THE EFFECT OF HEAT AND MOISTURE ABSORPTION OF JACKETS ON THE MICROCLIMATE ENVIRONMENT

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INTRODUCTION

A substantial function of clothing is to achieve a state of thermal balance . The process of keeping warm depends on certain interactions. The body, the environment, textile materials, and clothing forms all work together to create a thermal situation. The thermal transportation of the textile material is an important factor. The property of moisture absorption is one of the other key factors, since sweat evaporation induces heat loss and accompanying thermal discomfort. Although the thermal and water transport properties of textiles have been extensively studied 〔1-5〕, the performance of textiles on the microclimate environment which is between the body and clothing is not well understood. The aim of this study was to investigate the effects of the jackets made from varied nonwoven interlinings on the microclimate environment.

EXPERIMENT

Three different thermal bonded nonwoven fabrics made from (a) fine denier polypropylene fibre (0.001 denier) 65%／polyester hollow fibre (6 denier) 35% (FPP/HPET), (b) polyester hollow fibre (15 denier) 50%／polyester fibre (3 denier) 50% (HPET/PET) , and (c) heat-regenerating polyester fibre (3 denier) 70%／polyester hollow fibre (6 denier) 30% (RPET/HPET) were prepared as interlinings of the experimental jackets. Here, different pressures were used for the FPP/HPET nonwoven fabric consolidation. One was with a pressure (FPP/HPETW) and another one was without a pressure (FPP/HPET). The facing fabric made from polyester fibre (1.0 denier) with 114 ends/inch and 104 picks/inch of the jackets was a regular twill-woven fabric. The lining fabric made from rayon fibre (0.7 denier) with 108 ends/inch and 90 picks/inch of the jackets was a simple plain-woven fabric. The experimental materials used are shown in Table 1.

Table 1 The experimental materials used

Fabric	Code	Fibre type		
		Facing	Interlining	Lining
Facing	A	PET		
Interlining	B1		FPP/HPET	
	B2		FPP/HPETW	
	B3		HPET/PET	
	B4		RPET/HPET	
Lining	C			Rayon
Jacket	D1	PET	FPP/HPET	Rayon
	D2	PET	FPP/HPETW	Rayon
	D3	PET	HPET/PET	Rayon
	D4	PET	RPET/HPET	Rayon

The air permeability of the material was measured by the Textest FX 3300 Air permeability Tester. The water vapor permeability was tested in accordance with JIS L1096. The thermal resistance was measured by the kawabata Thermal Labo Ⅱ system. For details of the experiment refer to reference [6].

For the understanding of the effect of the jackets on the microclimate environment in cold and wet weather, three healthy young males, after a repeatability evaluation, volunteered as subjects. The temperature deviation of the replication test was in the range of 0.3 ℃ and the absolute humidity deviation was in the range of ± $0.3g/cm^3$. In each trial a two-layer clothing system, an inner long -sleeved cotton /polyester underwear layer and an outer experimental jacket layer, was used. Subject wore the underwear inside a climatic chamber for a 30 minutes' conditioning. After that, subject wore an experimental jacket outside the underwear for the test. Each test consisted of a 20 minutes sedentary exposure with a 500 w halogen lamp, which was 100 cm away from the back of the body, and then 10 minutes without an exposure. Subject sat on a chair without moving during the test. The climatic chamber was in a wet and cold environment at a temperature of 15 ℃, a relative humidity of 70%, and a air movement of 0.25 m/s.

RESULTS

The ability of the thermal and water transmission of clothing which relates to the volumetric and geometric configuration of the fabric. The thickness,, bulk density, air permeability, water vapor permeability, and thermal resistance properties of the experimental materials are shown in Table 2. For the neglect of the fabric thickness effect, a unit of thermal resistance per thickness (clo/min) was used here (see Table 2). Although the thickness and bulk density of B1 and B2 interlinings were lower than those of B3 and B4 interlinings, the thermal resistance values of B1 and B2 interlinings were quiet higher than those of B3 and B4 interlinings. This phenomenon can be observed in the experimental jackets. The ability of the jacket to keep warm, therefore, was influenced by the performance of the interlining.

Table 2 Means of experimental material geometric and volumetric determinations

Material	Code *	Weight (g/㎡)	Thickness (mm)	Bulk density (g/cm^3)	Thermal resistance (clo)	Thermal resistance per thickness (clo/mm)	Air permeability (ft^3/ft^2.min)	Water Vapor Permeability (g/㎡.24hr)
Facing	A	140	0.28	0.5	0.71	2.54	27.4	9470
Lining	C	69.5	0.10	0.695	0.645	6.5	90.8	8490
Interlining	B1	100	2.79	0.036	1.64	0.59	45.2	8017
	B2	100	2.77	0.036	1.58	0.57	36.5	7340
	B3	135	2.93	0.047	1.31	0.45	723	8000
	B4	145	3.34	0.066	1.52	0.46	607	7250
Jacket	D1	309.5	2.80	0.111	1.67	0.60	12.2	7100
	D2	308	2.97	0.104	1.67	0.56	13.2	6480
	D3	345	3.31	0.104	1.48	0.45	21.6	6780
	D4	350	4.21	0.083	1.75	0.42	22.4	7780

*code refers to Table 1

The temperature (T1) and the relative humidity between the underwear and the experimental jacket and the skin temperature (T2) of the body back were recorded during the test. The T1 values of D1, D2, and D3 jacket systems had no significant difference. However, the T1 value of D4 jacket system was higher than that of the other three jacket systems. The difference was about 3 ~ 5 °C. Typical T1 temper-

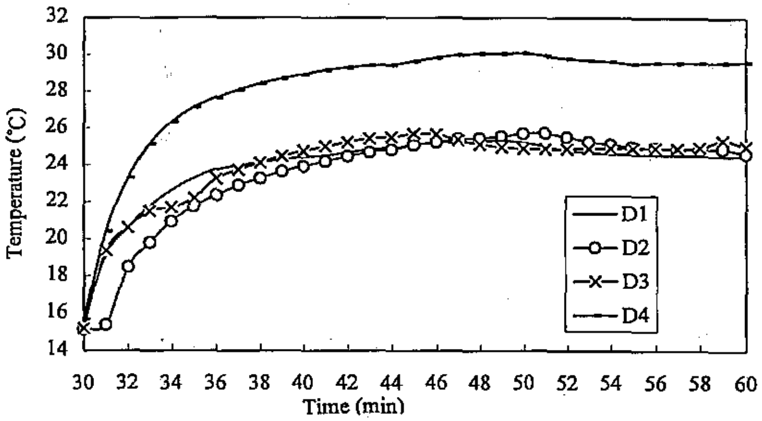

Figure 1 A comparison of the changes in temperature between the underwear and different jackets.

ature history during the tests is shown in Figure 1. The effect of the fibre type of the jacket at T2 temperature (the body back skin temperture) is similar to T1 temperature. The difference was about 0.5 ℃. The effect of fibre type of the interlinings on the relative humidity was not significant in this test method.

CONCLUSIONS

The property of keeping warm of interlining was a key factor in the thermal performance of the jacket. The effect of the fibre type of the interlining on the thermal property was significant. The thickness of the nonwoven fabric could not be a decisive factor for the thermal resistance property. However, the air content of the fabric could affect the thermal property. The nonwoven fabric made from fine denier polypropylene fibre and polyester hollow fibre had a higher thermal resistance property. On the other hand, the nonwoven fabric made from heat-regenerating polyester fibre and polyester hollow fibre had a higher heat absorption property. Therefore, the fabric made from heat-regenerating fibre could be a right selection in a cold environment.

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