봉합에 따른 투습방수직물의 물리적특성

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The Physical Properties of Seamed-Breathable Waterproof Fabrics

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1. Introduction

Garment manufacture represents the final stage of processing for a finished fabric. The main task of the garment manufacturer is to produce shell structures out of flat fabrics to match the shape of the human body. In all shape-producing methods, there will be an interaction between different methods and various mechanical and physical properties of the fabrics. The tailoring operations influence not only garment appearance but also clothing comfort, so the mechanical properties of the seamed fabrics are as important as those of the finished fabrics prior to tailoring[1,2].

The breathable waterproof fabrics are usually manufactured into sportswear, footwear, and the other outdoor equipments, etc.. And in these cases, the products are composed of more than one layer. These layers are usually combined together by sewing, which is one of the most commonly used manufacturing processes. And then, in case of breathable waterproof fabrics, the seamed fabrics are sealed by waterproof sealing tape to prevent water from penetrating through the holes caused by stitching of needle. Most of the breathable waterproof finishing is carried out on fabric substrates, and the combination of the materials have the advanced properties, but various physical properties are significantly changed after finishing, seaming, and sealing processes.

Generally, it has been reported that the effect of sewing on fabric bending behavior depends on the nature of the seam, the seam allowance, seam direction[3], and the layers of the fabrics[4]. However, wearing comfort is related to mainly fabric tensile and shearing deformations, and also related to comfortable wear associated with less restraint of human body by fabric. The shape-retention of suit is also covered by this property[5,6]. So the tailoring properties and the changes of the mechanical performances from sewing process should be considered for high production efficiency with the most suitable functional quality.

In this study, tensile and shear properties with small deformation and various seam characteristics with finishing, seaming and sealing processes were investigated.

2. Experimental

2.1. Materials

The specimens used in this study were prepared by coating and laminating processes, and classified according to the coagulation method, shape of knife, and the number of laminating layer. The pre-finished fabrics of coating and laminating methods were also used to compare with finished ones in this study.

2.2. Preparation of the specimens

The seaming was performed on standard domestic sewing machine, and the details of the fabric samples and the sewing conditions are shown in Table 1. All seams were sewn at constant machine conditions. Each samples were sewn together in warp and weft direction, respectively.

Table 1. Sewing conditions

	Specifications
Seam type	SSa-1
Seam allowance	10mm
Stitch type	301
Stitch density	4.7±0.5 stitches per centimeter
Needle size & finish	Metric 90, nickel plated
Sewing thread	100% polyester spun yarn

Then, the seamed fabrics were sealed with waterproof sealing tape using seam sealing machine. In this case, the temperature and feeding speed was controlled with the characteristics of the specimen.

2.3. Tensile and shear properties with small deformation

Tensile properties and shear properties with small deformation were measured with breathable waterproof finishing, seaming, and sealing by using Kawabata evaluation system (KES-FB). From this system, the various mechanical parameters can be calculated.

2.4. Characteristics of the seam

Measurement of seam performances was carried out on a constant-rate-of extension (CRE) type of machine capable of jaw separation rate of 305±10mm/min in accordance with ASTM D 1683. During application of the force to the sewn seam specimen, the seam rupture was observed and recorded whether it was caused by (1) fabric yarn rupture, (2) sewing thread rupture, and (3) sewn seam yarn slippage.

3. Results and Discussion

Tailoring engineers have found good fabrics through experience and have expressed the properties of these good fabrics with a combination of fabric mechanical parameters. There are no equations and particular values expressing the excellence of this property, however, they expressed the good zone directly by using the mechanical parameters of tensile and shearing properties[7]. In this quality range, fabric extensibility and shear deformation ability are important for fabric deformation with human body. Especially, tensile and shear properties were significantly changed after sewing and sealing processes in breathable waterproof fabrics. In tensile and shear test with small deformation, they were measured both of perpendicular and parallel directions to seam. Figures 1-3 show the various tensile characteristics with wet-coating, seaming, and sealing processes. Generally, different tendencies were remarkably appeared with seaming and sealing in perpendicular direction to seam. LT and RT significantly decreased after seaming, and then somewhat increased by sealing process, and EM showed opposite aspect to LT and RT. On the other hand, the changes of the properties in parallel direction after seaming were positively maintained to sealed fabrics. Figures 4-5 show the shear characteristics with dry coating, seaming and sealing processes. First of all, shear stiffness and hysteresis significantly increased after coating compared with pre-coated ones. In case of perpendicular direction, G and 2HG5 gradually increased with seaming and sealing, but 2HG rather decreased after sealing compared with seamed ones. It meant that sealing process played an important role in resistant to shear deformation to certain range.

4. References

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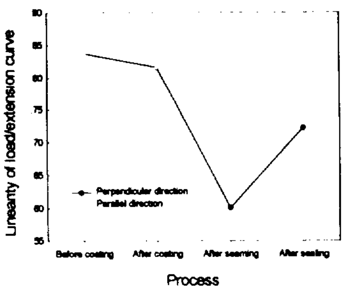

Figure 1. The changes on tensile linearity with coating, seaming and sealing.

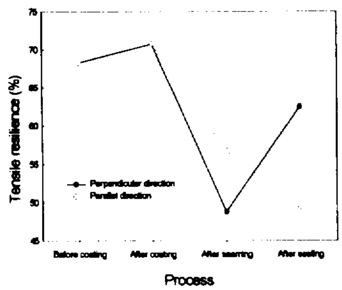

Figure 2. The changes on tensile resilience with coating, seaming and sealing.

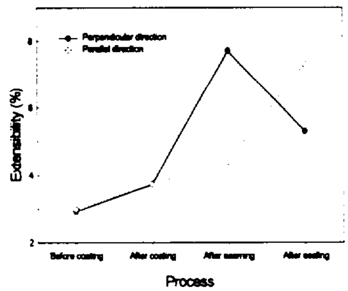

Figure 3. The changes on extensibility with coating, seaming and sealing.

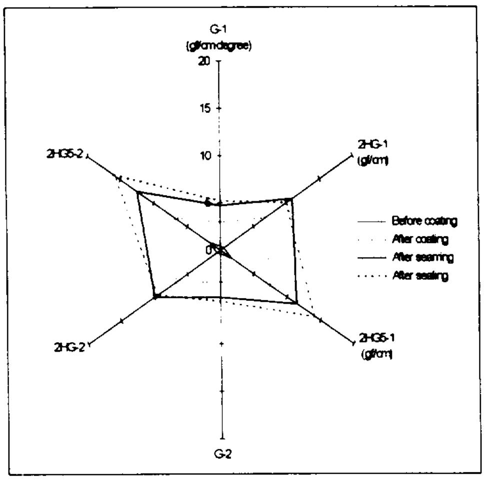

Figure 4. Shear characteristics with breathable waterproof finishing, seaming, and sealing process in perpendicular direction to seam.

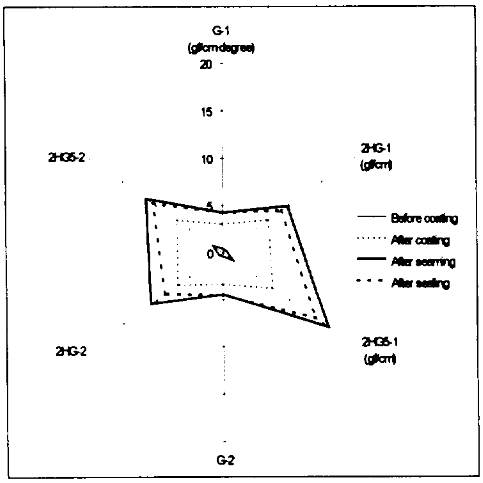

Figure 5. Shear characteristics with breathable waterproof finishing, seaming, and sealing process in parallel direction to seam.