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Performance of Chenille Yarns with Elastane

Abstract
The effect of the presence of elasthane in the structure of chenille yarn on the abrasion resistance, dimensional and physical properties of plain jersey fabrics is investigated in this experimental study. Based on the results obtained, it can be said that using elasthane in one of the cores of the chenille yarn results in the lowest amount of pile loss after abrasion, and a lower tendency to shrinkage, similar to that of fabrics without elasthane. It was also observed that for both dry relaxed and tumble dried fabrics, pile loss tends to be lower on the back of the knit structure.

Key words: *chenille yarn, core yarn, elasthane, pile loss.*

Introduction

Fancy yarns are an important element of fashion, and are currently in great demand by knitters and weavers. A fancy yarn is one that differs from the normal construction of single and folded yarns by deliberately produced irregularities in its construction [1].

Chenille yarn, which is a kind of fancy yarn, consists of short lengths of spun yarn or filaments that are held together by two ends of highly twisted fine strong yarn. The short lengths are called the pile, and the highly twisted yarns are called the core [2, 3]. They are traditionally used in the manufacture of furnishing fabrics and trimmings, fashion knitwear, and as decorative threads in many types of broad and narrow fabrics.

Chenille yarns' properties and their performance, mainly in terms of abrasion resistance, in woven and knitted fabrics, the effects of chenille yarn's properties – pile material type, pile length, and twist level – on the boiling shrinkage behaviour of chenille yarns, and the weavability of chenille yarns on air-jet looms, have all been reported by various researchers [4 – 12].

Nergis & Candan [13] further investigated the dimensional and physical properties of fabrics from different chenille yarns under different laundering conditions.

Piles give chenille yarns their characteristic appearance, and a high amount of pile loss after a short usage period is the main problem of fabrics made from chenille yarns. The aim of this work was to determine conditions for using elasthane yarn in the structure of chenille yarn which would be advantageous from the point of view of pile loss in a fabric manufactured from the yarn discussed. Such fabric properties as dimensional properties, bursting strength and thickness should be additional factors for estimating the best yarn structures and structure selection.

Materials and methods

Materials

OE-rotor cotton and OE-rotor viscose yarns were chosen as the pile of the chenille yarns because, in a previous study [4], it was reported that the use of OE-rotor yarns as pile yarns had the effect of decreasing pile loss against abrasion. Cotton pile yarns were used with cotton core yarns, and viscose pile yarns were used with viscose core yarns.

Nine different chenille yarns were produced with a final linear density of 250 tex, incorporating core yarns shown in Table 1, except 15 tex cotton ring yarn. When using 15 tex cotton ring yarn, it was impossible to produce chenille yarns due to frequent breakages. Plain jersey fabrics from these yarns were knitted on an E5 gauge flat hand-knitting machine. Yarn and fabric codes are listed in Table 2.

Table 2. *Yarn and fibre codes; The first number following the letters indicates the count of the core yarn used, and the second one indicates twist coefficient of the core yarn.*

Product	Codes	Description
Yarn	CE	Core spun ring yarn (Cotton-Elasthane)
	C	Ring yarn (Cotton)
	VE	Core spun ring yarn (Viscose-Elasthane)
Knitted fabric	A	CE-CE/20/7
	B	CE-CE/20/7/$_{\text{low twist*}}$
	C	C-C/20/7
	D	C-C/20/7/$_{\text{low twist*}}$
	E	CE-C/20/7
	F	CE-CE/20/7.4
	G	CE-CE/20/8.3
	H	CE-CE/15/7
	J	VE-VE/20/7.5

** The twist of chenille yarns in the fabrics with 'low twist' index is lower than that of the chenille yarns in the same coded 'fabrics' without any index.*

Methods

Some of the yardage of the knitted fabrics was set aside and dry-relaxed for 1 week in standard atmospheric conditions. The rest was first washed with a wetting agent using a standard washing machine at 40 °C (wool programme), and then tumble-dried at 70 °C in a household tumble dryer for 60 minutes. The washing and tumble-drying procedures were repeated five times, and then each group of fabrics, dry-relaxed and washed & tumble-dried was subjected to areal density, bursting strength, fabric thickness, abrasion resistance and dimensional stability tests according to the relevant

Table 1. *Properties of the core yarns; the yarn codes are described in Table 2.*

Yarn type	Linear density of yarn, tex	Linear density of yarn CV, %	Twist coefficient, α_{tex}	Twist CV, %	Tenacity, cN/Tex	Tenacity CV,%	Elongation at break, %	Elongation at break CV,%
CE	20	1.1	7.0	3.0	15.9	6.0	7.26	5.3
CE	20	0.7	7.4	4.2	13.1	6.6	7.15	5.4
CE	20	1.9	8.3	3.6	15.9	7.3	6.77	6.2
C	20	1.5	7.0	3.3	8.3	5.6	4.35	4.9
CE	15	1.4	6.3	4.9	13.4	5.0	7.27	4.5
C	15	0.8	6.3	2.5	7.8	4.8	3.41	4.6
VE	15	1.2	7.5	2.1	12.8	5.2	14.4	5.0

standards, ISO 3801, ISO 2960, BS 2544, BS 5690 and ISO 6330 respectively.

The abrasion resistance measurements were carried out with the help of a Martindale abrasion tester. At the end of 2500 rubs, the abrasion cycle was ended, as most of the piles had left the surface of the fabrics and they had started to attain a worn-out look. The abrasion resistance of the fabrics were evaluated according to their weight loss (%) (in other words, pile loss) after 2500 rubs. For each fabric sample, the abrasion tests were carried out 4 times. As is already known, plain jersey fabrics have wales on their face and courses on their back, and either side can be used as the fashion side. For this reason, the abrasion test was applied to both sides of the fabrics.

Results and discussion

The results of all the measurements carried out are given in Tables 3, 4 and 5. They served as the basis for the statements discussed below, and for the conclusions which I drew.

Abrasion resistance

The results (Figures 1a and 1b) can be evaluated as follows:

- After tumble-drying, the amount of pile loss decreased on both the front and back of the fabrics. The highest improvement in terms of pile loss was observed on viscose fabrics. This can be attributed to the dimensional changes observed on the fabrics after tumble-drying, where the knitted fabric structures become tighter. As a result, it became more difficult for the piles to be removed from the fabric structure.
- The pile loss on back of the fabrics was less than that on the front for dry relaxed fabrics. (Only 2 of the fabrics out of 9 showed higher pile loss on the back.)
- Although it is not as strong as the dry relaxed fabrics, the same tendency is present for the tumble-dried ones. (4 of the fabrics out of 9 showed higher pile loss on the back.)
- The presence of elasthane in either one or both of the core yarns improved the fabrics' pile loss behaviour. When there is no elasthane in the cores of the chenille yarns, pile loss is high on both the front and back of the fabrics. The lowest pile loss on both sides was observed in those fabrics where only one of the cores contained elasthane.
- The twist amount of core yarns does not seem to have any influence on pile loss.

Table 3. Results of the abrasion tests; the fabric codes are described in Table 2.

Fabric code	Dry relaxed fabrics-Front	Dry relaxed fabrics-Back	Tumble dried fabrics-Front	Tumble dried fabrics-Back
A	4.4	2.4	1.7	2.1
B	5.2	3.3	1.1	1.2
C	7.6	6.8	7.8	5.4
D	6.0	9.6	5.3	2.5
E	3.4	1.8	0.5	1.8
F	5.1	4.9	1.4	2.3
G	5.4	4.1	1.7	0.9
H	6.1	5.6	1.0	1.8
J	13.4	19.1	3.1	1.9

Dimensional properties

A comparative study of the fabrics from cotton chenille yarns showed that, unlike weft knitted fabrics from conventional yarns, there were no dimensional changes in dry-relaxed samples, since their stitch density values remained the same (Table 4), apart from the fabrics from viscose chenille yarns. However, as can be seen from Table 5, after tumble-drying, fabrics from cotton chenille yarns that do not contain any elasthane or that contains elasthane only in one of the core yarns tend to give the smallest stitch density values, whereas the stitch density values of the fabrics from cotton chenille yarns with elasthane in both cores are higher than those of the others. The stitch density of fabrics from elastic viscose chenille yarns is the highest. During relaxation, yarn characteristics determine the frictional properties of fabrics, and the presence of elasthane in both of the core yarns seems to increase the shrinkage potential of fabrics from chenille yarns.

From Table 5, it can also be seen that after tumble-drying, loop length remained more or less constant for all types of fabrics. The same Table and Figure 1c also illustrate the change in the loop shape factor after tumble-drying. This shows that distortions in the fabrics are a result of distortions in the loops themselves rather than in the yarn structure. The loop shape factor of fabrics from chenille yarns that contain elasthane in both cores seems to be within the range of 1.77 - 1.85, whereas that value for fabrics from chenille yarns that do not contain any elasthane is below 1.70. The behaviour of viscose yarns that contain elasthane in plain jersey knit structures needs further study.

Bursting strength and thickness of the fabric

No obvious influence of the presence of elasthane on bursting strength or thickness is seen. For all fabrics, bursting strength and thickness tend to increase after tumble-drying; this improvement can be attributed to the dimensional properties of the fabrics.

Conclusions

In this paper, the effect of the presence of elasthane in the chenille yarn structure on

Table 4. Properties of dry-relaxed knitted fabrics from chenille yarns; the fabric codes are described in Table 2.

Fabric code	Courses /10 cm	Wales /10 cm.	Loop density/ 100 cm^2	Loop length, cm	Loop shape factor k_r	Weight, g/m^2	Thickness, mm	Bursting strength, N/cm^2	Chenille yarn count. tex	Chenille yarn twist., t/m
A	36	24	864	1.440	1.50	263	2.88	54.9	137	870
B	36	24	864	1.432	1.50	280	2.88	58.8	144	800
C	36	24	864	1.430	1.50	258	2.78	53.9	140	870
D	36	24	864	1.428	1.50	270	2.95	51.9	144	800
E	36	24	864	1.502	1.50	302	3.11	54.9	147	900
F	36	25	900	1.438	1.40	262	2.96	51.9	134	890
G	35	24	840	1.432	1.50	293	2.86	53.9	131	910
H	36	24	864	1.418	1.50	293	2.98	49.0	147	900
J	37	27	999	1.346	1.37	317	2.72	50.9	140	860

Table 5. Properties of tumble-dried knitted fabrics from chenille yarns; the fabric codes are described in Table 2.

Fabric code	Courses /10 cm	Wales /10 cm.	Loop density /100 cm²	Loop length, cm	Loop shape factor k_r	Weight, g/m²	Thickness, mm	Bursting strength, N/cm²
A	49	27	1323	1.440	1.81	363	3.33	85.3
B	48	26	1248	1.493	1.85	382	3.26	107.8
C	42	25	1050	1.466	1.68	302	3.30	71.5
D	43	26	1075	1.468	1.66	322	3.12	60.8
E	43	25	1100	1.538	1.72	376	3.68	74.5
F	50	28	1400	1.400	1.78	395	3.31	111.7
G	50	27	1350	1.424	1.85	364	3.18	94.1
H	46	26	1196	1.503	1.77	359	3.47	79.4
J	43	53	2279	1.318	0.80	603	3.76	129.4

the abrasion resistance, dimensional and physical properties of plain jersey fabrics was studied.

For both dry-relaxed and tumble-dried fabrics, the pile loss tends to be lower on the back of the knit structure. In a plain jersey fabric, the loops have different appearances on the front and the back of the fabrics. Loops on the front side have a shape that allows good contact between the legs of the loops and the abrasive surface. However, it is only the peaks of the loops on the back of the fabrics that may contact the abrasive surface. This might be the reason for such a result. It would be advisable to study other knit structures' behaviour against abrasion in terms of pile loss.

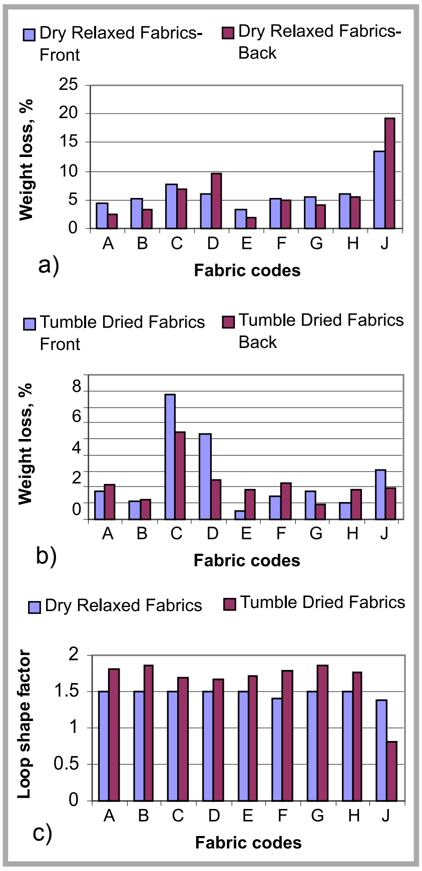

Figure 1. Pile losses and loop shape of the particular fabrics; a) pile loss on dry-relaxed fabrics after abrasion, b) pile loss on tumble-dried fabrics after abrasion, c) loop shape factor of fabrics.

After tumble-drying, the pile loss amount decreased on both sides of the fabrics. This can be attributed to the dimensional changes observed on the fabrics after tumble-drying. The use of elasthane in at least one of the cores of the chenille yarns seems to decrease the pile loss tendency. Pile loss occurs as a result of removal of piles from between the cores. The presence of elasthane renders the yarns elastic. When exposed to abrasive forces, yarns with elasthane might have elongated to some extent, and this might have slowed down the movement of the piles relative to the core/cores. In other words, the core yarns might have elongated in the direction of the movement of the piles, delaying their removal. The twist amount of the core yarns does not seem to have any influence on pile loss.

It is possible to say that dimensional changes occur as a result of changes in loop shape rather than loop length. The presence of elasthane in both of the core yarns seems to increase the shrinkage potential of plain jersey fabrics manufactured from chenille yarns. A proper setting procedure applied to such fabrics might eliminate this disadvantage.

The bursting strength and thickness of knits from chenille yarns do not seem to be influenced by the presence of elasthane at all.

Finally, it could be concluded that using elasthane in one of the cores of the chenille yarn results in the lowest amount of pile loss after abrasion, as well as a lower shrinkage tendency, similar to that of fabrics without elasthane.

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