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REČ UREDNIKA

Inovativnost, kao jedan od najbitnijih faktora razvoja i konkurentnosti u savremenim uslovima poslovanja, u domaćem sektoru malih i srednjih preduzeća ima veoma značajnu ulogu. Za njen razvoj nisu stečeni svi neophodni uslov, kako sa stanovišta neophodnih finansijskih, materijalnih i kadrovskih resursa, tako i sa stanovišta postojanja podrške šire društvene zajednice. Budući da inovativnost podrazumeva znatna ulaganja resursa, a budući da je u savremenim uslovima poslovanja inovativnost jedan od neophodnih preduslova efikasnijeg i konkurentnijeg poslovanja, država kao celina mora izdvajati dugoročno kritičnu sumu resursa kako bi podržala inovativnost i sve subjekte koji su za nju opredeljeni.

Brza i efikasna implementacija informaciono telekomunikacionih tehnologija-IKT u proizvodne procese predstavlja osnovu uspešnog rada i razvoja svake ekonomije danas, pa su i sve preporuke i težnje u napretku poslovanja malim i srednjim preduzećima-MSP odevne industrije usmerene na taj segment. Za implemetaciju IKT i modernizaciju, a time i poboljšanje rada MSP odevne industrije neophodan je stručni kadar, kao i permanentan rad sa programima celoživotne kontinuirane edukacije i rešavanje mnogih drugih problema stručnosti, obrazovanja i ljudskih resursa opšte.

Tendencije razvoja odevne industrije moraju da sadrže posebne programe za podsticaj inovativnih aktivnosti u domenu MSP, zatim programe za popularizaciju i stimulisanje mladih naučnika u pokretanju sopstvenih poslovnih aktivnosti u visokotehnoškim industrijama kao i načine stimulisanja istraživanja i programe poboljšanja kvalitativnih performansi stručnjaka, a to pre svega kvantitativnim i kvalitativnim povećanjem obuke u visokim strukovnim školama i fakultetima, povećanjem informisanosti i kontinuiranom obukom stručnjaka u radu sa IKT- CAD/CAM sistemima, organizovanjem celoživotne kontinuirane edukacije stručnjaka, u svim mogućim oblicima.

Glavni i odgovorni urednik
Prof. dr Snežana Urošević

INVESTIGATION OF SEAM PUCKERING IN WOMAN'S BLOUSE

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Abstract: *In this study, mechanical properties of the fabrics were investigated in order to find the cause for seam puckering problem in armhole and neckline area of woman's blouse. The same model of woman's blouse was produced from two types of fabrics with different raw material content: 100% silk and 100 % polyester. The obtained results show that both fabrics have a low shear rigidity, indicating that fabrics extension in bias direction is high. The fabrics extension in bias direction has influence on seam puckering in armhole and neckline area of the blouse because there is sewing in bias direction except sewing in warp and weft directions.*

Keywords: seam puckering, mechanical properties, FAST system.

ISPITIVANJE NABIRANJE ŠAVA KOD ŽENSKJE BLUZE

Apstrakt: *U ovom radu ispitivane su mehaničke osobine tkanina kako bi se pronašao razlog nabiranja šava u predelu rukavnog i vratnog izreza ženske bluze. Isti model ženske bluze proizveden je od dva tipa tkanina različitog sirovinskog sastava: 100% svila i 100% polyester. Rezultati ispitivanja pokazuju da obe tkanine imaju nisku krutost smicanja, što ukazuje na veliko istezanje tkanina u dijagonalnom smeru. Istezanje tkanina u dijagonalnom smeru utiče na nabiranje šava u predelu rukavnog i vratnog izreza bluze, jer ovde osim šivenja u pravcu osnove i potke postoji i šivanje u dijagonalnom smeru.*

Ključne reči: nabiranje šava, mehaničke osobine, FAST sistem.

1. INTRODUCTION

The development of the apparel industry is conditioned by the successful management in terms of price and delivery on the one hand, and constant monitoring and meeting consumer demands in terms of quality on the other. Consumers evaluate the clothes quality through the comfort, aesthetic and functional properties of the clothes [1]. The seam is one of the basic ways of clothes assembling and as such, the quality of the seam is essential to the quality of clothes. The properties through which the quality of the seam is assessed are seam puckering, seam strength, seam slippage, uneven stitch density

and other. In clothing manufacture, the seam puckering is a defect that occurs very often. Seam pucker is defined as [2] "a ridge, wrinkle or corrugation of the material or a number of small wrinkle running across and into one another, which appear in sewing together two pieces of fabric". Various factors have influence on seam puckering as the structural parameters of the fabrics, type of sewing machine, seam construction, as well as sewing parameters: feed mechanism, presser foot, stitch density, needle size and thread tension. During the clothing manufacture fabrics are exposed to various deformations like extension, compression, shear and bending that affect the aesthet-

ic and functional quality of seams. Many researchers have investigated the influence of structural and mechanical properties of fabrics on seam puckering. Dobilaitė and Petrauskas's [3] research has shown that shear rigidity, extension and flexibility of the fabrics have an impact on the seam puckering. Stylious and Lloyd [4] also have investigated the influence of mechanical properties of fabrics on seam puckering and results show that shear and bending rigidity are the main factors which have influence on this defect. Carvalho, Demboski and Nofitoska [5] have investigated the relation between seam puckering, formability and tightness of fabric. The obtained results have shown that seam puckering increases when fabrics formability decreases.

In this study, mechanical properties of the fabrics were investigated to find the reason for seam puckering in woman's blouse during the production process.

2. EXPERIMENTAL

2.1. Materials

The same model of woman's blouse from two different fabrics was manufactured. In the both cases there were the seam puckering in neckline and armhole area. The model of woman's blouse is presented in Figure 1. The blouse is sleeveless with six pleats on the front neckline.

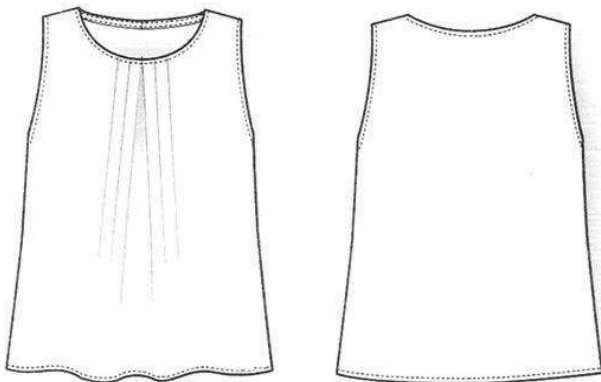


Figure 1: Technical sketch of the model

The properties of used fabrics in Table 1 are given. The surface density was measured according to the standard MKS BS EN 12127:1998, yarn count according to the standard ISO 7211-5:1984 and MKS EN 1049-2:2007 was used to determine yarn density. The blouse was sewn according to the parameters given in Table 2.

Table 1: Structural properties of fabrics

Fabric		F1	F2
Composition		100% Silk	100% PES
Weave		Plain	Satin
Yarn count (tex)	Tt_w	6.4	5.6
	Tt_{wf}	11.8	7.20
Yarn density (dm^{-1})	n_w	580	1060
	n_{wf}	390	460
Yarn thickness (cm)	d_w	0.0098	0.0089
	d_{wf}	0.0134	0.0101
Cover factor		0.7939	0.9696
Surface density (g/m^2)		83.61	91.36

Table 2: Sewing parameters

Fabric	Thread structure	Thread count (tex)	Needle size, Nm	Stitch density/100 mm
F1 / F2	Core-spun	24	80	40

In Figure 2 and Figure 3 the seam puckering in the woman's blouse is presented for fabrics F1 and F2 respectively.



Figure 2: Seam puckering in armhole (left) and neckline (central and right), fabric F1

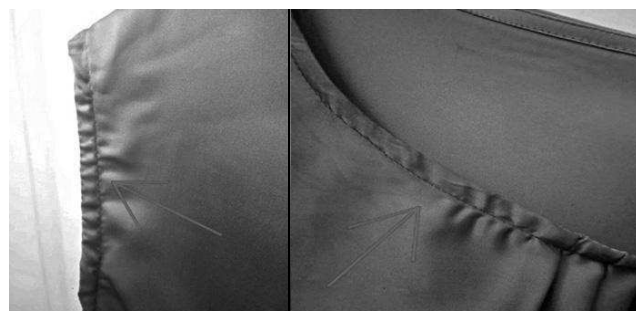


Figure 3: Seam puckering in armhole (left) and neckline (right), fabric F2

2.2. Methods

In order to find the cause for seam puckering in neckline and armhole area, the mechanical properties of fabrics under small loads using FAST (Fabric Assurance by Simple Testing) system were investigated. The samples of fabrics were tested using compression meter (instrument FAST 1), bending meter (instrument FAST 2) and extension meter (instrument FAST 3) [6].

- Using the instrument FAST 1 the fabrics thickness was measured under loads of 2 g/cm² and 100 g/cm². The surface thickness of the fabrics was calculated as:

$$ST = T_2 - T_{100} \quad (1)$$

Where:

T_2 – average thickness of fabric under load of 2 g/cm²

T_{100} – average thickness of fabric under load of 100 g/cm².

- Using the instrument FAST 2 the fabric bending length was measured. Bending rigidity was calculated using the equation:

$$B = 9.8 \cdot 10^{-3} \cdot Q \cdot C^3 \quad (2)$$

Where:

B – bending rigidity (μNm)

C – bending length (mm)

Q – fabric surface density (g/m²).

- Using the instrument FAST 3 the fabric extensibility under three different loads (5 g/cm, 20 g/cm and 100 g/cm) in warp and weft direction was measured. Extensibility of fabric under loads of 5 g/cm and 20 g/cm in combination with bending rigidity determines the fabric formability, according to the equation:

$$F = [B \cdot (E_{20} - E_5)] / 14.7 \quad (3)$$

Where:

F – formability of fabric (mm²)

B – bending rigidity (μNm)

E_{20} – extension under load of 20 g/cm

E_5 – extension under load of 5 g/cm.

The extensibility is also measured in bias direction under 5 g/cm load to determine fabric shear rigidity, using the equation:

$$G = 123 / EB_5 \quad (4)$$

Where:

G – fabric shear rigidity (N/m)

EB_5 – extension under load of 5 g/cm.

In order to obtain consistent results, fabrics were conditioned overnight in standard atmosphere 20 ± 2°C temperature and 65 ± 2% relative humidity before cutting. The fabrics sample cutting scheme in Figure 5 is presented.

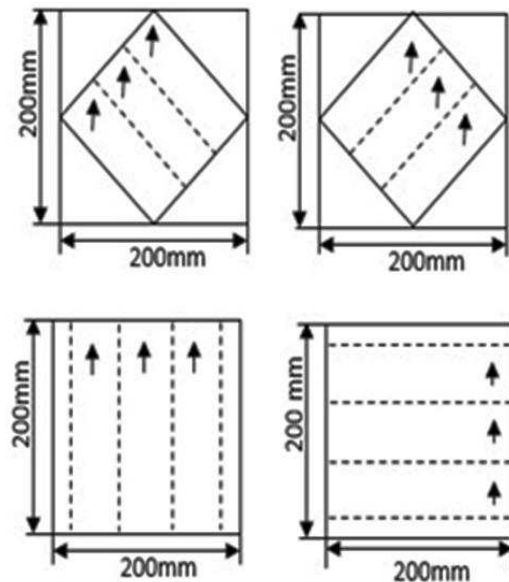


Figure 5: Fabric sample cutting scheme

3. RESULTS AND DISCUSSION

Table 2 shows the obtained results for mechanical properties of the used fabrics. The formability values for both fabrics in weft direction are higher than 0.25 mm². In warp direction, the fabric F1 has good formability, higher than 0.25 mm², while the formability of the fabric F2 is 0 mm². Formability values under 0.25 mm² create the possibility of fabrics producing seam puckering after sewing. The fabric F1 in both, warp and weft directions, and the fabric F2 in weft direction have extensibility values higher than upper control limit, which indicate that fabrics can easily stretched during cutting and sewing. In warp direction fabric F2, has extensibility values 0%, and this can lead to problems with overfeed seams. The fabric F1 in weft direction and fabric F2 in both warp and weft directions have bending rigidity below 5 μNm. Low values of bending rigidity mean that those fabrics potentially cause difficulty during cutting and sewing. For shear rigidity, both fabrics have values less than 30 N/m. Low shear rigidity makes the fabric difficult to lay for cutting and these fabrics may require pinning down to avoid displacement of the cutting layer. According to the surface density both fabrics are lightweight fabrics. The control charts for fabric mechanical prop-

erties, in Figure 6 and Figure 7 are shown for fabric F1 and F2, respectively.

Table 2: Mechanical properties of fabrics

Properties		F1	F2
Extension	E100-1 (%)	10.9	0
	E100-2 (%)	11.9	13.2
Formability	F-1 mm ²	1.003	0
	F-2 mm ²	0.51	1.11
Shear rigidity	Gf (N/m)	10.3	13.4
	B-1 (μNm)	3.88	16.47
Bending rigidity	B-1 (μNm)	3.88	16.47
	B-2 (μNm)	1.88	3.21
Compression	T2 (mm)	0.205	0.126
	T100 (mm)	0.107	0.085
	ST (mm)	0.098	0.041
	STR (mm)	0.098	0.041
Weight	Q (g/m ²)	83.61	91.36

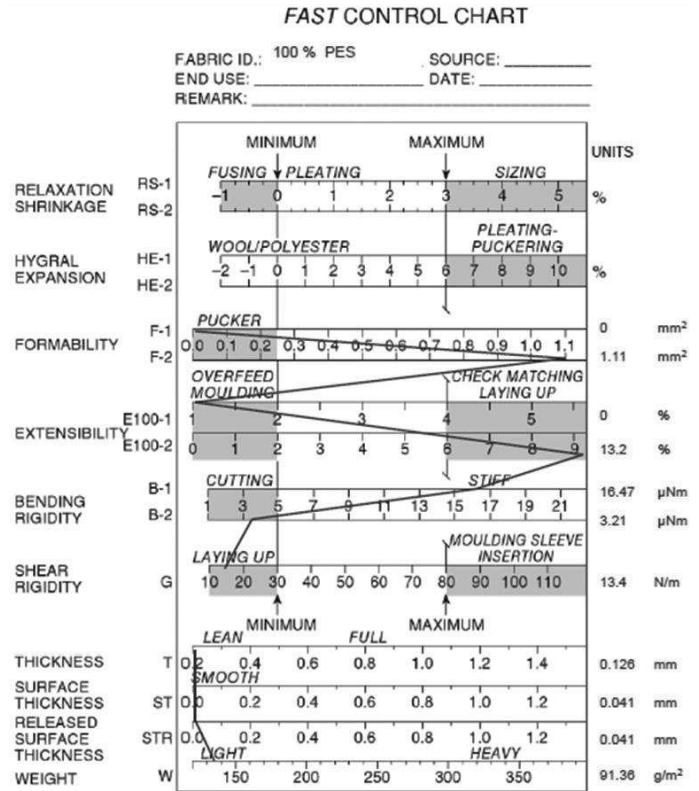


Figure 7: Control chart for fabric F2

During the sewing process, fabric is stretched along the stitch line as a result of transporting between feed dog and presser foot. If the fabric has high extensibility then stretching during sewing will be high, which can be reason for seam puckering along the seam line after sewing. In the apparel industry, fabrics are usually sewn in the warp and weft direction. In the woman's blouse, except seams sewn parallel to the warp and weft yarns, there are seams which deviates from warp and weft direction (Figure 8). In the area of neckline, sewing starts in warp direction, goes to bias direction, then in weft direction, again in bias and ends in warp direction. Similarly, the armhole seam, sewing starts in weft direction, goes to a bias, continues in warp direction, again in bias direction and ends to a weft.

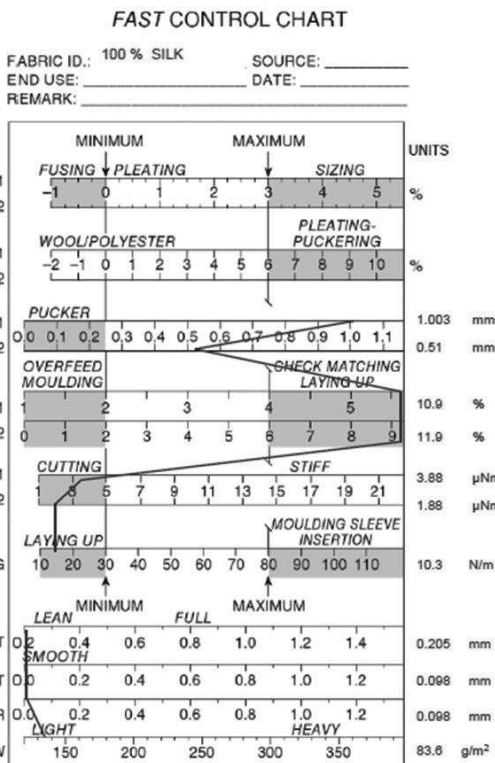


Figure 6: Control chart for fabric F1

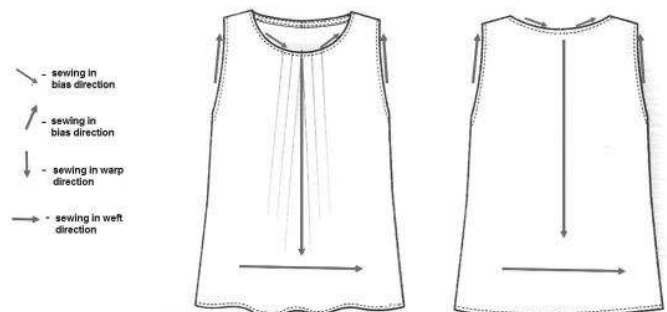


Figure 8: Sewing directions

In the analyzed models of woman's blouse, seam puckering in side seams (seam in warp direction) and shoulder seams (seam in weft direction) didn't occur. There wasn't seam puckering in weft direction because both fabrics have formability in control zone, 0.51 mm² and 1.11 mm² for fabric F1 and F2 respectively. In warp direction, fabric F1 has formability in the control zone 1.003 mm² and there wasn't seam puckering. Although, fabric F2 has formability in non-control zone in warp direction 0 mm², there is no seam puckering because of the high bending rigidity in this direction (16,47 µNm). From Figure 2 and 3 it can be seen that puckering occurs in those seams which have deviation from the warp and weft direction of sewing, i.e. seam sewn in bias direction. The low shear rigidity values, 10.3N/m for fabric F1 and 13,4 N/m for fabric F2, indicate that fabric extension in bias direction is high. For fabric F1 extension in bias direction under 5 g/cm load is 11.9% and for fabric F2 is 9.2%. Although the FAST system doesn't set control limits for fabric extension in bias direction, low shear rigidity shows that the fabric extension is high. Based on the literature, the important property that affect the seam puckering is extensibility. Fabric with high extensibility is proneness to seam puckering.

4. CONCLUSION

During the manufacturing of woman's blouse, seam puckering was occurred in neckline and arm-hole area. In order to find the reason for this problem, the mechanical properties of fabrics on FAST system were investigated. The obtained results have shown that the value for shear rigidity in both fabrics is low-

er than 30 N/m. The low value of shear rigidity means that the fabric extension in bias direction (11.9% for fabric F1 and 9.2% for fabric F2) is high and that cause seam puckering.

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