〔보 문〕

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Changes in Physical Properties of Wool-Blended Fused Fabrics after Pressing and/ or Dry Cleaning(Part I)

모 접착포의 프레싱 처리와 드라이크리닝 처리에 의한 물성의 변화(제1보)

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Abstract

본 연구에서는 모 직물의 접착심과의 접착 후, 프레싱 처리 후, 드라이클리닝 처리 후 프레스로 처리 한 실제의 의복의 관리와 생산 면에서 접할 수 있는 직물 변화에 대하여 물성 변화를 살펴보았다. 겉감으로는 신사복 춘하용 모 100 % 또는 모 혼방 직물 15종류를 사용하였으며 심지로는 신사복에 많이 쓰이는 3종류 심지를 사용하였다. KES시스템을 이용하여 직물의 접착 후 , 프레싱 처리 후, 드라이크리닝과 프레싱 처리 후의 물성 변화를 시험하였으며 다음과 같은 결과를 얻었다.

1) 접착 후 EM은 대체로 감소하지만 강성과 이력 현상은 증가하는 것으로 나타났다. 결과로 KOSHI, SHARI, HARI는 증가하고 THV는 감소하여 태는 접착으로 저하되었다. 2) 프레싱 처리 후는 접착 후와 큰 차이를 보이지 않는다. 마찰특성에서 좀더 매끄러워지고 마찰 계수는 증가하는 것으로 나타났다.

3) 드라이크리닝과 프레싱 처리 후의 물성의 변화에서는 위사 방향의 큰 값을 갖는 경우에 감소하는 것으로 나타났다. 굽힘강성과 전단강성은 감소하였지만 이력은 증가하는 흥미로운 결과를 보인다. 드라이클리닝 용제의 효과로 여겨진다. 무게는 증가하여 직물이 처리 후 수축한 것으로 나타났다. 프레싱 처리 후와 비교시 KOSHI, SHARI, HARI와 FUKURAMI 는 감소하고 THV는 증가하여 태가 향상하였다.

***Key words*:** wool-blended fused fabric, pressing, dry-cleaning, mechanical property, total hand value (THV); 모접착포, 프레싱, 드라이크리닝, 물성, 태

I. Introduction

The aim of fabric finishing is to provide the market with a valuable product, both from an aesthetic and a functional point of view, and in particular to satisfy the technical requirements of the garment industry[1].

The physical properties of fabrics change as a result of different finishing processes. So, it is important for the finishing process to take into account the mechanical properties of fabrics. It is necessary for the fabric manufacturer to supply qualify fabrics which satisfy the demands such as make-up property or the easy tailoring of garments. There are certain mechanical properties of fabrics which are influenced by combining the finishing processes in various ways and these characteristics are moved to good or bad values of the good zone. On the other hand, other mechanical properties are not affected by that at all. The problem is that how can we control these mechanical properties which are connected to make-up property, within the good zone of the present finishing process. Therefore, the relationship between mechanical properties and finishing process should be investigated.

In this paper, the changes in the mechanical properties of fabrics using different finishing processes are reported. The investigated finishing process of fabrics consists of three parts: fusing, steam pressing, and steam pressing after dry cleaning

In garment manufacturing, the fused fabrics provide on effective sewing process, wide choices of composite fabrics and good productivity. The aim of pressing is to give the fabric a smoother, brighter surface, with some degree of permanence, and this is done by subjecting the fabric to a strong compression against a polished, heated surface. Pressing is considered a mild, mainly cohesive setting treatment. The steaming operation aims at relaxing the fabric internal stresses, in order to reduce(even if it is not completely eliminated) the first cause of dimensional instability , namely relaxation shrinkage[2].

There are many reports concerning the mechanical properties of fabrics by different finishing processes. Jee et al[3, 4] reported the changes in the mechanical properties of fabrics by fusing. Y Okamoto[5] reported the influence of repeated dry-cleaning on the handle of men's suits. But there are few papers that have reported the changes in the mechanical properties of fabrics by the sequence of these finishing processes. Therefore, it is necessary to investigate the changes in the physical properties resulting from different finishing processes by measuring the physical properties at each stage.

The purpose of this study is to investigate the changes in the physical properties, the primary hand value(HV) and the total hand value(THV) of fabrics after these different finishing processes have been applied. The results will be reported in two sections . In the first section of this paper, the physical properties, the primary hand value(HV) and the total hand value(THV) of fabrics changed by these finishing processes will be reported. In second section, the dimensional stability and formability will be reported.

II. Experimental

1. Test Materials

Fifteen types of wool blended fabrics for spring/summer men's suits and three types of fusible interlinings were used in this study. Characteristics of test materials used in this study are given in Tables 1 and 2.

2. Finishing Process

Test materials were subjected to a three part finishing process. The fusing condition for fifteen fused fabrics were recommended by the interlining manufacturer. The appropriate interlining for face fabric was chosen by the best result of the peel strength test and the rate of shrinkage test. The finishing conditions are described in Table 3. The investigated finishing process of fabrics consisted of three parts: 1. fusing, 2. steam pressing, and 3. steam pressing after dry cleaning.

Table 1. Characteristics of wool fabrics.

No	material(%)	yarn no. (Nm)		wt. (g/m^2)	fabric count (ends × picks/in^2)	thickness (mm)
		warp	weft			
F1	wool/silk=82/18	2/140, 2/90	2/90	16.71	92×88	0.4549
F2	wool/silk=60/40	2/72	2/140	18.72	56×82	0.5379
F3	wool 100	1/30	1/30	18.89	64×60	0.5770
F4	wool/linen=88/12	1/24, 2/72	2/72	21.47	52×54	0.5387
F5	wool/silk=82/18	2/72	1/36	16.71	60×62	0.4549
F6	wool 100	2/70, 2/72	2/70, 2/72	18.72	68×64	0.5379
F7	wool/PET=95/5	1/30, 1/49	1/302/72	18.89	72×69	0.5770
F8	wool/PET=96/4	2/72, 2/160	2/72	21.47	56×58	0.5387
F9	wool/PET=96/4	1/42, 2/72	2/72	16.71	56×58	0.4549
F10	wool/PET=96/4	2/72, 2/72	1/42, 2/72	18.72	56×58	0.5379
F11	wool 100	1/30	1/30, 2/72	18.89	64×66	0.5770
F12	wool/silk=82/18	2/72, 2/60	2/72, 2/60	21.47	68×64	0.5387
F13	wool 100	2/90	2/90	16.71	84×88	0.4549
F14	wool 100	2/90	2/90	18.72	92×88	0.5379
F15	wool 100	2/60	2/60	18.89	56×54	0.5770

Table 2. Characteristics of interlinings.

No	material(%)	weave	fabric count (ends × picks/in^2) (yarn no : Nm)	adhesive material	no. of adhesive dot per in^2	adhesive wt (g/m^2)	wt. (g/m^2)	thickness (mm)
I 1	cotton 100	plain	44×29 (2/40, 2/40)	Polyamide	17	11	7.4517	0.7674
I 2	cotton 100	broken -twill	46×39 (2/40, 2/40)	Polyamide	17	11	7.73911	0.7438
I 3	cotton 100	plain	53×44 (2/40, 2/40)	Polyamide	17	11	7.6612	0.6291

Table 3. Finishing conditions

Step	Process	Parameters
1	Fusing (roller press fusing machine)	temp. 120-140℃ pressure 4kgf/㎠ time 12sec
2	Steam Pressing	steam 5sec. pressing 5sec. vacuum 5sec.
3	Dry-cleaning	solvent: perchloro-ethylene cleaning temp. 30℃ cleaning time 8min.
	Steam Pressing	steam 2sec. pressing 2sec. vacuum 2sec.

3.Measurement of Mechanical Properties

All of the materials were conditioned at 20±2℃ and 65±5% R.H. before testing.

Before and after finishing, the tensile, bending, shearing , surface and compressional properties of fabrics were measured using the KES-FB system. And the HV(Hand Value) and THV(Total Hand Value)were calculated by the equation[6] on the basis of this mechanical data.

III. Results and Discussion

The change in mechanical properties of fused fabrics after mechanical action was very severe compared with that of the face fabric only.

1. Thickness(T) and Weight(W)

Firstly, the fabrics remarkably changed in dimension after finishing

The thickness(T) and weight(W) of the fabrics are shown in Table 4. All the data are mean of 15 samples and averaged value of fabric deformation .

After fusing, the T and W of fabrics increased, as expected. After pressing of the fused fabrics, the T decreased and the W increased. It is a interesting phenomena. The heat and steaming of the pressing made fused fabrics more compact. The steaming operated as relaxing the fabric internal stresses and caused fabric shrinkage. After pressing followed by dry cleaning the T and W of fabrics increased. This means that the actions of mechanical force and dry cleaning solvents used in dry cleaning, made the fabrics shrink and bulky.

Table 4. Thickness and Weight of Fabrics Obtained from Various Processes

	T	W
only fabric	0.506	17.36
fusing	0.782	23.75
pressing	0.746	24.09
dry cleaning	0.832	24.17

These changes in dimension would be influenced by the mechanical properties of the fabrics.

2. Compressional Properties

As reviewed in the previous section, the fabrics' dimensions changed and influenced the mechanical properties of the fabrics. The compressional properties of the fabrics are shown in Table 5.

Table 5. Compressional Properties of Fabrics Obtained from Various Processes

	LC	WC	RC
only fabric	0.361	0.132	59.69
fusing	0.458	0.202	57.037
pressing	0.393	0.164	57.04
dry cleaning	0.385	0.209	53.34

After fusing, the values of LCs and WCs increased, and RCs decreased. The increasing of LCs of fabrics means that the fabrics became more elastic to compression by adhesives. The values of WCs for fused fabrics were 1.5 times greater than those for the face fabrics. It showed that the bulkiness was increased when face fabrics and interlinigs were folded together, as expected. After pressing the values of LCs of the fused fabrics decreased. It seems that the adhesives became softer and more flexible by steaming. It would be coincidence of the following tendency of bending properties. The values of WCs decreased. It showed the degrees of bulkiness decreased by compacting fabrics, as reviewed in the previous section. After pressing followed by dry cleaning, the values of LCs decreased by the actions of mechanical force and dry cleaning solvents used in the dry cleaning, and became soft and flexible and became bulky so the values of WCs increased.

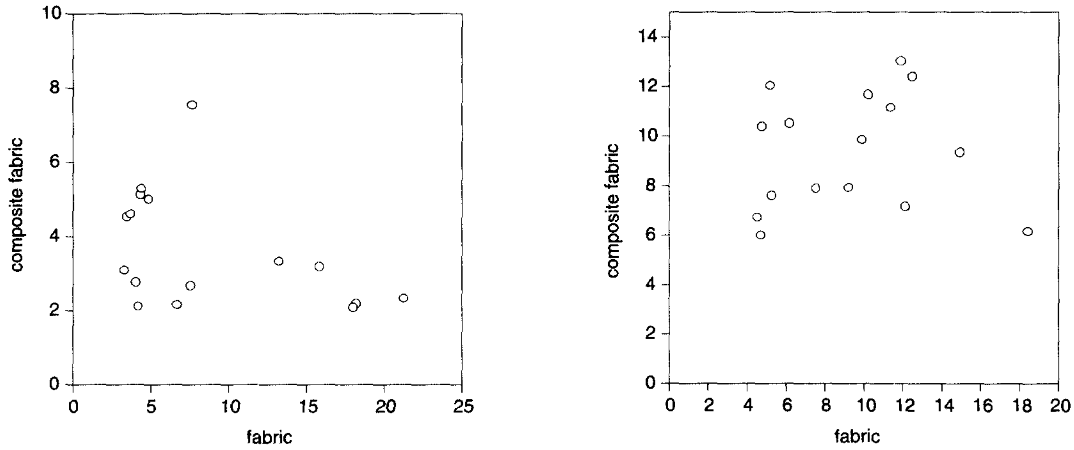
3.Surface Properties

The surface properties of the fabrics are shown in Table 6. All the data are mean of 15 samples and averaged value of warp and weft direction deformation. Finishing processes would change the surface properties of the fabrics.

MIU(mean value of the coefficient of friction) was

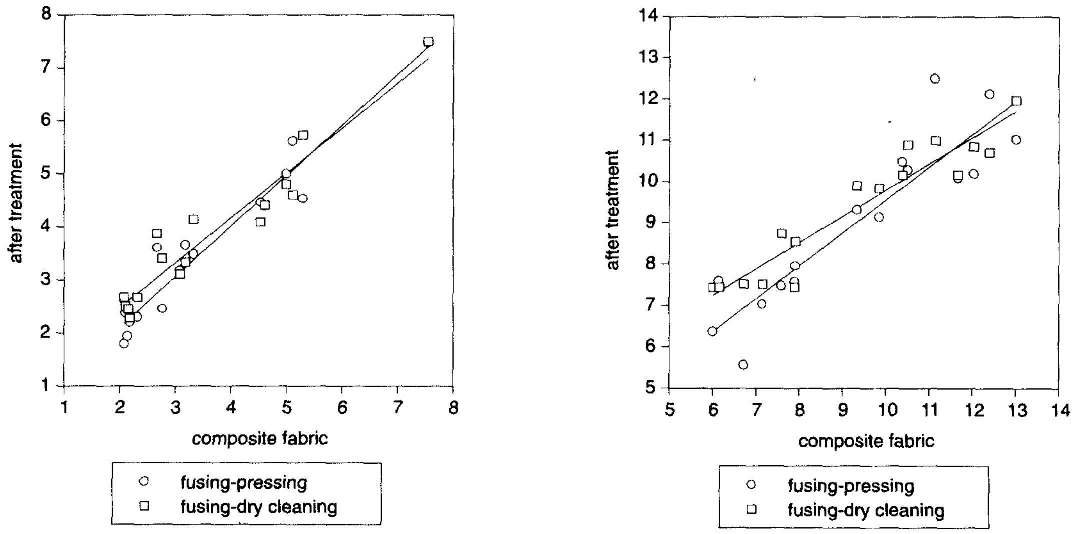
Table 6. Surface Properties of Fabrics Obtained from Various processes

	MIU-1	MIU-2	MIU	MMD-1	MMD-2	MMD	SMD-1	SMD-2	SMD
only fabric	0.150	0.147	0.148	0.022	0.023	0.022	5.238	5.659	5.511
fusing	0.150	0.145	0.147	0.020	0.018	0.019	4.499	3.817	4.149
pressing	0.149	0.145	0.147	0.022	0.017	0.019	4.683	3.848	4.266
dry cleaning	0.159	0.159	0.159	0.020	0.018	0.019	4.779	4.120	4.450



(a) warp (b) weft

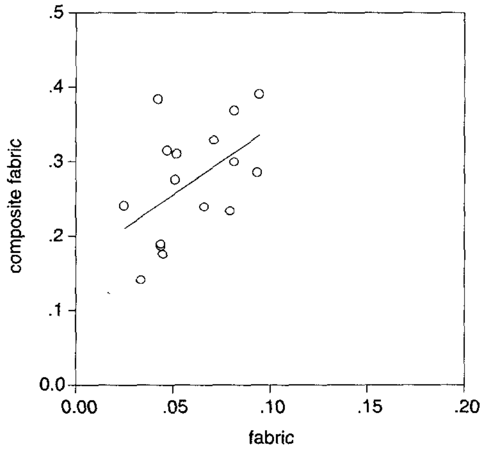
Fig. 1. a . Changes in EM after fusing.



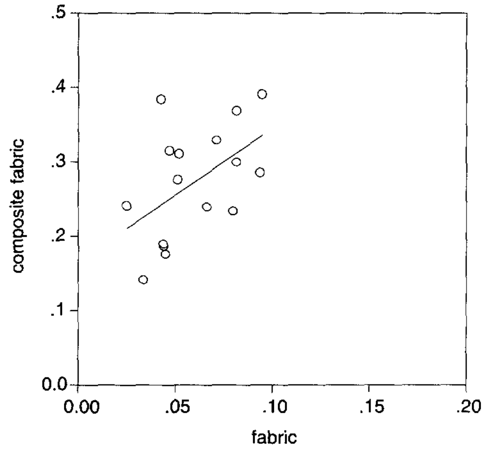
(a) warp (b) weft

Fig. 1. b . Changes in EM of composite fabrics after finishing.

not significantly changed after fusing and pressing. However, after pressing followed by dry cleaning, MIU1, and MIU2 increased. Through the dry cleaning process, the friction of the fabric's surface might be greater due to the action of mechanical force on the fabrics. SMD(mean deviation of surface roughness) was decreased by the fusing and was slightly increased by dry cleaning. The effect of fusing made the fabric's surface smoother. Through the dry cleaning process, the fabric's surface became rougher due to the action of mechanical force on the fabrics.

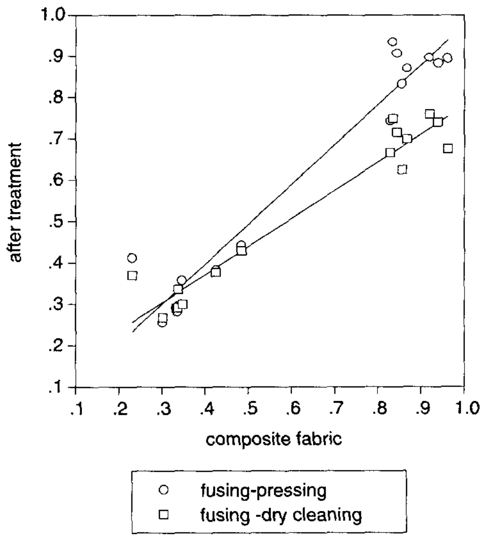


(a) warp

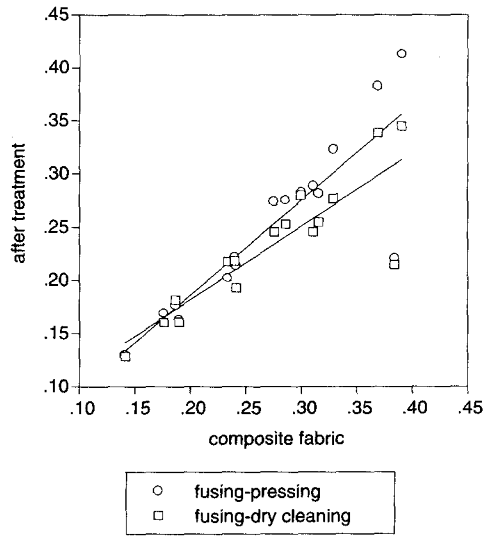


(b) weft

Fig. 2. a. Changes in B after fusing.



(a) warp



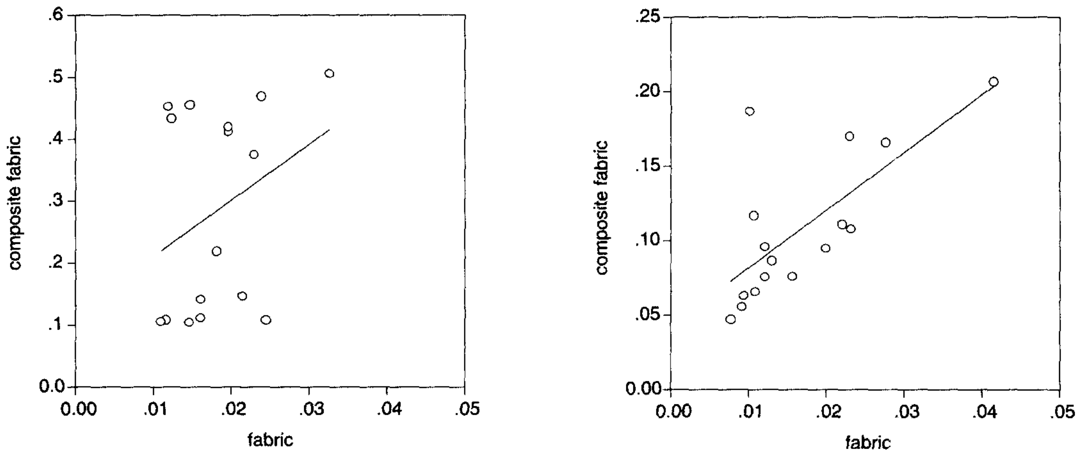
(b) weft

Fig. 2. b. Changes of B in composite fabrics after finishing.

4. Extensibility

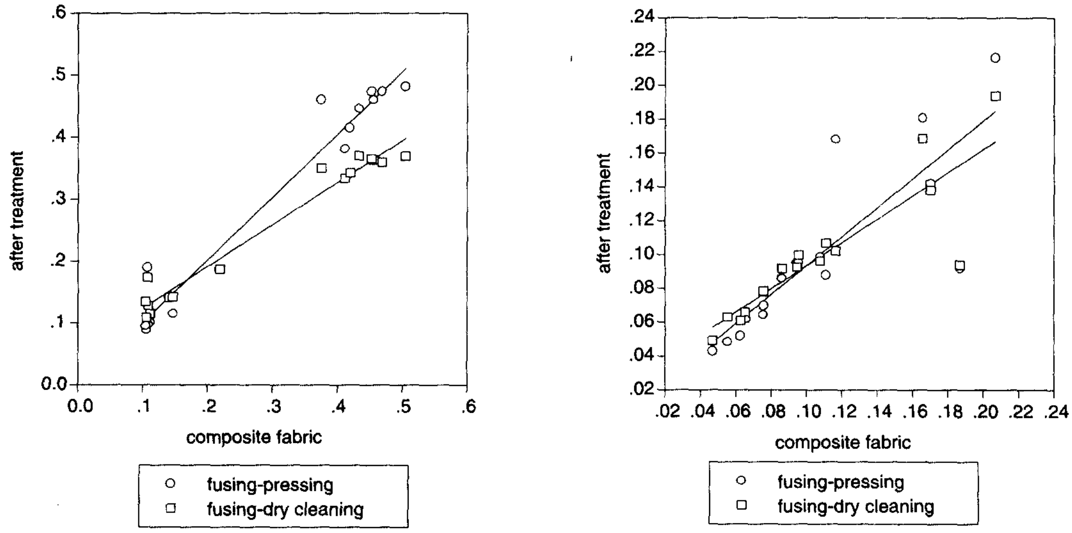
The changes of warpwise and weft wise extensibility after finishing were shown in Fig.1 a and b.

The extensibility of fabric is an important factor in garment manufacturing and for wear. After fusing an interlining to the face fabric, it is necessary that elongation of the fused fabric should be within a certain range. In this study, the range of elongation at the load of 100gf/cm(EM) was approx. 3.0-11.0%. This is similar to the result



(a) warp (b) weft

Fig. 3. a. Changes in 2HB after fusing.

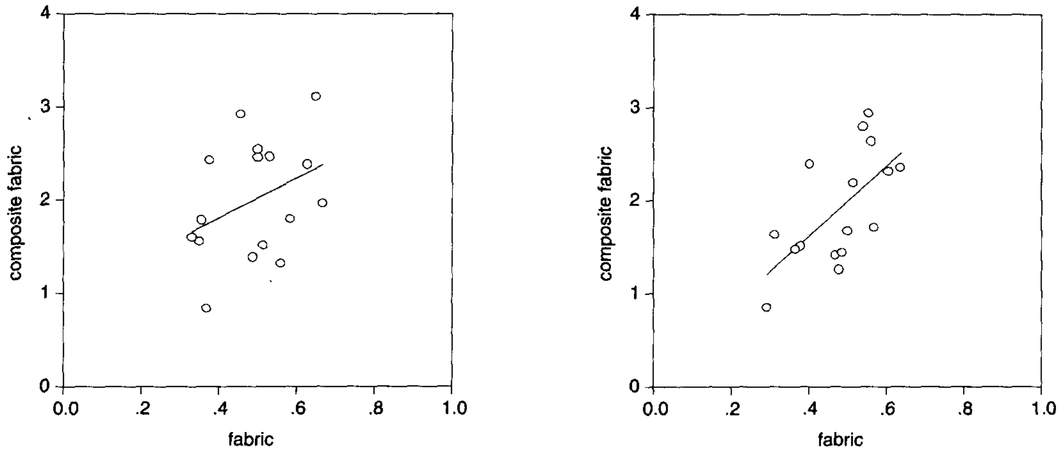


(a) warp (b) weft

Fig. 3. b. Changes of 2HB in composite fabrics after finishing.

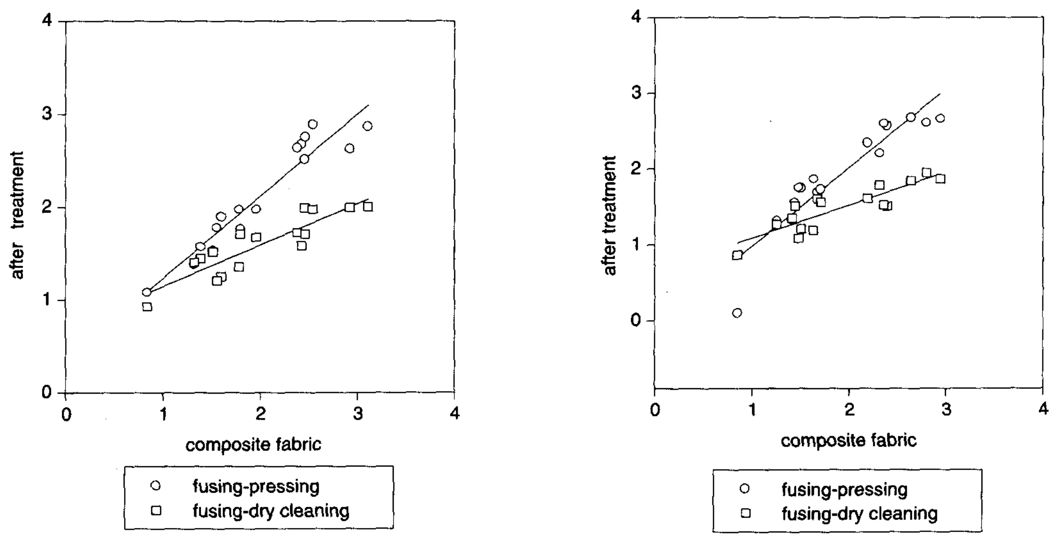
from the study carried out by Nagano.[7,8]

The EM1(warpwise extensibility) decreased more after fusing, rather than the EM2(weft wise extensibility). After pressing the EM1 of the fused fabrics increased a little, but the EM2 of the fused fabrics decreased. The steam during pressing may cause the stability of warpwise fabrics by relaxation shrinkage. This would be influenced the extensibility of EM1. The problem in the physical changes after finishing is how can we control those mechanical properties which are connected to the making-up property, to within the good zone by



(a) warp (b) weft

Fig. 4. a. Changes in G after fusing.



(a) warp (b) weft

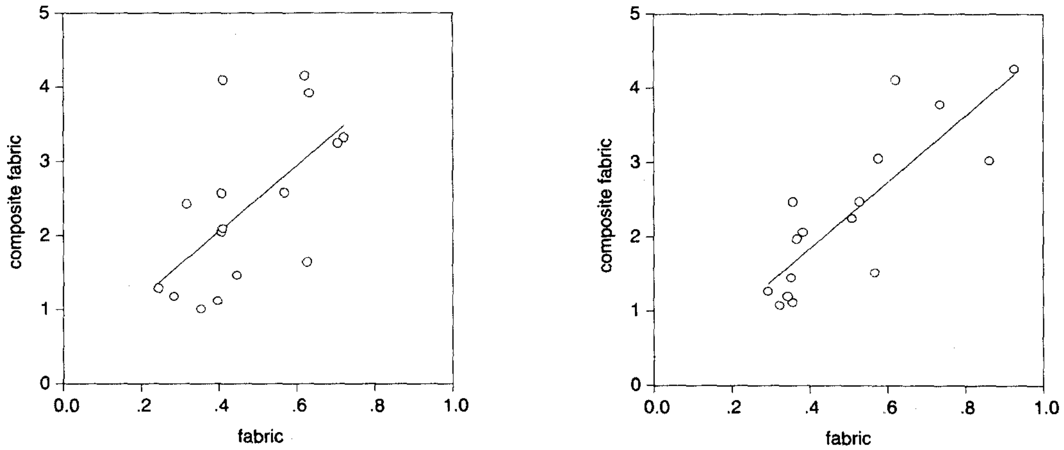
Fig. 4. b. Changes of G in composite fabrics after finishing.

the present finishing process.

Kawabata[9] suggested the non-control zone of the sewing process. The ranges of EM1 and EM2 are 4~5% and 4~8%, respectively. The values of EM1 and EM2 of used fabrics were wide range but after finishing the range showed better results. The problems related to fabrics in the sewing process might be solved after finishing.

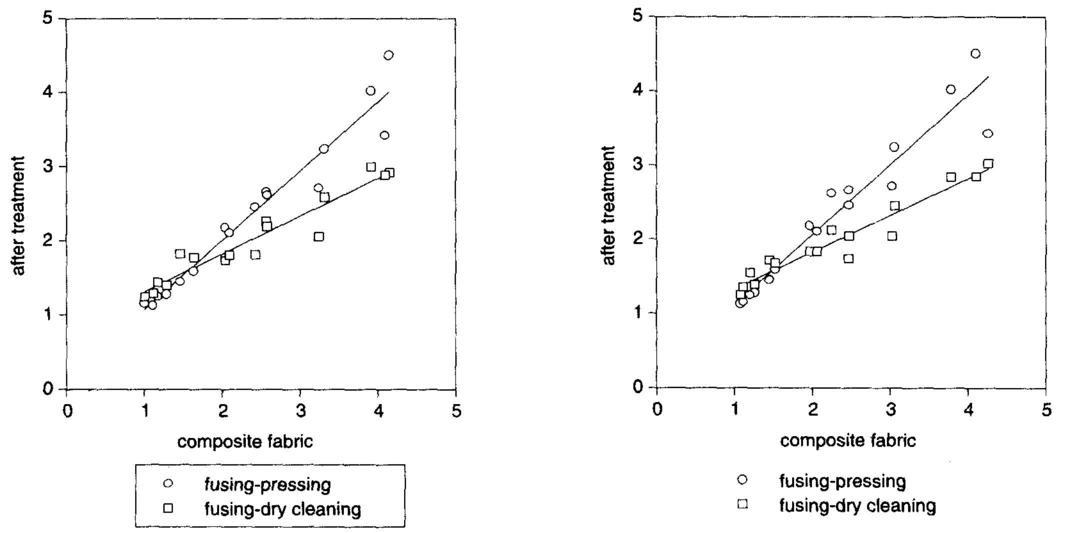
5. Bending Properties

The bending behavior of the fused fabric is important in relation to the shape formation and



(a) warp (b) weft

Fig. 5. a. Changes in 2HG after fusing.



(a) warp (b) weft

Fig. 5. b. Changes in 2HG of composite fabrics after finishing.

retention of a garment.[10,11] The changes of warpwise and weft wise bending rigidities (B)and bending hysteresis(2HB) of fabrics after finishing were shown in Fig.2 and 3, respectively.

After fusing the values of B1(warpwise bending rigidities), B2(weft wise bending rigidities), 2HB1 (warpwise bending hysteresis) and 2HB2(warpwise bending hysteresis) increased greatly. The increase of B and 2HB of fused fabrics may be mainly caused by the effect of penetration of adhesives[3]. The bending rigidity of yarns increased and the adhesive coating on the surface also resisted yarn rotation. As a whole, the adhesive dots on the base cloth have played an important role in resisting yarn bending, rotation and yarn movement inhibiting fabric bending. The adhesive blocked the movement of warp and weft at the crossover points and resisted yarn bending in the cloth structure.

The values of B1 and 2HB1 for the fused fabrics were not significantly changed after the pressing process. After pressing followed by dry cleaning, the values of B1 and B2 of the fused fabrics decreased. Okamoto[3] reported that these changes in mechanical properties are not caused by the changes in the fibers properties, but the changes in fabric srtucture. It is assumed that the fabric became bulky and spaces between fibres became larger after dry-cleaning thus facilitating yarn movement. The fused fabric became more relaxed after the dry cleaning process. This was also observed in the compressionl property.

6. Shearing Properties

Shearing property is one of the important factors in garment manufacture. The fused fabric provides good stability of face fabric.[10,11] The changes of warpwise and weft wise shear rigidities and shear hysteresis of fabrics after finishing were shown in Fig. 4. and 5, respectively.

The values of G1 and G2 increased greatly after fusing. The increase of G of fused fabrics may be caused by the effect of penetration of adhesives. The adhesives constrict the movement of fibers and yarns. After pressing, the fabrics became compact, so the friction of inter and intra-yarns increased. It caused the increasing of the G1 and G2 . As the shear rigidities increased, the shear hysteresis of fabrics increased, too. After pressing followed by dry cleaning, the values of G1 and G2 of the fused fabrics decreased through the dry cleaning. It seemed more flexible due to solvent. The friction of inter-yarn and intra-yarn may be reduced.

The non-control zone of shear rigidities were on 0.6~0.9g/cm · deg. Used fabric's range was 0.3~0.8g/cm · deg. Low values of fabric showed dimensions which were unstable, so there were some problems in laying-up. But after fusing, these problems disappeared. After dry-cleaning G deceased, which means that it is possible to change the shape of clothing.

The changes in 2HGs on the fabrics were similar to those in G on the fabrics.

7. Hand Value(HV) and Total Hand Value (THV)

It is reasonable to assume that these effects will translate to a change in the hand of these materials. The changes of HV and THV of fabrics after finishing were shown in Table 7. The used

Table 7. HVs(Hand Value) and TAVs(Total Hand Value) of fabrics Obtained from Various Process

	Koshi	Shari	Fukurami	Hari	THV
only fabric	2.557	3.389	4.542	2.798	2.693
fusing	9.943	5.246	4.532	88.161	1.563
pressing	10.05	5.341	5.37	10.462	1.555
dry cleaning	9.211	4.713	5.203	10.349	1.862

fabrics used were for summer/spring men's suits. The related HVs are Koshi (stiffness), Shari (crispness), Fukurami (fullness) and Hari(anti-drape stiffness). In the definition of the HVs, it was understood which properties were related to hand value measurement. Koshi for summer, was defined by its stiffness in bending, rough surface and high shearing resistance. Shari was defined by its rough surface, stiff and springy bending property. Fukurami for summer was defined by its extensible, especially in the realtively small tesile strain. Hari for summer was defined by its stiffness in bending, rough surface and high shearing resistance especially high 2HG5. Higher hysteresis also increases Hari.

After finishing, B, 2HB, G and 2HG increased, and also Koshi, Shari and Hari increased but Fukurami(fullness) decreased. As a result, THV of fused fabrics decreased. After fusing, Koshi, Shari and Hari increased but THV decreased. After pressing, Koshi, Shari and Fukurami increased. After pressing followed by dry cleaning, Koshi, Shari, Fukurami and Hari decreased but THV increased compared to those of fabrics after pressing.

IV. Conclusion

In this paper, the changes in the physical properties of fabrics through different finishing processes was reported. The finishing process of fabrics consisted of three parts: fusing, steam pressing, and dry cleaning. Fifteen types of wool blended fabrics for spring men's suits and three types of fusible interlinings were used for this study. Before and after finishing, the tensile, bending, shearing, surface and compressional properties of the fabrics were measured using the KES-FB system. And the HV and THV were calculated by the equation on the basis of this mechanical data.

The results obtained from this study were as follows.

1) After fusing, Koshi (stiffness), Shari(crispness) and Hari(anti-drape stiffness) increased by a decrease in the value of EM(extensibility) and increased in B(bending rigidity), 2HB(hysteresis of bending moment), G (shear rigidity) and 2HG(hysteresis of shear force). And THV decreased.

2) There was little difference between the mechanical properties of fused fabrics and those of pressing fabrics. In the case of frictional properties, pressing made fabrics a little smoother.

3) The mechanical properties of fused fabrics was changed as a result of steam pressing condition after dry cleaning. Because fabrics were influenced by the mechanical force, the dry cleaning solvents and the finishing press after dry cleaning. After finishing, B and G increased whereas 2HB and 2HG decreased, and also Koshi, Shari , Hari and Fukurami decreased compared to those of fabrics after pressing. . After finishing, THV of fused fabrics increased.

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