Factors influencing the abrasion properties of chenille yarns

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The effect of material type, pile length and twisting rate on the abrasion properties of chenille yarns has been studied. Twenty-seven different chenille yarns have been produced using three different twist levels (800, 850 and 900 twists/m) and three different pile lengths (0.7, 0.8 and 1.0 mm) from three different materials (cotton, viscose and acrylic) and then used as weft yarn for producing upholstery fabrics. It is observed that the material type, twist level and pile length have significant effect on the abrasion resistance of chenille yarns. The abrasion resistance of cotton chenille yarns is found to be higher followed by the acrylic chenille yarns and viscose chenille yarns.

Keywords: Abrasion resistance, Acrylic yarn, Chenille yarn, Cotton yarn, Pile length, Twist level, Viscose yarn

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Nowadays, the fancy yarns are one of the most important products of spinning and twisting process. A fancy yarn is one that differs from the normal construction of single and folded yarns by deliberately produced irregularities in its construction. Fancy yarns are generally used by designers to create interesting decorative effects in the fabrics.

Chenille is one kind of fancy yarn that has been produced commercially since 1970s. Differing from classical yarn structure, the chenille yarns have softy, fuzzy and lofty surface characteristics. Chenille yarns consist of short lengths of spun yarns or filaments that are held together by two ends of highly twisted fine strong yarns. The short lengths are called pile and the highly twisted yarns are called core or lock yarn. Chenille yarns can be produced from different types of yarns, such as cotton, viscose, acrylic and polypropylene. Same or different materials can be used as lock and pile yarns. Due to easy pile loss because of the low friction between filament yarns and pile yarns, the filaments should not be used as lock yarn.

Chenille yarns can be made in many different sizes, ranging from heavy (0.2 Nm) to fine (15.0 Nm). Chenille yarn production system is shown in Fig. 1. Chenille yarns are manufactured on a machine that is designed to combine the pile yarns and lock yarns together. During the manufacturing process, the pile yarns are wrapped around a short stem of polished metal, called a caliper, through which a rotating blade cuts the pile yarns into short lengths. The lock yarns are pressed onto the short lengths with grooved rollers.

The combined yarn is then fed onto a traditional ring twisting take-up process in which the two ends of lock yarns are twisted in order to trap the short ends of pile between the lock yarns. The size of the caliper determines the diameter of combined yarn. Chenille yarn count is determined by lock yarn count, pile yarn count and amount of pile yarns fed onto the lock yarns.

Especially, the furnishing fabric designers choose chenille yarns for many applications because of their beautiful shine appearance, reflection effect and softness. One of the main problems which furnishing fabric producers face is pile loss problem. Even this problem is related with surface characteristics of furnishing fabrics. The abrasion properties of chenille yarn affect pile loss degree of furnishing fabrics in which chenille yarn is used.

![Chenille yarn production system](image-url)
There are limited studies about the fundamental parameters that characterize chenille yarns and their usage properties. In the present work, some factors, namely material type, pile length and twisting rate, influencing the abrasion properties of chenille yarns have been studied.

Initially, 4 Nm count of acrylic, cotton and viscose chenille yarns were produced with different twist levels and pile lengths to investigate factors influencing the abrasion properties of chenille yarns. Then, these yarns were used as weft yarns to produce sample upholstery fabric which was used for the abrasion tests.

All types of chenille yarns were produced using Ne 20/1 count, two lock yarns and one pile yarn (650 twists/m, Z twist) on a chenille yarn machine with twist levels of 800, 850 and 900 twists/m and pile lengths of 0.7, 0.8 and 1.0 mm. To make all the chenille yarns to be of the same count, the head speeds on the machine were adjusted as 10800, 9800 and 9400 rpm for 0.7, 0.8 and 1.0 mm pile lengths respectively. Production speed was held constant at 8 m/min.

Upholstery fabric, which is a double-cloth structure, was produced on a rapier weaving machine fitted with a jacquard. The weaving construction is shown in Fig. 2. Sample fabric had 66 ends/cm warp density and 21 picks/cm weft density. Polyester yarns of 150 denier were used as warp yarns. Chenille yarns and cotton yarns (10 Ne count) were used as weft yarns. These are pointed with odd numbers and even numbers respectively in Fig. 2.

Abrasion tests were performed on 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 fabric. Since the number of rubs at which specimen breakdown occurred between 10000 and 15000 rubbing cycles for the sample fabrics studied, mass loss values were determined at the end of 5000, 7500 and 10000 rubbing cycles according to BS EN ISO 12947-3 standards. Three tests were carried out for each sample. Results were also tested for significance in differences using there-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.

The analysis of variance results for mass loss values are given in Table 1. P-values show that there are statistically significant differences between mass loss values for different material types, pile lengths and twist levels at all rubbing cycles.

Results from analyses of variance and SNK tests show that there is statistically significant difference between different material types for mass loss readings at all rubbing cycles. Interactions of material types with pile lengths and twist levels also have significant effects on abrasion resistance for all rubbing cycles (Table 1). Cotton has good abrasion resistance while acrylic and viscose have a lower abrasion resistance. It is stated that although the high elastic energy of fibres is the main factor necessary to prevent inherent abrasion damage, the yarn extensibility, surface and friction must also be taken into account. Therefore, the surface characteristics of viscose and acrylic yarns also affect pile loss of chenille yarns.

SNK test results (Table 2) show that the average mass loss has a tendency to decrease with the increase in twist level for all rubbing cycles. It can also be observed from Fig. 3. Based on these results, it may be
Table 2—Effect of material type, pile length and twist level on the abrasion resistance of chenille yarns (Student Newman-Keuls test)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Average mass loss, mg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0-5000) \textsuperscript{a}</td>
</tr>
<tr>
<td>Material type</td>
<td></td>
</tr>
<tr>
<td>Viscose</td>
<td>25.222 \textsuperscript{a}</td>
</tr>
<tr>
<td>Acrylic</td>
<td>8.481 \textsuperscript{b}</td>
</tr>
<tr>
<td>Cotton</td>
<td>4.444 \textsuperscript{c}</td>
</tr>
<tr>
<td>Pile length, mm</td>
<td></td>
</tr>
<tr>
<td>0.7</td>
<td>14.851 \textsuperscript{c}</td>
</tr>
<tr>
<td>0.8</td>
<td>12.185 \textsuperscript{b}</td>
</tr>
<tr>
<td>1.0</td>
<td>11.111 \textsuperscript{b}</td>
</tr>
<tr>
<td>Twists/m</td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>19.222 \textsuperscript{a}</td>
</tr>
<tr>
<td>850</td>
<td>11.185 \textsuperscript{b}</td>
</tr>
<tr>
<td>900</td>
<td>7.740 \textsuperscript{c}</td>
</tr>
</tbody>
</table>

\textsuperscript{a,b,c} Factor levels having same letters are not different from each other at 0.05 significance level

\textsuperscript{d} Abrasion cycles.

According to ANOVA results, pile length is also a significant factor affecting the abrasion resistance of upholstery fabrics at all rubbing cycles. Reduction in mass loss values with the increased pile length can be attributed to the fact that short piles can be easily removed from the twists of lock yarn as compared to the long piles. Since all the chenille yarns used have the same linear density (4 Nm), the difference of mass loss values between different pile lengths decreases with the increase in rubbing cycles (Fig. 3).

It is inferred that the abrasion resistance of cotton chenille yarns is higher than that of viscose and acrylic chenille yarns. Also, the acrylic chenille yarns have better abrasion resistance than the viscose chenille yarns. These findings can be related with the differences in surface characteristics and extensibility properties of viscose, acrylic and cotton chenille yarns.

There is a tendency of increase in the pile loss with the decrease in twist level of chenille yarns, since the individual fibres of pile at low twist level can be easily pulled out from lock yarns. Yarn twist affects yarn shape as well as degree of pile packing. The low twist chenille yarns tend to flatten and as such greater sur

Fig. 3—Average mass loss values vs pile lengths and twist levels for different types of chenille yarns at different rubbing cycles face may be exposed to abrasion while higher twist chenille yarns maintain their roundness and cohesionness.

Pile length is one of the chenille yarn properties which affects abrasion resistance of upholstery fabrics. It is hard to remove longer fibres incorporated into the twists of chenille yarns in comparison to short fibres. Pile loss shows a tendency of decrease with the increase in pile length. But this tendency changes with the increase in rubbing cycles since all the chenille yarns have the same linear density.

Here, the abrasion resistance of chenille yarns has been measured at weaved fabric form. It will be useful to measure the abrasion resistance of chenille yarns in the yarn form for further studies.

Acknowledgement

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