

Research Article

Analyzing of the Single Pique and Double Pique Fabrics with Different Contents and Dyeing Effects

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Abstract

In apparel production, various fabrics are used. Among these fabrics, knitted fabrics are preferred due to their touch properties, high breathability, flexibility and comfort. Single-pique and double-pique fabrics are among the knitted fabrics preferred in the production of clothes generally worn in formal places such as business life. For this reason, although it is intended to give a formal attitude, physical and performance properties are important in pique fabrics. In this study, fabric developments were made to analyze the physical and mechanical performance properties of single-pique and double-pique fabrics. Dimensional change, color fastness to washing, color fastness to rubbing, color fastness to water, color fastness to perspiration, pilling, and bursting strength tests were performed on the developed fabrics, and the effect of fabric content and dyeing properties were investigated. According to the results, the general properties of cotton-polyester blended fabrics were found to be better. In addition, fabrics dyed in light colours were found to be more suitable for all properties except pilling. When the knitting type was analysed, it was determined that the physical properties of single pique fabric were more favourable.

Keywords: Pique Fabric, Knitwear, Dyeing Parameters, Dimensional Stability.

1. Introduction

From past to present, people need to dress and have different dressing behaviours. Knitted fabrics have become the most preferred fabric type in apparel industry because of their soft touch properties, flexibility and comfort [1,2].

Clothes made from knitted fabrics are more preferred in clothes to wear in business life due to their high breathability. Among knitted fabrics, especially pique fabrics are knitted types used to create a formal look. For this reason, among the features expected from pique fabrics to meet the features such as offering a beautiful appearance for business life, high bursting strength and thus being able to move comfortably in it, having a soft touch [3,4].

The final properties of knitted fabrics are influenced by many different parameters starting from the raw material and formation stage of the fabric. In the knitting stage, machine features, machine frequency setting and yarn count are important. In the later stages, dyeing properties and finishing processes play an important role in the physical properties of the knitted fabric. In addition, many studies have been carried out to investigate the effect of changing temperature parameters in sanforizing machines on the physical and performance properties of knitted fabric [5,6,7].

At the same time, in the literature, researchers have carried out many studies on the effect of knitting type, fabric content properties, yarn type and count, machine parameters, elastane ratio on the properties of knitted fabric. Kane, Patil and Sudkakar, [8] investigated the effect of ring and compact yarn on fabric properties of single jersey, single pique and double pique fabrics. Fatkic et al [1] investigated the effects of the feed speed factor on the physical properties of the fabric during the knitting process of fabrics consisting of cotton and elastane yarns.

In this study, the effects of light color-dark color dyeing of single pique and double pique fabrics and the effects of single and double dyeing as a result of fabric content on physical and performance properties were investigated.

2. Materials and Methods

2.1. Material

Within the scope of this study, 8 fabric developments were made for the investigation of the effect of color parameters (light color dyeing-dark color dyeing) and differences in fabric content on the change in fabric properties. 4 single pique fabrics and 4 double pique fabrics have been developed. The fabrics used in the study were produced in TYH Tekstil. The fabrics developed within the scope of the study are given in Table 1.

Table 1: Developed fabrics

Sample code	Fabric composition	Color	Knitted type
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	Cotton	Polyester			Number of dyeing
DDP	50	50	Dark Blue	Double Pique	2
SDP	50	50	Dark Blue	Single Pique	2
DDC	100	-	Dark Blue	Double Pique	1
SDC	100	-	Dark Blue	Single Pique	1
DLP	50	50	Light Blue	Double Pique	2
SLP	50	50	Light Blue	Single Pique	2
DLC	100	-	Light Blue	Double Pique	1
SLC	100	-	Light Blue	Single Pique	1

2.2. Methods

In this study, Ne 30/1 100% cotton and Ne 30/1 50-50% cotton-polyester yarns were used for fabric development. Then, 4 single-pique and 4 double-pique fabrics were produced using these yarns. The fabrics were knitted on a 28 fine 32 pus circular knitting machine in collaboration with PERGE Tekstil İşletmeleri A.Ş. As a result, two 100% cotton single-pique fabrics, two 100% cotton double-pique fabrics, two 50-50% cotton polyester single-pique fabrics and two 50-50% cotton polyester double-pique fabrics were developed. One of the fabrics from each of the two groups was dyed navy blue and the other light blue. While single dyeing was performed for cotton-containing fabrics, double dyeing was performed for cotton polyester-containing fabrics to dye both cotton and polyester. As a result, 8 different fabrics were developed to observe the effects of knitting variation, fabric content, and color parameters on the properties of the fabric.

After the fabric developments were completed, the same tests were performed on the fabrics at the same standards. Firstly, the basis weight of the fabric was taken to see the weight differences in the fabric. The mass per unit area of fabric test was performed on the fabric with TS EN ISO 12127 standard. The dimensional change of fabrics was measured according to the TS EN ISO 5077 test standard. Perspiration fastness, water fastness, fastness to rubbing, and washing fastness were tested according to ISO 105 E04, ISO 105 E01, ISO105X12, and ISO 105 C06 standards, respectively. Pilling tests were performed according to ISO 12945-2 test standard using the SDL ATLAS Martindale M235 pilling tester. Fabric bursting strength was measured according to TS EN ISO 13938-1 test standard and test results were represented in units of kgf.

3. Results

Mass Per Unit Area Test

Firstly, mass per unit area (basis weight) of fabric tests of the developed fabrics were carried out. The basis weight of the fabric test results is given in figure 1.

In the basis weight tests, the basis weight of the double pique was higher than the single pique. When we analyzed the effect of color parameters; in double-dyed fabrics, the fabric dyed in dark color was measured heavier and the fabric dyed in light color was measured lighter. When we look at single-dyed fabrics, the situation is the opposite; light-colored fabrics are heavier, and dark-colored fabrics are lighter. However, it was observed that there was less difference in single-dyed fabrics than double-dyed fabrics. Double-dyed fabrics contain cotton polyester, and single-dyed fabrics contain only cotton.

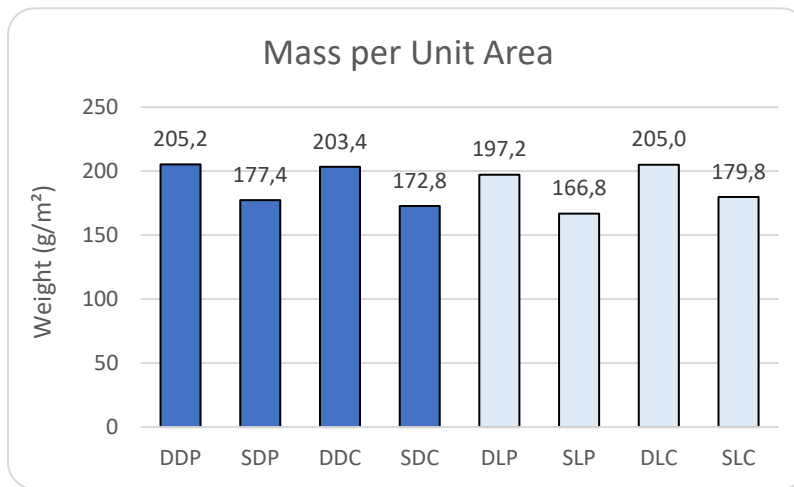


Figure 1: Basis weight of developed fabrics

Dimensional Stability Tests

Dimensional stability tests of the developed fabrics were carried out. As a result of the tests, the width, length shrinkage, and release values of the fabrics were determined. And dimensional change in width (DC_w) and dimensional change in length (DC_L) of fabrics are given in Figure 2 and Figure 3.

When the dimensional changes in width (DC_w) are evaluated, it is observed that the fabrics generally release themselves in width. While width release was observed in all fabrics except for SDP and SLP-coded fabrics, width shrinkage was observed in these fabrics. This allows us to see the effect of the fabric content and the type of knitting on the shrinkage. The highest rate of release was observed in cotton-containing SDC and SLC-coded single pique fabrics. When the test results are examined, the dimensional stability values in the width of cotton polyester-containing fabrics are better than 100% cotton-containing fabrics.

When the dimensional changes in length (DC_L) were analysed, it was observed that shrinkage in length occurred in all fabrics. Similarly, the maximum width release was

observed in single pique and cotton-containing fabrics and the maximum length shrinkage was also observed in these fabrics. These fabrics fell outside the general customer acceptance criteria. While there is no clear effect of other factors in the dimensional change in length results, the effect of knitting type is observed. The length shrinkage values of double-pique fabrics were less than single-pique fabrics.

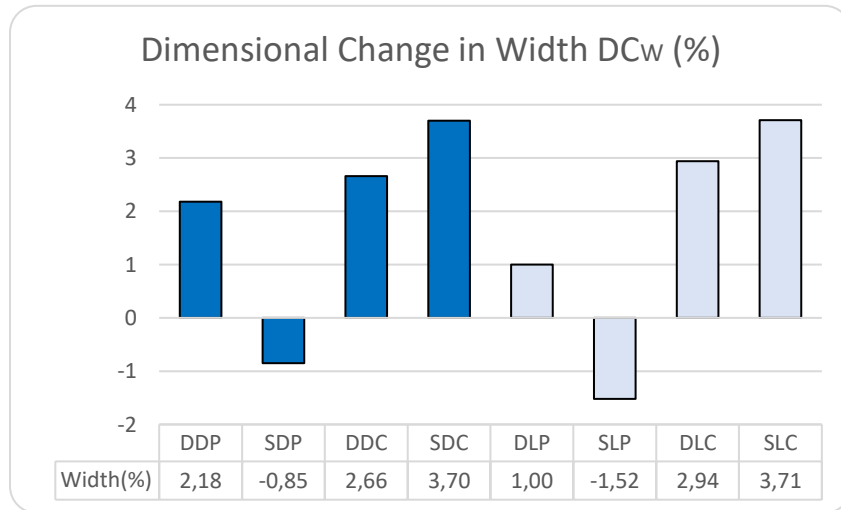


Figure 2: Dimensional change of developed fabrics in width

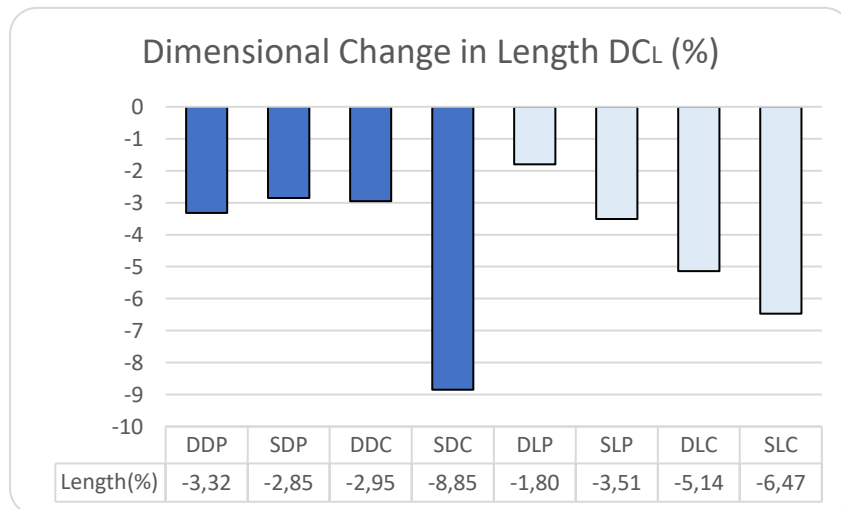


Figure 3: Dimensional change of developed fabrics in length

Color fastness to Washing Test

When the washing fastness values were examined, it was observed that the test results of both dark and light-colored fabrics were at good levels. However, the washing fastness

values of light-colored fabrics are 1 point lower than the washing fastness values of dark colored fabrics. And color fastness to washing test results were given in the table 2.

Table 2: Color fastness to washing test results of developed fabrics

Sample Code	DDP	SDP	DDC	SDC	DLP	SLP	DLC	SLC
Color fastness to washing	5	4/5	5	5	4/5	4/5	4/5	4/5

Color fastness to Rubbing Test

When the rubbing fastness values were analysed, it was determined that the test results of all fabrics were at the best level in dry rubbing fastness test results. When wet rubbing fastnesses were examined, the fastness values of light-colored fabrics were at the best level, while the fastness values of dark colored fabrics decreased.

Table 3: Color fastness to rubbing test results of developed fabrics

Sample Code		DDP	SDP	DDC	SDC	DLP	SLP	DLC	SLC
Colorfastness to rubbing values	Dry	5	5	5	5	5	5	5	5
	Wet	3/4	4	4	4	5	5	5	5

Color fastness to Water Test

When the water fastness values were examined, it was observed that the water fastness of light-colored pique fabrics was worse than the water fastness of dark colored fabrics. Despite this, it is clearly seen that the water fastness of all fabrics is above the acceptance criteria.

Table 4: Color fastness to water test results of developed fabrics

Sample Code	DDP	SDP	DDC	SDC	DLP	SLP	DLC	SLC
Color fastness to water values	5	5	5	4/5	4/5	5	4/5	4/5

Color fastness to Perspiration Test

When the color fastness to perspiration values are examined, all values for both acid and alkaline are excellent. Test results were given in table 5.

Table 5: Color fastness to perspiration test results of developed fabrics

Sample Code		DDP	SDP	DDC	SDC	DLP	SLP	DLC	SLC
Color fastness to perspiration	Acid	5	5	5	5	5	5	5	5
	Alkaline	5	5	5	5	5	5	5	5

Pilling Test

According to the pilling test results of the fabrics, it was observed that pilling is generally lower in dark color-dyed fabrics. When the pilling tests of the dark-colored cotton polyester-containing fabrics were examined, pilling was observed less in single pique fabric. It was determined that the pilling rate of double pique fabric was higher in dark colored and cotton containing fabrics. In light-colored cotton polyester-containing fabrics, pilling was observed higher in double-pique fabrics in the same way. Although the results were generally below the acceptance criteria, the results were interpreted among themselves.

Table 6: Pilling test results of developed fabrics

Sample Code	DDP	SDP	DDC	SDC	DLP	SLP	DLC	SLC
Pilling Values	2/3	3/4	2	4	1/2	3/4	2/3	1/2

Bursting Strength Tests

The test results shows that the bursting strength of the single-pique fabrics is higher than the double-pique fabrics and it is observed that they have a more flexible structure. When the effect of dyeing parameters on bursting strength was examined, it was found that the elasticity was less in pique fabrics dyed in dark color. However, a high effect such as the effect of knitting type was not observed here. When the effect of fabric content was evaluated, it is seen that the bursting strength of cotton polyester blended fabrics is higher than 100% cotton blended fabrics.

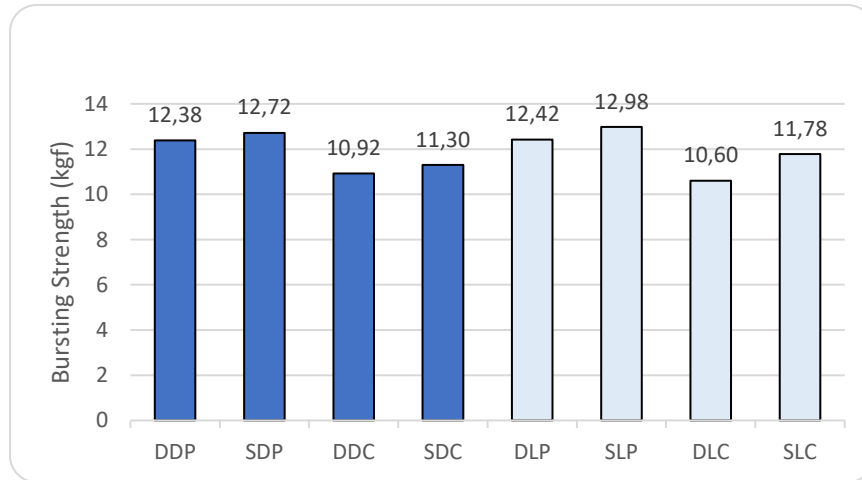


Figure 4: Bursting strength test results of developed fabrics

4. Discussion and Conclusion

When the basis weights of the pique fabrics were analyzed, it is seen that double pique fabrics were heavier. It was also observed that the basis weight of double-dyed light-colored fabrics was lower than double-dyed dark-colored fabrics, while the basis weight of single-dyed light-colored fabrics was higher than single-dyed dark-colored fabrics.

In the analysis of the dimensional properties, it was noted that cotton-polyester blended fabrics exhibited superior performance compared to 100% cotton fabrics, while single pique and 100% cotton fabrics were below customer acceptance criteria. Additionally, when washing fastness was evaluated, light-colored fabrics displayed one-point lower values compared to dark-colored fabrics. However, all fabrics showed excellent dry rubbing fastness, with only a slight decrease of half a point in wet rubbing fastness, particularly evident in dark-colored fabrics.

While all pique fabrics exhibited good water fastness with slightly lower performance in light colors, while excellent resistance to both acid and alkaline perspiration was observed across all variations. According to the results, it was determined that pilling tendency was higher in light color dyed and double pique fabrics. The results also showed that elasticity values were higher in single pique, light color dyed and cotton polyester blended fabrics.

According to the results of the tests, cotton-polyester blended fabrics were found to have superior overall properties. Also, fabrics dyed in light colors were found to be more advantageous in terms of all properties except pilling. When the knitting type was analysed, it was determined that the properties of single pique were more favourable according to this study. For these reasons, when we ignore the pattern factors of knitting, the most superior fabric in terms of physical properties was evaluated as SLP coded fabric (single pique, light color dyed and cotton-polyester blended).

After the determining appropriate fabric quality, design studies were carried out. Four different products were developed and sketches are given in figure 5.



Figure 5: Polo tshirt designs from pique fabrics

5. Acknowledge

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