Features of the method for producing cross-knitted knitwear with a discontinuous linear melange effect

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Abstract. The textile industry occupies one of the most important places in the production of socially significant products and meeting the needs of the economy and population. In recent years, issues of effective use of existing technological capacities and the use of diverse raw materials have been on the agenda. The article reveals the features of the method for producing cross-knitted knitwear with a discontinuously linear melange effect from dissimilar or multi-colored threads or yarn.

1. Introduction

In recent years, under conditions of integration, significant changes have been observed in the development of the textile industry. The share of this industry in the total volume of industrial production is 6-8% in Germany, France and the USA, and 12% in Italy. This made it possible to generate up to 20% of the country’s budget through the production of textiles and clothing. Uzbekistan also pays serious attention to the sustainable development of the textile industry. In 2022, Uzbekistan exported textile products worth 3,200 million US dollars, accounting for 16.5% of total exports, an increase of 8.6% compared to 2021 [1].

The local and foreign markets, along with products made from environmentally friendly cotton, require the production of textile fabrics and products of mixed composition that meet international standards. To achieve new indicators, characteristics and a unique patterned effect, the issues of effective use of existing technological capacities and the use of diverse raw materials are on the agenda. Unique features and characteristics are inherent in composite threads, fabrics and finished products, which come from the specific properties of the constituent components [2-4]. In order to expand the range of textiles, the industry received raw materials such as polyester, modal, bamboo, lycra, as well as melange yarns. Spinning mills have introduced technologies for producing melange from fibrous raw materials cotton/polyester, cotton/modal, viscose/polyester, cotton/bamboo, cotton/modal and others [4].

Melange – (French “melange”, means “mixture”) i.e., in the textile industry, dissimilar or multi-colored fibers are present in the composition of melange yarn [5]. In textile fabrics made from heterogeneous or multi-colored raw materials, the melange patterned effect is clearly reflected. Including fabrics, knitted fabrics and products made from melange yarn, including a mixture of dissimilar or multi-colored fibers, also have a melange patterned effect.

2. Methods

The method of producing traditional melange is accompanied by the preliminary formation of melange yarn from dissimilar or multi-colored fibers with the investment of additional costs. In addition, the melange patterned effect of fabrics, knitted fabrics and products depends on subsequent factors:

- on the fractional proportion of the components of dissimilar or multi-colored fibers in the yarn;
- subject to the formation of raw materials obtained by rewinding from single threads and/or yarn, on the torsion coefficient, linear density, type and color;
- knitting equipment for fabrics or products from monotonous or varied threading systems (smooth or patterned).

If there is subsequent dyeing of the canvas or product, it is necessary to take into account the heterogeneity of the constituent components.

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It is known that [6] when rewinding yarn or threads from cylindrical forgings, winding can be done both clockwise and counterclockwise. Depending on the direction of winding and the direction of twist, the yarn and thread itself receives either additional twist or a decrease in twist (Fig. 1, a). When rewinding yarn or thread from conical forgings, the winding is done only counterclockwise, and the yarn or thread receives an additional left-hand twist.

![Fig. 1. Obtaining additional twist (a) and the process of enveloping the axial yarn or thread (b) during winding](image)

It was revealed that when winding yarn or threads from a forging in the direction of the axis of the rod or forging, in all cases one torsion occurs over the length of one turn. Based on this pattern, we have developed a new method for producing cross-knitted knitwear with a discontinuously linear melange effect [7] from dissimilar or multi-colored threads or yarn.

![Fig. 2. The structure of cross-knitted knitwear with a discontinuously linear helical melange effect based on the satin surface](image)

In this case, the ratio of the total linear density $\sum T$ of dissimilar or multi-colored threads or yarns and the class of knitting equipment $K$, obeys established patterns by professor A.S.Dalidovich:

$$\frac{1000}{\sum T} \geq \frac{K^2}{10}$$  (1)
The essence of the new production method is to form loop rows from dissimilar or multi-colored threads or yarn, obtained by removing them from at least one package, passing the first along the axis of the second, followed by joint feeding (Fig. 1, b).

When feeding dissimilar or multi-colored threads or yarn, at least one passing along the axis (axial 1) of the other is covered (encompassing 2) by the winding thread or yarn.

The resulting torsion of each turn allows the axial thread or yarn to wrap around another when coming off, which contributes to the subsequent formation of looped rows with a discontinuously linear melange effect.

The amount of additional twist – \( K_r \) (Fig. 1, a) can be determined by the following formulas:

\[
K_r = \frac{1}{L} \quad \text{or} \quad K_r = \frac{1}{\pi d}
\]

here, \( L \) – coil length, mm; \( d \) – round diameter, mm.

Naturally, the number of additional twist (Fig. 1, a and b) is equal to the number of coverage, which is accompanied by the location of dissimilar or multi-colored threads or yarn in the loops of the loop row.

Figure 2 shows the structure of loop rows of cross-knitted knitwear with a discontinuously linear melange effect based on the satin surface. Repeat patterned effect - R weave conditionally consists of sections a, b, c. Moreover, the repeat, consisting of sections, includes rows, \( a \) – (from 1 to \( n \)), \( b \) – (from \( n+1 \) to \( m \)), \( c \) – (from \( m+1 \) to \( d \)). A discontinuous linear melange effect is formed by removing dissimilar or multi-colored threads or yarn from at least two packages, passing the first along the axis of the second, followed by joint feeding in section \( b \) - /from \( n+1 \) to \( m \) /.

### 3. Results and Discussion

As an example, let’s consider a cross-knitted screw knit with a discontinuously linear melange effect, obtained in laboratory and production conditions on a Suprem circular knitting machine. Experimental samples were obtained from cotton yarn with a linear density of 33.3 tex (№30) and natural silk yarn with a linear density of 8.33 tex (№120) (Fig. 3.) with uniform filling of all systems.

The filling and technological parameters of the variations of experimental cotton-silk knitted fabrics based on satin stitch are given in Table 1.

<table>
<thead>
<tr>
<th>Option</th>
<th>System</th>
<th>Filling, tex and %</th>
<th>Loop step, mm</th>
<th>Height of loop row, mm</th>
<th>Raft. loops</th>
<th>Length of thread in loop, mm</th>
<th>Hang. raft., g/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>odd</td>
<td>cotton (81.6) 33.3 + silk 8.33 (18.4)</td>
<td>0.8</td>
<td>0.5</td>
<td>70</td>
<td>95</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>even</td>
<td>cotton 33.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>odd</td>
<td>cotton (81.5) 33.3 + silk 8.33 (18.5)</td>
<td>0.6</td>
<td>0.4</td>
<td>85</td>
<td>135</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>even</td>
<td>cotton 33.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>odd</td>
<td>cotton (81.7) 33.3 + silk 8.33 (18.3)</td>
<td>0.8</td>
<td>0.5</td>
<td>60</td>
<td>100</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>even</td>
<td>cotton 33.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In all variants, the discontinuously linear melange effect of screw knitwear is achieved by the joint feeding of two dissimilar threads or yarns, threading one through the forging axes of the other through the system. The options differ directly in knitting density, as can be seen from the technological parameters given in the table. Odd systems create a melange effect when knitting by combining cotton and natural silk yarn with one thread through the forging axes of the other, and even systems form a regular loop row of cotton yarn when knitting. Without changing the filling parameters, within the technological capabilities of the Suprem circular knitting machine, samples of cross-knit pressed, jacquard, partial and lined knitwear with a discontinuously linear screw melange effect were obtained.

With the introduction of an additional lined thread into the structure of melange cotton-silk knitwear based on satin stitch, within the technological capabilities of the “Suprem” circular knitting machine, it is possible to form new assortments of lined fabrics with improved heat-shielding properties. From the course on patterned knitwear it is known that weaves in which additional lined threads are introduced into the ground by selectively laying them on needles without subsequent knitting into loops are called lined. Depending on the number of sequentially supplied lined threads in one loop row, simple, double, triple lined knitwear is distinguished. In this case, the sketches and broaches of the lining thread, depending on the purpose of the fabric, can be located in a loop row according to the repeat 1+1, 1+2, etc. The length of the footer with 1+1 laying will be greater than with 1+3 laying, and therefore, with the same knitting density, the surface density of the fabric will be greater [8-10].

According to the classification of knitted weaves, lining thread can be knitted into any of the existing main weaves, derivatives, and patterned ones. Thanks to a new approach to creating a discontinuously linear melange effect based on lined knitwear, it is also possible to form a series of varieties of lined fabrics with a melange patterned effect.

4. Conclusions

The results of the study established that in order to obtain cross-knitted knitwear with a uniform discontinuous linear melange effect from dissimilar or multi-colored threads or yarns, the following must be taken into account:

- alternate complete and incomplete forgings of enveloping thread or yarn;
- taking into account the previous condition, when filling, combine the location of the axial and female forgings.

Thus, the features of the method for producing cross-knitted knitwear with a discontinuously linear melange effect are disclosed.

The method was tested under production conditions, experimental samples of smooth and patterned canvases with a discontinuously linear melange effect were obtained.

References

1. Urishev B, Five-year economic analysis of the textile industry of Uzbekistan, Economy: analyzes and forecasts 23, 48-52 (2023)