Study on Anti Pilling Finishing of Embroidery Products

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Abstract. The problem of easy pilling of embroidery has become a pain point of consumption. The water-soluble polymer finishing agent is applied on the embroidery along the embroidery pattern line with a brush. The treated embroidery is ironed and solidified with an iron. Natural extract finishing agent was used for secondary reinforcement in the later use. The results show that the film with good mechanical properties and transparency can be formed on the surface of embroidery fiber when the finishing agent concentration is 0.6 wt%. The breaking strength of embroidered silk fiber is improved and the fuzzing degree is reduced. The fuzzing resistance of the finished embroidery decreased with the increase of washing times. The fuzzing resistance of the finished embroidery was restored to a certain extent after the secondary reinforcement with 0.2 wt% Gleditsia sinensis gum.

1. Introduction
Embroidery is a craft of embroidering various exquisite patterns on silk, velvet, and cotton threads on silk, satin, cloth and other base fabrics with the help of needles to pierce and pierce. It is a traditional national craft that is both ornamental and practical. It is a traditional national craft in my country and the world. Precious cultural heritage. With the development and reform of economy and culture, the application of embroidery is no longer limited to traditional clothing and craft exhibits, but to embroidered scarves, bags, shoes and many other new fields. The application of embroidery in these products greatly improves the added value of related products, and is also one of the important contents of the transformation and upgrading of silk industry[1][2]. However, the structure of the embroidery pattern is loose, and the length of the surface embroidery thread is different, and the embroidery thread floating on the surface of the fabric is easy to be friction and damage in the process of use, resulting in fuzzing, which reduces the aesthetic feeling and consumer experience of the product, and highlights the seriousness of easy pilling of embroidery.

There is a lack of research on anti pilling finishing of embroidery at home and abroad, and there is not much experience for reference [3][4][5]. The research on silk finishing with water-soluble polymer [4][5] carried out by the project team in the early stage is of high relevance. It is necessary to supplement and improve the process conditions and detection and evaluation methods, so as to form a complete anti pilling finishing scheme for embroidery products. It mainly includes the following problems: (1) The traditional dip rolling finishing process makes the pattern part and the substrate part of the embroidery need to be finished by the finishing agent. Therefore, it is urgent to develop the corresponding finishing technology according to the characteristics of embroidery. (2) Most of the anti pilling finishing agents on the market are O/W emulsions. When finishing embroidery, it is easy to produce obvious water stains on the edges of embroidery patterns. In addition, the organic solvents in the finishing agent can easily lead to the dissolution and exudation of Spiraea dyes. Therefore, the finishing agent also needs to be optimized. (3) At present, there is no national standard for testing and evaluating the anti pilling performance of embroidery. Therefore, it is necessary to develop the testing and evaluation method of anti pilling performance of embroidery according to the characteristics of
embroidery fuzzing.

In this paper, anti pilling finishing technology of Suzhou embroidery was studied, and a new anti fuzzing finishing method for embroidery was developed. The finishing process is simple and feasible, suitable for batch finishing, and the finished embroidery products basically maintain the original luster and handle, which has a good effect and market prospect.

2. Experiment

2.1. Experimental Materials and Equipment
Embroidery products (Suzhou xiuyanliaoxia Embroidery Technology Co., Ltd.); Tm3030 scanning electron microscope (HiTAC company, Japan); Yg502 fuzz pilling instrument (Changzhou Taylor Instrument Technology Co., Ltd.); Check III spectrophotometer (American Datacolor company), etc.

2.2. Method

2.2.1. Development of anti pilling finishing process
The base material of embroidery is not easy to form wool due to single fiber fracture, so it is necessary to avoid the base material part in anti fuzzing finishing of embroidery. In order to solve the problems such as the hardness of embroidery and the water stain on the substrate caused by the dip rolling process, this project tested the anti fuzzing finishing of embroidery with brush method.

2.2.2. Optimization of anti pilling finishing agent
The anti pilling O/W emulsion finishing agent used in traditional textiles in the market has many shortcomings. In this paper, water-soluble substances were selected for anti fuzzing finishing of embroidery, including water-soluble polymer a [6], water-soluble PVA polymer with medium alcoholysis degree as the main active component. Water soluble vegetable gum components include acacia gum [7], guar gum [8], etc.

2.2.3. Establishment of anti fuzzing performance test method
GB / T4802 and other national standards adopted by traditional textiles are not suitable for embroidery products. In order to evaluate the anti pilling performance of embroidery products after testing, anti pilling performance evaluation is needed. Based on the reference of GB / T4802.1-2008 "determination of pilling properties of fabrics Part 1: circular locus method" [9], the sample position and evaluation method are improved, mainly including the following two parts: a) sample position improvement: in this project, the complete embroidery sample is tightly hooped on the grinding table with large area in the instrument by using bamboo hoop. b) Improvement of abrasives: chemical fiber, cotton, hemp and handbag have been tested successively. Through the test, the mounting substrate material suitable for wear resistance, hardness and roughness is selected as abrasives. After cutting, it is clamped in the test chuck above the instrument for the fuzzing test of embroidery. c) Improvement of evaluation method, the higher the grade, the better the anti pilling performance.

3. Results and Discussion

3.1. Effects of Different Finishing Processes on Embroidery
It can be seen from table 1 that with the increase of the concentration of finishing agent, the overall feel of embroidery becomes more and more stiff and astringent. On the premise of acceptable handle, the maximum allowable concentration of finishing agent for dip rolling method is 0.4 wt%, and the maximum allowable concentration of finishing agent for brush method is 0.6 wt%, which is because brush finishing can avoid the influence on embroidery substrate.
### Table 1. Hand feeling, color difference and water stain of substrate after different processing

| concentration (wt%) | Finishing technology | feel      | chromatic aberration | Water stain on substrate | Fuzzing resistance (grade) |
|---------------------|----------------------|-----------|----------------------|--------------------------|----------------------------|
| 0.2                 | Immersion -Rolling   | Acceptable| 4-5                  | Yes                      | /                          |
|                     | brush                | Acceptable| 4-5                  | No                       | No                         |
| 0.4                 | Immersion -Rolling   | Hard and astringent | 4-5                  | Yes                      | /                          |
|                     | brush                | Acceptable| 4-5                  | No                       | 1                          |
| 0.6                 | Immersion -Rolling   | Hard and astringent | 3-4                  | Yes                      | /                          |
|                     | brush                | Acceptable| 3-4                  | No                       | 2                          |
| 0.8                 | Immersion -Rolling   | Hard and astringent | 3-4                  | Yes                      | /                          |
|                     | brush                | Hard and astringent | 3-4                  | No                       | 3                          |
| 1.0                 | Immersion -Rolling   | Hard and astringent | 3                   | Yes                      | /                          |
|                     | brush                | Hard and astringent | 3                   | No                       | 3                          |

With the increase of the concentration of finishing agent, the color difference of embroidery patterns after finishing by the two methods also showed a trend of deterioration, and the change law was basically the same. When the concentration of finishing agent reached 1.0 wt%, the color difference was more obvious and dropped to grade 3.

Because the distribution of finishing agent on the substrate can not be completely uniform, uneven water stains will be formed on the base material for the embroidery samples finished by dip rolling method, which greatly affects the appearance of embroidery. For the embroidery finished by brush method, the finishing agent is basically infiltrated into the embroidery line part of the pattern, and a small amount of finishing agent will penetrate into the base material of the edge of the embroidery pattern.

With the increase of the concentration of the finishing agent, the anti fuzzing performance of the embroidered fabric is gradually enhanced. After finishing with 0.8 wt% and 1.0 wt% finishing agents, the anti pilling performance of embroidery is improved significantly, reaching level 3. However, the handle of embroidery is very hard and can not meet the requirements. Therefore, the concentration of finishing agent is 0.6 wt%.

#### 3.2. Effect of Different Finishing Agent Concentration on Spiraea Fiber

It can be seen from Figure 1 that the surface of the original Spiraea fiber is relatively smooth, and there is an obvious separation state between the fibers. When the finishing agent concentration is lower than 0.6 wt%, the film solidified on the surface of the fiber is more uniform, the adhesion between the fibers is less, and the fibers are more separated. When the concentration of finishing agent is more than 0.8 wt%, the adhesion between fibers increases obviously, which leads to the state of fiber bundles formed by cohesion, resulting in the difficulty of sliding between fibers and the harder and more astringent hand feeling, which corresponds to the results of Table 2 embroidery hand feeling hard and astringent.
3.3. Effect of Washing on Anti Pilling of Embroidery

It can be seen from table 2 that there is no significant difference between the anti pilling performance of the finished embroidery after washing for 1-3 times and that of the original sample, which are all grade 2; the anti pilling performance of the finished embroidery after washing for 4 times and 5 times is reduced to grade 1, and the overall anti pilling performance of the embroidery shows a decreasing trend with the increase of washing times.

| Washing times | 0   | 1   | 2   | 3   | 4   | 5   |
|---------------|-----|-----|-----|-----|-----|-----|
| Fuzzing resistance (grade) | 2   | 2   | 2   | 2   | 1   | 1   |

**Note:** concentration (wt%): 0.6; finishing process: daubing; finishing amount (g/cm²): 0.0145

3.4. Follow up Maintenance Analysis of Anti Pilling Embroidery Products with Plant Ingredients

The water soluble plant components of Gleditsia sinensis, such as galactomannan, are sprayed on the polymer membrane prepared by 0.6wt% water soluble polymer finishing agent, and then can be reformed on the polymer membrane on the surface of the embroidery thread. When the concentration was 0.2 wt%, the secondary film formation of Gleditsia sinensis gum on the surface of fiber polymer membrane was continuous and uniform, and the adhesion between fibers did not increase significantly.

4. Conclusion

After finishing the embroidery products with optimized finishing process and finishing agent, the film with good mechanical properties can be formed on the surface of the embroidery fiber, and improve the anti pilling performance of the embroidery products. At the same time, the reasonable use of the finishing process and finishing agent can ensure that the softness of the finished embroidery products is acceptable, the color difference of the embroidery is small, and the appearance has no obvious change.

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