(REFEREED RESEARCH)

THE EFFECTS OF RAW MATERIAL, WEFT SETTING AND WEAVE ON THE BREAKING STRENGTH, ELONGATION AT BREAK AND TEAR STRENGTH OF UPHOLSTERY DOUBLE FABRICS

ÇİFT KATLI DÖŞEMELİK KUMAŞLARDA HAMMADDE, ATKI SIKLIĞI VE KUMAŞ KONSTRÜKSİYONUNUN KOPMA MUKAVEMETİ, KOPMA UZAMASI VE YIRTILMA MUKAVEMETİNE ETKİSİ

Hakan ÖZDEMİR[1*], Duygu YAVUZKASAP[2]

[1] Dokuz Eylül University, Department of Textile Engineering, İzmir, Turkey
[2] Ma-Ba Textile, İstanbul, Turkey

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ABSTRACT

The aim of this study is to investigate the effects of structural properties of yarn and fabric such as; raw materials, weft setting and fabric construction on the breaking strength, elongation at break and tear strength of upholstery double fabrics. For this purpose, double woven fabric samples with three different weft densities and of three different weave patterns with two types of warp and weft yarns, whose raw materials were different, were manufactured. The physical properties of woven fabric samples were determined by relevant tests. The effect of the fibre type, weft setting and weave pattern on the physical properties of upholstery fabrics were investigated by variance analysis by means of SPSS 15.0. Findings and evaluations of the study have been given in detail in the paper.

Key Words: Upholstery double fabrics, Physical properties of fabrics, Breaking strength, Elongation at break, Tear strength

ÖZET

Bu çalışmanın amacı hammadde, atkı sıklığı ve kumaş konstrüksiyonunun gibi iplik ve kumaş yapısal özelliklerinin çift katlı döşemelik kumaşların kopma mukavemeti, kopma uzaması ve yırtılma mukavemeti üzerine etkisini araştırmaktır. Bu amaçla iki farklı hammaddeden üretilen atkı ve çözgü iplikleri ile üç farklı atkı sıklığında, üç farklı doku tipinde dokunan çift katlı kumaş numuneleri dokunmuştur. Dokunan kumaş numunelerinin kopma mukavemeti, kopma uzama ve yırtılma mukavemeti özellikleri test edilmiştir. Hammadde, atkı sıklığı ve kumaş konstrüksiyonunun döşemelik kumaşların fiziksel özelliklerine etkisini araştırmak için SPSS 15.0 paket programı kullanılarak varyans analizi yapılmıştır. Çalışmanın bulguları ve değerlendirmeler makale içeriğinde detayları ile verilmektedir.

Anahtar Kelimeler: Çift katlı döşemelik kumaşlar, Kumaşların fiziksel özellikleri, Kopma mukavemeti, Kopma uzaması, Yırtılma mukavemeti

[*] **Corresponding Author:** Hakan Özdemir, h.ozdemir@deu.edu.tr, Tel:+ 90 232 412 77 36

1. INTRODUCTION

Fabric can be defined as a smooth surface and as a thin, elastic and strong structure, which consists of textile fibers. Fabric is a covering surface geometrically and also an elastic material mechanically (1).

Breaking strength, elongation at break and tear strength are general properties, which define fabrics. Breaking strength can be defined as maximum drawing force, which is recorded at the moment of elongation at break. Elongation at break can be described as percentage of sample elongation at break. Tear is a breaking of yarns or yarn groups, which are in fabric structure consecutively; on the other hand tear strength is a force, which resists to start and to continue a tear (2). Breaking strength, which shows the force required for breaking a lot number of yarns at the same time, is less affected from yarn and fabric parameters, however tear strength is much affected from variations in yarn and fabric structural characteristics.

There are studies, which investigate the breaking strength, elongation at break and tear strength of woven fabrics: Ünal and Taşkın (3) have measured the breaking strength along both warp and weft directions after laundering plain and twill woven polyester fabrics, which have different warp and weft densities. Breaking strength values of plain weaves have been higher than those of twill weaves with the same yarn settings. Breaking strength along weft direction has increased with the increase of weft setting. The same situation has occurred for breaking strength along warp direction.

Oğulata ve Kadem (4), (5) have woven plain and 2/2 twill fabric samples of %100 cotton at varied settings with dyed yarns, whose counts have been different. Breaking strength values along warp direction have been higher than those along weft direction. They have observed that breaking strength along both weft and warp directions have increased in accordance with weft and warp settings. However, they observed that tear strength along both weft and warp directions have decreased with the increase of weft and warp settings. And also, tear strength values of twill fabrics where floating yarns form groups have been higher than those of plain fabrics.

Şekerden and Çelik (6) have woven fabric samples, which have different weaves, with different types of wefts and weft settings. They have observed that effects of weft count and weft settings have been higher than the effect of weave on breaking strength of fabrics. And also tear strength values of fabric samples, whose weft settings have been high, have been lower than those of fabric samples, whose weft settings have been low.

The studies in literature have focused on single layer woven fabrics. The aim of the study (7) is to investigate the effects of raw material, weft setting and weave on the breaking strength, elongation at break and tear strength of upholstery double woven fabrics.

2. MATERIAL AND METHOD

2.1. Material

In this research 36 kinds of self-stitching double upholstery fabric samples, whose face weave have been 5s sateen, 10s sateen, 20s sateen and back weave have been 5s satin, have been produced in Mega Textile Industry and Trade Inc. by Dornier machine with rapier picking mechanism. 150 denier of filament PES yarn with twist of 160 tpm in S direction and of filament rayon yarn with twist of 500 tpm in S direction have been used as warp yarns. In addition to this, Ne 30/2 cotton yarn with twist of 710 tpm in S direction and Ne 30/2 staple fiber PES yarn with twist of 600 tpm in S direction have been planned as weft yarns. Warp settings fabric samples have been 66 cm^{-1}, weft settings of fabric samples have been 32, 35 and 38 cm^{-1}.

Cotton and polyester have been used as raw material of weft yarns so fabric samples have produced in raw color namely ecru. Fabric samples have been applied hard finishing process and passed from RAM, which has 8 sections, at the velocity of 25 m/min.

The technical properties of sample fabrics are introduced in Table 1.

Table 1. The technical properties of sample fabrics

Fabric Number	Fabric Code	Weft Setting	Raw Material of Warp	Raw Material of Weft	Face Weave
1	1111	32	Filament Polyester	Cotton	5s sateen
2	1112				10s sateen
3	1113				20s sateen
4	2111	35			5s sateen
5	2112				10s sateen
6	2113				20s sateen
7	3111	38			5s sateen
8	3112				10s sateen
9	3113				20s sateen
10	1121	32		Staple Fiber Polyester	5s sateen
11	1122				10s sateen
12	1123				20s sateen
13	2121	35			5s sateen
14	2122				10s sateen
15	2123				20s sateen
16	3121	38			5s sateen
17	3122				10s sateen
18	3123				20s sateen
19	1211	32	Rayon	Cotton	5s sateen
20	1212				10s sateen
21	1213				20s sateen
22	2211	35			5s sateen
23	2212				10s sateen
24	2213				20s sateen
25	3211	38			5s sateen
26	3212				10s sateen
27	3213				20s sateen
28	1221	32		Staple Fiber Polyester	5s sateen
29	1222				10s sateen
30	1223				20s sateen
31	2221	35			5s sateen
32	2222				10s sateen
33	2223				20s sateen
34	3221	38			5s sateen
35	3222				10s sateen
36	3223				20s sateen

2.2. Method

Breaking strength, elongation at break and tear strength tests have been conducted on the fabrics according to the features and methods of TS11818 EN 14465 Textile Upholstery Fabrics (8) in Physical Testing Laboratory of DEU Textile Engineering Department. The fabric samples have been conditioned at standard atmosphere conditions (20 ± 2 °C, %65 ± 2 relative humidity) for 24 hours.

Breaking strength and elongation at break values of fabric samples have been determined by stripe method according to TSE EN ISO 13934-1 (9). 5 numbers of pieces of 70×350 mm along both weft and warp directions have been cut and dimensions of the parts have been reduced to 50×350 mm by raveling yarns from long edges of samples. Samples have been pulled until break by Multipurpose Strength Tester, Instron 4411, at 100 mm/min. Measurement length has been 200 mm. Average values of breaking strength and elongation at break of samples have been calculated.

Tear strength of the upholstery fabric sample have been measured by single tear method according to TS EN ISO 13937-3 (10). 5 number of wing shaped fabric samples have been prepared along both weft and warp directions. Each sample has been torn until 25 mm has been left to the bottom edge at 100m/min, by Instron 4411 strength tester. The values of tear strength have been inferenced from force and distance graphics according to TS EN ISO 13937-3.

Test result for upholstery fabric samples have been evaluated statistically by Analysis of Variance (ANOVA) according the General Linear Model with SPSS 15. Significance degrees (p), which have been obtained from ANOVA, have been compared with significance level (α) of 0,05. The effects, whose significance degrees have been lower than 0,05, have been interpreted as statistically important.

3. FINDINGS AND STATISTICAL EVALUATIONS

The works conducted in this scope of the study have been evaluated in two groups: upholstery fabrics woven with polyester warps and with rayon warps. Breaking strengths of fabric samples woven with polyester warps are shown in Figure 1. It is observed that if weft density is increased, breaking strength along weft direction will increase. However it is seen that if sateen number of face weave is increased, breaking strength along weft direction will decrease. Breaking strengths along weft direction of samples woven with wefts of staple polyester yarn have been higher than those of samples woven with cotton wefts.

Results of ANOVA, which has been performed for breaking strengths of fabrics woven with polyester warps along warp and weft directions separately, are shown in Table 2. It can be concluded that effects of weft density and raw material of weft on breaking strength along warp and weft directions are statistically important at the significance level of 0,05. On the other hand, the effect of face weave on breaking strength along weft direction is statistically important at the significance level of 0,05.

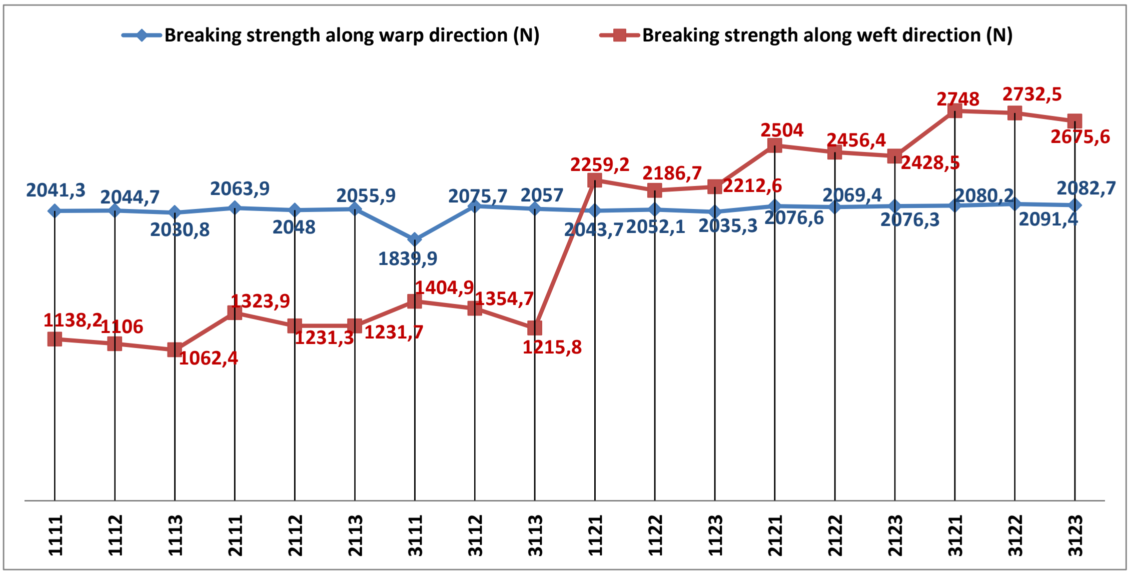


Figure 1. Breaking strength of fabric samples woven with polyester warps

Table 2. Results of ANOVA for breaking strength of fabrics woven with polyester warps

	along warp direction		along weft direction	
Source of Variance	**F**	**p**	**F**	**p**
Weft Setting	25.440	0,000	971.740	0,000
Raw Material of weft	17.103	0,000	34067.074	0,000
Face Weave	1.239	0.296	63.023	0,000

Breaking strengths of fabric samples woven with rayon warps are shown in Figure 2. It is observed that if sateen number of face weave is increased, breaking strength along warp direction will increase. Breaking strength along weft direction of samples woven with wefts of staple polyester yarn has been higher than those of samples woven with cotton wefts. While breaking strength along weft direction of samples woven with wefts of staple polyester yarn have increased in accordance with weft setting, this property has decreased in accordance with sateen number of face weave.

Results of ANOVA, which has been performed for breaking strengths of fabrics woven with rayon warps along warp and weft directions separately, are shown in Table 3. It can be concluded that while raw materials of weft have affected breaking strength along warp and weft directions, weft density and face weave only have affected breaking strength along weft direction, statistically (α = 0,05).

Elongations at break of fabric samples woven with polyester warps are shown in Figure 3. It is seen that elongations at break along warp direction of samples woven with wefts of staple polyester yarn have been higher than those of samples woven with cotton wefts. Elongations at break along warp direction are higher than elongations at break along weft direction.

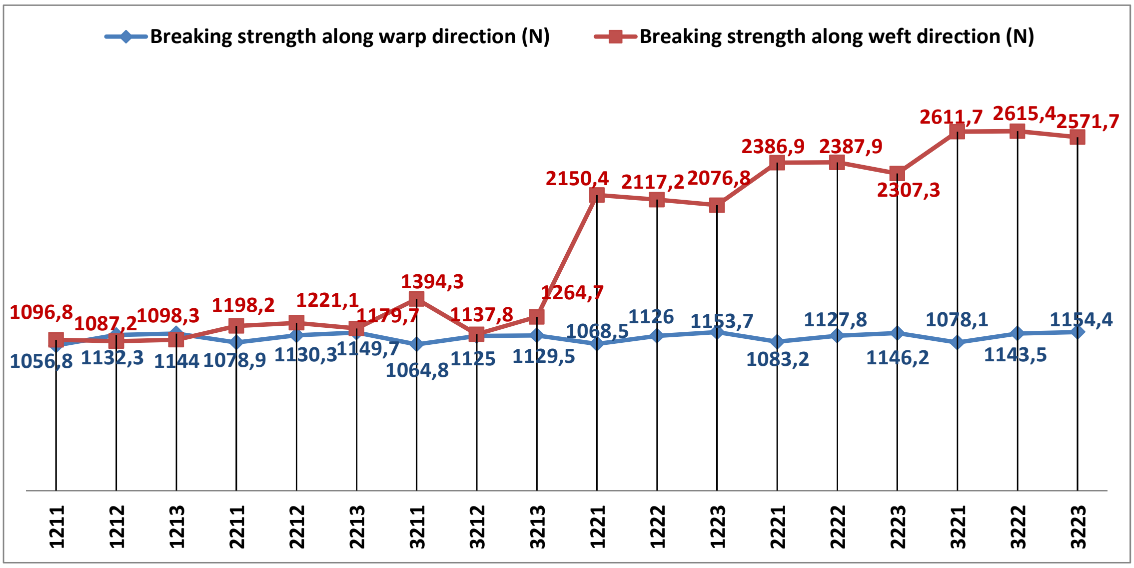


Figure 2. Breaking strength of fabric samples woven with rayon warps

Table 3. Results of ANOVA for breaking strength of fabrics woven with rayon warps

	along warp direction		along weft direction	
Source of Variance	**F**	**p**	**F**	**p**
Weft Setting	0.845	0.434	1174.157	0,000
Raw Material of weft	4.479	0,038	35625.133	0,000
Face Weave	2.481	0.091	137.449	0,000

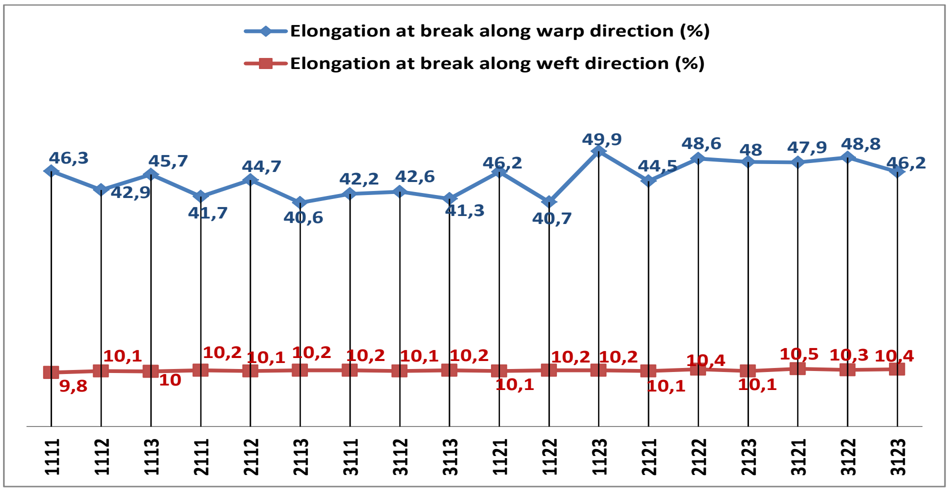


Figure 3. Elongation at break of fabric samples woven with polyester warps

Results of ANOVA, which has been performed for elongations at break of fabrics woven with polyester warps along warp and weft directions separately, are shown in Table 4. It can be concluded that effects of weft density, raw material of weft and face weave on elongation at break along warp and weft directions are statistically important at the significance level of 0,05.

Elongations at break of fabric samples woven with rayon warps are shown in Figure 4. It is observed that elongations at break along warp direction are higher than elongations at break along weft direction. Elongations at break along warp direction of samples woven with cotton wefts have been higher than those of samples woven with wefts of staple polyester yarn; however opposite is seen for elongations at break along weft direction.

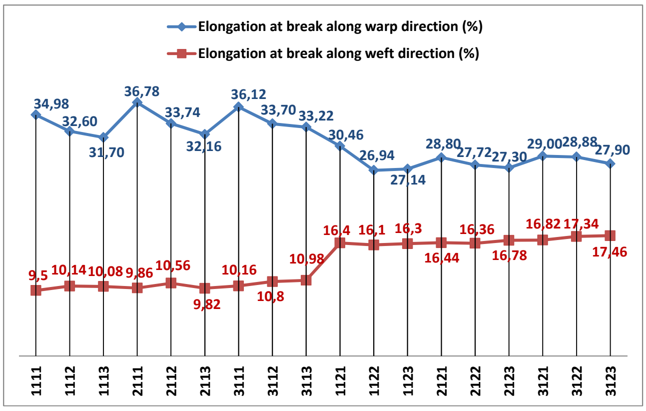
Results of ANOVA, which has been performed for elongations at break of fabrics woven with rayon warps along warp and weft directions separately, are shown in Table 5. It can be concluded that while weft density and raw materials of weft have affected elongations at break along warp and weft directions, face weave only have affected elongations at break along warp direction, statistically (α = 0,05).

Tear strengths of fabric samples woven with polyester warps are shown in Figure 5. It is seen that tear strength along weft direction has increased in accordance with sateen number of face weave. On the other hand, it is observed that tear strength along weft direction have decreased with increase in weft density. Tear strengths along warp direction of samples woven with wefts of staple polyester yarn have been higher than those of samples woven with cotton wefts.

Results of ANOVA, which has been performed for tear strengths of fabrics woven with polyester warps along warp and weft directions separately, are shown in Table 6. It can be concluded that effects of weft density, raw material of weft and face weave on tear strength along warp and weft directions are statistically important at the significance level of 0,05.

Table 4. Results of ANOVA for elongation at break of fabrics woven with polyester warps

	along warp direction		along weft direction	
Source of Variance	**F**	**p**	**F**	**p**
Weft Setting	21.305	0,000	16.351	0,000
Raw Material of weft	145.351	0,000	15573.660	0,000
Face Weave	170.121	0,000	13.767	0,000



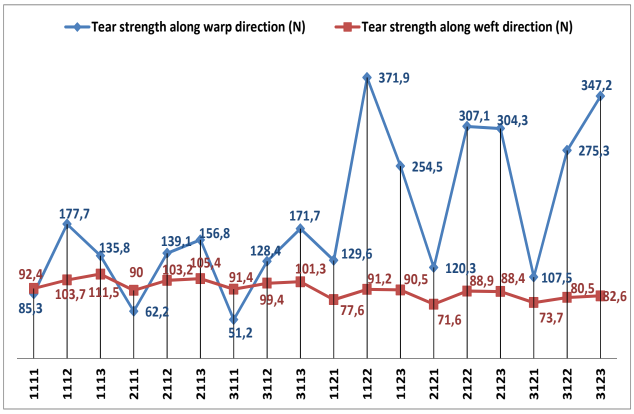


Figure 4. Elongation at break of fabric samples woven with rayon warps **Figure 5.** Tear strength of fabric samples woven with polyester warps

Table 5. Results of ANOVA for elongation at break of fabrics woven with rayon warps

	along warp direction		along weft direction	
Source of Variance	**F**	**p**	**F**	**p**
Weft Setting	6.889	0,002	86.012	0,000
Raw Material of weft	948.775	0,000	14135.720	0,000
Face Weave	4.747	0,012	1.137	0.326

Table 6. Results of ANOVA for tear strength of fabrics woven with polyester warps

	along warp direction		along weft direction	
Source of Variance	**F**	**p**	**F**	**p**
Weft Setting	20.701	0,000	60.652	0,000
Raw Material of weft	5267.888	0,000	1320.809	0,000
Face Weave	2943.181	0,000	337.170	0,000

Tear strengths of fabric samples woven with rayon warps are shown in Figure 6. It is observed that if sateen number of face weave is increased, tear strength along weft direction will increase. However, it is seen that tear strength along weft direction have decreased with increase in weft density. Tear strength along warp direction of samples woven with wefts of staple polyester yarn have been higher than those of samples woven with cotton wefts. And also tear strength along warp direction are higher than tear strength along weft direction.

Results of ANOVA, which has been performed for tear strengths of fabrics woven with rayon warps along warp and weft directions separately, are shown in Table 7. It can be concluded that while weft density and raw materials of weft have affected tear strength along warp and weft directions, face weave only have affected tear strength along weft direction statistically (α = 0,05).

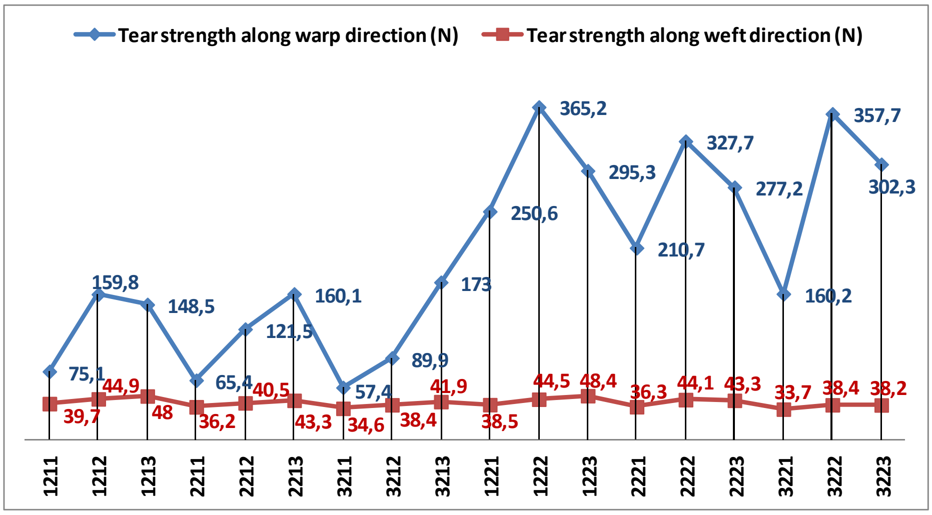


Figure 6. Tear strength of fabric samples woven with rayon warps

Table 7. Results of ANOVA for tear strength of fabrics woven with rayon warps

	along warp direction		along weft direction	
Source of Variance	**F**	**p**	**F**	**P**
Weft Setting	8.877	0,000	621.558	0,000
Raw Material of weft	955.022	0,000	468.414	0,000
Face Weave	1.125	0.330	474.024	0,000

4. DISCUSSION AND CONCLUSIONS

Face weave have effects, statistically significant for the significance level of 0,05, on the breaking strength of upholstery double fabrics along weft direction. Breaking strength along weft direction has decreased in agreement with increase in sateen number of face weave. This results from increase in the length of yarn floats, namely decrease in the density of yarn interlacing. Ünal and Taşkın (3) reached similar results for twill fabrics.

While face weave affects the elongation at break of upholstery double fabrics woven with polyester warps along both warp and weft directions, it affects those of fabrics woven with rayon warps only along warp direction, statistically (α = 0,05). Elongation at break values of upholstery double fabrics woven with rayon warps has decreased in accordance with increase in sateen number of face weave.

On the other hand, face weave affects the tear strength of upholstery double fabrics woven with polyester warps along both warp and weft directions; however it affects those of fabrics woven with rayon warps only along weft direction, statistically (α = 0,05). Tear strength of upholstery double fabrics has increased in agreement with increase in sateen number of face weave, because yarns slide and form groups in weaves, whose density of interlacing point are low, and so these weaves have high resistance against tear. Oğulata ve Kadem (5) obtained similar results for twill fabrics.

While weft setting has effect, statistically significant for the significance level of 0,05, on the breaking strength of upholstery double fabrics woven with polyester warps along both warp and weft directions; it has effect on those of upholstery double fabrics woven with rayon warps only along weft direction. Breaking strength along weft direction has decreased in accordance with increase in weft setting. Ünal and Taşkın (3), Oğulata and Kadem (4) reached same results.

Although there has been no regular effect of weft setting on the elongation at break of upholstery double fabrics, this effect is significant for the significance level of 0,05.

Weft setting affects the tear strength of upholstery double fabrics along both warp and weft directions statistically (α = 0,05). Tear strength of upholstery double fabrics has decreased in agreement with increase in weft setting, because yarns slide and are closed each other in fabrics, whose density is low, during tear strength test, and so these fabrics have high resistance against tear. Oğulata ve Kadem (5), Şekerden and Çelik (6) obtained same results.

Raw material of weft has effects, statistically significant for the significance level of 0,05, on the breaking strength of upholstery double fabrics along both warp and weft directions. Breaking strength of upholstery double fabrics woven with wefts of staple polyester yarn along weft direction has been higher than those of upholstery double fabrics woven with cotton weft yarns. This is probably due to the fact that the breaking strength of polyester fibers is higher than those of cotton fibers. The effect along warp direction results from that wefts of staple polyester yarn, which have been perpendicular to the applied force direction, have supported warp yarns more than does the cotton fibers in breaking strength test along warp direction.

And also, raw material of weft affects the elongation at break of upholstery double fabrics along both warp and weft directions, statistically (α = 0,05). Elongation at break of upholstery double fabrics woven with rayon warps and wefts of staple polyester yarn along weft direction has been higher than those of upholstery double fabrics woven with rayon warps and cotton weft yarns. This probably results from the fact that the elongation at break of polyester fibers is higher than those of cotton fibers.

Furthermore, raw material of weft affects the tear strength of upholstery double fabrics along both warp and weft directions statistically (α = 0,05). Tear strength of upholstery double fabrics woven with wefts of staple polyester yarn along warp direction has been higher than those of upholstery double fabrics woven with cotton weft yarns. This results from the fact that polyester fibers, whose breaking strength are higher than those of cotton fibers, resist to force applied in tear strength test along warp direction.

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T.C.

EGE ÜNİVERSİTESİ
MÜHENDİSLİK FAKÜLTESİ
TEKSTİL MÜHENDİSLİĞİ BÖLÜMÜ

TEKSTİL VE KONFEKSİYON SANAYİCİLERİNE AÇIK DAVET

Türkiye'nin ilk ve en gelişmiş altyapısına sahip Tekstil Mühendisliği Bölümü olan Ege Üniversitesi Tekstil Mühendisliği Bölümü, Türk Tekstil ve Konfeksiyon Sanayi için bugüne kadar 3800'ün üzerinde tekstil mühendisi yetiştirmiş olup, buna ilaveten bu yıl da Tekstil Teknolojisi (İplik - Dokuma - Örme), Tekstil Kimyası - Terbiyesi ve Konfeksiyon opsiyonlarında her birinden 40'ar olmak üzere toplam 120 genç tekstil mühendisinin daha iş hayatına başlayacakları tahmin edilmektedir.

En iyi şekilde yetiştirmek için gayret gösterdiğimiz tekstil mühendislerini, tekstil ve konfeksiyon sanayicilerimizle buluşturmak ve tanıştırmak için 1997 yılında Üniversitemiz Tekstil ve Konfeksiyon Araştırma Uygulama Merkezi bünyesinde bir kariyer servisi kurulmuştur. Kurulduğu yıldan beri 15 yılı aşkın süredir görevini 12 ay boyunca kesintisiz olarak sürdürmekte olan servisimiz 2008 yılından itibaren Ege Tekstil Sanayici Danışmanlık Servisi olarak hizmet vermeye devam etmektedir. Ege Üniversitesi mezunu tekstil ve/veya konfeksiyon mühendisi istihdamını düşünen firmalar, aradıkları elemanlardan istedikleri özellikleri bu servise bildirdikleri takdirde, bu bilgiler duruma göre iş arayan eski mezunlarımıza veya mezun adaylarımıza duyurulmakta ve eleman arayan kuruluş ile iş arayan elemanın buluşması sağlanmaktadır. Bu kapsamda bu yıl da eleman arayan Firmalar adaylarımızla ilk mülakatlarını 09 Mayıs 2012 tarihi Çarşamba günü saat 10.00'da tanışma günümüzde yapabileceklerdir.

Sizlerden verilecek bu hizmet karşılığı sadece talep edilen, Ege Tekstil Sanayici Danışmanlık Servisi kanalı ile işe alacağınız elemanın bir maaşı kadar bir meblağın gönüllü olarak Ege Üniversitesi Tekstil ve Konfeksiyon Araştırma-Uygulama Merkezi Döner Sermaye İşletme Müdürlüğüne ödenmesidir. Bu meblağ, aynı amaçla vereceğiniz bir gazete ilanından çok daha düşük bir rakamdır. İlan ücretinden farklı olarak, arzu ettiğiniz gibi bir elemanın temin edilmediğinde, ödenmesi söz konusu değildir. Unutulmaması gereken bir husus da, bu hizmet karşılığı sağlanacak gelirin daha iyi eleman yetiştirilmesini ve daha iyi araştırma geliştirme, yayın, yayım (danışmanlık dahil) hizmetlerinin verilmesini sağlamak için kullanılarak size fazlasıyla geri döneceğidir.

Bu seneki adaylarımızdan firmanızda çalıştırmayı düşündükleriniz var ise, lütfen hangi görevler için kaçar tane ve hangi özelliklerde eleman istihdamını düşündüğünüzü, firmanızı tanıtıcı bilgileri ve tanışma gününe katılıp katılmayacağınızı en geç 30 Nisan 2012 tarihine kadar Ege Tekstil Sanayici Danışmanlık Servisi'ne bildirmenizi rica eder, işlerinizde başarılar dilerim.

Saygılarımla

Prof. Dr. Hüseyin KADOĞLU
Bölüm Başkanı