Wetting Balance of Fabric Thermal and Moisture

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Abstract: Thermal-wet comfort of fabrics is an important index of clothing comfort, and it is important to evaluate clothing thermal-wet comfort under the state of moving and high temperature and humidity. Many performances of fabrics change when wetted, and the comfort of fabrics fall down, the wet fabrics even influence the hygiene and health of human body. By the practical significance to the dynamic heat and moisture from the clothes comfort, the actual situation of human wearing wet clothing fabrics and heat and moisture balance in the laboratory is simulated, that is, through the heat and moisture balance test to close plate and the air layer, the distribution ratio through heat absorbed from the processing of wetting fabric evaporation. Through this research, as perspiration clothing under the basis of thermal comfort performance of wet, high temperature and humidity on the human environment in the dress and maintain human health, healthy, comfortable and instructive, and in this environment, clothing materials development of protective clothing such as a certain reference.

Keywords: Wetting of fabrics; Thermal-wet comfort; Air layer;Close to flat

1. Introduction

We can see that wetting the fabric of the theory of thermal comfort is not perfect from the research situation at home and abroad, although the heat and moisture comfort in the clothing field of a certain scale, and the study has been refined to all aspects of heat and moisture comfort. At present the majority of the evaluation of heat and moisture comfort with the relevant indicators and test equipment are built on the fabric dry state, rare wetting properties of fabrics study. The human body is usually in a hot environment and a lot of sweating in the intense exercise, sweat in the form of liquid water over the skin surface, even flow, clothing is usually invasive. It is understood that the human body after intense exercise, the weight of water vapour together lead to an increase of 10% of clothing, perspiration formed by moisture, it must be exclusive to the fabric permeability and absorption in vitro [1-5]. If it can not discharge body heat, moisture back and forth between the collision in the body and the clothing will cause discomfort, the functions of the human body perspiration is normal behaviour response, comfort or a greater relationship with the fabric. [6-9]

2. Explore and design of experiments to heat and moisture balance of wetting the fabric

2.1 Experimental preparation

2.1.1 Sample preparation

The paper selected market common fabric, including woven and knitted fabric, involved in a common natural fiber and synthetic fiber, as well as some new type of fiber.

Table l. Composition and specifications of the selected fabric

Fabric number	Material type	Thickness	Weight	Volume weight	Notes
1	cotton	0.4138	128	0.3093	twill woven fabric
2	wool	0.5132	208	0.4053	twill woven fabric
3	viscose	0.3210	115	0.4828	twill woven fabric

2.1.2 The experimental apparatus and equipment

AVM-05 measuring the temperature / velocity air flow meter and SL7900 automatic woven proofer.

3. The fabric test methods of the balance of heat and moisture wetting

3.1 Basic theory of heat and moisture balance

Conduction dissipation:

$$q=A\frac{ts-ta}{0.155Rt} \quad (1)$$

q—Significant heat loss through clothing,0.155 conversion factor for the thermal units;

R_t—The total thermal resistance, clo;

t_s—Average skin temperature,℃;

t_a—The human body ambient temperature,℃;

A—Effective conduction area, m^2.

Evaporative dissipation:

$$E = \alpha \cdot G \quad (2)$$

E —Evaporative heat dissipation,w/m^2;

α —Heat coefficient of water evaporation, w. h /g;

G —Surface of the body of water evaporation, g/(m^2.h).

3.2 Wetting fabric thermal and moisture testing

Resistance in parallel by the principle of the experiment, we cut in a certain area of the sample among the small box small box this fabric wetting, so that through the small square of fabric heat loss is not great, to ensure the experimental end of the flat plate heat meter readings can be displayed correctly[10-13]. In addition, the wetting of the small squares of fabric moisture will evaporate, our experiment, the capillary effect through the fabric, wet with a good lead sliver, piercing from the hose to prevent the sliver on the water evaporation, by controlling the surface level of the water flow rate to a fixed spread to a small box the fabric to ensure that small box in the experiments before and after the same amount of fabric wetting.

Through the infrared thermometer in the experiment on fabric surface temperature measurements, and end of the experiment immediately after the determination of plate temperature. Weighing before and after the experiment the moisture systems (conical bottles, hoses and sliver) of weight, poor impulse obtained shall be the weight of evaporated water, heat required for evaporation can be obtained.

4. Results and analysis of heat and moisture balance test

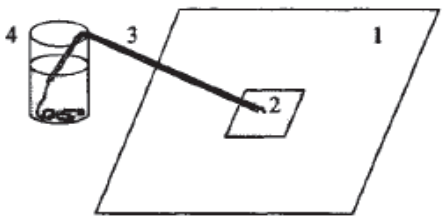

Figure 1. Schematic of heat and moisture balance

1.Testing samples
2. Cut out the fabric to be wet in the small box
3. Hose and sliver
4. Erlenmeyer flask with Cover

4.1 Fabric close to flat in the heat and moisture balance

Heat and moisture balance in the selection experiment 1, cotton fabric, natural fabric flat on the slab insulation apparatus, cut out a small piece of fabric of an area of 0.06× 0.06 m^2, weight 0.41 g. Temperature at 37℃, the latent heat of evaporation is about 2415 J / g. The results shown in **Table 2**, the table is the heat conduction through a small square fabric wetting the conduction heat loss, according to plate-type heat meter test of time and equilibrium time, heat dissipation units are converted to joules (J).

As can be seen from **Figure 2**, wetting the fabric close to the heat meter plate, with the increasing amount of wetting, heat conduction increases, mainly due to wetting increase and decrease the thermal resistance of the fabric, thermal speed. The figure is the conduction heat evaporation to remove heat radiation and convection heat after heat, that is heat of flat provide to the evaporation of wet fabric.

4.2 Moisture balance with the air layer heat

The air layer on the fabric contains a simulated situation (part of the closed mode), the experimental data the following table. Table contains the air layer thermal resistance measurement unit clo "—" was that the environmental heat transfer to the fabric, ambient temperature 23.5℃.

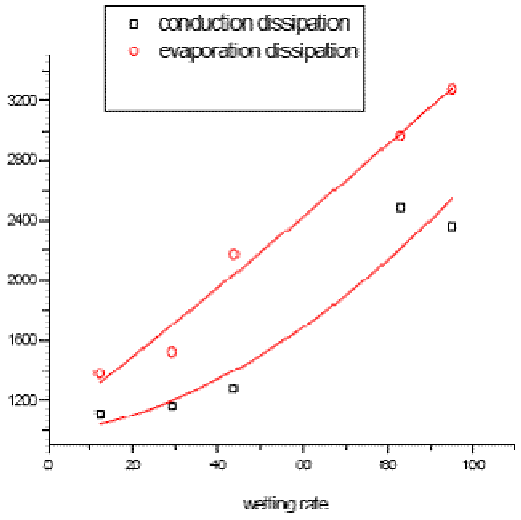

Figure 2. Equilibrium heat and moisture (fabric close to flat)

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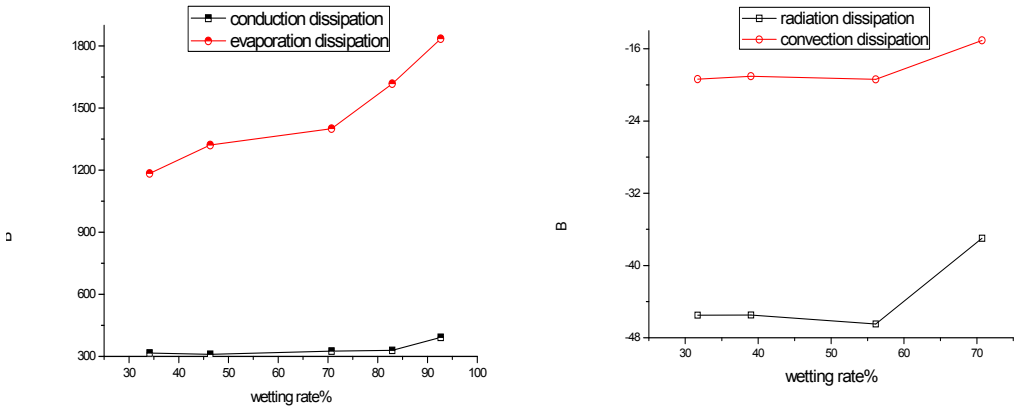

Figure 3. Wetting the fabric heat and moisture balance diagram (air layer 10-15mm)

Table 2. heat and moisture balance data (air layer 10mm)

Fabric-Weight (g)	Wetting rate (%)	Clo value	Temperature difference (℃)	Conduction dissipation (J)	Water evaporation (g)	Evaporation dissipation (J)	Surface temperature (℃)	Radiation dissipation(J)	Convection dissipation (J)	Percentage (%)
0.8	95.1	0.08	4.0	2364.8	1.36	3284.4	35.6	310.6	191.9	56.70
0.7	82.9	0.09	5.0	2490.9	1.23	2970.4	34.6	268.9	157.84	69.15
0.6	43.9	0.14	3.8	1275.4	0.90	2173.5	35.4	301.3	185.04	36.30
0.5	29.3	0.17	4.4	1161.3	0.63	1521.4	35.2	291.9	178.16	45.43

Figure 3 show the wet fabric and air layer between the hot-plate case, the overall trend, with the increase in the amount of wetting, conductivity heat dissipation increased. Volume increase was mainly due to wetting after the fall of fabric thermal resistance, thermal speed. But with the air layer, the performance of this change is not so obvious.

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