Sülar. J Fashion Technol Textile Eng 2016, S2
DOI: 10.4172/2329-9568.S2-003

Journal of Fashion Technology & Textile Engineering

Research Article

A SCITECHNOL JOURNAL

Prediction of Fabric Bagging Occurred by an Artificial Arm Under Dynamic Conditions

Vildan Sülar[1*]

Abstract

In recent research, the bagging behaviour of fabrics occurred during the cyclic motions of an arm were investigated experimentally by using a set of woven fabrics. The new testing instrument similar to an arm and having an elbow joint was used and test fabrics were deformed under dynamic conditions. 22 suiting fabrics were used as test fabrics composed of 100% cotton and cotton blend, 100% wool and wool blend, 100% linen and 100% polyester fiber as raw material. Besides fabric bagging tests, fabric structural properties, tensile and bending properties were determined in the context of the study. All objective data were used to predict fabric bagging parameters. Regression analyses were performed by multiple linear regression models to predict residual bagging height.

Keywords

Fabric bagging; Artificial arm; Prediction; Suiting

Introduction

Textile fabrics are exposed to variable dynamic and/or static loads in temporary cycles which can cause change in the shape of garments. During wearing, the shape of a garment keeps changing, but due to the elasticity of fibers, these changes are temporary unless the stresses are too great or last too long [1]. Based on their elastic or viscoelastic character, the changes permanent and irreversible deformation can result if the stresses are great and last too long especially elbows, knees and hips of garments with woven and knitted fabrics [2]. It is an important property and many researchers have studied to evaluate fabric bagging behaviour theoretically and experimentally. There are several methods developed based on two main approaches to investigate the bagging behaviour of fabrics experimentally. Some of the researchers such as Şengöz [1,3-8] used an apparatus adaptable to a tensile tester to simulate fabric bagging. On the other hand, the researchers such as Grunewald and Özdil [9] used a device similar to an arm as described in DIN 53860 and they examined fabric bagging behaviour occurred on the elbow of an arm in static conditions. Abghari [10] investigated the relation of in-plane fabric tensile properties with woven fabrics bagging behaviour. Apart from the previous studies, Sülar [11] designed a similar device for bagging deformation of the fabrics under dynamic conditions simulating real arm movements and developed an optical system) to measure the bagging height in accordance with DIN 53860 [12].

***Corresponding author:** Vildan Sülar, Faculty of Engineering, Textile Engineering Department, Dokuz Eylül University, Tınaztepe Campus 35397 Buca/Izmir, Turkey, Tel: 0090 232 301 77 10; Fax: 0090 232 301 77 50; E-mail: vildan.sular@deu.edu.tr

Received: August 19, 2016 **Accepted:** September 16, 2016 **Published:** September 21, 2016

In this research, the bagging behaviour of fabrics occurred during the cyclic motions of an arm were investigated experimentally by using a set of woven fabrics. The new testing instrument similar to an arm and having an elbow joint was used. Test fabrics were deformed under dynamic conditions and regression equations were conducted to predict fabric bagging occurred during the cyclic motions of an arm.

Experimental

Material

Fabric bagging is an important property and when it is occurred in the fabrics suitable for jackets, trousers and suiting the situation is more disturbing. From this point of view, 22 suiting fabrics were used in the current study. The test fabrics were composed of 100% cotton and cotton blend, 100%wool and wool blend, 100% linen and 100% polyester fiber as raw material (Table 1).

Method

All fabrics were tested under standard atmosphere conditions (20 ± 1°C temperature, 65 ± 1% relative humidity). After deforming fabrics by the newly designed artificial arm, bagging height values were measured by an optical system also explained in our previous study [11]. In recent study, all fabric samples were deformed at 45° deformation angles which is the angle at maximum deformation position and the bagging load and bagging height values were determined for two different bagging cycles such as 100 and 200. Residual bagging height values were calculated after 24 hours. Figure 1 shows a test fabric sample during bagging test.

Besides fabric bagging tests, fabric structural properties, tensile and bending properties were determined in the context of the study. All objective data were used to predict fabric bagging

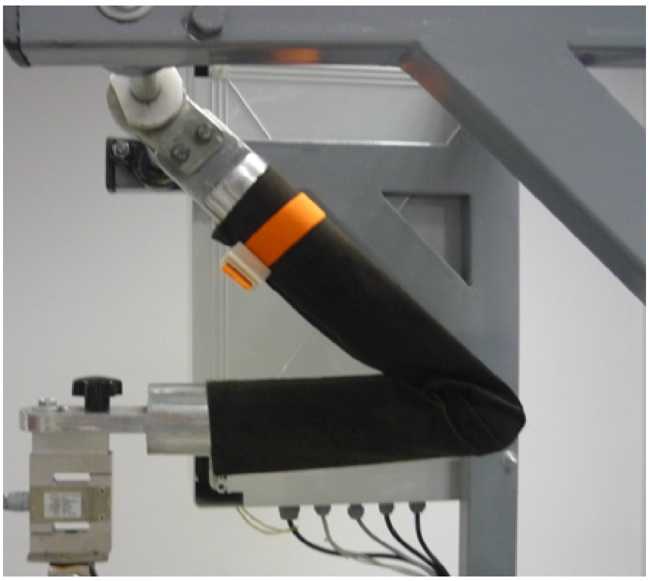

Figure 1: Test fabric sample during bagging test by artificial human elbow.

doi: 10.4172/2329-9568.S2-003

parameters. Regression analyses were performed by multiple linear regression models to predict residual bagging height. The test instruments and the measured parameters with abbreviations were given in Tables 2 and 3.

Results and Discussion

In this study linear regression was used to model the value of a dependent scale variable based on its linear relationship to one or more predictors. RH100 and RH200 were the dependent variables for regression equations and the regression equations were obtained by stepwise regression method (Table 4 and 5).

The adjusted R^2 values were determined between 0.748- 0.960. In these equations the parameters such as bending rigidity in bias direction, warp density, breaking elongation in bias direction, fabric thickness, fabric bending rigidity were entered in the regression equations. Table 4 shows the summary of the regression models obtained by using RH100 as dependent variable. Also in the second stage, RH200 was taken as the dependent variable .The adjusted R^2 values were determined between 0.587-0.857 (Table 5). In these equations, it is very important that residual bagging height values were predicted with high adjusted R^2 values by using maximum five different parameters.

Conclusion

In this study a new bagging testing instrument by an artificial human elbow was used to simulate fabric bagging. Fabric structural, physical and mechanical were used to predict fabric bagging parameters. In our previous study [11], the new bagging tester has

Table 1: Some structural properties of fabrics used in experimental study.

Fabric no	Raw material	Weave	Yarn setting (thread/cm)		Fabric unit weight (g/m²)	Fabric thickness* (T) (mm)
			Warp (S1)	Weft (S2)		
1	100 %WO	Plain	27	25	157.7	0.33
2	100 %WO	Plain	26	23	132.8	0.30
3	98 %WO, 2% EL	Plain	24	24	169.6	0.41
4	98 %WO, 2% EL	Plain	30	26	260.0	0.30
5	100% WO	2/1 Twill	34	32	147.0	0.29
6	100% WO	2/1 Twill	33	30	149.2	0.32
7	100% WO	2/1 Twill	21	29	189.7	0.51
8	%100 WO	Herringbone	45	44	131.3	0.32
9	55% WO, 45% CO	Plain	46	29	124.1	0.27
10	50% WO, 50% PES	Herringbone	32	29	270.0	0.31
11	70% WO, 30% PES	2/1 Twill	34	28	260.0	0.28
12	80% WO, 20% PES	Herringbone	39	34	250.0	0.26
13	44% WO, 54% PES, 2%EL	2/1 Twill	37	29	295.0	0.35
14	49% CO, 49 %PES, 2% EL	3/2 Twill	47	32	286.2	0.66
15	97% C0, 3% EL	2/1 Twill	60	31	192.8	0.44
16	88% WO, 97% PA, 3% EL	Plain	33	25	270.0	0.28
17	75% CO, 25% SE	Basket	38	38	270.0	0.35
18	75 %W, 25% SE	2/2 Twill	32	29	245.0	0.28
19	100% LI	Plain	22	17	260.0	0.33
20	100 %PES	Fancy Twill	114	48	169.5	0.45
21	100 %CO	Plain velvet	26	38	177.7	0.91
22	90% CO, 8% WS, 2% EL	Corduroy	39	24	263.3	1.18

Note: WO: Wool, CO: Cotton, PES: Polyester, EL: Elastan, WS: Cashmere SE:Silk

*: under 5gf/cm² pressure

Table 2: Fabric mechanical properties determined in experimental study.

Property	Test Instrument	Measured parameters	Abbreviation
Tensile	Universal testing machine	**Breaking strength (N)** in warp, weft and bias directions **Breaking elongation (%)** in warp, weft and bias directions **Elongation at 250cN load (mm)** in warp, weft and bias directions	**BS1, BS2, BS3** **BE1, BE2, BE3** **E1, E2, E3**
Bending	Shirley stiffness tester	**Bending length (mm)** in warp, weft and bias directions **Bending rigidity (mg.cm)** in warp, weft and bias directions **Fabric rigidity(mg.cm)**	**C1, C2, C3** **G1, G2, G3** **G**

doi: 10.4172/2329-9568.S2-003

Table 3: Fabric bagging parameters measured in the experimental study.

Property	Measured parameters	Abbreviation
Fabric bagging	**Residual bagging height (%)** for 100 and 200 bagging cycles	**RH100, RH200**

Table 4: Summary of the regression models obtained by using RH100 as dependent variable.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.872[a]	0.760	0.748	80.79680
2	0.918[b]	0.843	0.826	70.29962
3	0.940[c]	0.884	0.865	60.43322
4	0.963[d]	0.926	0.909	50.28029
5	0.985[e]	0.969	0.960	30.51127

Note: a. Predictors: (Constant) G3

b. Predictors: (Constant) G3, S1

c. Predictors: (Constant) G3, S1, BE3

d. Predictors: (Constant) G3, S1, BE3, T

e. Predictors: (Constant) G3, S1, BE3, T, G1

Table 5: Summary of the regression models obtained by using RH200 as dependent variable.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.780[a]	0.608	0.589	150.11058
2	0.859[b]	0.738	0.711	120.66937
3	0.905[c]	0.819	0.789	100.81700
4	0.927[d]	0.859	0.825	90.84254
5	0.944[e]	0.891	0.857	80.91057

Note: a. Predictors: (Constant) G

b. Predictors: (Constant) G, BS3

c. Predictors: (Constant) G, BS3, E2

d. Predictors: (Constant) G, BS3, E2, T

e. Predictors: (Constant) G, BS3, E2, T, C3

been shown that it has the ability to distinguish different fabric types for different deformation cycles and it can provide repeatable test results.Thus in the present study, it was used to predict fabric bagging from some fabric properties by using linear regression models. The parameters such as bending rigidity in bias direction (G3), warp density (S1), breaking elongation in bias direction (BE3), fabric thickness (T) and fabric bending rigidity (G) were entered in these regression equations with high adjusted R^2 values. Especially bagging height values were found very evident for 200 cycles deformed fabrics. Combining bagging height and residual bagging height values, it is possible to say that this newly designed bagging tester can be used to examine fabric bagging occurred under dynamic conditions. It is concluded that especially fabric bending parameters are good predictors to predict fabric bagging.

Acknowledgement

This study was supported as a scientific project and funded by the Scientific and Technological Research Council of Turkey (TÜBİTAK). The author is very thankful for their financial support.

References

1. Kisilak D (1999) A new method of evaluating spherical fabric deformation. Text Res J 69: 908-913.
2. Nyoni AB, Brook D (2010) The effect of cyclic loading on the wicking performance of nylon 6.6 yarns and woven fabrics used for outdoor performance clothing. Text Res J 80: 720-725.
3. Şengöz G (2004) Bagging in textiles. Textile Progress 38: 1-64.
4. Zhang X (1999) Mechanism of woven fabric bagging. PhD Thesis, Institute of Textile and Clothing, The Hong Kong Polytechnic University, China.
5. Zhang X, Li Y, Yeung KW, Yao M (1999a) Fabric bagging: Part I: Subjective perception and psychophysical mechanism. Text Res J 69: 511-518.
6. Zhang X, Li Y, Yeung KW, Yao M (1999b) Fabric bagging: Part II: Objective evaluation and physical mechanism. Text Res J 69: 598-606.
7. Uçar N, Realff ML, Radhakrishnaiah P, Ucar M (2002) Objective and subjective analysis of knitted fabric bagging. Text Res J 72: 977-982.
8. Doustar K, Najar SS, Maroufi M (2009) The effect of fabric design and weft density on bagging behavior of cotton woven fabrics. J Text I 101: 135-142.
9. Özdil N (2008) Stretch and bagging properties of denim fabrics containing different rates of elastane. Fibres & Textiles in Eastern Europe 16: 63-67.
10. Abghari R, Najar SS, Haghpanahi M, Latifi M (2004) Contributions of in-plane fabric tensile properties in woven fabric bagging behaviour using a new developed test method. International Journal of Science and Technology 16: 418-433.
11. Sülar V (2011) A new testing instrument with artificial arm to simulate fabric bagging by human elbow. Industria Textila 62: 259-264.
12. DIN 53860 Teil 1 (1981) Prüfung der Ausbeulneigung von textilen Flächengebilden Deutsche Normen. Beuth Verlag GmbH, Berlin, Germany.

This article was originally published in a special issue, **Proceedings of AUTEX-2015 Conference**

Author Affiliations

Top

[1]*Faculty of Engineering, Textile Engineering Department, Dokuz Eylül University, Tınaztepe Campus 35397 Buca/Izmir, Turkey*