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# Shrinkproof Effects of Shrinkproof Finished Wool Knit

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## Ⅰ. Introduction

The surface of the wool fiber, Cuticle, is made up of an epicuticle and a horny, nonfibrous layer of scales. The epicuticle is a thin, nonprotein membrane that covers the scales. This layer gives abrasion resistance and water repellency to the fiber, but is easily damaged by mechanical treatment. Under mechanical action, such as agitation, friction, and pressure in the presence of heat and moisture, the wool fiber tends to move rootward and the edges of the scales interlock, thus preventing the fiber from returning to its original position in the fabric. The result is the shrinkage, or felting, of the cloth, which makes the laundering of wool more difficult. Dry-cleaning is the recommended care procedure for wool fabric due to its tendency to felt and be degraded by alkaline laundry detergents. However, washable wool is important in clothing that has easy-care characteristics to keep its original size with laundering. Therefore, treatments to prevent felting shrinkage have been studied, based on the principle of smoothing off the rough edges of the scales[1-5]. This study is designed to analyze the impact of various shrinkproof finishing methods for wool fabrics on the shrinkage effects of knitted fabrics, which will find out an optimal finishing method with shrinkproof effects to manufacturers and help consumers handle wool knitted clothes more conveniently.

## Ⅱ. Experimental

### 1. Materials

Wool shrinkproof finished yarns were used for the manufacturing of test knitted fabrics. Three kinds of finished yarns were modified by resin coating to mask the scales, combining of resin coating & softening, and chlorination to dissolve the scales (2/48's).

### 2. Knitting Method

The test fabrics were knitted by a weft knitting machine (SHIMA SEIKI SES124 S) with 48

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inch width, 12 gages, and all needle knitting structure (0×0 rib) under the same knitting conditions with gage loop 5.4 mm long and degree of density.

### 3 Fiber Surface Examination

The wool shrinkproof finished yarn is considered to have different scale formats of fabric surface depending on finishing processes. Therefore, a SEM, scanning electron microscope, (JSM 6330F, JEOL Korea) is introduced to observe the fiber surface at a magnification of 1,000 times.

### 4 Mesurement of Dimensional Stability

The specimens were prepared in size of 50×50 $cm^2$ and the evaluation was performed by the washing method (KS C 9608) 28). The washer, which is the rotating drum type washing machine (TROM WD R100C, LG Electronics) was under the same washing conditions of general cloths. The washing was carried out for 40 minutes at 30℃ temperature with commercial all-purpose detergent with a regular washing course. The time spent for washing, rinse, and spin drying was an hour and 20 minutes. In each cycle, shrinkage of the length, width, and area of specimens were calculated.

## Ⅲ. Results and Discussion

### 1 Alteration of Scale Structure

From the observation of the scale patterns and of how many scales were removed depending on the shrinkproof finish types with the SEM, the scale layer was clearly displayed on the surface of original wool yarn. In regard to the resin coated wool yarn, which was processed with shrinkproof finish, the scale layer was covered with resin showing the scale less clearly than the original wool yarn. The scale layers of resin coating & softening were less clearly. As for chlorinated wool fiber, its surface had no friction and the layers of scale were not found; so it seems that it was dissolved most.

From the results, we examined the changes in shapes of the scale layer of the wool fiber through the resin coating and chlorination. It is considered that the fiber of the knitted fabrics, which are made of shrinkproof finished yarn would greatly influence the changes in the shrink effect of the knitted fabrics depending on the modification of the scale layer and the level of removal. Chlorinated wool fiber is thought to be the optimal material for producing wool innerwear since the removal of the scale layer strengthens the shrink proof effect and effectively reduce injuries caused by skin irritation.

### 2. Effect of Dimensional Stability

The shrink resistance of knitted fabrics while washing was evaluated by measuring the fabric shrinkage rates in both horizontal and vertical directions and the dimensions before and after

repeated washing of the knitted fabrics. The course wise shrinkage rate of original wool continuously increases as washing was repeated, but the shrinkproof-finished knitted fabric reached the even point at the third washing. Superior shrink resistance was found at less than 5% for all washing rounds. For the shrinkproof-finished knit, there was a little difference among materials. The chlorination process showed the best shrink resistance followed by the resin/ softening process and resin finished process in order. The resin/softening-finished knit and chlorinated knit were a little loosened at the first and second washing cycles. However, it started shrinking from the third.

On the other hand, the shrinkage rate difference was identified more drastically in the warp direction than the course direction, and the first washing cycle generated the highest shrinkage rate. For all the shrinkproof-finished knitted fabrics, the shrinkage was deemed to discontinue at the washing cycle of washing. While original wool (non-finished yarn) shrinkage by repeated washing, the shrinkage of shrinkproof-finished knitted wool did not change much from ones shown in the first and second washing. Among shrinkproof-finished knits, Chlorinates wool showed the lowest shrinkage rate with 6.6%.

The shrinkproof-finished yarn material showed the highest shrinkage rate on the first washing, and reached the equilibrium after the second cycle. However, those knitted fabrics in non-finished yarn kept shrinking (34.6%) as washing was repeated. From the results above, the shrink proof effects of shrink proof finished knitted fabrics were all good enough. Especially, the direct removal of scale will bring more effective results than the resin coating process, which prevents scale from being activated. Therefore, the scale free chlorination process is regarded to be appropriate for the manufacturing of inner wear easy to be exposed to water washing.

Besides, since the shrink proof finished knitted fabric showed lower shrinkage rate even in harsh washing conditions (machine washing in hot alkali detergent solution for a long agitation process period), it is considered that it could be machine washed at home with other laundry. Particularly, it is expected to bring more enhanced shrink proof effects in using a general wool washing method (hand laundered in low temperature of neutral detergent solution with less agitation). Thus, it is considered to help consumers easily care wool wear.

## Ⅳ. Conclusion

Upon the results from the surface examination of shrinkproof finished wool fibers, the patterns of scale layer and degree of scale removal were subject to change according to the finishing processes, and the shrink resistance was significantly enhanced when repeatedly washing shrink-proof finished knits. Addition of strong physical force and alkali detergent applied in this washing experiment brought about superior effects with the low shrinkage rate although it was very severe washing conditions for wool fabrics. The results from the washing experiment implies that shrinkproof finished knitted fabrics can be machine washed at individual households with other ordinary laundry.

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