A NEW PERSPECTIVE ON THE ROLE OF FIBER PROPERTIES IN COMFORT

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INTRODUCTION

Interest in the area of clothing comfort is increasing as its importance to consumers is recognized [1-4]. Studies of clothing comfort based exclusively on the measurement of physiological parameters have been unable to identify any interaction between fiber type and metabolic performance [5,6]. This is mainly because the body sees clothing as a resistance to heat and moisture transfer, and these parameters are determined by fabric construction rather than fiber properties. The use of human sensory perception analysis [7] enables subtle differences between fabric properties to be distinguished. The present paper describes how this technique has been utilised to investigate the role of fiber properties on parameters which contribute to the perception of comfort.

METHOD

The general details of the procedure have been described in detail elsewhere [7]. Experimental garments were worn by 30 subjects who rated a number of different descriptive terms appropriate to clothing comfort. Grouping of these descriptive terms during analysis provides information about the moisture, surface, and handle/fit characteristics of a fabric. Trials have been conducted to study the influence of fabric surface energy and fiber hygroscopicity on the perception of these descriptors. In both instances, the fabric was lightweight knitwear, made up into a spencer (a skin contact, long sleeved undershirt).

In the first trial, the surface energy of 100% wool fabric was increased by chlorination or decreased by the addition of a hydrophobic fluorocarbon based product. Both treatments modify fiber properties such as surface friction and surface structure as well as surface energy, and this factor must be considered in the interpretation of the experimental data.

The second trial compared a series of blend fabrics whose fiber contents increased in steps of 25% from 100% wool to 100% acrylic. After initial dry cleaning, these fabrics were found to have similar surface energies. A comparison of the subjective evaluations of these fabrics identified differences which could be attributed largely to fabric hygroscopicity.

In both trials, fabrics and garments were very carefully matched in all possible aspects of construction and fit so that the influence of steady-state heat and moisture transport properties could be minimized. Evaluation took place in both sweating and non-sweating conditions for the surface energy experiments, and in sweating conditions only for the hygroscopicity experiments. Surface energy was ranked by means of a modified drop test which measures the length of time for 30μl of a liquid of known surface characteristics to be absorbed into the fabric.

RESULTS

During conditions of light sweating, subjects perceived descriptors associated with moisture, such as stickiness, dampness, clinginess, clamminess, absorbency and breathability, more intensely as the surface energy of the fabric decreased. As only very small quantities of liquid sweat were present on the skin during the greater part of the trial cycle, these differences cannot be directly attributed to differences in the wicking bahaviour of the fabrics. Such differences are believed to be the result of the higher surface energy changing the way moisture is perceived by the skin. There are several mechanisms which could be contributing to this, and work is in progress to clarify this hypothesis. There were no significant differences ($P > 0.05$) perceived in the tactile properties of the fabrics (prickliness, scratchiness) when evaluated under these conditions.

When the same garments were evaluated during non-sweating conditions, only the tactile-related parameters were perceived as differing significantly between garments. The overall mean values for these descriptors were compared to those obtained during light sweating conditions. It was found that although light sweating increased tactile-related discomfort, there were no significant differences between garments while moisture-related sensations were present. This indicates that the presence of moisture in the clothing microclimate dominates other sensations typically perceived during wear.

The second trial used conditions of light sweating to compare the perception of fabrics of varying hygroscopicity but constant surface energy. These fabrics were perceived as having similar moisture-related properties, but differed significantly in tactile sensations. These differences corresponded to small dimensional changes which occurred as a results of laundering between wearings, with the looser garments being less scratchy, prickly, etc. The lack of perceived differences in the moisture-related descriptors suggests that, during conditions of light sweating, the hygroscopicity of this fabric construction did not significantly influence the perceived moisture sensations.

Hygroscopicity has been shown to have a significant influence on the perception of thermal sensations, coolness in particular, during non-sweating conditions [8]. These differences were most noticeable when the fabrics were brought into momentary contact with the skin and then removed. This sequence causes desorption to occur in the hygroscopic fibers, which is sufficient for subjects to rate the hygroscopic fabric as cooler than a matched non-hygroscopic fabric. This enhanced coolness was perceived for a range of warm humid conditions in the absence of thermoregulatory sweating.

CONCLUSION

The use of human sensory perception techniques has shown how fiber properties can affect the perception of parameters that relate to garment comfort. It has been found that when liquid moisture is present in the clothing microclimate, fiber surface energy has a significant influence on garment comfort.During non-sweating conditions, neither fiber surface energy nor hygroscopicity has a perceivable effect on moisture-related comfort sensations. However, under these conditions, other characteristics of the fabric, such as the tactile properties, become more noticeable to the wearer. It has been shown that hygroscopicity influences the perception of thermal sensations in non-sweating conditions.

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