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Pilling Performance of Cashmere Knitted Fabric of Woollen Ring Yarn and Mule Yarn

Abstract

The yarn for cashmere knitted fabric is mainly processed by ring spinning and mule spinning. In this paper, four kinds of cashmere dye colours (red, black, grey, and beige) were selected to compare the pilling performance of cashmere knitted fabric of mule yarn and ring yarn. The pilling rates of the fabrics for different colours and spinning methods were tested using ICI's Pilling Box, and the worn-off weight of the pill and fuzz for each sample was measured using an electronic balance. The results showed that the pilling rate of cashmere knitted fabric of mule yarn is higher than that of ring yarn, and that the worn-off weight of cashmere knitted fabric of mule yarn is less than that of ring yarn.

Key words: cashmere knitted fabric, ring yarn, mule yarn, pilling.

Introduction

There are many factors, such as the yarn spinning system, fabric construction and finishing operation, which affect abrasion resistance and pilling performance [1]. Özdil et al. compared knitted fabrics from compact spun yarns with classic ring spun yarns and reported that knitted fabric from compact yarns demonstrated better pilling performance [2]. Candan & Önal evaluated the pilling performance of weft knitted fabric made of open-end and ring spun yarns. They reported that 100% cotton samples knitted from ring spun yarns tend to have lower pilling rates than those constructed from 100% cotton open-end spun yarns [3]. Beltran et al. [4] compared piling performance among fabrics made from conventional worsted spun yarns, solospun ring spun yarn, and jetwind modified yarns, and found that compared to conventional ring spun yarn fabric, the pilling performance of solospun yarn fabric and jetwind modified yarn fabric showed a half grade and full grade improvement, respectively. As an expensive textile material, cashmere fibre exhibits a small diameter, short length and smooth surface. The pilling of cashmere knitted fabric has attracted the attention of consumers, manufacturers and researchers. Li et al. [5] reported that the relationship between the pilling rates of cashmere knitted fabric and yarn properties was obtained using optimal

scaling regression analysis. For the same spinning method, the dye colour of cashmere fibre is of primary importance in influencing fabric pilling rates, followed by the interaction of the actual yarn twist and its CV, and the yarn tensile strength. Generally two spinning methods are used for processing cashmere knitting yarn, that is, ring spinning and mule spinning. For ring spinning, drafting, twisting and winding are done at the same time. However, for mule spinning, a few twists are added during drafting, and then the spindle rotates to twist the yarn to the twist designed after the drafting is finished, after which winding is done. Because a few twists are added during drafting for mule spinning, yarn unevenness is decreased. Moreover Liu and Wang [6] compared the cashmere yarn structure of ring, mule and rotor spinning by means of SEM observations. They reported that the structure of cashmere mule yarn was compacted and the hairiness of cashmere mule yarn was less than that of cashmere ring yarn and rotor yarn. In this paper, the pilling performance of cashmere knitted fabric from ring yarn and mule yarn was compared.

Experimental

Material

Cashmere knitting yarns (26 Nm/2) were spun by ring spinning and mule spinning, respectively. Before spinning, the cashmere fibres were firstly dyed. Four kinds of cashmere dyed fibres were selected for each spinning method, that is, black, grey, beige, and red. The knitted fabrics were of plain stitch and the fabric density was 10.2 - 11.5 yarns/inch. Cashmere mule yarn unevenness was from 9.82 - 11.77%, and that of cashmere ring yarn - from 11.56 - 12.3%.

Pilling rates test

The pilling rates were tested using ICI's Pilling Box. The test time was 2, 3, 4 and 5 h. The pilling of the fabrics was tested and rated by an experienced test person. The pilling standards used for rating the fabrics had the following scales: 5 - no pills, 4 - slight pilling, 3 - moderate pilling, 2 - severe pilling, 1 - very severe pilling. The wear-off weight given by ICI's Pilling Box for each sample was measured using an electronic balance.

Analysis and discussion

The pilling rates of cashmere knitted fabric from ring yarn and mule yarn for different test times are shown in **Figure 1**. From the test results, it is shown that the pilling-resistance of cashmere knitted fabric of mule yarn is better than that of ring yarn. It is possible that cashmere mule yarn has a compacted structure and less hairiness, which makes fabric few fuzz during the pilling test. With an increase in the test time, the piling rates of cashmere knitted fabric decrease, because sample rub with the box cork liner increases with the test time, which makes sample fuzz increase, especially for ring yarn, owing to its loose structure. The fuzz entangles into pill on the surface of the sample.

The pill and fuzz on the sample can be worn off from the surface of the sample during the pilling test. **Figure 2** shows the worn-off weight of pill and fuzz for each sample. For the same dye colour of cashmere yarn and test time, worn-off weight for the fabric of ring yarn is higher than that of mule yarn. Moreover the worn-off weight of pill and fuzz increases with the test time. The magnitude of fibre fuzz and the process of pill worn-off depend on fibre tenacity, bending, twisting, and migrating capabilities [7]. The extent of initial fuzz is influenced by

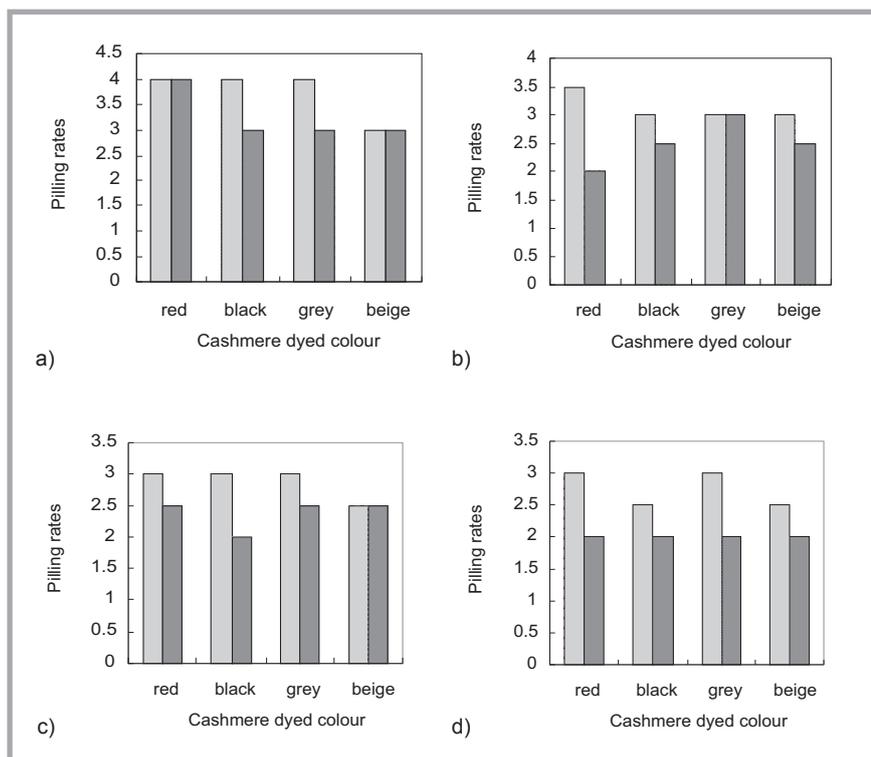


Figure 1. Pilling rate for: a) 2 h, b) 3 h, c) 4 h, d) 5 h test; □ mule yarn, ■ ring yarn.

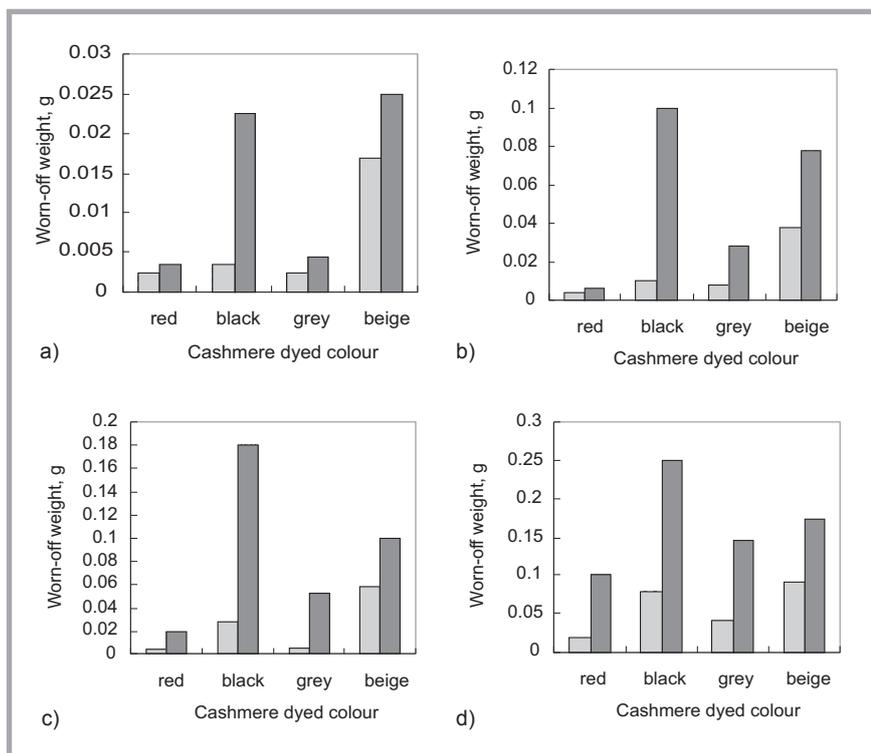


Figure 2. Worn-off weight for: a) 2 h, b) 3 h, c) 4 h, d) 5 h test; □ mule yarn, ■ ring yarn.

yarn hairiness, and the compacted yarn structure possesses a greater resistance to migration towards the yarn surface from an increase in frictional action. The projecting fibres, or yarn hairiness, must be considered as free fibre ends forming fabric surface fuzziness and subsequently develop pills.

Conclusions

The pilling of cashmere knitted fabric is influenced by the spinning method. For the same dye colour of cashmere yarn and test time, the pilling rates of cashmere knitted fabric of mule yarn are higher than that of ring yarn, and the worn-off

weight of the pill and fuzz of cashmere knitted fabric of mule yarn is lower than that of ring yarn. For mule yarn and ring yarn, the pilling rates of cashmere knitted fabric of four colour yarns have a tendency to decrease with an increase in the test time. The pilling rates of the samples of four colour ring yarns are grade 2 for a 5 h test, but the pilling rates of the samples of four colour mule yarns are not less than 2.5 grade. The worn-off weight of samples of red yarn is less than that of the sample of the other three colour yarns for mule yarn and ring yarn. The worn-off weight of samples of four colour ring yarns has an obvious increase with an increase in the test time. Thus mule yarn is suitable for cashmere knitting in order to decrease the pilling of the fabric.

Acknowledgements

We would like to thank the Education Department of Shaanxi Province and Science and Technology Department of Xi'an City of Shaanxi Province. This project is funded by the Education Department of Shaanxi Province (Project No. 08JK297), Science and Technology Department of Xi'an City of Shaanxi Province (Project No. CXY1018), and the key disciplines of Shaanxi Province (Project No. (2011)176).

References

1. Akaydin M, Can Y.; Pilling Performance and Abrasion Characteristics of Selected Basic Weft Knitted Fabrics. *Fibres & Textiles in Eastern Europe*, 2010; 18: 51-54.
2. Özdil N, Özdoğan E, Demirel A, Öktem T. A Comparative Study of the Characteristics of Compact Yarn-Based Knitted Fabrics. *Fibres & Textiles in Eastern Europe* 2005; 13: 39-43.
3. Candan C, Önal L. Dimensional, Pilling, and Abrasion Properties of Weft Knits Made from Open-End and Ring Spun Yarns. *Textile Research Journal* 2002; 72: 164-169.
4. Beltran R, Wang L, Wang X. A controlled experiment on yarn hairiness and fabric pilling. *Textile Research Journal* 2007; 77: 179-183.
5. Li L, Jia G, Zhou W. Effect of Yarn Properties on the Pilling of Cashmere Knitted Fabric. *Fibres & Textiles in Eastern Europe* 2009; 17: 76-79.
6. Liu J, Wang S. Study on the Knitted yarn of Cashmere fibers. *Shanghai Textile Science & Technology* 1998; 26: 19-20.
7. Ukponmwan JO, Mukhopadhyay A, Chatterjee KN. Pilling. *Textile progress* 1998; 28: 1-58.

Received 18.03.2013 Reviewed 20.06.2013