(REFEREED RESEARCH)

ÇOCUK GİYSİLERİNDE KULLANILAN ASTARLIK KUMAŞLARIN PERFORMANS ÖZELLİKLERİNİN DEĞERLENDİRİLMESİ

EVALUATING PERFORMANCE CHARACTERISTICS OF LINING FABRICS USED FOR CHILDREN DRESSES

Zümrüt BAHADIR ÜNAL[1], Eda ACAR[1], Funda YILDIRIM[2]

[1]Ege University, Department of Textile Engineering, İzmir, Turkey
[2] E.U. Textile and Apparel Research and Application Center Testing Laboratories

Received: 23.02.2015 Accepted: 04.12.2015

ABSTRACT

Clothing comfort is defined as anatomic, physical and/or mechanic and psychological harmony of man with material. Wearing does not only affect the comfort of man but also his performance and effectiveness, too. Each material forming clothing is an important factor affecting the comfort. Lining fabrics as one of the functional part of the clothing are the first surfaces contacting with the human body. Under the heavy and rapid living conditions of our century, lining fabrics become very important for the clothing with comfort and coziness are dominant over elegance and panache in textile sector. Lining fabrics exposed to friction and tension with body movement has great importance in terms of comfort. In this study the fabrics used widely for special occasions are investigated. Physical and comfort properties of lining fabrics were evaluated with various tests. In conclusion the most suitable lining fabric and its properties were determined.

Keywords: Clothing Comfort, Lining Fabric, Children's Wear, Thermal Comfort, Physical Properties.

ÖZET

Giyim konforu; insanın anatomik, fiziksel ve/veya mekaniksel ve psikolojik olarak materyalle uyum içerisinde olması olarak tanımlanmaktadır. Giyen kişiye rahatlık sağlamasının yanı sıra aynı zamanda performans ve verimliliği üzerinde de etkisi bulunmaktadır. Giysiyi oluşturan her bir materyal, konforu etkileyen önemli bir parametredir. Giysinin işlevsel parçalarından birisi olan astarlık kumaşlar ise insan vücuduyla ilk temas eden yüzeylerdir. Yüzyılımızın ağır ve hızlı yaşam koşullarında, giyim sektöründe şıklığın ve gösterişin yerini konforun ve rahatlığın egemen olduğu giysilerin alması ile astarlar son derece önemli hale gelmiştir. İnsan vücudunun hareketleriyle birlikte sürtünme, gerilme gibi etkilere maruz kalan astarlar, konfor açısından çok büyük bir öneme sahiptir. Bu çalışmada; özel günlerde giyilen çocuk giysilerinin astarlanmasında yaygın olarak kullanılan kumaşlar araştırılmıştır. Bu kumaşlardan temin edilerek çeşitli testlerle fiziksel özellikleri ve konfor özellikleri değerlendirilmiştir. Sonuç olarak en konforlu astarlık kumaş önerisinde bulunulmuştur.

Anahtar Kelimeler: Giysi Konforu, Astarlık Kumaş, Çocuk Giysileri, Termal Konfor, Fiziksel Özellik.

Corresponding Author: Eda Acar, eda.acar@ege.edu.tr

1. INTRODUCTION

Wearing is inseparable part of human life. Wear undertakes a buffering task between human and the environment and plays an important role for a healthy life. Wearing in our days takes an important state for the children as well as adults. Parents desire the most beautiful and the healthiest one for their children. For this reason, it can be suggested that parents give more importance for their children rather than themselves. Desire for choosing the healthiest and harmless products of the families for their children who has more sensitive skin than the adults is extremely important. It can be stated that all these differences and quests increase the demand of parents on child products. At this point lining fabrics play important role for touching the skin on the subject of choosing wear for the children.

Comfort is related with physical properties owned by dresses or fabrics. Wearing comfort can be defined as satisfaction and feeling the balance of a person inside the dress and environmental conditions at that time with physiological, psychological and physical point of view and it

is an important factor considering the selection of a dress. Comfortable dresses have capability of protecting the body heat and moisture balance at different conditions and different activities. Nowadays it is a study area attracting both industrialists and researchers.

Lining as one of the functional parts of a dress is a material used for giving shape to dress, for providing comfort of use, and covering inner surface of dress with complex textures aiming to provide an aesthetic and smooth appearance. The most important features expected from lining fabrics are that they should provide the appearance of a dress aesthetically inside the dress without deforming functionality and comfort during its usage, that they should have the same performance qualities and that they should complete their life simultaneously with dress. It is expected that dimensions of the dress and lining should not be changed after the lining process. Good values for pilling resistance, abrasion resistance, and tensile strength, color and sweat perspiration fastness are also very important to the user (1).

According to the literature research there are many different studies directed to evaluation of performance characteristics and wearing comfort in many fields. However it was observed that studies directed specifically to lining fabrics of dresses for the children were very few. Kalaoğlu and Meriç investigated the effects of warp density, stitch structure, and weave type on lining fabrics at stitching performance. They measured stitch strength, bending behaviour and comfort properties (1). Stitch strenght and elongation were evaluated by using different stitching thread, different sewing needle and different sewing denseness in diagonal, warp and weft directions on 100% polyester lining fabric (2). Lining high thermal comfort properties for automobile upholstery are determined (3). Sewability properties of main lining fabrics by using the L&M Sewability Tester are observed with six different types of linings (4). Another research is mainly about the investigations related to the seam quality of lining fabrics differing in their structure and fiber composition (5).

100% cotton gray marl, 100% cotton, 85% cotton-15% polyamide mixture fabrics are provided and their physical and fastness values were studied with special bare finish techniques applied to these fabrics. According to test results, it was observed that a progress on comfort properties of military fabric texture was observed at the end of special finish techniques applied (6). Examining the relation between subjective comfort evaluation and objective measurable evaluation, comfort properties of fabrics with different material and structures were analyzed (7). In order to analyze performance and different comfort properties of dresses made up from woven fabric for the children at elementary school age, 6 different single jersey fabrics were used and test results were compared statistically. The most suitable one was recommended (8).

Different design approaches to enhance the thermal comfort, particularly in terms of body cooling were discussed (9). It was studied to develop a method for providing thermal comfort to be determined with objective methods as easy as possible. Thermal comfort is one of the main components of comfort which is taking more importance gradually for selection of individual wearing (10).

Comfort and thermoregulatory requirements in cold weather clothing (11), medical textiles and thermal comfort (12), characterizing comfort properties of flame resistant fabrics and garments (13), comfort properties of textile materials for the military are also tested and analyzed (14). Considering environmental conditions of track sport, properties of track clothes are evaluated based on fabric, suitability to body production techniques and model (15). Effects of sewing parameters of lining fabric of 100% polyester on sewing resistance was reviewed and conforming parameters for obtaining a resistant sewing are recommended (16). Thermal conductivity, thermal diffusivity, thermal resistance, moisture and air permeability, of Viloft/cotton and Viloft/polyester blended knitted fabrics were investigated (17).

As it is seen from the literature reviews there are numerous studies on the subject of performance properties of the material. However, it is clearly seen that lining fabrics which play an important role for the dress are not examined adequately. With this study fabric types used as lining for children dresses are determined first of all. In order to evaluate the physical and comfort properties of such fabrics, material types were designated and later some tests like texture type, denseness of yarn, fabric weight, thickness, tensile strength, air permeability, moisture permeability and tear strength were applied. According to the data acquired, lining fabrics which have the best comfort and physical properties were determined among the ones available in the market and widely used.

2. MATERIAL AND METHOD

In order to obtain the material of the study, lining fabrics used widely for children dress were determined with correspondence with companies manufacturing in this field. These fabrics were analyzed according to TS 11156 Standard for woven lining fabrics.

Furthermore, tests required for the study were performed by the instruments available in Ege University Textile and Apparel Research and Application Center.

Lining fabrics used in the study were subjected to different tests; air permeability, moisture permeability, porosity, tear strength and tensile strength besides their initial properties. Realization of tests with the number of samples, names of instruments and their standards were given below.

Fabric Construction

Texture types were determined with five test samples by a suitable magnifying glass.

Density

Density of the fabrics in waft and weft direction was determined according to TS 250 EN 1049-2: Method A on 5 test samples.

Weight per Unit Area

Square meter weights (g/m^2) of the used fabrics were performed with five test samples according to TS 251 standard. They were cut with grammage stencil having an area of 100 cm^2 and weighed in precision balance.

Figure 1. Grammage Tester

Thickness

Digital Thickness Gauge Modal M034A machine is used in this analysis. Thickness test was performed according to TS 7128 EN ISO 5084 by applying 200 grams of load at 20 cm^2 area for 10 test samples of each sample.

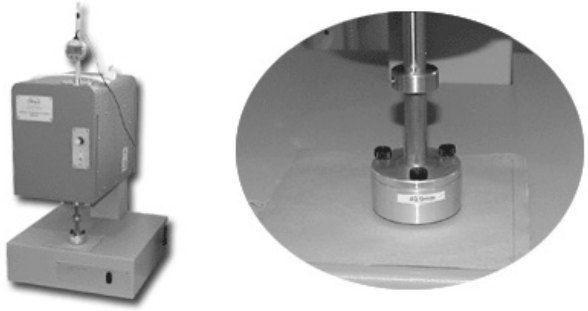

Figure 2. Digital Thickness Guage Modal M034A Tester

Porosity

The total porosity of the fabric has three components; intrafiber porosity, intrayarn porosity and interyarn porosity. Some structural parameters like yarn structure and knitting type have effects on porosity features (18). According to the equation given below, ρ_a (g/cm^3) and ρ_b (g/cm^3) represent the fabric and fibre density respectively (19).

$$\varepsilon = 1 - \frac{\rho a}{\rho b}$$

Tear Strength

Tear strength of fabrics was performed on 5 test samples according to TS EN ISO 13937-1 standard on Jeames Heal trademark Model Elmatear instrument by ballistic pendulum method.

Figure 3. Jeames Heal Elmatear Tear Strength Tester

Tensile Strength

Tensile strength tests of fabrics were performed with 5 test samples according to TS EN ISO 13934-1: band method by Zwick Z010 trademark Universal tensile test instrument; distance between jaws are 200 mm, velocity is 100 mm/min.

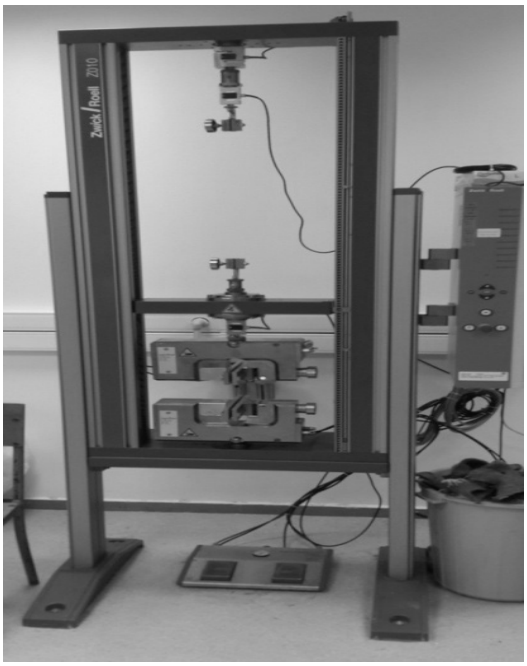

Figure 4. Zwick Z010 - Universal Tensile Strength Tester

Air Permeability

Measurements of air permeability of clothes were performed by Fx 3300 Air Permeability Instrument. According to TS 391 EN ISO 9237 for Air permeability test; for 10 test samples of each sample, 100 Pascal pressure difference at 20 cm^2 area were applied.

Figure 5. Textest AG - Air Permeability III Fx 3300 Tester

Moisture Transmission

Moisture transmission properties of the fabrics were measured with 5 test samples by MMT (Moisture Management Tester) instrument.

Properties measured with MMT test instrument can be listed as wetting time, absorption rate, maximum wetting diameter and spreading speed.

This instrument provides objective measurement of moisture transmission of fabric. The fabric is kept at horizontal position by top and low sensors under a certain pressure. A computer dynamically records resistance change between each pair of metal rings standing next to top and low sensors. During the period of 20 seconds of pumping, test solution of 0.15 grams is given to top surface of the fabric that is transmitted in three directions within a test period of 120 seconds. Liquid spreads from the point given from the top of the fabric surface to bottom, and from the bottom of the fabric to the sides and finally evaporates. Moisture management tester can be seen as follows (20).

Figure 6. SDL Atlas **-** Moisture Management Tester

Thermal Properties

Thermal properties of the fabrics was measured using ALAMBETA device. Various thermal comfort parameters of samples placed between the measurement plate can be measured in a short period. The temperature of the lower and upper plate are different. While top plate temperature is 33ºC, the bottom plate is 23° C.

Figure 7. ALAMBETA

Some parameters such as thermal absorbency, thermal conductivity, thermal resistance are measured with the help of the device (21).

3. FINDINGS

Initial properties of lining fabrics with different structures selected for tests were determined according to TS 11156 Standard. These fabrics and their properties were presented in Table 1.

Results of tests on the samples were given in the figures shown below.

Tear Strength

According to tear strength test results given in Figure 8, tear strength of the fabric was increased with the increased polyester content of the fabric. For 100% cotton fabrics tear strength was increased in direct proportion with density.

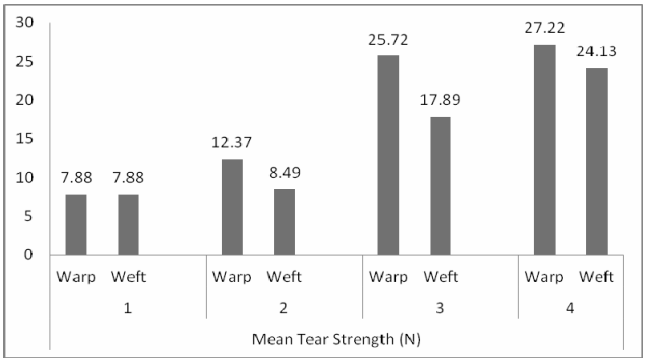

Figure 8. Test results measured by tear strength

Tensile Strength

According to tensile strength test results given in Figure 9, a direct proportion was observed between tensile strength of fabric and polyester content of the fabric. For 100% cotton fabrics tensile strength was increased in direct proportion with denseness.

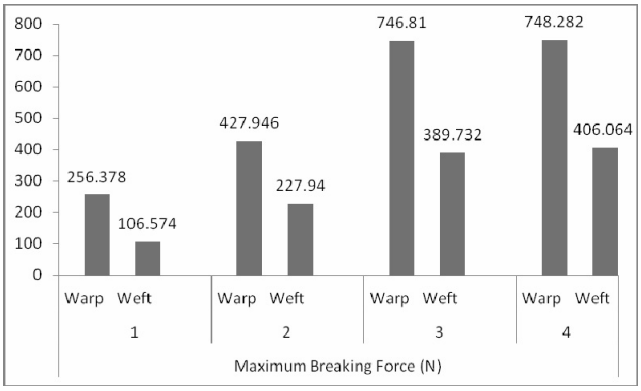

Figure 9. Test results measured by tensile strength

Table 1. Structural characteristics of lining fabrics used in testing

Fabric Number	Material Composition (%)	Fabric Construction	Warp yarn per cm (ends/cm)	Weft yarn per cm (picks/cm)	Weight per unit area (g/m^2)	Porosity (%)
1	Cotton 100%	1/1 Plain	21.7	18.2	57	80%
2	Cotton 100%	1/1 Plain	37.3	20.3	72	72%
3	Cotton 70 % Polyester 30%	1/1 Plain	42.4	30.8	106	71%
4	Polyester 100%	1/1 Plain	26.2	25.3	59	46%

Air Permeability

Results of air permeability tests applied to fabrics were given in Figure 10. It was observed that when the polyester content of fabric was increased, air permeability was decreased. For 100% cotton fabrics it was observed a decrease in air permeability depending on the increase of denseness.

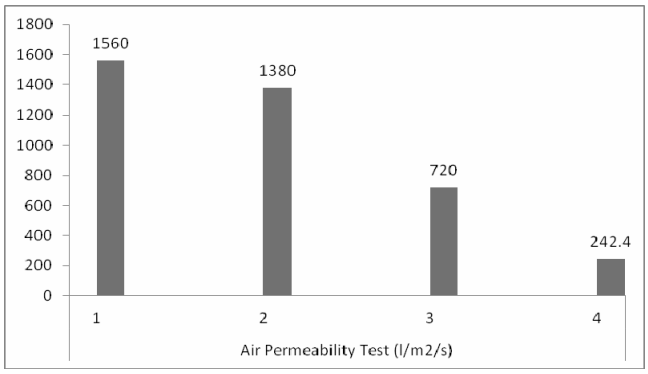

Figure 10. Test results measured by air permeability

Moisture Transmission

As shown in Figure 11, the highest moisture transmission was owned by fabric 1, open textured cotton fabric. The second one was fabric 2, cotton fabric followed by fabric 3 and fabric 4 respectively. Here it was seen that there were differences in moisture transmission depending on cotton amount and fabric volume.

Correlation analysis has been performed to evaluate the relationship between air permeability and moisture transmission test results by using SPSS 18.0 given in Table 2. Correlation coefficient is calculated as 0,996. According to the results this relationship is statistically significant ($p<0,05$) and there is a strong relationship between these two parameters.

According to the results in Table 3, Fabic 2 has the highest thermal conductivity value. Although fabric 1 and fabric 2 has the same material composition, fabric 2 has better conductivity since it is thinner. Thermal absorbency values show an increasing trend from fabric 1 to 4. Considering the results of thermal resistance, fabric 2 has the highest resistance value depending on the fabric material, thickness and density.

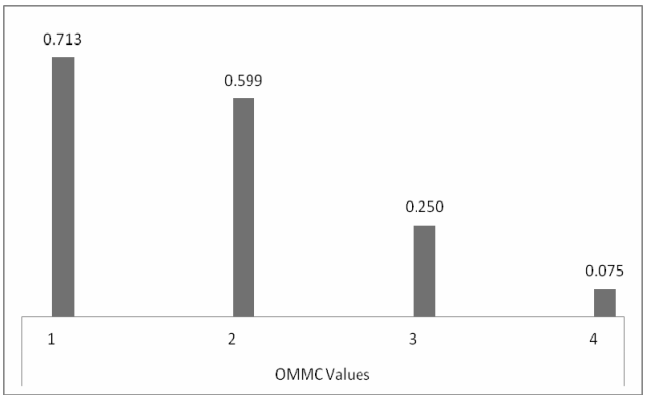

Figure 11. Test results measured by MMT tester

4. CONCLUSION

Since there is less fat layer is present in the skin structure of children than adults, protective layer is not fully developed against external factors. For this reason some fabrics may cause undesirable effects on the skin of children. In order to minimize this problem, families specially prefer dresses from cotton raw materials. Skin is an organ providing heat control covering a large area of the body. Therefore products with high absorbance must be preferred for the children having sensitive skin. However in some special days, athletes with cotton are not preferred since their appearance is not good. They are not preferred also because using them in special days of hot seasons creates generally a sense of excess and increases sweat. In this case it is necessary that dresses should create air conditioner for the skin.

Table 2. Correlation analysis of air permeability and moisture transmission

Correlations			
		Air permeability	Moisture transmission
Air permeability	Pearson Correlation	1	0.996
	Sig. (2-tailed)		0.004
	N	4	4
Moisture transmission	Pearson Correlation	0.996	1
	Sig. (2-tailed)	0.004	
	N	4	4

Thermal Conductivity, Absorption and Resistance Values

Table 3. Test results measured by ALAMBETA Tester

Fabric Number	Material Composition (%)	Conductivity (W/mK)	Thickness (mm)	Absorption (Ws½/m²K)	Resistance (m²K/W)
1	Cotton 100%	0.038	0.19	135	0.0063
2	Cotton 100%	0.044	0.17	140	0.0073
3	Cotton 70% Polyester 30%	0.042	0.25	147	0.0060
4	Polyester 100%	0.036	0.08	169	0.0038

Night dresses produced for girls generally put on directly over the skin. For these dresses generally synthetic and satin weave structure are preferred as the main fabric. Visual richness, brighter appearance in comparison with natural material, obtaining vivid color with painting process and capability to make various ornaments of such fabrics provide their selectivity. In fact some of them were made with materials used in wedding dresses. There is absolutely lining process during production stage of these dresses. The most important material providing comfort is lining since it is in contact with skin directly. The highly used linings used in production of children dresses were considered and evaluated in respect of comfort and physical properties. The children's dresses for special occasions are not used for a long time. However, most children are very energetic inherently. Therefore, the materials used in the children's dresses are required to be strength.

Tear and tensile strength tests showed similar results. It was observed that fabric 4 as the most resistant one since it contained synthetic raw material. Fabric 3 is a mixture of cotton and PES and had nearly the same resistance but it should be preferred since it contained cotton rather than fabric 4. Dresses put on special days have not been used for a long time since their name implies. For this reason resistance properties of such lining fabrics of such dresses can be ignored.

Children show less patience than adults against some discomforts. For this reason they should feel comfortable in clothes. Regarding air and moisture transmission of the fabrics, Number 1 fabric has the best properties since it is sparsely textured cotton fabric. Number 2 fabric is better than fabrics 3 and 4 with respect to comfort. High air and moisture permeability of fabric 1 and 2 provides them to be preferred as such dresses to be used for warmer climates. Thus, vapor when body temperature rises will be absorbed by the fabric and this makes children dryness feel. It was observed that as the synthetic fiber amount increases, performance properties showed differences. Tear and tensile strength has increased and air permeability and moisture transmission has decreased depending upon the increase of synthetic content of the fabric.

If it is necessary to make a preference among four fabrics, the most comfortable ones were 1 and 2. However since resistance values of fabric 1 are very low and its texture is sparse and ready-made dress manufacturing has difficulties in production, it is not much preferred for children night dress wearing. However it can be suggested that fabric 2 has advantages of cotton, becoming thin and light, also convenient to serial production; thus it is the most favorable fabric to be used as lining fabric in terms of comfort.

However, Fabric 3 has to be chosen especially if there is a better expectation from the product in terms of strength. Fabric 3 has natural and synthetic mixed structure and it reflects the best features of both raw materials.

It is a common fact that parents generally change their children’s evening dress with a comfortable one after a couple of hours. For the special days convenience of parents essentially depends on convenience of children. Wearing the clothes during the night depends on the comfort of it. Therefore, using natural raw materials and performance properties of lining take an important role.

REFERENCES

1. Kaloğlu, F., Meric, B., 2005, "Investigation of the Performance of Lining", *International Journal of Clothing Science and Technology,* pp: 171-178.
2. Çitoğlu, F., Yükseloğlu, T. E., et al., 2011, "Polyester Astarlik Kumaşta Dikiş Parametrelerinin Dikiş Mukavemetine Etkilerinin Incelenmesi." *Tekstil ve Konfeksiyon,* pp: 82-86.
3. Berber, R. Ö., Marmaralı, A., Ertekin, G., 2014, ‘‘Otomobil Döşemeliklerinde Yüksek Isıl Konfor Sağlayacak Sünger ve Astar Özelliklerinin Belirlenmesi’’. XIIIth International Izmir Textile and Apparel Symposium, pp: 320-326.
4. Pamuk, O., Kurtoğlu, Ö., Tama, D., Öndoğan, Z., 2011, ‘‘Sewability Properties of Lining Fabrics’’, Journal of Textile & Apparel/Tekstil ve Konfeksiyon, 21(3).
5. Bačkauskaitė, D., and Daukantienė, V., 2008, Tensional Behaviour of Seamed Lining Fabrics Book of Proceeding of the 4th International Textile. In Clothing & Design Conference pp: 05-08.
6. Bilgi, M., and Kalaoğlu F., 2010 "Özel Apre Tekniklerinin Askeri Kumaşların Performans ve Konforu Üzerindeki Etkileri", *Tekstil ve Konfeksiyon*, pp: 20-4.
7. Yüksel, H. G., 2011, "Subjektif Konfor Değerlendirmeleri ile Laboratuvar Testleri Arasindaki İlişkiler".
8. Özdil, N., Ünal, B. Z., Süpüren, M. G., Boz, S., 2014, "Properties of The Knitted Upper Clothes Used By Primary School Children". *Industria Textila,* pp: 287-293.
9. Song, G., 2011, "*Improving Comfort in Clothing*", pp: 165–181.
10. Kaplan, S., 2009, “Kumaşların Mekanik Özelliklerinden ve Geçirgenlik Özelliklerinden Yararlanılarak Giysi Konforunun Tahminlenmesi”, İzmir.
11. Williams, J. T., 2009, *Textiles for Cold Weather Apparel*, pp: 3–18.
12. Bartels, V., 2011, *Handbook of Medical Textiles*. Elsevier”, pp: 198-218.
13. Rossi, R., 2013, "Characterizing comfort properties of flame resistant fabrics and garments", *Handbook of Fire Resistant Textiles*, pp: 415-433.
14. Wilusz, E., 2008, *Military Textiles*, Elsevier, pp: 107-136.
15. Kurtoğlu, N. Ö., Tama, D., Öndoğan, Z., 2014, "Atletizm Giysilerinin Özellikleri", XIII. Uluslararası İzmir Tekstil ve Hazır Giyim Sempozyumu, pp: 300-305.
16. Kuyucu, Y. A., 2009, "Astarlık Kumaşlarda Dikiş Parametrelerinin Dikiş Mukavemetine Etkilerinin İncelenmesi", Yüksek Lisans Tezi, Tekstil Eğitimi Anabilim Dalı, İstanbul.
17. Demiryürek, O., Uysaltürk, D., 2013, "Thermal Comfort Properties Of Viloft / Cotton and Viloft / Polyester Blended Knitted Fabrics", *Textile Research Journal*.
18. Turan, R. B., Okur, A., 2008, "Kumaşlarda Hava Geçirgenliği", *Tekstil ve Mühendis*, pp: 16-25.
19. Çay, A., Atav, R., Duran, K., 2007, "Effects of Warp-Weft Density Variation and Fabric Porosity of the Cotton Fabrics on their Color in Reactive Dyeing", *Fibres & Textiles in Eastern Europe*, pp: 91-94.
20. Özdil, N., Süpüren, G., Özçelik, G., 2009, "Farklı Materyallerden Üretilen Örme Kumaşların Çok Yönlü Nem İletim Özellikleri (Bölüm 1)", *Tekstil Teknoloji*, pp: 172- 186.
21. Özdil, N., 2008, ‘‘A Study on Thermal Comfort Properties of the Socks’’, *Tekstil ve Konfeksiyon Dergisi,* pp: 154-158.