QUALITY EVALUATION OF KNITTED USED IN INTERIOR DESIGNS, THROUGH EXTENSIBILITY

Ș.l. dr. ing. **Liliana LUTIC**

"Gheorghe Asachi" Technical University of Iaşi,
Faculty of Textiles & Leather Engineering and Industrial Management

REZUMAT. Tricoturile tehnice destinate articolelor pentru decoraţiuni interioare (şi în special pentru realizarea saltelelor şi a huselor de protecţie pentru articolele de mobilier, inclusiv tapiţarea acestora) trebuie sărăspundă multiplelor cerințe solicitate de către beneficiari. Printre acestea, durabilitatea, menţinerea aspectului, formei şi a dimensiunilor, capacitatea de curăţare, remediere șirecondiționare, sunt de primă importanţă. Aceste cerințe stau la baza activităţii de creaţie şi proiectare, finalizate cu întocmirea documentaţiei de produs şi proces. Indiferent de tipul saltelelor, sau articolelor de mobilier realizate, pentru tapiţarea sau protejarea acestora pot fi utilizate tricoturi din bătătură, sau tricoturi din urzeală. Evaluarea calităţii tricoturilor destinate unui anumit domeniu presupune stabilirea caracteristicilor reprezentative pentru destinaţia impusă şi aplicarea metodelor corespunzătoare în vederea alegerii variantelor optime. Extensibilitatea este una dintre cele mai importante caracteristici ale unui tricot, influenţând comportarea acestuia în timpul utilizării şi determinând în mare măsură funcția ergonomică a produsului ce urmează a fi realizat. Lucrarea are drept obiectiv evaluarea comparativă a calităţii unui sortiment de tricoturi destinate saltelelor şi huselor de protecţie pentru articolele de mobilier, prin măsurarea extensibilităţii şi alegerea variantelor optime.

Cuvinte cheie: tricot, extensibilitate, proiectare, huse, saltele.

ABSTRACT. Technical knitted used for the confection of interior design articles (especially mattresses, furniture slipcovers, including upholstering) must meet the specific requirements solicited by the beneficiaries. Among which we mention durability, maintenance of aspect, shape and dimensions, cleaning capacity, remedy and refurbishing are of utmost importance. These requirements stand at the base of the creation and design processes and they are stated in the documentation of the product.Regardless of the type of mattress, the upholstering can be made with either weft or warp knitted. Quality evaluation of a knitted used in a certain domain, implies establishing the representative characteristic of the required domain and applying the correct methods in order to choose the optimal variants. Extensibility is one of the most important characteristics of a knitted, influencing its behavior during use and determining greatly the ergonomic function of the manufactured product.The purpose of this paper is the comparative quality evaluation of a knitted type used in mattress and protective slipcovers for furniture, by measuring extensibility and choosing the optimal variants.

Keywords: knitted, extensibility, designs, slipcovers, mattresses.

1. INTRODUCTION

Currently the furniture and technical knitted automobile industry used in upholstering various forms and surfaces are greater than ever due to the following facts:

● the creation of knitted fabrics which combine both woven fabrics features (mechanical stress resistance, limited extensibility) and knitted fabrics features (3D modelling capacity, high volume, wide choice of models, nice touch feeling, economical efficiency);

● new knitting technologies were developed;

● the production of knitting machines used specifically for upholstery knitted fabrics;

● use of a wide variety of fibres with superior features.

The main demands from the beneficiaries of knitted fabrics used in mattressupholstering and protective furniture slipcovers manufacturing are related to [3, 4, 5, 6, 7]:

- maintaining the shape and size during use;
- ensuring sensorial and thermal comfort;
- stress resistance during use;
- dirt resistant and easy cleaning;
- showing some new features regarding structure, chromatic, layer aspect;
- maintaining and improving health;
- environmental protection.

These requirements stand at the base of the creation and design processes and they are stated in the documentation of the product [1].

● Some of the solutions found in order for the knitted to meet the solicited requirements took into consideration:

● Producing integrated knitted fabrics with “padded” finish; the thickness comes by inserted filling fibres between the two knitted fabric layers;

● Improving elastic rebound after normal use stress, by creating a Jacquard structure with high volume filling fibres, fixed between the knitted fabric’s two layers by connection points;

● Using yarns made of natural fibres which can absorb and wick away moisture, allow air circulation and regulate temperature feeling (warm or cool sensation according to the outside temperature);

● Using technologically advanced synthetic fibres, which can create large volume structures and have a natural fibres feel;

● Using yarns with a high mechanical stress endurance;

● Using yarns with filaments and a pilling resistant material;

● Producing knitted structures with high resistance against homogenous and heterogeneous friction;

● Using yarns and knitted structures with high endurance for cyclical stress (pull – return, repeated bending and compression);

● Using advanced technologies to produce dirt proof and moisture proof materials;

● Using yarns and a finish technology to ensure a fast and efficient cleaning.

2. INTEGRATED KNITTED FABRICS USED IN MATTRESS UPHOLSTERING AND PROTECTIVE FURNITURE SLIPCOVERS MANUFACTURING

Integrated knitted fabrics are complex multilayer type structures. The fibres used in the manufacturing are specifically chosen in order to obtain specific characteristics according to the final use of the fabric. As such, both faces of the fabric contain fibres with esthetical, comfort, protection and durability features, while the filling fibres serve the purpose of thermal isolation and elastic rebound after compression.

In table 1 are presented and characterized eight variants of integrated knitted manufactured and used in protection or upholstering of mattresses and furniture pieces [4, 6]. The first four variants have a double relief rib jacquard structure and the other four are irregular jacquard.

Table 1. **Integrated knitted variants**

Knitted fabric model	Structure	Raw material/composition				Width [m]	Thickness [mm]	Weight [g/m^2]
		Front yarns	Back yarns	Filling yarns	Sequence filling yarns			
V1	Double relief rib jacquard	PES Nm 18/1, PES 150 den	PES Nm 18/1, PES 150 den	PA 1250 dTex	1/3	2,35	3,05	350
V2	Double relief rib jacquard	PES Nm 24/1	PES 150 den	PA 300 de	1/2	2,30	2,69	210
V3	Double relief rib jacquard	Bam-boo-viscose, Nm 20/1	PES 150 den	PES 1200 den	1/4	2,30	2,49	250
V4	Double relief rib jacquard	Bam-boo viscoseNm 20/1	PES 150 den	PA 1250 dTex	1/2	2,30	3,21	320
V5	Irregular Jacquard	52% PES, 48% Viscose, Nm 20/1	PES 150 den	PA 1250 dTex	1/1	2,30	3,95	350
V6	Irregular Jacquard	52% PES, 48% Viscose, Nm 20/1	PES 150 den	PES 1200 den	1/4	2,64	1,88	257
V7	Irregular Jacquard	52% PES, 48% Viscose, Nm 20/1	PES 150 den	PES 1200 den	1/2	2,72	2,38	342
V8	Irregular Jacquard	PES Nm118/1	PES 150 den	PES 600 den	1/4	2,36	1,59	245

3. METHODS OF DETERMINING THE KNITTED EXTENSIBILITY

The integrated knitted fabrics described before can be used as outer layer for producing mattresses, furniture and automobiles upholstery and for interior design (covers, coverlets), etc. As such, it is necessary that they have the following features:

● easy to model 3D;

● elastic rebound ability after mechanical stress while in use;

● proper adhesion strength to contact outer layers.

In these circumstances, assessing the extensibility is primary.

Also knows as structural deformity, **extensibility** is the capacity of a knitted to elongate under the action of a static solicitation, whose intensity is at the limit between the non-destructive plastic strain domain and the destructive one [2].

By contrast to extensibility, **elasticity** represents the capacity of the knitted to store up in a reversible way the deformation energy during use and return to its original dimensions after ceasing the solicitation in the elastic domain.

In figure 1 the force – elongation diagram is presented in which three domains are marked:

● elastic elongation domain that reveals the elasticity ε_{el} (point A abscissa is the limit of the elastic domain);

● extensibility domain ε_{ex} (point A abscissa – point B abscissa);

● plastic elongationdomain ε_p (afterpoint B abscissa).

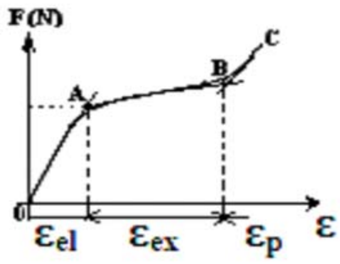

Fig. 1. Force – elongation diagram.

During designing a knitted product, the extensibility values on different directions determines adopting the structure and structural parameters, the shape, dimensions, the type and parameters for the applied seams as well as the finishing operations parameters.

For the study of knitted behavior during elongation with a force lower than the breaking one, three methods can be utilised with the specific equipment:

● the standard method based on the textile relax meter;

● the dynamometric method (with a textile dynamometer);

● the method based on the use of a Fryma extensometer.

The method based on the use of a Fryma extensometer leads to determining the elongation of fabrics under the action of a constant force. The apparatus can be used on knitted with an elongation of up to 300% and a weave with an elongation of up to 50 % [8]. The testing purpose is not to determine the breaking elongation, but to establish the degree of elongation and rebound of a fabric with the precision required by the British standard BS 4292/1968.

The model of the Fryma extensometer is presented in figure 2.

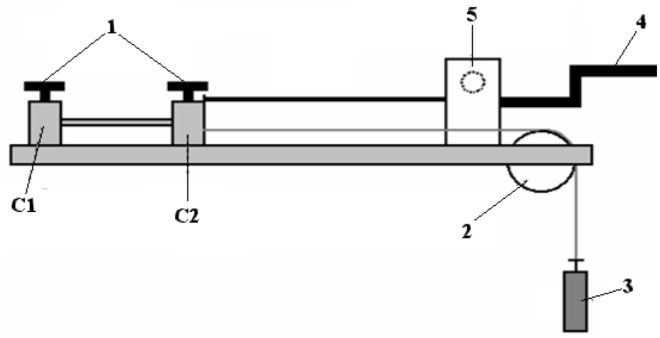

Fig. 2. Fryma extensometer construction:
C1 – fixed clamp; C2 – moving clamp; *1* – tee screws;
2 – sustain wheel of the weight cable; *3; 4* – winding handle;
5 – quick return button.

4. EXPERIMENTAL DETERMINATIONS

In this paper from theeight variations of integrated knitted structures samples were taken with standard dimensions (75x85 mm), cut on the direction of the stitch row and well. These samples were acclimated and put under a 3 daN force stretch strain. The determinations were executed on a five samples specimen (on each direction –row/wells), on each structure analyzed, after calculating the medium values of extensibility as read on the machines graded scale.

The medium values of extensibility recorded are presented in table 2.

Table 2. **The medium values of extensibility recorded on integrated knitted**

Knitted variant	Recorded medium values of extensibility[%]	
	Well	Row
V1	29,0	14,5
V2	31,5	26,0
V3	37,5	24,0
V4	28,5	17,0
V5	24,5	8,0
V6	22,5	7,0
V7	25,0	7,5
V8	12,5	22,5

5. RESULTS INTERPRETATION

Comparative analyse of extensibility of the eight variants of integrated knitted on the wells and rows of stitches are illustrated in the figures 3, 4, 5, 6 and 7.

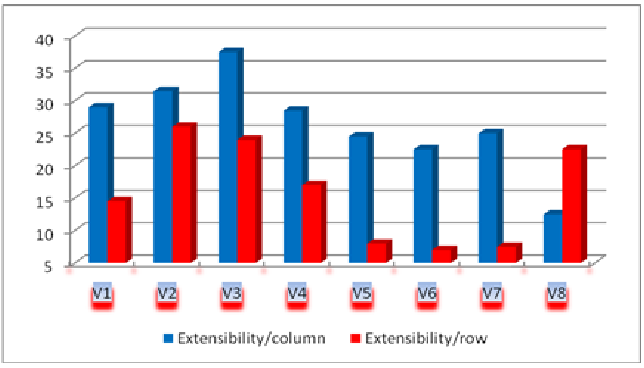

Fig. 3. Comparative analyze of extensibility of the eight knitted variants on the wells and rows of stitches.

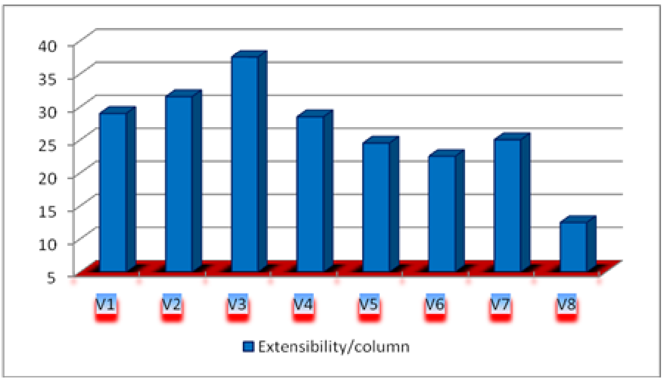

Fig. 4. Comparative extensibility analysis of the eight knitted variants on stitch well direction.

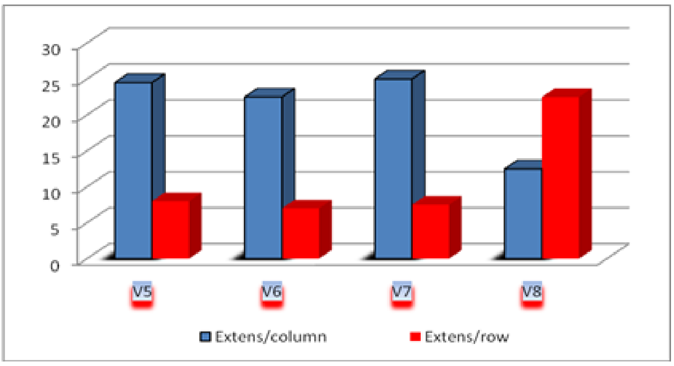

Fig. 5. Comparative extensibility analysis of knitted variants in irregular jacquard on well direction and stitch row.

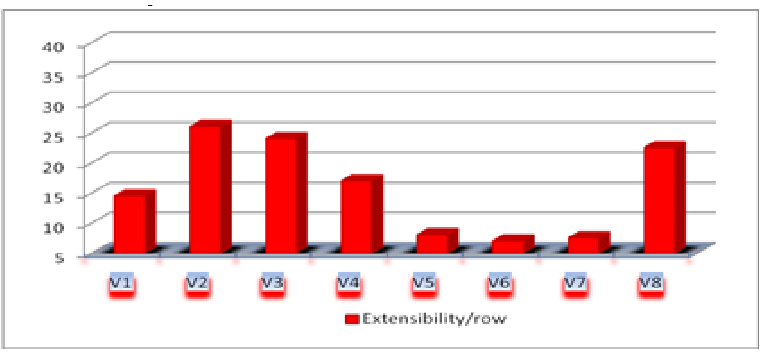

Fig. 6. Comparative extensibility analysis of the eight knitted variants on stitch row direction.

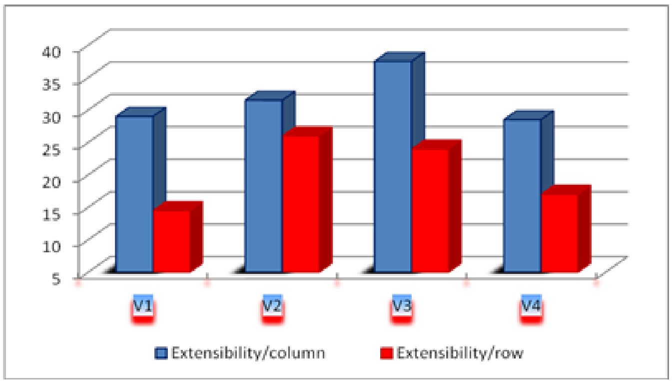

Fig. 7. Comparative extensibility analysis of knitted variants in double relief rib jacquard on well direction and stitch row.

6. CONCLUSIONS

The testing results and graphics presented in the above figures brought the following conclusions:

● Withthe exception of knitted fabric V8, the extensibility on the direction of the stitch row is lower for all knitted model analysed than the extensibility on stitch well direction.

● The lowest values of extensibility on the stitch well were recorded for model V8, followed by the V6 and V5 models.

● On irregular jacquard knitted structures (variants V5, V6, V7 and V8), the extensibility measured on the well direction is lower, because of the connective points of each row. These better attach the two sides of knitted, as well as the filling fibres layer between them.

● Considering the extensibility on stitch row direction, it was revealed that it reaches the lowest values for models V6, V7 and V5. This is explained by the high number of connective points in the pattern drawing, resulting in a better consolidation between the two knitted sides.

● In the case of double relief rib jacquard structures (model V1, V2, V3, V4) the connective points appear only on the rows realized by the ground yarns. As a result the extensibility measured on the stitch well direction varies in a reduced range, the lowest values being recorded for the models V1 and V4.

● Taking into consideration the conditions required by the destination of the integrated knitted (reduced deformation), the models with the lowest extensibility (V8, V6, V5, V7) can be considered the most adequate.

● Considering the analysis done, the variant of integrated knitted with the highest quality level is V6 (with irregular jacquard structure) on which extensibility is the lowest.

REFERENCES

[1] Lutic, L.: *Knitted structures used in Mattress manufacturing.*46th International Congress IFKT, ISSN 2285-5378, Romania.

[2] Moisescu E., Lutic L., *Metrologie textilă, Tricotaje – Confecţii.* Ed. Performantica, ISBN 978-973-730-525-1, Iaşi, 2008.

[3] http://www.online-home.ro

[4] http://www.desleeclama.com

[5] http://www.ikea.com/ro/catalog/categories/departments/bedroom

[6] http://www.deslee-interior.com/functions/content

[7] http://www.dormeo.ro

[8] ***, BS 4294/1968 – FrymaFabric M 031 Extensometer.

Despre autor

Şef lucr. dr. ing. **Liliana LUTIC**
Universitatea Tehnică „Gh. Asachi” Iaşi

Absolventă a Institutului Politehnic din Iaşi, Facultatea de Tehnologia şi Chimia Textilelor, promoţia 1984; doctor inginer din anul 2005. În prezent, şef lucrări la Facultatea de Textile Pielărie şi Management Industrial. Domenii de competenţă: Tehnologii de tricotare pe maşini circulare / rectilinii de tricotat; Studiul parametrilor tehnologici ai operaţiei de tricotare; Analiza şi controlul calităţii tricoturilor realizate pe maşini circulare / rectilinii de tricotat; Corelarea parametrilor tehnologici în vederea asigurării calităţii proceselor şi produselor; Metrologie Textilă (Testarea caracteristicilor de calitate ale tricoturilor cu aparate de măsură şi control).