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Evaluation of Textile Materials in Physical Activity

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This paper "Evaluation of Textile Materials in Physical Activity" compared how the different properties of fibers, such as cotton and polyamide 6.6, affect the sport performance. The purpose of this study was to evaluate the physical performance improvement during the physical activities due to the use of clothing made of high-technology fabrics. For this comparative study, two raw materials were chosen, cotton and polyamide 6.6, and, through the properties of these samples, the behavior of these fabrics was studied by comparing them. Polyamide 6.6 fabric presented a small loss of body temperature during the physical activity when compared to cotton fabric. The existence of a significant correlation between the body temperature and the lactate index reduction was proved by this study. Such correlation showed the importance of body temperature variation during an activity performance; the lower is this variation, the greater is the reduction in the lactate index. Currently, modified polyamides allow the fabric to interact with human body by emitting an infrared, retarding muscle fatigue and improving skin elasticity.

1. Introduction

The great challenge of textile industry is to make fabrics that improve the performance of athletes by using technology. The raw material largely influences on the fabric functional aspect.

Studying the properties (Fourt, Lyman; Hollies, Norman[1]. 1970) of fibers (physical, thermal properties) is fundamental to establishing a relation with the clothing functionality. The threads and intelligent fabrics add technology and science inside the fiber. For this reason, such threads and fabrics are able to offer functional properties of performance and well-being, supplying in their application a range of requirements in addition to the conventional ones.

Relating the properties of fibers to the thread functionality is an effective way to get clothes with technology and better performance.

[1] Fourt, Lyman; Hollies, Norman. 1970. Clothing Comfort and Function. New York: Marcel Dekker Inc., p. 31-45, 115-150, 123, 133, 172.

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2. Goal

This paper mainly aims at analyzing the performance of textile materials during the physical activity. Two fibers were chosen: one natural (cotton); and the other, one synthetic fiber, Polyamide 6.6. With these two fibers, clothes were developed from knits in which one evaluated the correlation level between the average body temperature in legs and the lactate concentration measured before and after the exercise treadmill test.

3. Experiments

3.1 Materials

Two types of threads were chosen for the assays:
- Polyamide 6.6 thread with 2x80/68 dtex[2]
- Cotton with Ne 30/1 carded denier (process flow of cotton spinning in which the fibers pass through the Carding machine and are turned into thread)

3.2 Worn Clothes and Group of Volunteers

One analyzed 2 groups having 15 persons each who wore loose T-shirt and boardshorts. In this study, one evaluated the performance of volunteers wearing boardshorts with different textile materials that are distributed in the following way:

Control Clothes:
- Boardshorts 100% polyester, not compressed, made of flat fabric.
- T-shirt 100% cotton, loose over the body.

Sample "A":
- Boardshorts 86% cotton and 14% spandex, compressed, knitted.
- T-shirt 100% cotton, loose over the body.

Sample "Y":
- Boardshorts 86% polyamide 6.6 and 14% spandex, compressed, knitted.
- T-shirt 100% cotton, loose over the body.

3.3 Methodology

Controls and Limits

By reaching any of these (Kosmoscience Consultoria e Assistência Técnica[3], 2007) parameters, the test will be stopped and the recovery will start: Systolic Blood Pressure (SBP: 220 mmHg); Diastolic Blood Pressure (DBP: > 15 mmHg); Heart Rate (HR: 220 – age); Fatigue (FAD: subjective, defined by the volunteer when reaching the tiredness limit).

Lactate Concentration Measure in Blood

Equipment used:
- Accutrend Lactato (*Roche Diagnóstica Brasil*)
- BM test straps – Lactate (*Roche*)

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[2] Instituto De Pesquisas Tecnológicas (IPT). 1983. Manual de dados técnicos para a indústria têxtil. Publ. IPT n° 1.257. São Paulo, p. 40-45.

[3] Kosmoscience Consultoria e Assistência Técnica. 2007. Implementation of the study RD001-06. Valinhos, 52p.

Infrared Thermography

Infrared thermography aims at measuring the average body temperature in a certain region. The equipment used was *Raytec Fluke Ti 300* that provided the average temperature and its respective standard deviation.

4. Results and Discussions

4.1 Thermal Efficiency – Definition

In percentage, it represents the extent that the temperature gradient[4] (initial temperature less final temperature) of the sample was lower than the Control Clothes gradient for the volunteers of each group. This measure is performed by thermography. The definition of Gradient and Thermal Efficiency is as follows:

- Gradient of Control boardshorts = initial temperature – final temperature
- Gradient of Sample boardshorts = initial temperature – final temperature

The expression that shows the thermal efficiency (EFIC) is:

$$\mathbf{EFIC(\%)} = \frac{\text{gradiente controle} - \text{gradiente amostra}}{\text{gradiente controle}} \times 100 \qquad (1)$$

4.2 Comparison between the Thermal Efficiencies of Groups "A" and "Y" (Costa Neto, Pedro Luiz de Oliveira[5]. 1977)

The method "t" of Student (parametric) was used, since the groups for this data set obey a normal distribution to compare the thermal efficiency of groups "A" (CO) and "Y" (PA). Figure 1 below shows the differences between the medians of both groups.

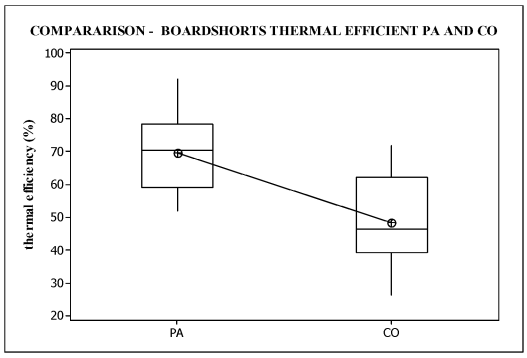

Figure 1. Comparison between the thermal efficiencies - PA and CO
Source: *Programa Estatístico, 2007.*

Difference Test-T, IC of 95% with "p" value = 0,0000
Reliability Interval (-30,3462, -12,0551)

[4] Gystad, Trude; Bakkevig, Martha K. 1994, Correlation between Different Formulas for Mean Skin Temperature and Thermal Comfort. Art. publ. in Sixth International Conference on Environmental Ergonomics. Canada: J. Frim, M. B. Ducharme & P. Tikuisis, p. 162-163.

[5] Costa Neto, Pedro Luiz de Oliveira. 1977. Estatística. São Paulo: Ed. Edgard Blücher, p. 84-120, 145-146, 181-188.

4.3 Comments on the Comparison between the Thermal Efficiencies of Groups "A" and "Y"

For a 95% reliability level, one can statistically state that the group of volunteers who wore the sample "Y" (Polyamide 6.6) presented a thermal efficiency that is higher than that of the group who wore the sample "A" (cotton).

4.4 Correlation between the Lactate Reduction Efficiency by Boardshorts Thermal Efficiency

Figure 2 below shows the existence of a correlation between the lactate index reduction efficiency and the thermal efficiency ("p" value < 0.05).

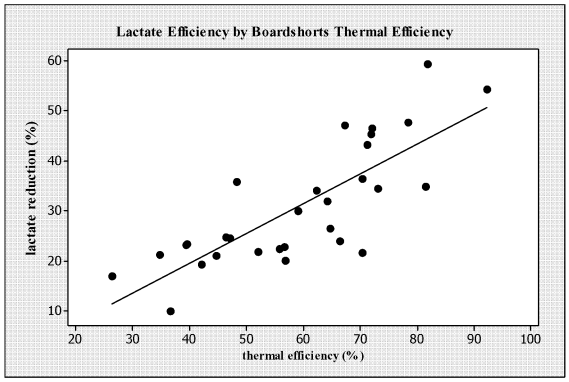

Figure 2. Correlation between the lactate efficiency and thermal efficiency
Source: *Programa Estatístico, 2007.*

Correlation Coefficient	0,793
"p" – value	0,000

4.5 Comments on the Lactate Index Reduction by Thermal Efficiency

The existence of this correlation shows the importance of body temperature variation during an activity performance; the lower is this variation, the greater the lactate index reduction will be during an activity (Kosmoscience Consultoria e Assistência Técnica[6]. 2007).

[6] Kosmoscience Consultoria e Assistência Técnica. 2007. Implementation of the study. Execução do estudo RD001-06. Valinhos, 52p.

5. Conclusions

During the evaluation, Polyamide 6.6 fabric provided the volunteers with a small body temperature variation throughout the physical activity when compared to cotton fabric; this way, it provided the group of volunteers (group "Y") who wore Polyamide 6.6 fabric with a thermal efficiency that is higher than that of the other group (group "A") who wore cotton fabric. A higher thermal efficiency allows a better local peripheral blood circulation.

The body temperature variability (standard deviation) of the volunteers who wore Polyamide 6.6 sample (group "Y") was lower than that of the group that wore cotton sample (group "A").

The existence of a correlation between the lactate index reduction efficiency and the thermal efficiency shows the importance of body temperature variation during an activity performance; the lower is this variation, the greater the lactate index reduction will be during an activity.

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