THE INFLUENCE OF WEFT DENSITY AND WEAVE ON THE WEAVING SHRINKAGE IN NARROW FABRICS

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REZUMAT. Benzile țesute sunt utilizate frecvent în industria marochinăriei, fiind realizate din poliester sau polipropilena. Una din caracteristicile structurale de bază ale acestora este contracția firelor de urzeală în bandă, care influențează în special comportarea la întindere și la frecare. Scopul lucrării este analiza influenței desimii firelor de bătătură și a legăturii asupra contracției firelor de urzeală în banda de polipropilenă. S-au realizat în total nouă variante de benzi țesute cu legăturile pânză, D$\frac{211}{121}$, diagonal D 2/2, pentru fiecare legătura fiind experimentate trei desimi ale firelor de bătătură. Cercetarea aplicativă a pus în evidență ca indiferent de legătură, creșterea desimii firelor de bătătură duce la creșterea contracției firelor de urzeală în bandă. Valorile cele mai ridicate ale contracției firelor de urzeală se obțin pentru legătura pânză, benzile înregistrând alungirile cele mai mari prin comparație cu celelalte legături. În practică, cea mai utilizată este legătura D2/2, care are contracția firelor de urzeală cea mai mică.

Cuvinte cheie: polipropilenă, produse din piele, fire ondulate, contracția urzelii.

ABSTRACT. Narrow fabrics are frequently used in the leather industry, being manufactured from polystyrene and polypropylene. One of their main structural characteristics is warp shrinkage in the fabric, which especially influences their behavior at tension and friction. The purpose of this work is to analyze the influence of the weft density and the weave on the warp shrinkage in the polypropylene narrow fabric. Nine variants of narrow fabrics were manufactured (with plain weave, diagonal weave D 211/121, and diagonal weave D 2/2), three weft yarns densities being experimented for each type of weave. The applicative research has revealed that, irrespective of the weave, the increase of the weft yarns density results in the increase of the warp shrinkage in the narrow fabric. It was obtained the highest values of the warp shrinkage for plain weave, these narrow fabrics recording the biggest elongations as compared to the other weaves. In practice, one uses mostly the D2/2 weave, which has the smallest warp shrinkage.

Keywords: polypropylene, leather products, yarns crimping, warp shrinkage.

1. INTRODUCTION

Narrow fabrics represent an important category of products with most diverse utilizations. For example, one uses the so-called "lashes" to drive the spindles at the spinning and twisting machines. Some textile machines are equipped with conveyor bands or belts for feeding or/and delivery. Other applications of the narrow fabrics are for sportware or camping products, automobile and electrotechnical industries, health care, etc.

The main requirements imposed by the utilization fields to narrow fabrics are: dimensional stability, high tensile strength, good bending strength, resistance to repeated bending, good wear resistance at friction, small mass.

Leather industry uses more and more often the woven narrow fabrics. In order to respond to this sector, one uses frequently polyester and polypropylene as raw materials.

The subunit volume density of polypropylene (0.91 g/cm^3) and its high mechanical strength (50-95 cN/tex) are major advantages that permit the realization of light wear-resistant products [1]. Pleasant touches, wrinkle-proofing and high resistance to chemical agents are other valuable properties of the polypropylene products [3].

Standard polypropylene has a specific strength of 54 cN/tex and is used for draperies, filters, cords, sportwares. In wet condition, the tensile strength of the polypropylene products remains adequate, because their strength does not decrease.

High strength polypropylene does not mould or get rotten, having the regain of 0.05% and a high abrasion resistance, and is used in military applications for lorry baffle fabric.

Yarn crimping degree in narrow fabrics has a big influence on their physico-mechanical properties and especially on their traction and friction behavior.

The purpose of the work is to analyze the influence of weft density and weave on weaving shrinkage in polypropylene narrow fabric destined to fancy leather goods.

2. MATERIALS AND METHODS

The degree of yarn crimp expresses the extent to which the yarns deviate from the rectilinear position after their integration in the woven fabric [3]. The crimping degree is expressed practically through the percentage of yarns shrinkage or contraction in the fabric. From the physical point of view, the yarns crimp after their integration in the narrow fabric a difference appears between the initial yarns length and the length of the produced narrow fabric. This difference is called warp shrinkage and is expressed in percent's.

The factors that determine the yarn contraction in the narrow fabric are yarn count, yarn density and weave. The influence of weft density and the weave on warp yarns shrinkage in the narrow fabrics destined to fancy leather goods have been studied.

Warp shrinkage in the narrow fabric is determined experimentally and computed with the following relation:

$$C_u = \frac{l_f - l_t}{l_t} \cdot 100 \ [\ \%\ ] \qquad (1)$$

where: C_u is warp shrinkage degree or the contraction of warp yarns in %, and l_f is the mean length of the yarn necessary to produce a narrow fabric length l_t.

For the experimentally produced narrow fabrics, the shrinkage is determined using the measured lengths of the warp yarns pulled out from the narrow fabric. In order to measure them, they are stretched with a torsiometer until the yarn crimps are removed. Warp shrinkage in the narrow fabric is calculated with the relation (1).

One needs to know the yarn shrinkage in the narrow fabric in order to establish the quantity of warp yarns necessary to produce an imposed fabric length.

The experiments were carried out at *SC Plastprod SRL Iassy* on a VARITEX-type narrow fabric weaving machine which works at a rotation speed of 1200 rpm. One uses eight shafts and cover plate-driven mechanism in order to form the shedding.

In order to reveal the influence of weft yarns density on warp shrinking, two variants of narrow fabrics were produced, with codes presented in *Table 1*. The warp and weft yarns are made of 100% polypropylene (PP), warp having the linear density of 1000 dtex and weft 1000x2 dtex.

Table 1 Structural characteristics for woven narrow fabrics

Weave	Narrow fabric code	Weft yarns density, [yarns/cm]	Warp yarns density, [yarns/cm]
Plain	V1	6.3	16
	V2	7.2	16
	V3	8.4	16
Diagonal D $\frac{211}{121}$	V4	6.3	16
	V5	7.2	16
	V6	8.4	16
Diagonal 2/2	V7	6.3	16
	V8	7.2	16
	V9	8.4	16

3. RESULTS AND DISCUSSIONS

For textile design, one uses fabric models that serve to calculate the fabric structural parameters. The mostly used analytical fabric model is the geometric model [3]. At very narrow fabrics (1-20 cm), the geometric model of the fabric cannot be applied in design calculations, because the length of the inserted weft yarn is very small. Under these circumstances, one cannot use the existing analytical models to compute yarn shrinkage.

Warp shrinkage is calculated with the relation (1). *Table 2* summarizes the results obtained from the performed experiments.

Table 2 Variation of warp yarns shrinkage as function of weave and warp yarns density

Db, yarns/cm / Weave	6.3	7.2	8.4	Variation C_u, [%]
Plain	9.83	14.67	19.58	49.80
D $\frac{211}{121}$	8.20	10.87	15.73	47.87
D 2/2	5.50	7.42	8.75	37.14
Variation C_u, [%]	*44.04*	*49.42*	*55.31*	-

The shrinkage variation C_u(%) was calculated for each type of weave, to determine the influence of warp density on the weft shrinkage in the woven narrow fabric. The warp shrinkage was calculated using the relation (1).

One can notice that for a 25% increase of the weft density, from D_b = 6.3yarns/cm to D_b = = 6.3 yarns/cm, the warp shrinkage in the narrow fabric records the following variations:

● for plain weave (experimental variants coded as V1, V2 and V3), the increase is by 49.80% (from C_u = 9.83% to C_u= 19.58%);

● for the weave D 211/121 (variants V4, V5 and V6), the increase is by 47.87% (from C_u = 8.20% to C_u = 15.73%);

● for the D2/2 weave (variants V7, V8 and V9), the increase is by 37.14% (from C_u = 5.5% to C_u = 8.75%).

Similarly, the study of the weave influence on warp shrinkage in the narrow fabric was carried out maintaining constant the weft density (D_b, yarns/cm) on the three possible technologically levels, namely:

● for D_b= 6.3 yarns/cm, the warp contraction in the narrow fabric decreases by 44.04% (from C_u= = 9.83% for the fabric variant coded V1, to C_u= = 5.50% for the variant V7) when the float increases;

● for D_b= 7.2 yarns/cm, the warp shrinkage in the narrow fabric decreases by 49.42% (from C_u= = 14.67% for the variant V2 to C_u= 7.42% for the variant V8) when the weave repeat increases;

● for D_b= 8.4 yarns/cm, the decrease of the warp shrinkage is by 55.31% (from C_u= 19.58% to C_u= = 8.75% for the variant V9).

Figure 1 presents the mean values of the warp shrinkage in the narrow fabric for the nine variants in the fabric.

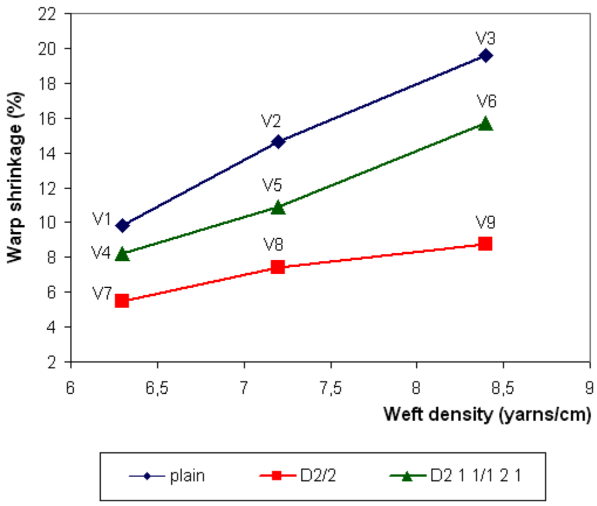

Fig. 1. Variation of warp yarns shrinkage C_u (%).

One can notice that the maximum value for C_u= = 19.58 is obtained at the narrow fabrics produced with plain weave (experimental fabric encoded V3).

The measurements show that the narrow fabrics with plain weave (V1, V2 and V3) have the biggest values of the warp yarn shrinkage, as compared with the other two weaves, the explanation being that the crimp of these yarns has the highest frequency. The narrow fabrics made with plain weave have an extension capacity much superior to the narrow fabrics manufactured with other weaves (that have a larger float than that of the plain weave). The graphic shows off that the contraction (C_u) decreases with the increase of the float (from the plain weave to D2/2 weave), irrespective of weft yarn density.

Figure 1 also reveals that, regardless the weave, the increase of weft yarns density by 25%, from 6.3 yarns/cm to 8.4 yarns/cm, leads to shrinkage increase.

4. CONCLUSIONS

1. Weft density, a basic parameter of the fabric structure, influences in direct proportion the warp shrinkage of the narrow fabric.

2. The increase of the warp shrinkage with the increase of warp density is due to the increase crimping frequency of the warp yarns in the narrow fabric.

3. For the narrow fabric length l_t, the yarn length l_f is much bigger at plain weave than in the case of the other studied weaves.

4. One does not recommend the utilization of the plain weave to produce narrow fabrics with small elongation. One can use the D2/2 weave, for instance.

5. The shrinkage value decreases with the increase of the mean float (C_u= 9.83% for plain weave, where the float is 1, and C_u = 5.5% for D2/2 weave, where the mean float is 2).

6. The value of warp yarn shrinkage in the narrow fabric is used to calculate the length of weft yarns necessary to produce a pre-established length of the narrow fabric.

REFERENCES

[1] Avram, D., Mustață, A.: *Technical yarns. Structure, properties and fields of utilization*, "Gh.Asachi" Publishining House, Iassy, 1999.

[2] Potop, G., Vîlcu, C.: *Polypropylene – More and More Present in the Technical Field*, Bulletin I.P.I, Tom LVI (LX), Fasc 2, , page 9 -16, 2010.

[3] Cioară, L.: *Textile Structure and design*, Performantics Publ. House, Iassy, 2001.

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