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EFFECTS OF SOME MECHANICAL PROPERTIES OF FABRICS FORMED BY INCLUSION OF RECYCLED COTTON IN PRODUCTION

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ABSTRACT

In the blend of 1st fabric recycled cotton produced in this study, plain fabric was produced from 50% recycled cotton and 50% cotton compact yarns. 2. Fabric is a plain fabric made from 65% recycled cotton and 35% cotton using compact yarns. The tear strength, abrasion resistance and pilling performance of the fabrics were examined when the blending ratios of the cottons obtained from the recycling used in these fabrics increased. For this purpose, the tear strengths of 2 fabrics produced were examined. For the wear resistance, the pilling performance was investigated by determining the number of 5 rounds. 2000, 5000, 8000, 11000 and 14000 round numbers were used in the test used for abrasion resistance. Finally, it was checked how many rounds occurred in the fabric. According to the results obtained, 65% recycled cotton and 35% cotton were used in the recycled blend, and the tear strength decreased and pilling properties increased.

1. INTRODUCTION

New raw material production continues every year in order to meet the need for dressing due to the increasing world population. New artificial fiber production techniques are being developed in laboratories by making use of artificial production techniques. While looking for ways to increase production, many studies are carried out to recycle the worn out, unusable textile materials that occur in consumption [1,2]. In this regard, there are many opinions about recycling or reuse in the textile industry on the recovery of textile waste. Recycle; It is the conversion of the product to be disposed of into a raw material for the formation of a different material or to improve its condition without being disposed of. In both cases, the concept of reuse also describes the use of the produced material in the same production chain [3,4].

In recycling techniques, if the raw material is a textile product produced from an artificial fiber, the use of recycling is easier and the production possibilities are many. For their recovery, it can be melted to make staple fiber and use it as a nonwoven surface [1,5]. While the fibers produced as nylon, polyester, polyurethane and polypropene are made by melting the recycling, care should be taken to ensure that the polymer structure is not deteriorated. In this production, the recovery is evaluated in this way by producing a thicker number than the target number determined in this production [6].

It can be evaluated by reusing a product consisting of natural fibers by shredding and producing them according to the cut thickness in the weaving system [2,5]. In recycling, the color of the colored textile product is removed and there are recycling possibilities while it is white. This process causes great damage to the fabric and nature. Processing this process without discoloration causes less damage to the fiber [7,8].

In this study, it is aimed to investigate the effects of the tear and abrasion resistance and pilling performance of the plain fabric obtained by increasing the ratio of the recycled cotton in the blend.

2. MATERIALS AND METHODS

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The aim of this study is to determine the tearing and pilling performances of the product that occurs when the usage rate of cotton obtained from recycling in the blends prepared for yarn production increases. The properties of plain fabrics obtained from compact yarns used for production are given in Table 1.

Table 1. Technical Specifications of Fabrics

Sample	Sample 1 (1B)	Sample 2 (2B)
Fiber Composition	Recycled cotton 50% Natural cotton 50%	Recycled cotton 65% Natural cotton 35%
Weft Yarn Number	Ne 24 Compact Ring (Weft)	Ne 24 Compact Ring (Weft)
Warp Yarn Number	Ne 12 Compact Ring (Warp)	Ne 12 Compact Ring (Warp)
Yarn layers	Single	Single
Warp density	22	21
Weft density	32	34
Weft yarn Twist number (t / m)	552	535
Weft Yarn Twist Factor (αe)	3,5	3,5
Warp yarn Twist number (t / m)	795	741
Weft Yarn Twist Factor (αe))	4,5	4,5
Weight	178	185
Fabric width (cm))	165	165

These two fabrics produced were coded as 1B for fabric 1 and as 2B for fabric 2. Desizing process was applied to both fabrics produced under laboratory temperature 20 °C relative humidity 65% conditions. The fabrics were treated with a solution containing 2.2 g/L nonionic wetting agent, 1.4 g/L enzyme, 2.3 g/L salt and 0.7 g/L CaCl2 at 70 °C by impregnation method in 2 hours. In the second process, desizing was done by rinsing at 40 °C for 15 minutes and with cold water for 15 minutes.

It has been measured with TS EN ISO 13937-1 and TS EN ISO 13937-1 standards for fabric tear strength, abrasion resistance and pilling performances. Tear strength tests were performed on Elma Tear Digital Tear Strength Meter. The abrasion resistance tests of the fabric were measured on the Martindale Abrasion and Pilling Meter. The tour numbers used in this device are 2000, 5000, 8000, 11000 and 14000 tour numbers.

For both fabrics, he continued to work until a hole appeared on the fabric. Comparison of pilling values was made with standard photographs numbered from 1 to 5. Photo number 1 shows that the fabric has more pilling and photo number 5 shows less pilling. In order to evaluate the experimental results statistically, the value of 4-5 in the table was evaluated as 4.5, the value of 3-4 as 3.5, the value of 2-3 as 2.5, and the value of 1-2 as 1.5. Evaluation criteria are given in Table 2.

Table 2. Evaluation Grades by Beading Eye

Degree	Definition
5	No change
4	A slight fuzz
3	Moderate pilling and pilling
2	Significant fuzzing and prominent pilling
1	Intense surface pilling and pilling

3. RESULTS AND DISCUSSION

In the study, measurements were made with Elma Tear Digital Tear Strength measuring device in both the warp and weft directions of the two fabric samples created. Tear strength results of the tested fabric are given in Table 3.

Table 3. Tear Strength Test Results

Tear Strength (Newton)	**1B**		**2B**	
	Warp	**Weft**	**Warp**	**Weft**
1	8,19	8,88	8,09	7,47
2	8,02	8,81	7,52	6,42
3	8,23	8,97	7,52	6,52
4	8,38	9,76	7,71	7,37
5	8,36	8,88	7,62	6,63
6	8,57	10,10	7,81	6,84
7	8,51	9,73	7,81	6,52
8	8,53	9,95	7,52	7,26
9	9,14	10,12	7,34	6,73
10	8,98	9,95	6,77	6,63

As seen in Table 3, it was observed that both warp and weft directional tear strength values of fabric no. 2B, whose mixing ratio was increased in the blend, decreased. The tear strength test results in the warp direction are shown in Figure 1.

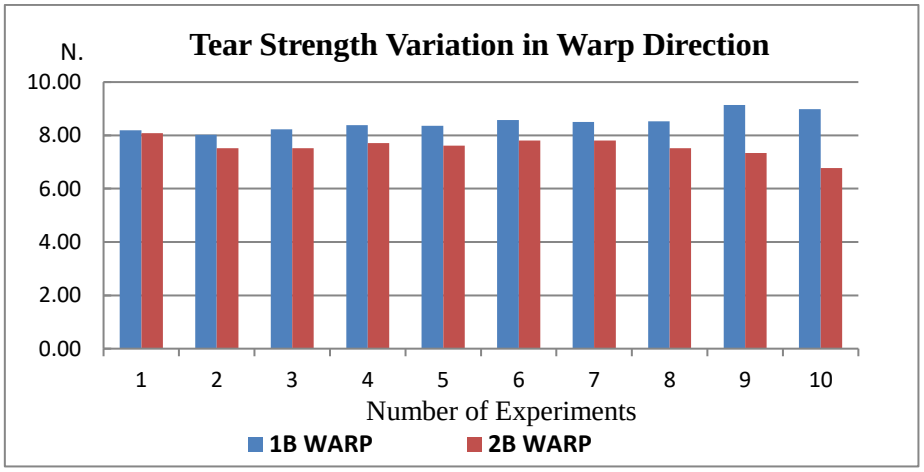

Fig 1. Tear Strength Variation in Warp Direction

The tear strength values of the 1B coded fabric in Figure 1 are the other 2B coded fabrics. It was observed that the tear values of the fabric were higher than the tear values. The excessive addition of the recycled cotton to the blend had a negative effect on the tear strength in the warp direction. In the tear strength test performed in the warp direction, the 1B coded fabric tear strength average was found to be 8.49 N and the standard deviation was 0.35. The average tear strength and standard deviation of the fabric no. 2B were found to be 7.57 N and 0.36. The tear strength values in the weft direction are shown in Figure 2.

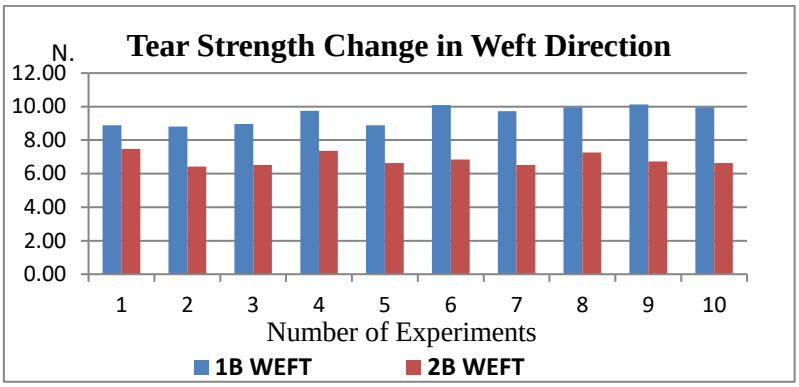

Fig 2. Tear Strength Variation in Weft Direction

In the tear strength test performed in the weft direction in Figure 2, the average of 1B coded fabric tear strength was found to be 9.51 N and the standard deviation was 0.56. The average tear strength and standard deviation of the fabric no. 2B were found to be 6.84 N and 0.38. The abrasion resistance and pilling values in various rounds in the experiment are given in Table 4.

Table 4. Abrasion Strength and Beading Test Results

Abrasion resistance (Number of Rounds)	2000		5000		8000		11000		14000	
Sample Code	1B	2B	1B	2B	1B	2B	1B	2B	1B	2B
1	4-5	4	3-4	3	3	2-3	2	1-2	1	1
2	4-5	4	3-4	3	3	2-3	2	1-2	1	1
3	4-5	4	3-4	3	3	2-3	2	1-2	1	1
4	4-5	4-5	3-4	3-4	2-3	3	2	1-2	1	1
5	4-5	3-4	3-4	3-4	2-3	2	2-3	1-2	1	1
6	4-5	4	3-4	3-4	2-3	2	2-3	1-2	1	1
7	4	4	3-4	3	2-3	2	2	1	1	1
8	5	4	3-4	3	2-3	2	2	1	1-2	1
9	5	4	3	3	3	2	2	1	1-2	1
10	5	4	3	3	2	2	2	1	1	1

It was observed that the pilling values evaluated using Table 2 increased by 0.5 units in direct proportion to the number of turns. If the number of turns is 11000 and 14000, it is seen that there is a noticeable difference in the fabric no. 2B. In the study, the machine was operated until holes were formed in the fabrics. Holes were formed in the fabric in an average of 16945 turns in 1B fabric and in an average of 1473 turns in 2B fabric. The graph of abrasion resistance and pilling values is shown in figure 3.

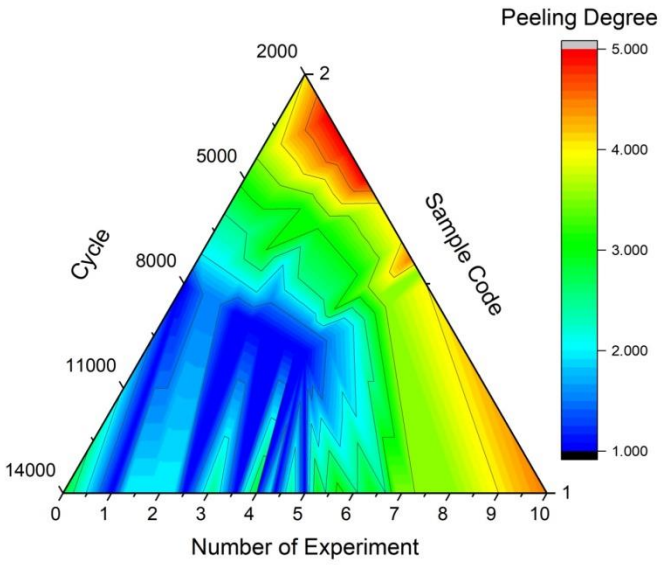

Fig 3. Abrasion Resistance and Pilling Performance Graph

The abrasion resistance of the fabrics is shown in red in the colored region, where the pilling is less. It is seen in the graph that the color distribution is more concentrated in 11000 and 14000, the number of rounds where pilling is high. The mixture ratios used in the chart show a positive outlook below 10000.

1B fabric abrasion resistance was determined as 4.5 at 2000 cycles, 3.5 at 5000 cycles, 2.5 at 8000 cycles, 2 at 11000 cycles and 1 at 14000 cycles. The 2B fabric abrasion resistance was determined as 4 in 2000 cycles of pilling, slightly above 3 in 5000 cycles, less than 2.5 in 8000 cycles, less than 1.5 in 11000 cycles, and 1 in 14000 cycles.

In the result evaluation, it is aimed to determine whether the recycled cotton fibers, which are aimed in the study, are used at a rate of 65% in the blend, can provide a positive improvement in tearing and abrasion resistance. In the experimental study, the average tear strength in the warp direction was 8,49N in the 1B coded fabric, although the number of the weft yarn was 9,51N, although the number of the weft yarn was thinner, it is seen that the density values of the fabric reflected positively here. In the 2B arm fabric, the number is the same, but the high rate of recycled cotton in the blend negatively affected the tear strength despite the high weft density of the fabric. By keeping the mixing ratio at this level, increasing the number of twists and the density ratio, which are among the parameters affecting the tear strength of the yarn, can be considered to carry out experiments that can positively reflect the tear strength. The plain fabrics produced are planned to be used in the field of health in the next stage. When the recovery rate is used excessively in the blend, the effect of other parameters can be investigated.

When the wear resistance and pilling values increased, an increase was observed in the 1B arm fabric at a rate of 0.5 units. In the 2B coded fabric, this is now almost 1 unit. Increasing the mixing ratio in the blend negatively affected the abrasion resistance. It is seen that the cottons obtained as recycled are damaged more in the shredding processes and as a result, the pilling value is high.

When the rate of recycled cotton used in the study increases, it is seen that the processes in which parameters such as fabric density, number of twists of the spindle or the use of ply yarn are effective on the tear and abrasion resistance of the fabrics. This negativity can be reduced by changing the physical properties of the yarn and fabric, as well as increasing the amount of recycled cotton in the blend blend amount.

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