Drying Rate Evaluation of Men's Quick-Dry Sportswear

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Abstract

Drying rate and time are two important components for drying a fabric to evaluate the quick dry property. This study evaluated the quick dry properties of summer men's sportswear T-shits of different brands (Nike, Adidas, Laishilong and Columbia) by studying the drying rate. It was found that all the samples showed satisfactory drying rate. The fabrics of Adidas showed the highest drying rate, only 45 minutes required for drying, followed by Laishilong samples, while the poorest drying properties was seen in Columbia T-shirts.

Keywords: Drying rate, Sportswear; Quick dry property, Fabric structure

INTRODUCTION

Drying process means the removal of moisture remained in the fabric after squeezing or hydro-extraction. The amount of moisture in a fabric depends on the thickness, structure such as size and shape of pores of the fabric, and also the chemical interaction between the water molecules and the surface of that fabric [1]. The rate of drying is determined by the moisture content of the particular fiber, the drying temperature, the relative humidity (RH), and the velocity of the air in contact with the fiber [2].

The quick dry clothes refer to the fabric or garment will dry faster when compared with the wool or cotton materials under the same conditions of temperature and humidity. It does not mean that it will absorb the sweat but transferred the sweat to the surface of the clothes and make people feel dry on the side touch with human skin [3]. Most of quick dry fabric are made of synthetic fiber, which has lower water absorbing performance, higher air permeability and water proof performance [4].

Quick dry fabric is designed for the requirements of outdoor environment. It is easy to sweat when people are in outdoor activities. The quick dry clothes will make the sweat to evaporate into the air to keep your skin dry [5]. Some of them use the principle of similar characteristics of shape memory polymer, or microporous membrane principle, or the principle of difference between water molecules diameter and the diameter of air molecules. It will accelerate the evaporation of sweat and avoid the getting cold by heat loss [6].

Quick dry is an important property of sportswear and contributes to the prevention of heat loss, wearing comfort and light weight. This has made quick dry a common performance requirement for garments. Moisture from the fiber inside the infiltration of water can be quickly release, discharge and maintain in an excellent dry effect, which enables the fabric in an often dry and comfortable state. In this study, we aims to comparatively evaluate the quick dry properties of sportswear available in Hong Kong market by analyzing the drying rate behavior.

EXPERIMENTAL

Fabric samples

Four summer men's running T-shirts of different brands, i.e., Nike, Adidas, Laishilong and Columbia, were selected for this study. These running T-shirts were claimed and advertised that they can keep human body dry with excellent quick dry behavior when people are exercising. The samples are single and double jersey but with different colors, fiber types and content. Cotton and polyester are the major fibers, including the recycled polyester and spandex, used in the fabric samples. Detailed fabric specification was shown in Table 1.

Table 1. Specification of tested samples.

Item		Sample specification			
Brand		Nike	Adidas	Laishilong	Columbia
Composition		85% polyester 15% cotton	Front body: 61% polyester recycled and 39% polyester; Back body: 51% polyester and 49% polyester recycled	100% polyester	Shell face: 100% polyester; Side panel: 86% polyester and 14% elastane
Color		Grey	Black	Black	Blue
Fabric structure		Single Jersey	Double Jersey	Double Jersey	Double Jersey
Fabric weight (g/m^2)		130.61	128.41	142.76	77.74
Fabric thickness/mm		0.299	0.328	0.292	0.194
Fabric density	Wale/cm	With holes: 18 Without holes: 13.5	Front body:18 Back body:18	17.5	25
	Course/cm	With holes: 17 Without holes: 27.2	Front body:19 Back body:23	20	30

All samples before testing were conditioned with the temperature 20±2°C and relative humidity 65±2% for at least 24 hours. After conditioning, samples were used in physical testing and all the experiments were carried out under standard testing condition.

Surface morphology analysis

The surface morphology of sportswear samples was observed by the Digital Microscope (Leica DVM6, Hamburg, Germany).

Drying rate evaluation

Drying rate and time used for drying a fabric are two important factors to evaluate its quick dry properties, which may greatly affect the comfort of clothing. Drying ability is determined by the rate of moisture retention in fabric and time used for drying. Effectiveness of perspiration removal from skin to outer environment through evaporation can be demonstrated by drying rate of fabric. Drying measurement becomes crucial for the study of moisture management fabrics performance since a slow drying fabric may negatively affect the thermal comfort of a greatly active wearer who may excessively sweat. Therefore, drying rate testing was conducted to evaluate the drying ability and speed of fabric under standard atmosphere.

The testing procedures were set as below.

1. Fabric samples were cut into size of 5x5cm.
2. The specimens were weighted before wetting and recorded for further calculation.
3. As 1 gram is equivalent to 1 mL, same amount of water with the fabric weight was applied to fabric for 100% soaking.
4. The weight of fabric was measured every 5 minutes until 3 consecutive unchanged weights were recorded.
5. Step 4 and 5 were repeated until all specimens were measured.

The total time used for drying the wetted fabric to its original dried weight would be recorded. Also, the drying rate would be calculated for every 5 minutes as an interval in order to monitor the water retention percentage in the fabric per unit time. The equation was shown as follows.

For determining the drying rate of fabric, calculation of drying rate of fabric in each time shot is required and the equation used is:

$$(W_a - W_b)/T \times 100\%$$

Where, W_a = Weight after testing, fabric weight after wetting and drying again; W_b = Original Weight or Weight before test; T = Time (min).

RESULT AND DISCUSSION

Fabric appearance and structure analysis

The appearance and fabric structure of four samples were shown in Figure 1. Two samples, Nike and Adidas, were knitted by single jersey, while the other two samples, Laishilong and Columbia, were knitted by double jersey with specific techniques. The miss

stitches were applied on the back body of Nike T-shirt to create the holes on the fabric. For the Adidas's T-shirt, there were two tensions of the double jersey applied on the front body of garment, thus to create subtle disruptive pattern. Its back body was knitted by plain single jersey but every three wales has constant tension and then one wale has different tension. The whole garment of the Laishilong's T-shirt was knitted by plain stitches. The fabric structure of Columbia's T-shirt was special knitted by every 5 wales of front loops with 1 wale of back loops. Also, every 5 courses plain stitches were knitted and followed with 1 course of tuck stitches. Therefore, the overall fabric structure of Columbia's T-shirt seems plaid pattern.

Figure 1. Appearance and fabric structure of fabric samples of different brands: Nike (A, a), Adidas (B, b), Laishilong (C, c) and Columbia (D, d).

Drying rate analysis

Drying rate and time are two important components for drying a fabric to evaluate the quick dry property. The drying rate was measured periodically every 5 minutes and the measurement was determined by the change in volume per unit time. The high drying rate means the fabric can become dried easily.

As shown in Figure 2, it can be seen that the fabric with holes of Nike took 1 hour to dry from the wetted fabric to its original dried weight (0.3305 g). For Laishilong fabric, it took 55 minutes for drying. Both front body and back body from Adidas took the shortest time for drying, which took 45 minutes. Only Columbia fabric took the longest time for drying that needs 80 minutes.

The periodical drying rates of the specimens were calculated every 5 minutes. All the fabric specimens have regular drying rate since the percentage of moisture retention are reduced constantly for every interval. When the fabric was nearly dried to its original weight, the change in the percentage of moisture retention becomes less and less. Figure 3 summarized the total drying rates of the specimens. The Columbia fabric has the highest total drying rate (54.028%) while the front body fabric from Adidas has the lowest total rate (43.739%). By

contrast, other three specimens have similar total drying rates. The potential reason may be due to the fabric construction and fiber content.

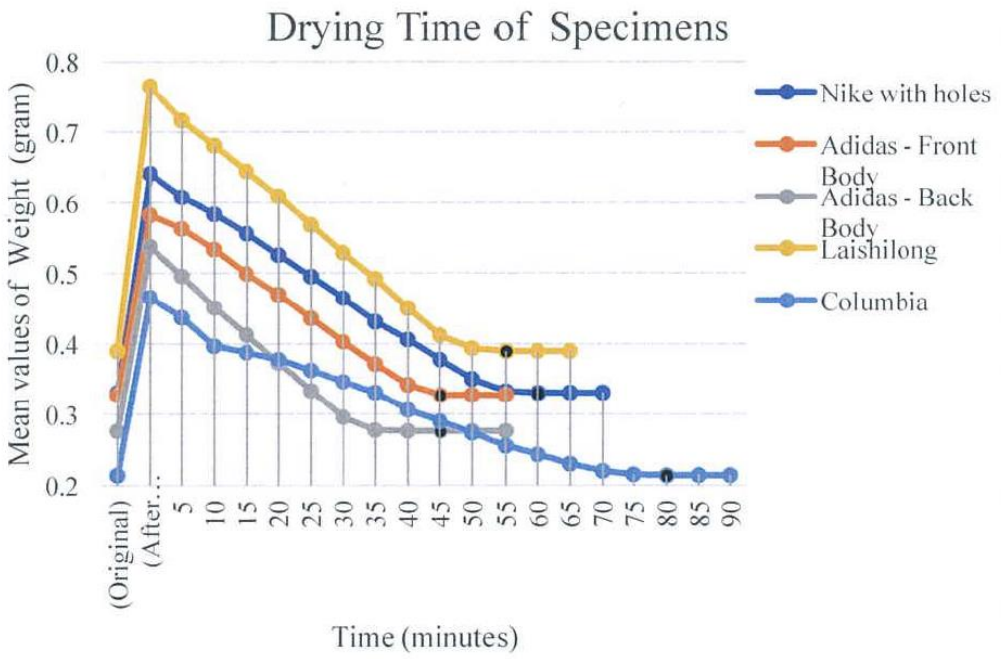

Figure 2. Drying time of samples.

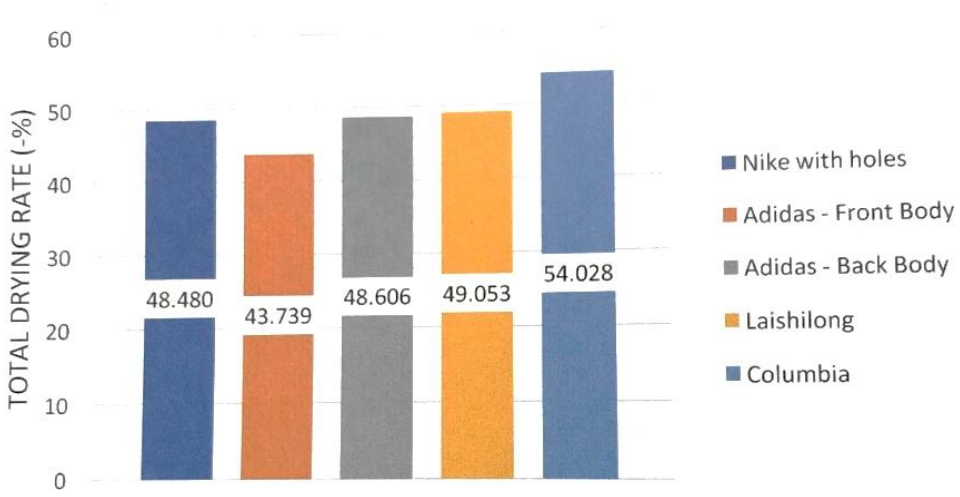

Figure 3. Total drying rate of samples.

Effect of fiber content on drying rate

Fiber content is one of the factors affecting the drying rate (the percentage reduced). Since polyester is the common fiber used in sportswear, only polyester and recycled polyester fiber were further studied here. Figure 4 shows the distribution of polyester content and total drying rate, which reflects a positive relationship of polyester content and total drying rate. The

more polyester fibers used in the fabric, the higher drying rate reduced, which means more moisture dried.

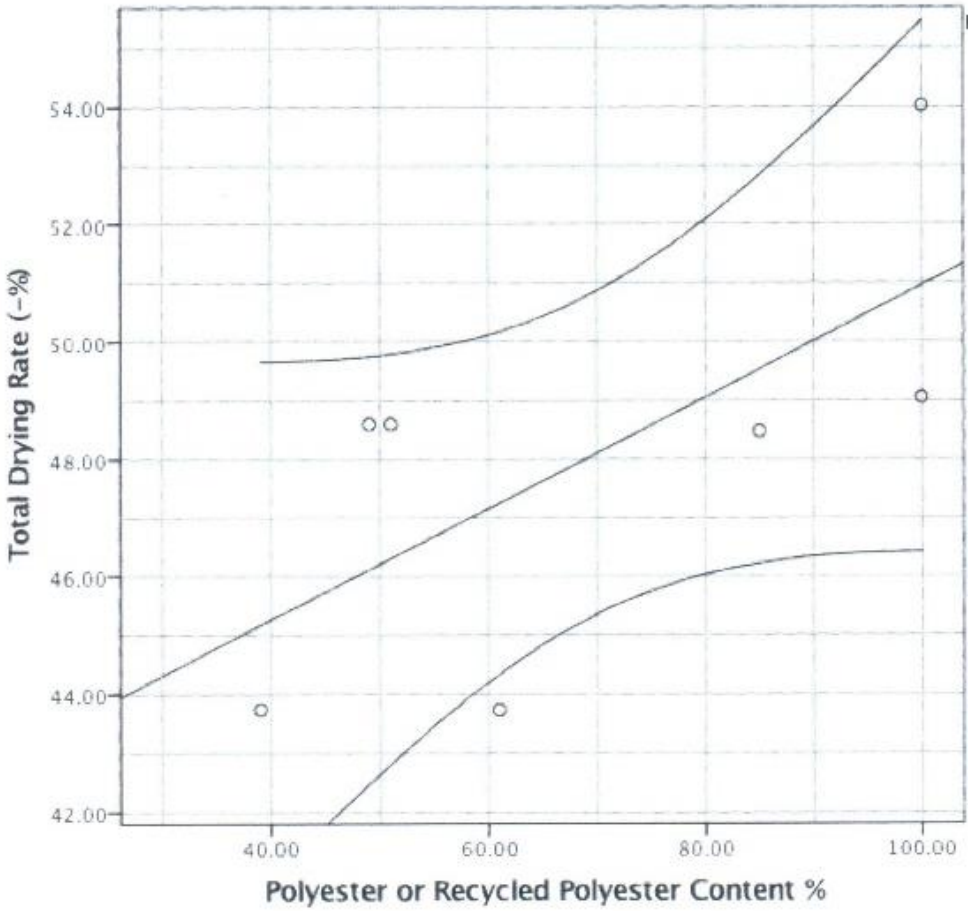

Figure 4. Relationship between polyester content and total drying rate.

Effect of fabric density on drying rate

The correlation analysis (Table 2) shows that there was a significant correlation between the drying rate and fabric course density (p value = 0.042 < 0.005), and the relationship was strongly positive (r value =0.773>0.7). However, the relationship between drying rate and the fabric wale density was not significant but the correlation was strongly positive (r value =0.729>0.7). These relationship between drying rate and fabric density, both wale and course density, can be elaborated via Figure 5. The drying rate has directly proportional relationship with fabric course and wale density. This implies that the higher fabric course and wale density, the higher the drying rate reduced.

Table 2. Correlation analysis among drying rate and fabric density.

		Wale density	Course density
Drying rate	Pearson correlation	0.729	0.773*
	Sig. (2-tailed)	0.063	0.042

*correlation is significant at the level 0.05 level (2-tailed).

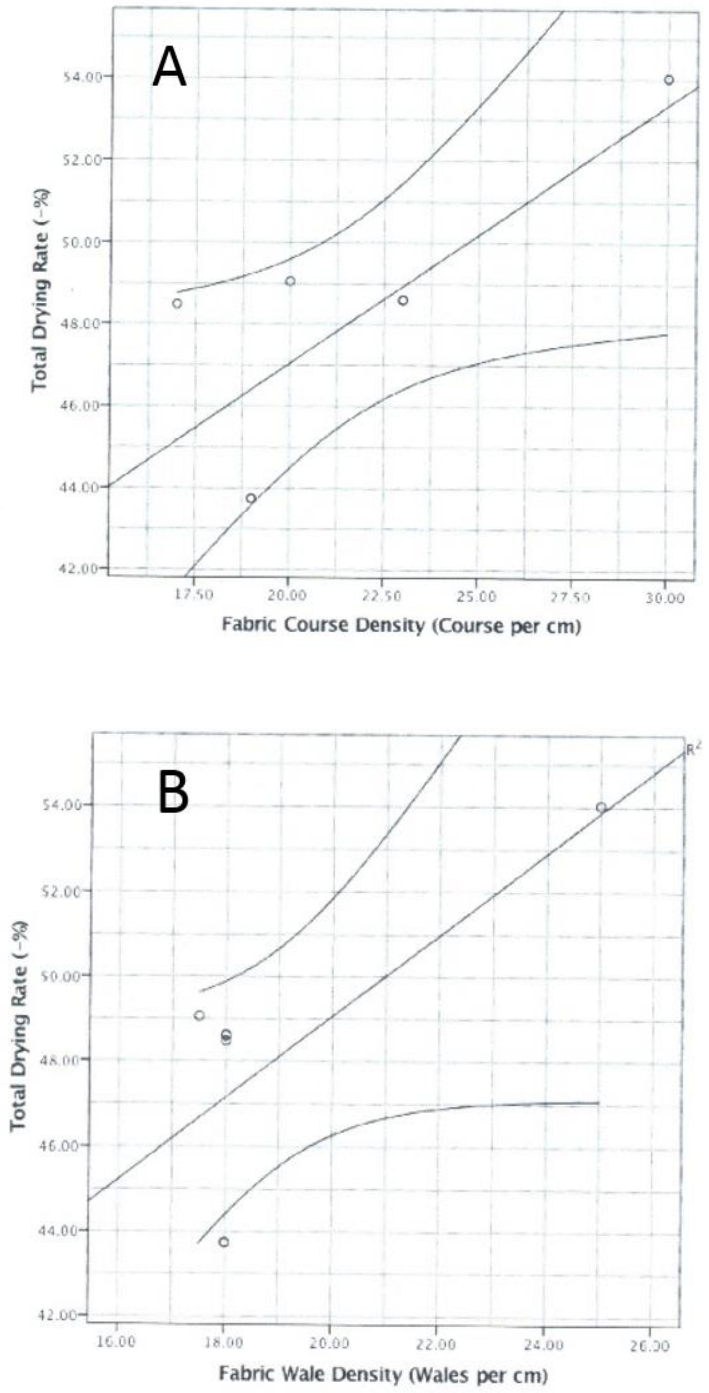

Figure 5. Relationship between drying rate and fabric course density (A) and wale density (B).

Effect of fabric thickness on drying rate

The effect of the fabric thickness on drying rate was different from that on polyester content and fabric density. This is because the relationship between fabric thickness and drying rate was in inverse proportion, as shown in Figure 6. This implies that the higher the fabric thickness, the lower the drying rate.

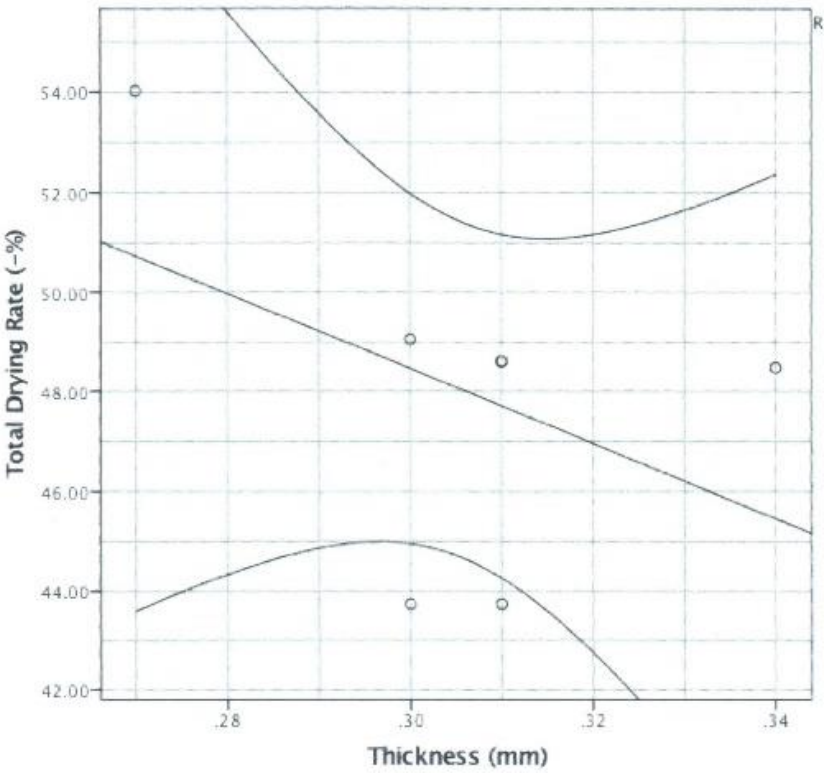

Figure 6. Relationship between drying rate and fabric thickness.

CONCLUSIONS

In this study, the quick dry properties of summer men's sportswear T-shirts of different brands available in Hong Kong market were comparatively evaluated by studying the drying rate. It was found that the fabrics of Adidas, both front body and back body, showed the highest drying rate, only 45 minutes required for drying, followed by Laishilong samples, whereas the Columbia T-shirts took the longest time for drying (80 minutes) and showed the poorest drying property.

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