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The Effect of Chenille Yarn Properties on the Abrasion Resistance of Upholstery Fabrics

Abstract

In this study, we have examined the effect of chenille yarn properties, pile length, twisting rate, and weaving construction on the abrasion resistance of upholstery fabrics. Different acrylic chenille yarns have been produced at three different twist levels with 0.7, 0.8 and 1.0 mm callipers. These yarns were then used in three different weaving constructions as weft yarn. All the samples were tested to observe abrasion resistance on the Martindale Abrasion Tester. The results indicate that twist levels, pile lengths, and weaving constructions have significant effect on the abrasion resistance of upholstery fabrics.

Key words: abrasion resistance, chenille yarn, pile length, twist level.

Introduction

A fancy yarn is one that differs from the normal construction of single and folded yarns by deliberately produced irregularities in its construction [5]. Fancy yarns help to create decorative effects in the fabrics. The use of fancy yarns is solely for aesthetic effects. The first such yarns, such as slubbed, bouchlé, and knop types, became established textile novelties in the last century, but it was only in the 1970s that non-traditional yarns experienced a boom in the market [7]. Today, fancy yarns are a very important product of spinning and twisting processes [3].

Chenille is a pile fancy yarn that has been produced commercially since the 1970s. Modern machinery was introduced in Europe and North America in the early 1990s, and today's chenille is a reliable and beautiful yarn that is gaining in popularity with each passing day.

Chenille yarn consists of short lengths of spun yarn or filament 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 or lock yarn.

Chenille yarn can be made from many different types of fibres and yarns, most commonly cotton, viscose, acrylic, and polypropylene. The lock and pile yarn can be of the same or a different material. However, filament yarns should not be used as lock yarn, because of easy pile loss due to the low friction between filament yarns and pile yarns. Chenille yarn can be made in many different sizes, ranging from as heavy as Nm 0.2 to as fine as Nm 15.0 [2-4].

Chenille yarn is manufactured on a machine designed to bring the pile yarns and lock yarns together. During manufacture, the pile yarns are wrapped around a short stem of polished metal called a calliper or gauge, through which a blade passes to cut the pile yarns into short lengths. The lock yarns are pressed onto the short lengths with a rotating wheel which is also called plywood. Basically, the calliper and plywoods are represented in Figure 1 [3].

The resulting yarn is then fed onto a traditional ring-twisting take-up mechanism. In the twisting process, the two ends of lock yarn twist and trap the short ends of pile between the lock yarns. The size of the calliper determines the diameter of the resulting yarn. The count of the lock and pile yarns, the number of the pile yarns and how many of them are fed onto the lock yarns determines the count of the chenille yarns.

After the twisting process, chenille yarns are rewound onto a cone or dye tube. An

electronic clearer is located in the yarn path in order to detect lengths of yarn that are missing pile in this rewinding process. When the electronic clearer detects a section of missing pile greater than the minimum setting specified (usually 3 mm), a cutter is electronically activated. The yarn is cut, and the winder operator then pulls the yarn back and cuts out the missing pile section, reties the yarn, and continues winding the package [2].

The chenille manufacturing process creates pile that lies in one direction. When woven into a fabric, chenille reflects light differently when viewed from different directions. This is known as the 'reflection effect', and is one of the unique and desirable characteristics of chenille goods. Because of this, strict control of the pile direction must be maintained during manufacturing, as must all subsequent

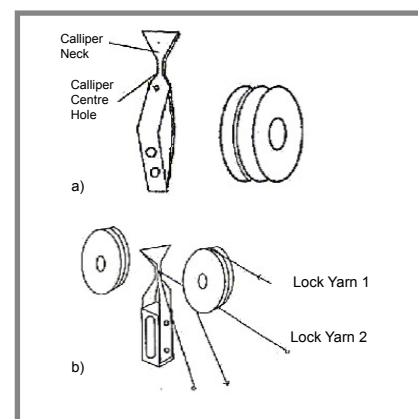


Figure 1. a) The calliper and plywood, b) Location of the calliper and plywoods.

processes required to convert the chenille into a finished article also be [2].

During the last decade, chenille yarns have found a wide range of application areas including outerwear fabrics, sweaters, furnishing fabrics, car interiors, blankets, and area rugs in the textile industry. Especially, furnishing fabric designers choose chenille yarns for many items because of their beautiful shiny appearance, reflection effect and softness.

In the literature, there are few studies about the fundamental parameters that characterise chenille yarns and their usage properties; thus the aim of this study is to fill this gap.

Materials and Methods

For chenille upholstery fabrics, the most important property is abrasion resistance due to occurring pile loss. Therefore in this study, the abrasion resistance of upholstery fabrics was related to some chenille yarn properties and weaving construction.

In order to investigate this relationship, we initially produced Nm 4 count 100% acrylic chenille yarns with different twist levels and pile lengths. Then these yarns were used as weft yarns to produce upholstery fabrics with three different weaving constructions.

The chenille yarns were produced using Ne 20/1 count, two lock and one pile yarn (650 T/m - Z) on a Giessi AC 91/E model chenille yarn machine with twist levels of 800, 850, 900 T/m and with pile lengths of 0.7, 0.8 and 1.0 mm. To ensure all the chenille yarns had the same count, that the head speeds on the machine were adjusted to 10 800, 9 800 and 9 400 rpm for 0.7, 0.8 and 1.0 mm pile lengths respectively. Production speed was held constant at 8 m/min.

Upholstery fabrics, which are double-cloth structure, were produced with three different constructions on a rapier weaving machine fitted with a jacquard. These constructions are given in Figure 2. Chenille weft yarns pointed with odd numbers in the Figure 2 were interlaced every six, eight and twelve warp yarns for A, B, and C weaving constructions respectively at the face of double-cloths upholstery fabrics. Ne 10 count cotton yarns pointed with even numbers in Figure 2 were also used as weft yarns. All

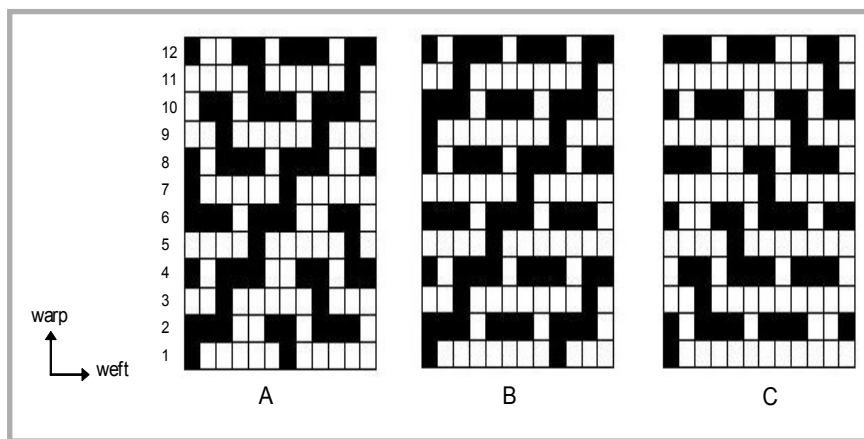


Figure 2. Constructions of upholstery fabrics used in the work.

samples have 66 ends/cm warp density and 21 pics/cm weft density. 150 denier polyester yarns were used as warp yarns.

Abrasion tests were performed on a Martindale Abrasion Tester. Before starting the abrasion tests, primary trials were made to determine the rubbing cycles that would be applied to the specimens of upholstery fabrics. Since the number of rubs at which specimen breakdown occurred between 10 000 - 15 000 rubbing cycles for our samples, mass loss values were determined at the end of 5000, 7500, and 10 000 rubbing cycles, according to BS EN ISO 12947-3 standards. Three tests were made for each set of samples. The results were also tested

for significance in differences using three-way repeated measures analysis of variance, and the means were compared by Student-Newman-Keuls (SNK) tests at 0.05 level in the COSTAT statistical package.

Results and Discussion

The results of the analysis of the variance for mass loss values are summarised in Table 1. The P values in Table 1 show that there are statistically significant differences between mass loss values for different twist levels and weaving constructions at all rubbing cycles. The effects of interactions between twist level and weaving construction, and also

Table 1. Analysis of variance for mass loss values.

Parameter		P value		
		0-5000	0-7500	0-10 000
Main effect	Twist level (T)	0.0000	0.0000	0.0000
	Pile length (P)	0.0022	0.0353	0.0635 ns
	Weaving const. (W)	0.0000	0.0000	0.0000
Interaction	T x P	0.0065	0.0289	0.1880 ns
	T x W	0.0000	0.0000	0.0000
	P x W	0.0202	0.0407	0.0408
	P x T x W	0.0002	0.0009	0.0023

Table 2. Effects of pile lengths and twist levels of chenille yarns and weaving construction of upholstery fabrics on abrasion resistance, Student-Newman-Keuls Test.

Parameter		Average mass loss, mg		
		0-5000	0-7500	0-10 000
Twist level, T/m	800	13.740 a	23.555 a	32.333 a
	850	7.814 b	13.740 b	19.333 b
	900	4.555 c	8.037 c	10.925 c
Pile length, mm	0.7	10.111 a	16.592 a	22.296 a
	0.8	8.629 ab	14.481 b	20.444 a
	1.0	7.370 b	14.259 b	19.851 a
Weaving construction	C	12.333 a	21.666 a	29.592 a
	B	8.481 b	14.629 b	20.444 b
	A	5.296 c	9.037 c	12.555 c

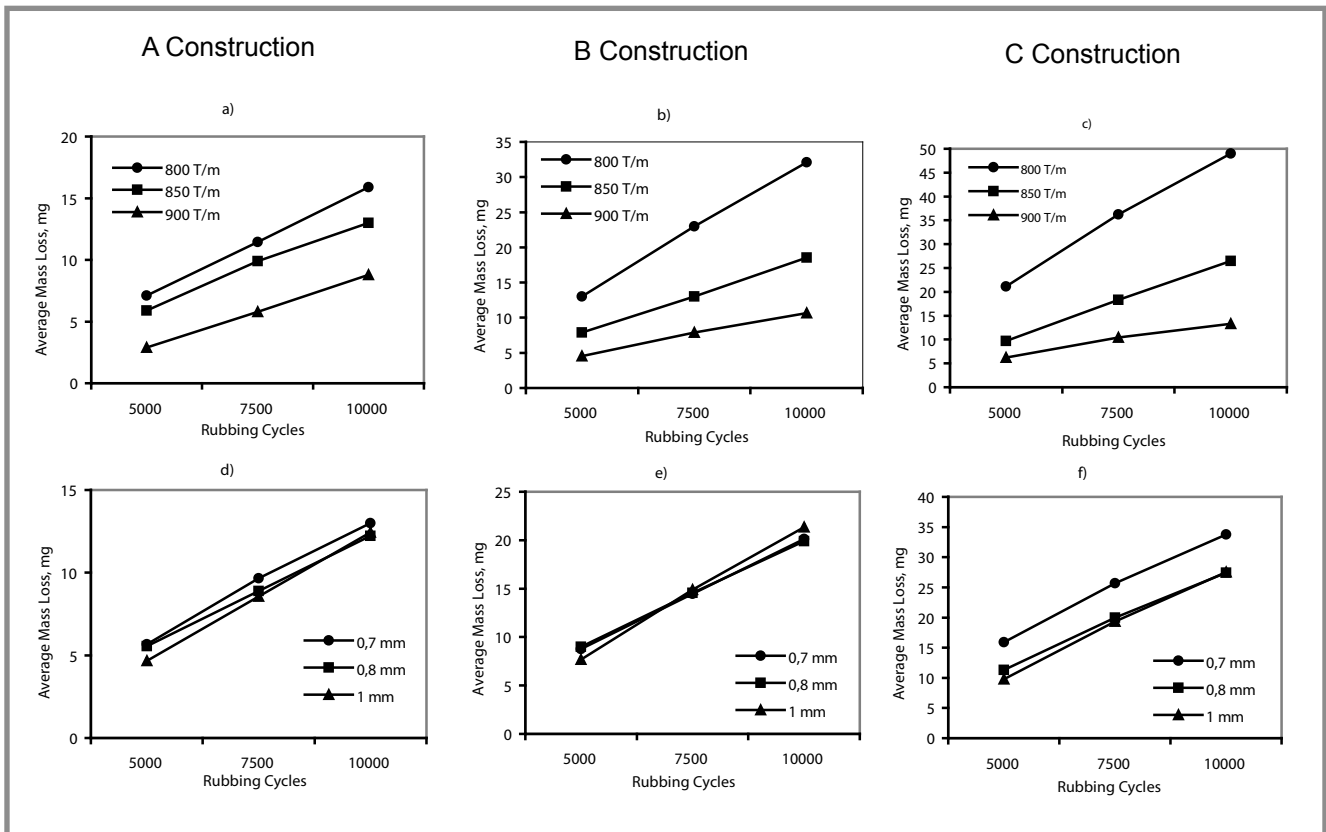


Figure 3. Average mass loss values versus rubbing cycles for different twist levels (a,b,c), and for different pile lengths (d,e,f).

between pile length and weaving construction, are statistically significant for mass loss values.

The SNK test results given in Table 2 show that the average mass loss has a tendency to decrease with increasing twist level. Figure 3 (a,b,c) show that this tendency is the same in all weaving constructions. Based on these results, we may postulate that as the twist level of chenille yarn decreases, pile yarns may not be held well by lock yarns and can be easily pulled out. In other words, the twist level of chenille yarns affects the degree of pile packing.

According to the ANOVA results, pile length was a significant factor affecting

upholstery fabrics' abrasion resistance at the 5000 and 7500 rubbing cycles. However, the effect of pile length has a tendency to decrease with increasing rubbing cycle. For the 10 000 rubbing cycle, pile length was not a significant factor on abrasion resistance. Similarly, the interaction between twist level and pile length was an insignificant factor at the 10 000 rubbing cycle. Since all the chenille yarns used in our work have the same linear density, Nm 4, the difference of mass loss values decreases with the increase in the rubbing cycle. Figure 3 (d,e,f) illustrates the mass loss values of fabrics versus rubbing cycles for three different pile lengths at three different weaving constructions. The reduction in mass loss values with increased pile

lengths can be attributed to the fact that short piles can be easily removed from the twists of lock yarn as compared with long piles.

The mass loss values of fabrics also changed when different weaving constructions were used. The results from the analysis of variance show that there is a statistically significant difference between different weaving constructions for mass loss readings at all rubbing cycles.

As a result, we can conclude that the surface characteristics of upholstery fabrics exposed to abrasion are very important for abrasion resistance. The interactions of weaving construction with twist level and pile length also have significant effects on abrasion resistance for all rubbing cycle, as shown in Table 1.

We plotted the average mass loss values versus rubbing cycles for all the weaving constructions in Figure 4. It can be seen that as the existence of chenille yarns on the fabrics' surface increases, mass loss also increases.

Conclusions

Our findings show that there is a tendency to an increase in the pile loss read-

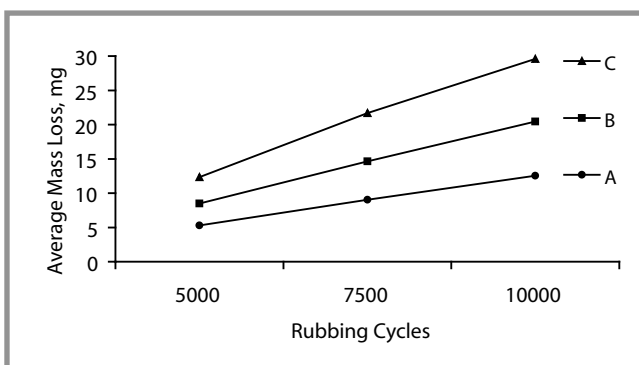


Figure 4. Average mass loss values versus rubbing cycles for the weaving constructions.

ings with the decrease in the twist level of chenille yarns, since individual fibres of pile in low twist level can be easily pulled out from between lock yarns. Yarn twist affects both yarn shape and the degree of pile packing. Because of the low twist, chenille yarns tend to flatten; a greater surface may be exposed to abrasion, while the higher twist chenille yarn maintains its roundness and cohesiveness.

Based on the results, we also conclude that pile length is one of the properties of chenille yarn which affect the abrasion resistance of upholstery fabrics. It is hard to remove longer fibres incorporated into the twists of the chenille yarns than short fibres. Pile loss readings show a tendency to decrease with increasing pile length. But this tendency changes with an increase in the rubbing cycle, since all the chenille yarns have the same linear density.

Also, the appearance rate of chenille yarns on the surface of upholstery fabrics related to weaving constructions is another important factor on the abrasion resistance, since chenille yarn is very vulnerable yarn to rubbing.



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