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An Experimental Study About Sewability and Bending Strenght Properties of Cotton Fabrics

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Abstract

In this study; influence of selected physical properties of 100% cotton woven fabrics with different constructions on fabric sewability and bending strength properties were investigated. Sewability values of fabrics and needle penetration forces were tested by using L & M Sewability Tester. Weft and warp yarns of fabrics used in this study have the same yarn count (Ne50). Fabrics have same warp density (40 yarns/cm), three different of weft densities (26-30-34 yarns/cm). Different weaving structures like twill (2/2), panama (2/2) and plain were used. As a result of this study, it is proved that weaving structure and weft density of fabric are parameters effect sewability property of fabrics. The best sewability property obtained from the fabric which has panama weaving structure and the lowest weft density. The lowest bending strength value was obtained the fabric which has twill weave structure and lowest weft density.

Key Words: Cotton fabrics, Sewability, Needle penetration force, Bending strength

Pamuklu Kumaşların Dikilebilirlik ve Eğilme Dayanımı Özellikleri Üzerine Deneysel bir Çalışma

Özet

Bu çalışmanın amacı; farklı konstrüksiyona sahip %100 pamuklu dokuma kumaşların seçilmiş bazı fiziksel özelliklerinin kumaşın dikilebilirlik ve eğilme dayanımı özelliği üzerindeki etkisini araştırmaktır. İplik numaraları ve çözgü sıklıkları aynı olan kumaşların atkı sıklıkları ve örgü yapıları değişiklik göstermektedir. Kumaşların dikilebilirlik değerleri ve iğne batış kuvvetleri, L&M Dikilebilirlik Test Cihazı kullanılarak tespit edilmiştir. Çalışmada Ne 50 iplik numarasına sahip atkı ve çözgü iplikleri kullanılmıştır. Bezayağı, Dimi (2/2) olmak üzere üç farklı örgü yapısına sahip kumaşlar aynı çözgü sıklığına (40 tel/cm), üç farklı atkı sıklığına (26-30-34 tel/cm) sahiptir. Yapılan çalışma sonucunda kumaşın örgü yapısının ve atkı sıklığının kumaşın dikilebilirlik özelliğini etkileyen parametreler olduğu sonucuna varılmıştır. En iyi dikilebilirlik değeri; panama örgü yapısına ve en düşük atkı sıklığına sahip kumaşta elde edilmiştir. En düşük eğilme dayanımı ise; dimi örgü yapısına ve en düşük atkı sıklığına sahip kumaşta elde edilmiştir.

Anahtar Kelimeler: Pamuklu kumaş, Dikilebilirlik, İğne batış kuvveti, Eğilme dayanımı

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1. INTRODUCTION

Seam damage can be a serious cost problem, often showing only after the garment has been worn. The most important parameters that have an influence on seam damage tendency are fabric construction, chemical treatments of the fabric, needle thickness and sewing machine settings with sewing thread. Fibre content, yarn construction, tightness and density are important parameters for fabric construction on seam damage. Needle cutting or yarn severance occurs due to the stiffness of the fabric yarn and its lack of the mobility [1]. Some types of fabric faults in seaming may be attributed to the sewing needle. The greater force produced by the thrusting needle, the higher is the number of problems during sewing. This determines the fabric sewability. Studies on the sewability of knitted fabrics were undertaken by Leeming and Munden in 1973. These authors studied the factors affecting the thrusting of a sewing needle into a knitted fabric and its relationship to fabric sewability. As a result of their work, an apparatus for measuring sewability characteristics, the L & M Sewability Tester, was developed [2].

2. LITERATURE REVIEW

In previous studies, when warp and weft densities are high, it has seen that the porosity of the fabric decreases, fabric becomes denser, more yarns are either broken or separated by the sewing needle, so the needle penetration force increases [3]. Needle penetration forces increase due to structure plain, density of weft at (weft&warp) directions [4]. Sewability property of fabric was affected by weave structure and weft density of fabrics [5]. When compared the seam performance of 12 woven fabrics by means of seam strength, seam efficiency, seam pucker, seam slippage properties, and visual observations and express that generally twill fabrics show lower seam pucker values for all types of the test fabrics [6]. An experimental study was carried out to determine the effects of the selected sewing parameters in denim fabric on seam strength, and the results were analyzed. The type of sewing thread, stitches per cm, and number of sewing thread were found to have statistically significant effect on seam strength according to the results of t-test [7]. When sewing thread size, stitch density and seam allowance of a vertical plain seam on the cotton woven fabric increased, bending length, flexural rigidity and stiffness of fabric also increased. Therefore there is necessity to optimize the seam parameters such as sewing thread size, stitch density and seam allowance in order to decrease the stiffness of the fabric on the garment [8].

3. MATERIALS AND METHODS

3.1. Materials

Physical properties of 100% cotton woven fabrics with different constructions used in this study are given in Table 1.

Table 1. The properties of fabrics

Sample Code	Weave Structure	Weight (g/m^2)	Thickness (mm)	Yarn Count (Ne)		Yarn Density (yarn/cm)	
				Weft	Warp	Weft	Warp
1	Twill (2/2)	79,47	0,308	50	50	26	40
2	Twill (2/2)	84,83	0,304	50	50	30	40
3	Twill (2/2)	92,6	0,334	50	50	34	40
4	Panama (2/2)	79,63	0,304	50	50	26	40
5	Panama (2/2)	83,7	0,318	50	50	30	40
6	Panama (2/2)	89,53	0,318	50	50	34	40
7	Plain	81,13	0,246	50	50	26	40

3.2. Methods

All specimens were placed in the standard testing atmosphere for 24 hours before test. L&M Sewability Tester (Figure 1) draws a fabric test strip past a test head where a needle automatically makes a series of penetrations. This device measures the penetration force exerted by a sewing needle on the fabric [9]. Sewing thread is not used. An extensive research and development programme has shown excellent correlation between fabric sewability and the proportion of penetrations where the force is above some pre-established threshold level. For instance; if no more than 10% of penetrations exceed the threshold force, the fabric can be expected to sew well in practice. If the figure is above 20%, the fabric will be much more difficult or in some cases impossible to sew [10].

Figure 1. L & M Sewability tester [9]

Sewability test parameters are given in Table 2. Threshold level (gf) was adjusted according to the fabric weight.

Table 2. Sewability test parameters

Maximum Force Range(gf)	500
Threshold Level (gf)	50
Needle Penetration Count	100
Needle Number	90/14

The test to determine the “Stiffness of fabric” was carried out according to TS 1409 with using a stiffness tester. Test specimens were cut 25 by 150 mm (+/- 1). Four samples with the long direction parallel to the warp and four samples with the long direction parallel to the weft were cut. Four observations from each sample were taken. Sample was slid between P-Plane and S-Bolt (Figure 2). When it is aligned with observation lines (L1) and (L2), the length of overhang was read on S-Bolt as centimeter. Bending lengths of samples (Ca, Cç) were obtained using Equation (1). Warp and weft flexural rigidities (Ga, Gç) were calculated using Equation (2).

$$C = X / 2 \quad (1)$$

C = Bending length
X= The length of overhang, cm

$$G = 0{,}1 * W * C^3 \quad (2)$$

G = Flexural rigidity, mg.cm
W = Weight per unit area, g/m^2

Equation (3) was used to calculate the stiffness of fabrics.

$$Go = (Ga * G ç)^{1/2} \quad (3)$$

Go = Overall flexural rigidity,
G ç = Warp flexural rigidity
G a = Weft flexural rigidity

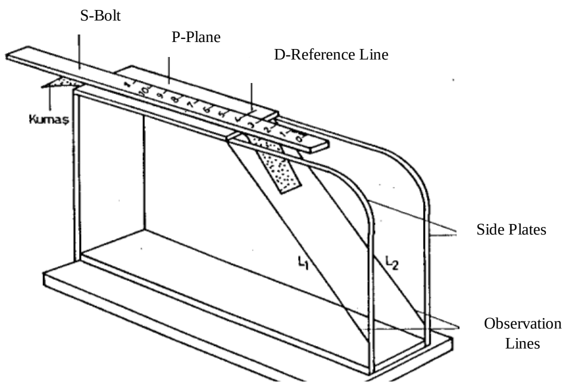


Figure 2. Bending strenght test device [11]

4. RESULTS AND DISCUSSION

4.1. Sewability Test Results

When sewability values range between 0 and 10%, the fabric sewability will be considered good; between 10% and 20%, even though no great difficulties arise during sewing, the sewability will be considered fair. When sewability values exceed 20%, then sewability will be considered poor [2].

Sewability test results of the samples used in this study are given in Table 3.

Table 3. Sewability test results

Sample Code	Weave Structure	Yarn Density (yarn/cm)		Needle Penetration Force (gf)		Sewability Value (%)	
		Weft	Warp	Weft	Warp	Weft	Warp
1	Twill (2/2)	26	40	11,1	10,9	0,1	0
2	Twill (2/2)	30	40	17,8	19,4	0,6	1,2
3	Twill (2/2)	34	40	23,2	24,3	2,8	2
4	Panama (2/2)	26	40	5,8	4,4	0	0
5	Panama (2/2)	30	40	8,7	7,5	0	0
6	Panama (2/2)	34	40	12,6	11,1	0	0,1
7	Plain	26	40	44,8	45,2	23	24,4

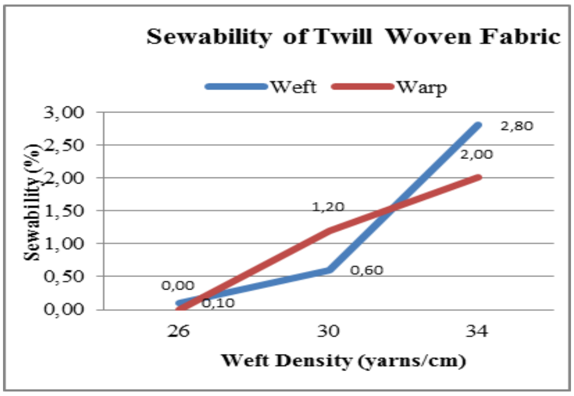
The influence of weft densities of twill woven fabrics on sewability value (%) and needle penetration force (gf) are shown in Figure 3.

It is seen that in Figure 3 when weft density of the twill fabric increases, needle penetration force of the fabric increases also. It means that sewability of fabric is hard. The influence of weft density of panama woven fabrics on sewability value (%) and needle penetration force (gf) are shown in Figure 4.

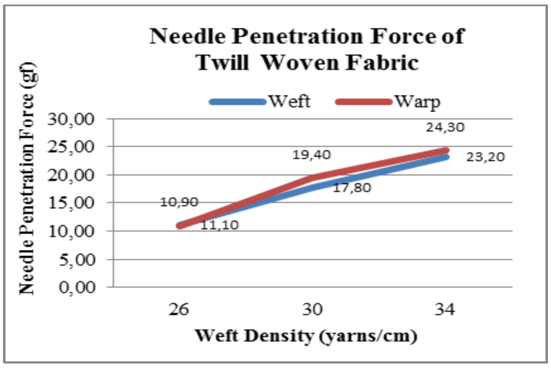
When weft density of the panama woven fabric increases, sewability of fabric is hard as shown in Figure 4.

4.2. Bending Strength Test Results

Bending strength test results of the samples used in this study are given in Table 4. The influence of weave structure of fabrics (which have 26 yarns per cm) on bending strength is shown in Figure 5.



(a)



(b)

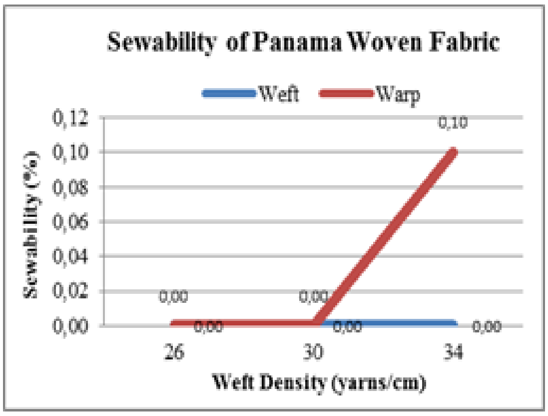
Figure 3. The influence of weft densities of twill woven fabrics; (a) sewability value (%), (b) needle penetration force (gf)

Plain woven fabric has maximum bending strength as shown in Figure 5. This is because of plain structure has more thread connections than the other weave structures. The influence of weft density of twill and panama woven fabrics on bending strength is shown in Figure 6.

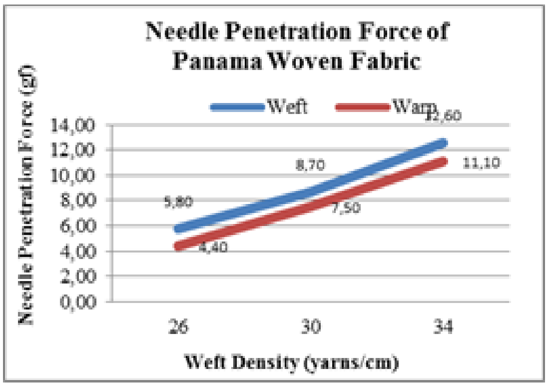
It is seen that in Figure 6 when weft density of the twill and panama fabrics increases, bending strength of the fabrics increases also.

5. CONCLUSION

In this study; influence of selected physical properties of 100% cotton woven fabrics with different constructions on fabric sewability and



(a)



(b)

Figure 4. The influence of weft density of panama woven fabrics: (a) sewability value (%), (b) needle penetration force (gf)

bending strength properties were investigated. The best sewability value was obtained from the fabric which has panama weave structure and lowest weft density. The lowest bending strength value was obtained from the fabric which has twill weave structure and lowest weft density. Plain woven fabric has maximum bending strength. This is because of plain structure has more thread connections than the other weave structures. As a result of this study; it was concluded that sewability property of fabric was affected by weave structure and weft density of fabrics. When weft density of the fabrics increased, fabrics had hard sewability and high bending strength.

Table 4. Bending strength test results **(**mg.cm)

Sample Code		The length of overhang Xa, Xç (cm)	Bending length Ca, Cç (cm)	Weft and Warp Flexural rigidity Ga, Gç (mg.cm)	Overall flexural rigidity (mg.cm)
1	Warp	2,23	1,11	10,99	8,91
	Weft	1,94	0,97	7,23	
2	Warp	2,28	1,14	12,54	10,22
	Weft	1,99	0,99	8,32	
3	Warp	2,35	1,18	15,02	12,92
	Weft	2,13	1,06	11,11	
4	Warp	2,32	1,16	12,46	10,22
	Weft	2,03	1,02	8,38	
5	Warp	2,28	1,14	12,37	10,37
	Weft	2,03	1,01	8,69	
6	Warp	2,39	1,20	15,29	12,56
	Weft	2,10	1,05	10,32	
7	Warp	2,47	1,23	15,26	11,94
	Weft	2,10	1,05	9,35	

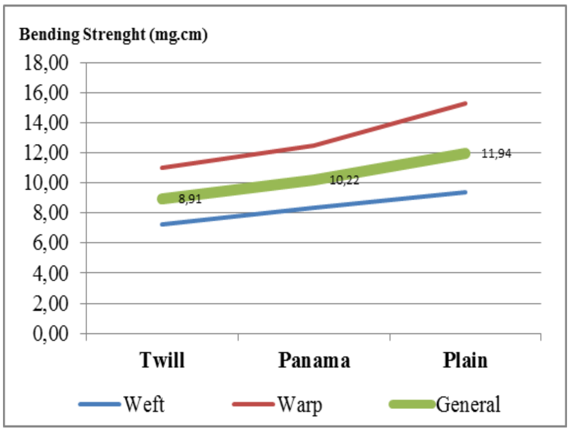
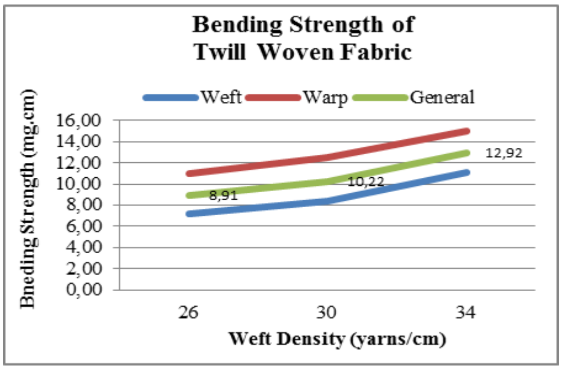


Figure 5. The influence of weave structure of fabrics (which have 26 yarns per cm) on bending strength



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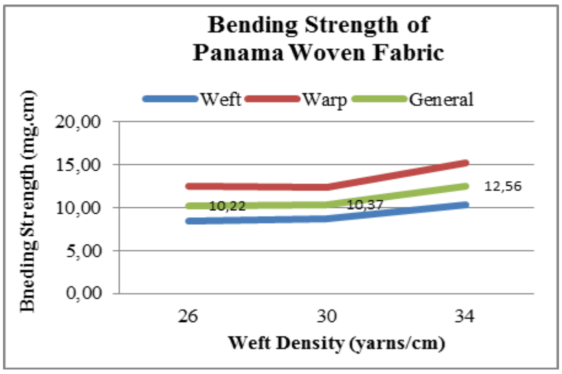

(b)

Figure 6. The influence of weft density of fabrics on bending strength; (a) twill woven fabric, (b) panama woven fabric

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