing profiled fiber both having abnormal cross section as well as pores on the fiber wall [1-4]. Moisture-transfer and quick drying performance of three existing abnormal cross section fibers that have formed the industrialization production were studied in this article.

## 2. Fiber cross section and degree of profile

### 2.1 Longitudinal and transverse cross section shape of fibre

In this study, "Y" shape polyester fibers made in Yizheng (China), and Coolmax "+" and "C-O" shape polyester fibers made in Dupont (US) were selected. Three kinds of profile fibers' transverse cross section shape that were observed under 500 times of electron microscope are shown in Figure 1.(a).(b).(c).Their longitudinal contour which were separately amplified 1000, 2500, 4000 times under the electronic microscope are shown in Figure 1. (d). (e). (f) .

### 2.2 Profile degree of the fiber cross sections

Profile degree of the fiber cross sections refers to the non-circular section shape concave-convex criterion. The bigger degree of profile indicates a more zigzag shape of cross section. The degree of profile can be expressed by branch [5]. The branch of a circle is 12.6. The bigger branch indicates the bigger profile degree. The branch B can be calculated according to formula (1):

$$B = \frac{L^2}{S} \tag{1}$$

Note: L is the fiber cross section' perimeter /m;
S is the fiber cross sectional area /$m^2$.

We project these three kinds of textile fibers' section graph to the graph paper, and select respectively three graphs having representation, and distinctly compute their perimeter and area and then put them into the formula (1) to figure out the value of B, finally figure out their mean value as this kind of textile fiber' branch. The branch of "Y" shape was 22.126, "+" shape was 27.556, and "C-O" shape was 34.169.

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*JFBI Vol. 2 No. 4 2010 doi:10.3993/jfbi03201007*

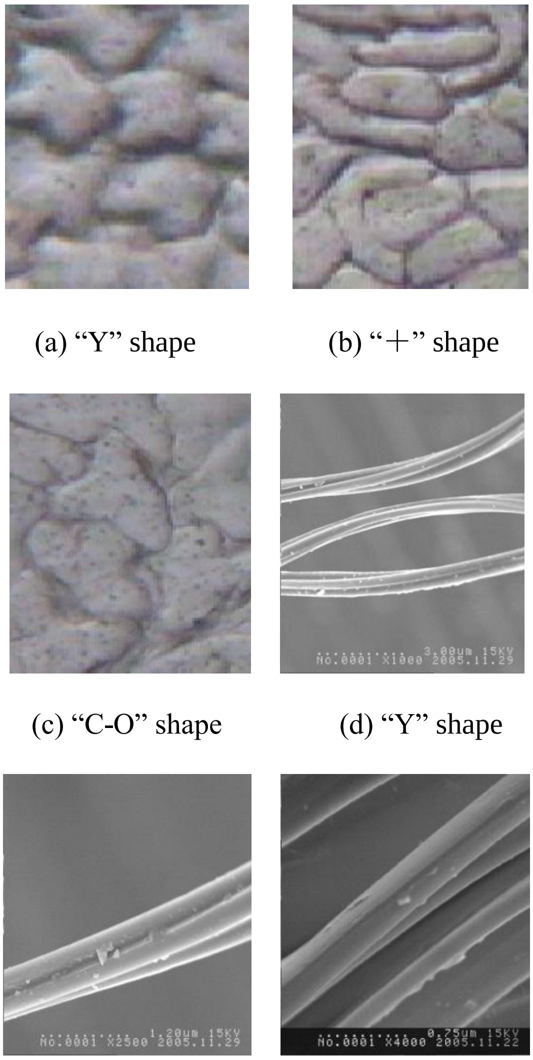


Figure 1 Fiber cross-sections.

## 3. Fabric design

Using different specification filaments formed by these three kinds of textile fibers, we designed four groups of fabrics that have different histological structures, and separately knitted on single and double circular knitting machine.

### 3.1 One-sided fabric design

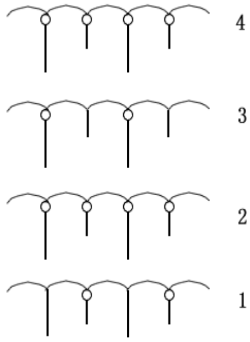


Figure 2 One-side mesh.

We have designed and developed two groups of fabrics: group A and B, and group A are jersey weft-knitted elastic fabrics, which were mix kitted by moisture-transfer and quick drying filament and cotton yarn. In addition, it has been joined with spandex filament, which was fed into plain circular knitting machine simultaneously with the cotton yarn. The total content of spandex filament in the fabric is 4%. Group B is one-sided mesh fabric, which were knitted by two kinds of moisture-transfer and quick drying filaments and fed into the knitting alternately in the proportion of 1:1. Fabric knitting chart is shown in Figure 2, and fabrics structure parameters are listed in Table 1.

Table 1 Structure parameters of one-sided fabrics

| Fabric | Yarn specification | Course count (wales/50mm) | Wale count (courses/50mm) | Gram weight ($g/m^2$) |
|---|---|---|---|---|
| A1 | Route 1: 16.6tex/48F“Y”shape filament;<br>Route 2 : 18 tex JC yarn×4.4 tex spandex | 75 | 118 | 176 |
| A2 | Route 1:16.6tex /144F“＋”shape filament;<br>Route 2:18 tex JCyarn×4.4 tex spandex | 75 | 118 | 176 |
| A3 | Route1:16.6tex/200“C-O”shape filament;<br>Route 2:18 tex JC yarn×4.4 tex spandex | 75 | 118 | 176 |
| B1 | Route 1, 3: 16.6tex /48F“Y”shape filament;<br>Route 2, 4: 16.6tex /200F“C-O”shape filament | 50 | 63 | 151 |
| B2 | Route1, 3: 16.6tex /144F“＋”shape filament;<br>Route 2, 4: 16.6tex /200F“C-O”shape filament | 50 | 63 | 151 |
| B3 | Route1, 3: 16.6tex /200F“C-O” shape filament;<br>Route 2, 4: 16.6tex/200F“C-O” shape filament | 50 | 63 | 151 |

Table 2 Structure parameters of double faced fabrics