Comparative Study on the Water Vapor Transmission Properties of the Mainstream Sportswear Brands

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Abstract

The property of water vapor transmission is of high importance for textile products, especially for sportswear products. The objective of the present study is to investigate the properties of water vapor transmission of some sportswear products (OUDIKE, NIKE and an unknown brand bought from the boutique) on the market. It was found that the samples bought from boutique showed the best water vapor transmission properties, while this property for NIKE sportswear samples was the lowest.

Keywords: Water vapor transmission, Sportswear, Fabric weight, Fabric thickness

INTRODUCTION

In the history of sportswear, the most commonly used materials for sportswear was cotton due to the properties of comfortable soft hand, good strength and good absorbency [1]. However, the poor wicking properties limit the application of cotton fiber in the development of sportswear products. Hence, the synthetic fibers such as polyester and spandex have been attracting tremendous attention due to the excellent wicking properties, which can move the moisture away from the skin to the outer surface of garment and keep the body of athletes at a lower temperature [2].

To enhance the quality of the sportswear, a wide range of international brands are designing and investigating numerous innovative products. For example, Nike is one of the leading brands which can produce the polyester microfibers to provide a comfortable feeling for the athletes and keep their temperature at an appropriate range [3]. At the same time, some brands also provide some similar products which are introduced as good wicking properties to bring the perspiration away from the human body.

The property of water vapor transmission of fabrics is closely related with the characteristics of fabric, such as fabric weight and thickness. The term water vapor transmission is defined as “the steady water vapor flow in unit time through unit area of a body, normal to specific parallel surfaces” in standard testing atmosphere [4-6]. The invisible moisture in the form of vapor passes through the air gap between yarns in a fabric from inner layer to outer layer. With high moisture transmission, the perspiration will not be accumulated on the skin, and the skin can become dry and feel comfortable.

This study aims to compare and evaluate the properties of moisture transmission of some mainstream sportswear products on the market. Three popular brands of sportswear with different composition and prices on the Hong Kong market were obtained from online shops and boutique.

METHODOLOGY

Fabric specimen

Three brands of sportswear with different price and material were selected in this study, as shown in Figure. 1, i.e., OUDIKE, NIKE and an unknown brand bought from the boutique. For the OUDIKE samples (a, b), both specimen were made up of 86% Terylene and 14% Elastane, while the samples of unknown brand were composed of 89% Polyester and 11% Spandex (c, d). The composition of two specimen of NIKE were different, one of which consisted of 100% Polyester and another which was made of 84% Polyester and 16% Spandex for Body, 92% Polyester and 8% Spandex for Back.

All samples were conditioned with the temperature at 20 ± 2℃ and the relative humidity at 65 ± 2% for 24 hours before testing.

Figure 1. Photos of sportswear of different brands: OUDIKE (a, b; both 86% Terylene and 14% Elastane); unknown brand (c, d; both 89% Polyester and 11% Spandex); and NIKE (e, 100% Polyester; f, 84% Polyester and 16% Spandex for Body, 92% Polyester and 8% Spandex for Back).

Water vapor transmission evaluation

The aim of the water vapor transmission test is to determine the efficiency water vapor transmission of the textile material and the ability of evaporating the liquid moisture from the textile material. To obtain the value of the water vapor transmission of the specimens, the permeability of water vapor pass through the samples is important for calculating the weight loss of water in a specific period and comparing the initial weight of the water.

The standard test method ASTM E96 was used to measure the ability of permeation of water vapor through the textile material. Water vapor transmission test was undergone at the standard condition for 24 hours with the standard temperature 21°C and the standard humidity 65%. The open mouth cup was covered by the test specimen with the smaller air space between the specimen and water. The distilled water in the cup would be evaporated and the moisture would be transferred to the environment by the pores of the textile material. The results were determined by the time of water vapor transmission per unit area of material. The unit was expressed as $g/h \cdot m^2$.

The procedures to measure water vapor transmission was as follows:

(i) The size of specimen should be cut as same size of the open-mouth cup in the circular form.

(ii) The distilled water was added to the cup to leave 1 cm air space between the fabric surface and distilled water and thus preventing the fabric contact to the water or moisture.

(iii) The back side of the specimen was required to adhere to the open mouth of the cup by using glue in order to prevent the water vapor and the moisture loss to the atmosphere.

(iv) Each sample should be prepared two specimens for testing the results. The following step was to weigh the sealed cup and the distilled water and record the data.

(v) The sealed cup was placed in the standard condition for 24 hours.

(vi) The sealed cup with the distilled water should be weighed again and calculated the loss of the water vapor and moisture through the period.

The performance of water vapor transmission of test specimen was calculated by equation (1). The higher the value, the better the ability of water vapor transmission.

$$WVT = \frac{G}{\mathrm{A \times T}} \ (\mathrm{g / m^2 h}) \qquad (1)$$

Where, WVT: Rate of water vapor transmission; G: Weight change (g); T: Time, 24 hours (h); A: Area of cup mouth (m^2).

RESULT AND DISCUSSION

Fabric Characteristics

Water vapor transmission property of textiles is greatly influenced by the fabric characteristics, such as fabric weight and thickness. In this study, the fabric weight of specimens were tested by the standard test method and the fabric thickness was tested by the method ASTM D1777. In order to make the measurement more accurate, 10 specimens for each sample was tested and the results were shown in Table 1. As can be clearly seen, sample b (OUDIKE) had the highest fabric weight, whereas the weight for sample e (NIKE) was the lowest. Analogously, sample a (OUDIKE) showed the highest fabric thickness, while the thickness for sample f (NIKE) was the lowest.

Table 1. Fabric thickness of each specimen.

Specimen	Mean fabric weight (g/m^2)	Fabric thickness (mm)
OUDIKE (Sample 1)	228	0.78
OUDIKE (Sample 2)	269	0.68
Unknown brand (Sample 3)	174	0.57
Unknown brand (Sample 4)	166	0.59
NIKE (Sample 5)	132	0.69
NIKE (Sample 6)	161	0.54

Water vapor transmission analysis

Water vapor transmission test aims to find out the degree of how water vapor moisture and human perspiration can transmit through the fabric. The loss of the water represents the water vapor passing through the fabric. The greater value of the loss of the water means that the higher efficiency of the water vapor transmitting through the textile material. The results of water vapor transmission of the samples were shown in Figure. 2.

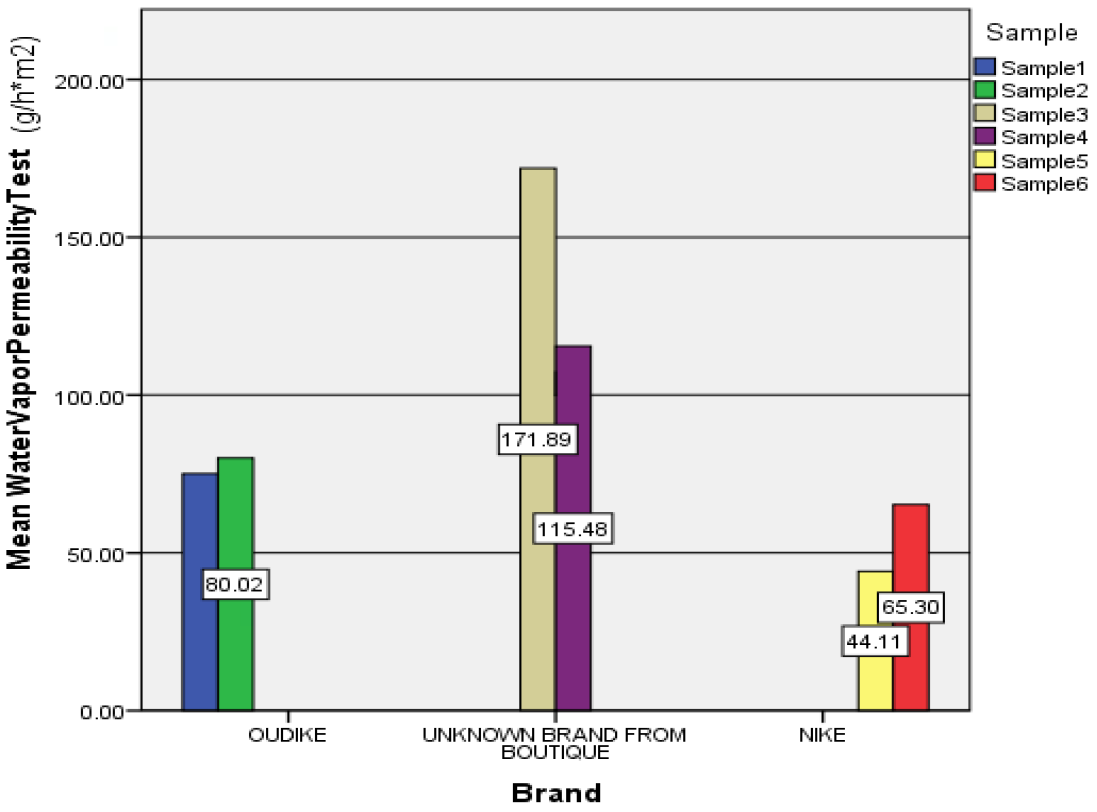

Figure 2. Mean of Water Vapor permeability between different brands.

It can be clearly seen that the sample bought from the boutique had the highest water vapor permeability rate, reaching up to 171.89g/h*m² and 115.48g/h*m² for Samples 3 and 4, respectively. Compared to the unknown brand, the samples of OUDIKE had the poorer water vapor transmission, while this property for the NIKE samples was the lowest. The reason may be related to the fabric and weight and thickness.

CONCLUSIONS

The property of water vapor transmission is of high importance for textile products, especially for sportswear products. In this study, the water vapor transmission of some famous brands of sportswear products in Hong Kong market were explored. It was found that the samples bought from boutique showed the best water vapor transmission properties, while this property for NIKE sportswear samples was the lowest.

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