Journal of Fiber Bioengineering & Informatics 4:3 (2011) 301–309
http://www.jfbi.org | doi:10.3993/jfbi09201110

Comparison of Deodorizing Properties of Several Typical Fibers

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Abstract

Socks and underwear emit unpleasant odor, especially after they have been worn for long durations under certain conditions. This paper discusses the deodorizing properties of several typical fibers such as deodorizing acrylic, wool, line, cotton, Modal® and polyester fibers by instrumental testing. The odor from the socks made of these fibers after a one-day wear in summer is further evaluated by three testers using a human olfactory test. The molecular structure of the deodorizing acrylic fiber was confirmed by infrared spectroscopy. In terms of the deodorizing property of the various fibers with respect to ammonia, it is found that the deodorizing acrylic fiber had the best performance. This is attributed to the carboxyl groups in its molecular structure. Wool, Modal®, cotton, and linen fibers were worse in turn; polyester fibers had the worst performance. The absorption of acetic acid by wool, linen, and deodorizing acrylic fibers was better, followed by Modal® and cotton fibers. The polyester fibers, once again, had the worst performance. Thicker socks diffuse less odor than thinner socks made from the same fibers. The results of chemical analysis and sensory analysis show that the deodorizing performance of deodorizing acrylic fibers is superior.

Keywords: Odor Intensity; Fiber; Sensory Evaluation; Deodorizing Property; Deodorizing Acrylic

1 Introduction

High humidity provides a favorable growth condition for bacteria. Many of the characteristic malodors associated with the human body are due to the presence of large populations of microorganisms [1-2]; the associated malodors are the result of micro-organisms digesting nutrients present in sweat and releasing volatile, pungent waste products. Textile products can absorb, retain, and output the sweat produced by the human body. Enhanced retention of sweat by the textile leads to a persistent increase in the metabolic activity of skin bacteria and an accumulation of the odor-causing products produced by bacterial metabolism [3]. The role of textiles in odor production has been studied from the 1950s. It has been suggested that textiles contribute to odor development because the odor is potentially more intense in the fabric substrate than in the

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adjacent axilla [4]. For this reason, it is important to choose the correct fiber type in deodorant textile design. The fact that natural fibers are better at reducing odor than synthetics was a generally held belief [5], but there has been little, if any, published reports supporting this fact.

People generally considered that the main component of body odor was the production of ammonia, acetic acid, and isovaleric acid [6], although this is still somewhat unsubstantiated.

The Japanese Society of Fibers has developed a related instrumental evaluation method to determine the deodorizing performance of textiles. This method includes chemical analysis and sensory analysis [7]. However, due to sensitivity limitations and the threshold of the main component of odor usually being very low (acetic acid: 0.01 ppm; isovalerate: 0.001 ppm), the instrumental evaluation method cannot on occasion accurately detect all the problem compounds. Nevertheless, the final evaluators of the textile performance are the wearers of textiles themselves, so the shortcomings of any chemical analysis method can be overcome to some degree through the use of sensory analysis [8].

In this work, deodorizing acrylic fibers, along with several typical fibers such as wool, cotton, Modal® linen, and polyester were analyzed. The fiber structure of the deodorizing acrylic fibers was confirmed by infrared spectroscopy (IR). Deodorizing performance was tested using chemical analysis. An additional test was performed on socks made of the different fibers; three participants wore each sock for one hot summer day, after which the odor was tested. The latter test was performed by sensory analysis. The results of both the chemical analysis and sensory analysis showed that the deodorizing performance of deodorizing acrylic fibers is superior.

2 Materials and Methods

2.1 Materials

Materials used for the tests were knitted fabrics made from cotton, wool, linen, Modal®, polyester, and deodorizing acrylic fibers. The properties of the various sock samples are listed in Table 1.

Table 1: Description of samples

Type	Fiber material	Weight(g)		Thickness (mm)
		Man socks	Woman socks	
GT-962B	15% Deodorizing acrylic; 15%Anti-bacterial acrylic fibers; 15% Common acrylic; 55% Cotton	3.8	3.6	0.20
GT-962B	15% Deodorizing acrylic; 15% Anti-bacterial acrylic fibers; 15% Common acrylic; 55% Cotton	11.3	10.2	0.75
Cotton	100% Cotton	3.4	3.2	0.22
Polyester	100% Polyester	4.5	4.1	0.38
Modal®	100% Modal®	3.9	4.2	0.29
Linen	100% Linen	10.1	9.3	0.48
Wool	100% Wool	5.2	5.1	0.25