Effect of coating ratio and weft density on some physical properties of upholstery fabrics

DOI: 10.35530/IT.070.04.1695

GIZEM KARAKAN GÜNAYDIN

REZUMAT – ABSTRACT

Influenţa raportului de acoperire și a desimii în bătătură asupra proprietăților fizice ale țesăturilor pentru tapițerie

Această lucrare își propune să analizeze influenţa raportului de acoperire (g/m^2) și a desimii în bătătură (fire de bătăură/cm) asupra unor proprietăți fizico-mecanice ale țesăturilor acoperite, precum rezistenţă la abraziune, pilingul, permeabilitatea la aer și rezistenţa la alunecarea firelor la cusături în direcția urzelii și bătăturii. În acest studiu, au fost realizate țesături pentru tapițerie din 100% poliester la trei niveluri de desime în bătătură, cu 5, 7 și 9 fire de bătătură/cm pe mașina de țesut Dornier, cu aceeași desime a firelor de urzeală de 8 fire de urzeală/cm. Trei raporturi de acoperire au fost selectate de 30 g/m^2, 60 g/m^2 și 90 g/m^2 pentru aplicarea substanței de acoperire cu spumă acrilică pe țesăturile pentru tapițerie. Au fost realizate 18 tipuri de țesături acoperite, în procese de producție controlate, iar jumătate dintre acestea au fost supuse unui proces suplimentar de interțesere, înainte de acoperire. Țesăturile pentru tapițerie cu legătură pânză au fost evaluate în ceea ce privește rezistenţa la abraziune, pilingul, permeabilitatea la aer și rezistenţa la alunecarea firelor la cusături în direcția urzelii și bătăturii. Conform rezultatelor testelor privind pilingul țesăturilor pentru tapițerie care au fost expuse numai procesului de acoperire, acestea au fost satisfăcătoare în comparație cu grupurile de țesături acoperite şi interțesute. Conform testului ANOVA în ambele sensuri, raportul de acoperire a fost un factor semnificativ pentru țesăturile acoperite, în timp ce raportul de acoperire, desimea în bătătură și interacțiunea acestora au fost factori nesemnificativi pentru țesăturile pentru tapițerie interțesute și acoperite, în ceea ce privește rezultatele rezistenței la abraziune si pierderea de masă a țesăturilor (%). Proprietățile de permeabilitate la aer și rezistenţa la alunecare a firelor la cusături în direcția bătăturii au fost semnificativ influenţate de desimea în bătătură, de raportul de acoperire și de interacțiunea acestora între grupurile de țesături acoperite interțesute. Desimea în bătătură a fost un factor nesemnificativ de 0,05 pentru valorile rezistenței la alunecare a firelor la cusături în direcția urzelii, între grupurile de țesături acoperite.

Cuvinte-cheie: desimea în bătătură, raportul de acoperire, țesătură pentru tapițerie, permeabilitatea la aer, rezistenţa la alunecarea firelor la cusături

Effect of coating ratio and weft density on some physical properties of upholstery fabrics

This paper aims to examine the effects of coating ratio (g/m^2) and weft density (picks/cm) on some mechanical properties of coated fabrics such as abrasion, pilling, air permeability and seam slippage strength in warp and weft direction of fabrics. In this research, 100% Polyester upholstery fabrics were woven at three levels of weft density as 5, 7 and 9 picks/cm on Dornier weaving machine with the same warp density of 8 ends/cm. Three coating ratios were selected as 30 g/m^2, 60 g/m^2 and 90 g/m^2 for applying acrylic foam coating substance to the upholstery fabrics. 18 different coated fabrics were produced under controlled production processes where half of them were sent to an additional process of needle punching before coating and half of them were not. Plain type upholstery fabrics were evaluated in terms of abrasion, pilling grade, air permeability and seam slippage strength forces in warp and weft directions. According to test results, pilling results of upholstery fabrics which were exposed to only coating process were more satisfying comparing to coated needle punched fabric groups. According to two-way ANOVA test; coating ratio was a significant factor among the coated fabrics whereas coating ratio, weft density and their interaction were insignificant factors among the coated needle punched upholstery fabrics with respect to abrasion results in terms of fabrics' mass loss (%). Air permeability property, seam slippage strength in weft direction were significantly affected by the weft density, coating ratio and their interaction among the coated and coated needle punched fabric groups. Weft density was an insignificant factor for the seam slippage strength values in warp direction among the coated fabric groups at significance level of 0.05.

Keywords: weft density, coating ratio, upholstery fabric, air permeability, seam slippage

INTRODUCTION

Discovery of resin and polymeric materials and the developments in the chemical industry resulted in new products with different properties and usage areas. It is aimed to add the chemical finish to fabric in coating while the purpose is to join two textiles into one structure with the chemical adhesive in lamination. Coated or laminated fabrics have several end-uses such as aggrotech, hometech, medtech, protective clothes... etc. Knitted and non-woven structures are especially useful for coating and laminating but when strength and dimensional stability are required, woven fabrics are preferred. Coating and lamination technology provides products for automotive air bags, footwear, interlinings, upholstery, hats, labels, umbrellas, adhesive tapes, rainwear, protective clothing, artificial leather articles, window blinds, tents, sleeping bags, curtains, floor coverings, luggage, sails, mattress ticking, flexible fuel tanks, abrasive products, filter fabrics, geotextiles, hoses and many others. Fabric plays a major role for the final properties of the finished product. Yarn construction and fabric formation are influential factors in addition to chemical and physical properties of fibres. Fabric structure determines the degree of textile-finish interbonding as well as the final mechanical properties of the treated material. The chemicals used for coating and laminating are polymeric materials of natural or synthetic. These include natural and synthetic rubbers, polyvinyl chloride, polyvinyl alcohol, acrylic, phenolic resins, polyurethanes, silicones, fluoro chemicals, epoxy resins and polyesters. Additive formulations such as UV radiation, heat stabilizers, antioxidants, fillers to improve mechanical properties, fillers for cost management, FR chemicals, reinforcement fibres, and pigments may be applied to the fabric substrate in order to provide further features. There are different coating methods such as immersion coating, knife coating, transfer coating, kiss-roll rotating, metering road coating, gravure roll coating, screen coating, and curtain coating [1–4].

Rotary screen coating which will be mentioned in our experimental work below is the deposition of a coating material on a substrate through a mesh screen by squeezing [2]. The amount of coating (claimed between 5 and 500 g/m^2) is controlled by the screen mesh number, squeeze pressure, the angle between the squeeze blade and the screen and the viscosity of the coating fluid. An array of dots is pushed through the perforated screen by the squeegee bar inside the screen and by centrifugal force onto the fabric [1].

There are some early studies related to effect of coating process on some fabric properties. Wan and Stylios made a study related to effect of coating process on surface roughness of coated fabrics measured by Kawabata Evaluation System. The treatment temperature, gap spacing, coating speed and viscosity of the coating paste were selected for process parameters to be changed. Low surface roughness for coated fabrics could be obtained with the appropriate process parameters [5]. Some scholars also concluded that surface roughness is directly proportional with the coating thickness [6–7]. Twill weave cotton fabric that was coated with zinc oxide layer was investigated in terms of thermal comfort properties by using Permetest instrument [8]. Polyurethane (PU) and polyurethane/silicone (PU/silicone) coated fabrics were produced and the effects of coating parameters such as coating material, coating technique and production parameters on sewing performance of the coated fabrics were analysed in another study [9]. Effects of same coating process parameters on two type cotton-based fabrics were investigated in order to evaluate some mechanical properties of the coated fabrics such as breaking strength, tearing strength, bursting strength and bending rigidity [10].

Apart from the early studies, foam technology was preferred in our study during coating instead of the wet processes where the reagent was applied to the fabric in the foam form in contrast to the conventional processes [11]. Foams applied in textile are generally dispersion foams which are produced by the introduction and mixing of gas from an external source into a liquid phase containing a surface-active agent as the foaming agent. Before the coating process, upholstery producers propose “needle punching process” in order to improve the seam slippage strength of coated upholstery fabrics. This process provides a fabric surface with protruding fibres. Since the casual influence of some processing parameters such as weft density, coating ratio (g/m^2) is still not well understood, this research aims to contribute to the literature by investigating effect of coating ratio and weft density on abrasion, pilling, air permeability and seam slippage strength of the upholstery fabrics and also the effect of additional needle punching process before acrylic polymer foam coating.

MATERIAL AND METHOD

The same yarn of 1000 denier/516 filament air textured polyester was used as warp and weft yarns of upholstery fabrics. The plain woven fabrics having warp density of 8 warps/cm and weft densities of 5–7–9 wefts/cm were woven on Dornier brand industrial weaving machine. After weaving process, half of the samples were sent to Dilo needle punching machine with 12 penetrations and 180 punch/cm^2 stroke frequency after weaving process. Needle punching was applied along the one side of woven fabrics. After needle punching process, all samples were foam coated with the acrylic binder ORGAL HC 50 FF by using Stork rotary screen machine (figure 1, *a*). A foam generator was used in order to apply the foam via a “closed” squeegee using wet add-on (figure 1, *b*). Three different coating ratios were selected as 30 g/m^2, 60 g/m^2 and 90 g/m^2 in order to observe the

a

b

Fig. 1. *a* – fabric coating with rotary screen technique; *b* – foam generator

Table 1

EXPERIMENTAL DESIGN					
Fabric code	**Fabric weight (g/m^2)**	**Warp density (thread/cm)**	**Weft density (thread/cm)**	**Coating ratio (g/m^2)**	**Process**
C530	166.5	8	5	30	foam coating
C560	180	8	5	60	
C590	221	8	5	90	
C730	192.7	8	7	30	
C760	212	8	7	60	
C790	234.5	8	7	90	
C930	212.7	8	9	30	
C960	240	8	9	60	
C990	258.8	8	9	90	
NC530	167.8	8	5	30	needle punching + foam coating
NC560	189	8	5	60	
NC590	199.2	8	5	90	
NC730	197.9	8	7	30	
NC760	219.5	8	7	60	
NC790	219.7	8	7	90	
NC930	223.7	8	9	30	
NC960	248.7	8	9	60	
NC990	249.5	8	9	90	

effect of coating substrate amount on the woven fabrics' properties of pilling, abrasion, air permeability and sewing slippage strength. Coating speed in the machine was kept constant at 20 m/min for all woven fabrics. Afterwards, coated fabrics were sent to drying at 125°C for 54 seconds in Brückner Stenter. The experimental plan is indicated in table 1.

Prior to testing of abrasion, pilling, seam slippage strength of woven fabrics and air permeability tests, all fabrics were conditioned for 24 hours in standard atmospheric conditions (at the temperature of 21 ± 1 °C and relative humidity of 65 ± 2%). The abrasion resistances of the fabrics were tested with Martindale Abrasion Tester according to ISO 12947-3:1998 standard [12] where the mass loss is determined as the difference between the sample mass values before and after abrasion cycles of 40,000 with the nominal pressure of 12 kPa. The cycles in which the first yarn break occurrence were also tried to be determined. However, there was not any yarn breakdown until 200,000 cycles due to the high tensile properties of upholstery fabrics made of textured polyester yarn with high breaking forces [13–14]. Pilling tests were also conducted on the same Martindale test equipment according to standard of 12945-2: 2000. Three samples were tested for each fabric type on James Heal Martindale tester. The pilling properties of the samples were evaluated by comparing their visual appearance with standard photographs. Samples were rated on a scale of 1 to 5 (1 for the worst, 5 for the best) [14]. Air permeability of upholstery fabrics was measured in a 20 cm^2 test area at 200 Pa air pressure with test device of SDL ATLAS M021A according to EN ISO 9237 test standard [15]. Seam slippage is a kind of failure results from a yarn movement at either side of the seam creating a gap. The displacement of the yarns in fabric generates an opening in the fabric [16]. Rectangular specimens of 350 mm length and 100 mm width were prepared. 5 specimens (350*100) with their long sides parallel to the weft of the fabric for determining warp slippage and with their long sides parallel to the warp of the fabric for determining the weft slippage according to ISO 13936-1: 2004 test standard by using Testometric 5 kN device. The two force elongation curves were obtained from the unsewn and sewn sample and the force required to open the seam opening distance (3 mm) was determined by using the horizontal separation between the curves [17–18]

Statistical analyses

For interpreting the statistical significance of weft density and coating ratio on woven upholstery fabrics' properties such as abrasion in terms of mass loss (%), air permeability (mm/s) and seam slippage strength in warp direction and weft direction; Randomized two-direction ANOVA was performed. SNK tests were conducted for the comparison of means of fabric mass loss (%), air permeability (mm/sec) and seam slippage strength of the woven fabrics. The treatment levels in SNK tests were marked in accordance with the mean values and levels marked by different letter (a, b, c) indicating the significant differences. The significance level (α) selected for all statistical tests in the study is 0.05.

RESULTS AND DISCUSSION

Pilling and abrasion results

Pilling is caused by protruding fibres which entangle when a fabric is rubbed. The magnitude of the pilling depends upon the number and lengths of protruding fibres and the ease with which they can bend round one another [19]. Figure 2 illustrates the pilling values of upholstery fabrics after 5000 abrasion cycles. As it is observed there is not a prominent influence of weft density and the coating ratio (g/m^2) on the pilling value of the fabrics. However, the fabrics' pilling grades deteriorated regarding to application of needle punching process before coating process. This may be attributed to the increment of the yarn hairiness owing

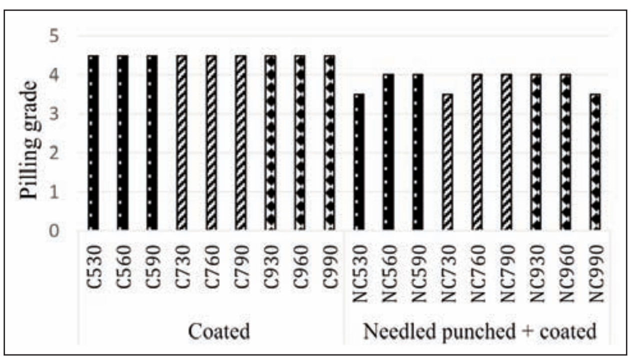

Fig. 2. Pilling grades

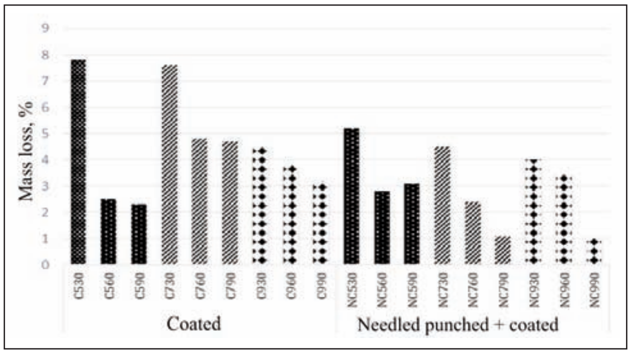

Fig. 3. Mass loss ratios (%) of the fabrics

Table 2

UNIVARIATE TWO DIRECTION ANOVA RESULTS FOR MASS LOSS (%)			
Physical property		**Mass losses of coated fabrics (%)**	**Mass losses of coated needle punched fabrics (%)**
Source		Sig.(p)	Sig.(p)
Main effect	weft density (D)	0.70	0.09
	coating ratio (R)	0.00*	0.15
Interaction	D*R	0.40	0.69

* Statistically important according to α = 0.05.

Table 3

EFFECT OF COATING RATIO ON MASS LOSS (%) STUDENT-NEWMAN-KEULS (SNK)		
Parameter		**Only coated fabrics**
Coating ratio (g/m^2)	30	4.50c
	60	4.07b
	90	2.44a

NOTE: The different letters next to the counts indicate that they are significantly different from each other at a significance level of 5 %.

to the filament breakages during fabric needling which results with high pilling tendency.

Diagram of mass losses of 18 different fabrics is presented in figure 3. According to figure 3, maximum mass loss ratio (7.8 %) was obtained from C530 fabric variant whereas the minimum mass loss ratio (1%) was obtained from NC990 fabric variant. In addition to this, there is a general decrement trend for the mass loss values of the fabric groups with the increased coating ratio. Needle-punching process slightly seems to be improving the abrasion properties of the fabrics in terms of mass losses (%). This may be attributed to better efficiency of coating process applied to the needle punched fabrics where the protruding fibres are strongly coated. There is not a prominent trend for the mass loss ratios (%) regarding to weft density considering all fabric groups.

Table 2 and table 3 indicate the ANOVA results and SNK results concerning the effect of coating ratio and weft density on mass loss of the fabrics. According to two-way completely randomized ANOVA (table 2), there were statistically significant differences (at significance level of 0.05) between the mass losses (%) of fabrics treated at different coating ratio (%) among the coated fabric groups without needle punching. However, weft density parameter, interaction of coating ratio (g/m^2) and weft density parameter were not significant factors for the mass loss ratios (%) of coated fabrics. Regarding to SNK test with respect to coating ratio (table 3), the highest mass loss (4.5%) was obtained from the coated fabric groups treated with 30 g/m^2 coating ratio whereas the lowest mass loss ratio (2.44%) was found among the fabrics treated with 90 g/m^2 coating ratio. This result may be attributed to the less yarn movement owing to the coating foam substance penetrating into the fabric resulting with lower mass loss (%). It is generally stated that the ability of a fibre and also yarn to withstand repeated distortion influence the abrasion resistance [20].

Air permeability results

Figure 4 indicates the air permeability measurement results of woven fabrics. It is observed that coated needled punched fabrics revealed lower air permeability values comparing to their counterparts of coated variants. It is also understood that as the weft density of the fabrics increased, air permeability of the woven fabrics decreased considering the both groups which were only coated and coated needle punched. When the effect of applied coating ratio is evaluated, air permeability of all upholstery fabrics prominently decreased as the coating ratio increased from 30 g/m^2 to 90 g/m^2. According to two-way ANOVA, weft density, coating ratio and their interaction significantly influenced the air permeability of all produced woven fabrics (table 4). SNK test results also indicated that fabrics produced with different weft density and treated with different coating ratio (g/m^2) possessed statically different air permeability values (table 5). Within the only coated fabric groups, the lowest air permeability value (1390.22 mm/s) was obtained from the fabrics coated with the amount of 90 g/m^2 acrylic binder whereas the highest value (1699.66 mm/s) was obtained from the coated fabric groups treated

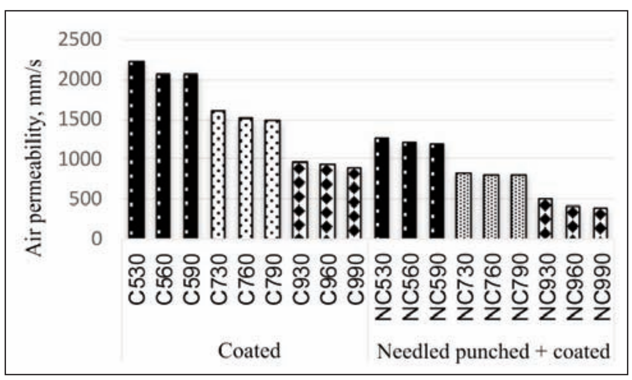

Fig. 4. Air permeability of the coated fabrics (mm/s)

Table 4

UNIVARIATE TWO DIRECTION ANOVA RESULTS FOR AIR PERMEABILITY			
Physical property		**Air permeability of coated fabrics**	**Air permeability of needle punched and coated fabrics**
Source		Sig.(p)	Sig.(p)
Main effect	weft density (D)	0.00*	0.00*
	coating ratio (R)	0.00*	0.00*
Interaction	D*R	0.00*	0.00*

* Statistically important according to α = 0.05.

Table 5

EFFECT OF COATING RATIO AND WEFT DENSITY ON AIR PERMEABILITY, STUDENT-NEWMAN-KEULS (SNK)			
Parameter		**Coated fabrics**	**Coated needle punched fabrics**
Coating ratio (g/m^2)	30	1699.66c	1025.6c
	60	1498.88b	864b
	90	1390.22a	803.3a
Weft density (D)	5	2220.77c	1319.55c
	7	1598.44b	863.44b
	9	971.55a	510a

NOTE: The different letters next to the counts indicate that they are significantly different from each other at a significance level of 5 %.

with coating ratio of 30 g/m^2. The same trend was observed among the coated needle punched fabric groups. It was also observed that needle punching process led to decrement of air permeability values of upholstery fabrics. Depending on the weft density, there is a decrement trend for the air permeability of the coated fabrics as the weft density increased. As a summary of SNK table (table 5), the air permeability decreased with the increase in amount of acrylic binder at a constant weft density while the air permeability decreased with the increase of weft density at a constant coating ratio.

Seam slippage strength

Upholstery fabrics hence the seams are constantly under different kinds of stresses in different directions [21]. Figure 5 indicates the seam slippage force in warp and weft direction. There is a clear increment trend for the seam slippage force in warp direction within the fabric groups of C530, C560, C590 and NC930, NC960, NC990 as the applied coating ratio (g/m^2) increased. Weft density increment generally resulted with better seam slippage results both in warp and weft directions (figure 5). Our result was also supported with Yıldırım et al.'s study in which the author established a non-linear regression model for the seam slippage values and emphasized that weft density played a major role in the seam slippage behaviour [22]. Additionally, two-way ANOVA test was performed in order to evaluate the effect of coating ratio (g/m^2) and weft density on the slippage strength values in warp and weft directions (table 6). Considering the coated fabric groups without needle punching process, coating ratio had significant effect on seam slippage strength (newton) in warp and weft directions at significance level of 0.05. However, weft density did not statistically influence the seam slippage strength in warp direction. Additionally, interaction of coating ratio and weft density had significant effect on the upholstery fabrics' seam slippage strength in warp and weft direction. Considering the coated needle punched fabrics, there was a significant difference of seam slippage values in warp and in weft direction of the fabrics produced at different weft densities and

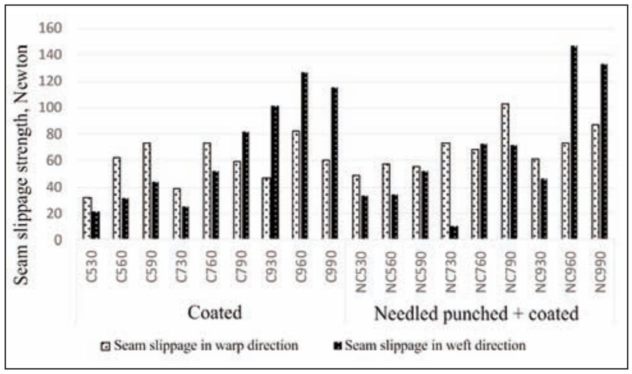

Fig. 5. Seam slippage force (Newton)

Table 6

UNIVARIATE TWO DIRECTION ANOVA RESULTS FOR SEAM SLIPPAGE STRENGTH					
Parameter		**Only coated fabrics**		**Coated needle punched fabrics**	
Source		Seam slippage strength in warp direction	Seam slippage strength in weft direction	Seam slippage strength in warp direction	Seam slippage strength in weft direction
		Sig.(p)	Sig.(p)	Sig.(p)	Sig.(p)
Main effect	weft density (D)	0.07	0.00*	0.00*	0.00*
	coating ratio (R)	0.00*	0.00*	0.00*	0.00*
Interaction	D*R	0.00*	0.00*	0.02*	0.00*

* Statistically important according to α = 0.05.

Table 7

SEAM SLIPPAGE STRENGTH, SNK RESULTS					
Parameter		Seam slippage strength in warp direction		Seam slippage strength in weft direction	
		Coated fabrics	Coated needle punched fabrics	Coated fabrics	Coated needle punched fabrics
Coating ratio (g/m^2)	30	39.03a	61.08a	49.17a	30.00a
	60	71.00b	66.33a	69.83b	83.75b
	90	64.41b	87.91b	86.58c	85.83b
Weft density (D)	5	55.75a	59.75a	32.08a	38.91a
	7	57.03a	81.41b	52.08b	51.83b
	9	63.16a	74.16b	94.50c	108.83c

NOTE: The different letters next to the counts indicate that they are significantly different from each other at a significance level of 5 %.

processed with different coating ratios. The interaction of coating ratio and weft density on fabrics' seam slippage strength in both directions was also statistically significant.

SNK test results in table 7 revealed that all produced fabrics processed with different coating ratios (g/m^2) possessed different seam slippage strength values in warp and weft direction at significance level of 0.05. Our results may be supported with Jankoska and Demboski's study where the authors confirmed that some of the fabric structural parameters such as weft density, weft yarn count and some special treatments were statistically significant factors on the seam opening results [23]. Within the coated fabric groups, when considering the seam slippage in warp direction, the lowest value was obtained in the fabrics processed with 30 gr/m^2 coating ratio while slippage strength values of fabric groups processed with 60 and 90 g/m^2 coating ratio were higher and in the same subset as at significance level of 0.05. It is also useful to emphasize that there is a clear improvement of seam slippage strength in the weft direction as the coating ratio increased. This result may be attributed to coating material penetrating into the fabric structure intercepting the yarn mobility [24]. Positive influence of weft density on seam slippage strength was more apparent for the seam slippage strength values in weft direction when comparing with the seam slippage strength values in warp direction. Our result was supported with Özdemir and Yavuzkasap's study where seam slippage strength of upholstery fabrics in weft wise increased with the weft density increment [25]. When the coated needle punched fabrics are evaluated; Increment of coating ratio (g/m^2) led to increment of seam strength in warp and weft wise. Seam slippage values in warp direction of the fabrics processed with 30 and 60 g/m^2 were in the same subset and lower than the seam slippage values of the fabrics processed with 90 g/m^2 coating ratio. Seam slippage values in weft direction of the fabric groups processed with 60 and 90 g/m^2 coating ratio were in the same subset and apparently higher than the seam slippage strength of fabric groups processed with 30 g/m^2 coating ratio. Increment of fabric weft density resulted with better seam slippage strength values especially in the weft direction.

CONCLUSION

Upholstery fabrics are the indispensable part of home textiles. The aim of this study was built on the investigation of effect of coating ratio (g/m^2) and weft density on abrasion, pilling, air permeability and seam slippage strength properties of upholstery fabrics considering the needle punching process. According to two directions ANOVA tests, weft density, coating ratio (g/m^2) and their interaction were insignificant factors for mass loss (%) of needle punched-coated fabrics. However, coating ratio was a significant factor for the mass loss (%) values among the fabrics treated to coating process without needle punching. Increment of coating ratio improved the abrasion results in terms of mass loss (%) among this group. Pilling results did not vary prominently regarding to weft density or coating ratio however coated needle punched upholstery fabrics had higher pilling tendency. Coated needle punched upholstery fabrics indicated lower air permeability results when compared with their coated counterparts. Coating ratio (g/m^2), weft density and their interaction significantly affected air permeability of all produced woven fabrics at significance level of 0.05. Lower air permeability values were obtained from the all types of produced fabrics as the coating ratio (g/m^2) and weft density increased.

According to test results, fabric structural parameters such as weft density and the coating ratio were thought to be influencing the seam slippage behaviour during deformation in the coated upholstery fabrics. Considering all fabric samples; Coating ratio, weft density and their interaction were significant factors on seam slippage strength forces in warp and weft wise except for in case. Weft density was not a significant factor for the seam slippage strength in warp wise among the coated fabric variants. Increment of weft density resulted with better seam slippage results in warp and weft direction among the whole fabric groups however the improvement was clearer for the seam slippage strength values in weft direction. Fabrics processed with higher coating ratio revealed better seam slippage strength values especially in the weft direction. It might be suggested to change some more coating process parameters such as coating speed, distance between knife and the rotary screen roller, paste viscosity and curing temperature for the evaluation of their influence on the woven upholstery fabrics' mechanical or comfort properties. This might be helpful for informing the suitable conditions for the most useful upholstery fabrics.

ACKNOWLEDGMENT

We wish to express our special thanks to Bülent ASLAN (production manager), Serkan ATAMAN, Bayram BAYSAL and all staff of TOSUNOĞLU Textile Company (Denizli, Turkey) for their technical support.

BIBLIOGRAPHY

[1] Singha, K. *A., Review on coating & lamination, in textiles: processes and applications*, In: American Journal of Polymer Science, 2012, *2*(3), pp. 39–49
[2] Schindler, W.D., Hauser, P. J., *Chemical finishing of textiles*, Elsevier, Textile Institute, Woodhead Publishing, 2004, ISBN 1855739054
[3] Fung, W, *Coated and Laminated Textiles*, Polymer Modified Textile Materials, New York, John Wiley and Sons, New York, 1988, pp. 50–58
[4] Smith, W.C. (Ed.), *Smart textile coatings and laminates*, ISBN: 9781845697785, Elsevier, 2010
[5] Wan, T., Stylios, G.K., *Effects of coating process on the surface roughness of coated fabrics*, In: The Journal of Textile Institute, 2017, 108(5), pp. 712–719
[6] Curran, J. A., Clyne, T.W., *Thermo-physical properties of plasma electrolytic oxide coatings on aluminium*, In: Surface and Coatings Technology, 2005, 199, pp. 168–176
[7] Parfenov, E.V., Yerokhin, A.L., Matthews, A., *Frequency response studies for the plasma electrolytic oxidation process*, In: Surface and Coatings Technology, 2007, 201, pp. 8661–8670
[8] Vedat, D., Ramazan, Ş., Lubos, H., Engin, A., Abdurrahim, Y., *Investigation of thermal comfort properties of zinc oxide coated woven cotton fabric,* In: The Journal of The Textile Institute, 2017, 108:3, pp. 337–340, DOI: 10.1080/00405000.2016.1166819
[9] Vildan, S., Cansu, M., Hülya, K., Yasemin, S., *A comparative study on seam performance of cotton and polyester woven fabrics*, In: Journal of the Textile Institute, 2015, 106:1, pp. 19–30
[10] Yasemin, B., Vildan, S., *Effects of process parameters on mechanical properties of coated fabrics*, In: International Journal of Clothing Science and Technology, 2011, 23, 4, pp. 205–221, https://doi.org/10.1108/09556221111136476
[11] Elbadawi, A. M., Pearson, J. S., *Foam technology in textile finishing*, In: Textile Progress, 2003, 33:4, pp. 1–31, DOI: 10.1080/00405160308688960
[12] ISO 12947-3: *Textiles. Determination of the abrasion resistance of fabrics by the Martindale method – Part 3: Determination of mass loss*, Switzerland, 1998
[13] Stojanović, P., Radmanovac, N., Trajković, D., Stepanović, J., Stepanović, J., *The influence of texturing process parameters on yield points and breaking forces of pes filament yarns*, In: Industria Textila, 2018, 69(4), pp. 281–286.
[14] 12945-2: 2000: Determination of resistance to pilling, Switzerland, 2000
[15] ISO 9237 Determination of air permeability of fabrics to air, Geneva, Switzerland, 1995
[16] Gurarda A. *Investigation of the seam performance of PET/nylon-elastane woven fabrics*, In: Textile Research Journal, 2008, 78 (1), pp. 21–27
[17] Malciauskiene, E., Milasius, A., Milasius, R., *Influence of fabric structure parameters on seam slippage*, In: Fibres & Textiles in Eastern Europe, 2012, 20, 3(92), pp. 98–101
[18] ISO 13936-1: 2004. *Determination of the slippage resistance of yarns at a seam in woven fabrics – Part 2: Fixed seam opening method,* Switzerland, 2004
[19] Saville, B. P., *Physical testing of textiles*, Textile Institute, Woodhead Publishing, Elsevier, 1999
[20] Kavuşturan, Y., Çeven, E. K., Özdemir, Ö., *Effect of chenille yarns produced with selected comfort fibres on the abrasion and bending properties of knitted fabrics*, In: Fibres & Textiles in Eastern Europe, 2010, 18(1), p. 78
[21] Namiranian, R., Shaikhzadeh, N. S., Etrati, S. M., Manich, A. M., *Seam slippage and seam strength behaviour of elastic woven fabrics under static loading,* In: Indian Journal of Fibre & Textile Research (IJFTR), 2014, *39*(3), pp. 221–229
[22] Yildirim, K., *Predicting seam opening behavior of woven seat fabrics*, In: Textile Research Journal, 2010, 80(5), pp. 472–480
[23] Jankoska, M., Demboski, G., *Influence of weft density, weft yarn count and finishing on slippage resistance of yarns at seam*, In: Advanced technologies, 2017, 6(2), pp. 78–83
[24] Izabela, J., *Assessment of a fabric surface after the pilling process based on image analysis*, In: Fibres & Textiles in Eastern Europe, 2009, 17(2), p. 73
[25] Özdemir, H., Yavuzkasap, D., *The effects of yarn and fabric structural parameters on the seam slippage, abrasion and pilling properties of double woven upholstery fabrics*, In: Industria Textila, 2012, 63, 6, pp. 307–314

Authors:

GIZEM KARAKAN GÜNAYDIN

Pamukkale University, Buldan Vocational School, Fashion&Design Programme, 20400, Buldan, Denizli, Turkey, e-mail: ggunaydin@pau.edu.tr

Corresponding author:

GIZEM KARAKAN GÜNAYDIN
e-mail: ggunaydin@pau.edu.tr