COMFORT PERFORMANCE OF THE ACTIVE SPORTSWEAR

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ABSTRACT

The complex interactions between fabric and garment design, climate, physiological, and psychological variables that define comfort performance make it one of the most important qualities influencing product acceptance by the end user. With both objective and subjective measurement techniques, specialists might have the tool that can inform the textile producer whether their efforts have potential for improving comfort while in the research and development stage. Comfort performance has obvious importance for daily fashion wear, specialized medical applications, varying types of athletic gear, and protective ensembles for military, industrial, and first responder personnel. Protective clothing has a unique and often contradictory set of properties. The essential requirements for protection against the penetration of environmental threats such as toxic chemicals, or hazardous heat exposures, results in a protective garment which itself contributes to the thermal discomfort, or worse, heat illness (exhaustion, hyperthermia, etc.). Combination of research and testing approaches may be the only way to define the optimum balance between protection and wearer comfort. The present paper summarizes the necessary testing standards from fabric level analysis to garment ensemble comfort evaluation. Here, the total wear comfort index as a combination of three important properties of fabric is used to objectively evaluate the comfort performance of clothing. According to Oxford English Dictionary, comfort means "a state of physical ease and freedom being free from pain or constraint."
***Keywords*:** performance of textiles, comfort, physical properties

1. INTRODUCTION

The interaction between skin and fabric/garment make comfort performance one of the most important characteristics affecting the acceptance level of the product from consumer. Comfort performance is determined based on many climateric, psychological and physiological

variables. It is of special importance is for the uniforms, medical clothing, sportswear, military wear and emergency care.

Sportswear is typically designed to be light weight so as not to encumber the wearer. The best athletic wear for some forms of exercise, for example cycling, should not create drag or be too bulky.

Sportswear or active wear is clothing, including footwear, worn for sport or physical exercise. Sport-specific clothing is worn for most sports and physical exercise, for practical, comfort or safety reasons (Das and Kothari 2012).

Typical sport-specific garments include shorts, tracksuits, T-shirts, tennis shirts and polo shirts. There are also specialized garments for swimming, diving or surfing, skiing, gymnastics. Sports footwear includes trainers. It also includes some underwear, such as the jockstrap and sports bra. Sportswear is also at times worn as casual fashion clothing. For most sports the athletes wear a combination of different items of clothing, e.g. sport shoes, pants and shirts. In some sports, protective gear may need to be worn, such as helmets or American football body armor. On the other hand, sportswear should be loose enough so as not to restrict movement (Das and Kothari 2012).

Sportswear design must consider the *thermal insulation* needs of the wearer. In hot situations, sportswear should allow the wearer to stay cool; while in cold situations, sportswear should help the wearer to stay warm. Sportswear should also be able to transfer sweat away from the skin, using, for example, moisture transferring fabric (Das and Kothari 2012). http://en.wikipedia.org/wiki/Spandex

Same as the trend of other sportswear, function performance becomes a more important factor to be concerned in the selection of golf wears nowadays. In order to maintain the proper human body temperature to avoid people suffered from the generation of huge metabolic heat or the heat/cold stress from surrounding environment, an ideal golf wear should provide a good thermal comfort performance. Also, good moisture transmission and breathability are required (Hassan *et al*., 2016).

2. METHODOLOGY

Fabric thermal resistance, thermal conductivity and absorptivity, heat flow, water vapor permeability and air permeability are the physical properties to be measured for a good view of heat and water transportation through the fabric.

Two types of fabrics used for sportswear in the home market are analyzed for this work, respectively 100% cotton and 100% PES.

Fabric density can be calculated using the relationship:

Fabric density (Fd) = Fabric weight (g/cm^2)/Thickness (cm)
Fabric porosity (Fp) = 1- Fabric density/Fibre density

Physical Testing Method
Water vapor permeability (WVP)
Water vapor permeability is calculated as below:

WVP = M/AxT (gr/m^2/24h); where:
M – weight loss
T- Time interval (24 hrs)
A – surface of sample (internal surface of the cup)

$A = \pi d^2/4 \times 10^{-6}$

The water vapor permeability test was conducted according to S SH 1150-5:1989 (ASTM96) cup method. This includes the measurement of the weight loss of the sample with evaporation time (1 day). The results for the two samples (CO and PES) were respectively 770 and 847 gr/cm^2/24hrs.

Amongst many methods and characteristics of textiles vapor permeability, it is difficult to select the best one for determining the breathability of fabrics. The impact of fabric characteristics to the health and performance of real persons is of great importance.

Experiment

Two types of fabrics used for sportswear in the home market are analyzed for this work, respectively 100% cotton and 100% PES.

General characteristics

Fabric #.	Content	Structure	Weight gr/m^2	Thickness, mm	Fabric porosity
1	100%CO	Knit	182	0,725	0,86
2	100%PES	Knit	175	0,739	0,81

The water vapor permeability test was made based on the ISO 15496 : 2018 (ASTM E96 / E96M-16) cup method. It involves the measurement of the weight loss of the sample with evaporation time (1 day). The results for the two samples (CO and PES) were respectively 770 and 847 gr/cm^2/24hrs.

Amongst many methods and characteristics of textiles vapor permeability, it is difficult to select the best one for determining the breathability of fabrics. It is important to see the impact of fabric characteristics to the health and performance of real persons.

Wear Trial

The second part of the research adresses the subjective human thermoregulation responses. During the wear trial, two men at the same age (24, 25) were asked to wear both models of sports blouses (model 1 and 2).

Procedure

The normal procedure was taking notes on the general data of wears:

General data of the wearers

The two young men were interviewed for major medical problems or prescription medication via an oral interview. They didn't eat anything 2 hours before the exercise sessions. They both performed the 12 minutes fitness run test developed by Dr. Ken Cooper in 1968 as an easy way to measure aerobic fitness and provide and estimate the VO2 max.

During the exercise sessions each of them was monitored through a heart rate monitor (beats/min). Both of them held one type of blouse one day at the same time. So, the exercise sessions were completed in two days. The running test requires that the runner walks or run as fast as possible and at the end of 12 minutes he measures the maximum distance.

The calculation is done as below:

$$VO2max = (22.351 \times kilometers) - 11.288$$

3. RESULTS AND DISCUSSIONS

The results of the two men were put in the table below:

Subject #	Heart rate	VO2 MAX
Man 1 Blouse CO	170	1694
Man 2 Blouse CO	178	1936
Man 1 Blouse PES	188	2028
Man 2 Blouse PES	181	2180

The results showed that subjects with PES blouse perform better although the heart rate is higher in the PES sportswear.

4. CONCLUSSIONS AND RECOMMENDATIONS

The results are considered as an original work of a wider research work. These results showed that the 100% PES fabric had better physiological response compared to the 100% Cotton. Although the perspiration is well absorbed in the cotton fabric it is not transported out of the body but remains

close to it. The correlation between water vapor permeability and subject performance was positive. The 100% PES fabric perspires more quickly the sweat from the body.

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