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Thermal Comfort Properties of Wool and Polyester/Wool Woven Fabrics Dyed in Black

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Abstract

An abaya is a traditional Muslim woman's outer garment. It is black and worn on a day-to-day basis when women are outside their homes. The abaya absorbs most of the heat from sunlight in a hot climate as it is black, making the wearer very uncomfortable. In order to reduce absorption of heat in an abaya and to make the wearer more comfortable, it is proposed that a treatment with a solar energy reflector could enable the wearer to perspire less; thus allowing them to feel cooler. This paper investigates the thermal comfort properties of plain-woven fabrics dyed in black and treated chemically to reflect a proportion of sunlight's energy. The fabrics were made from 100% wool and two polyester/wool blends. The testing results showed that the fabrics that had received the reflective treatment possessed marginally improved thermal comfort properties as compared to fabrics without the treatment.

Keywords: Abaya; Black Woven Fabric; Thermal Comfort; Air Permeability; Moisture Management

1 Introduction

Generally, garments provide protection from weather and enhance aesthetics [1]. Garments differ from region to region based on tradition as well as climatic conditions. The abaya (Fig. 1) is a traditional outer garment worn by some women in parts of the Islamic world including Turkey, North Africa and the Arabian Peninsula. Abaya is a very long cloak consisting of a large square of fabric draped from the shoulders or head. It covers the majority of the face and body and can be worn with the "niqab", a face veil covering everything but the eyes [2].

Most abayas are black as it is considered to be the most socially conservative way for women to dress in the Arabian Gulf. Considering the extreme climatic conditions in the Arabian Gulf region where the temperature in summer sometimes exceeds 45 °C, wearing an abaya can be very uncomfortable. Black fabrics are the most thermally uncomfortable to wear in hot climates

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due to the fact that darker fabrics absorb solar heat efficiently and this heat does not dissipate quickly [3]. Although many researchers have worked on the improvement of comfort performance in clothing [1, 4, 5], to date limited research has been undertaken to assess and alter the thermal comfort properties of the abaya. In order to improve abaya comfort performance, it is necessary to reduce the heat absorption so that the wearer will perspire less and feel more comfortable.

Fig. 1: Abaya and face veil in black colour

Generally, light coloured fabrics reflect both visible (colour) and invisible (heat) rays of sunlight. On the other hand, dark coloured fabrics absorb both types of radiation. The solar energy absorbing and retaining behaviour may be modified by incorporating a special chemical in fibre [6]. A treatment to textiles that reflects sun energy but without affecting the colour or feel of the fabric could be an effective solution for reducing thermal discomfort caused by wearing a black garment. Therefore, the present study aims at improving the thermal comfort properties of the traditional abaya by giving black fabrics for making the abaya an energy reflecting treatment.

Some investigators have reported that sweat can be readily absorbed by natural fibers, such as wool and cotton, and this improves the thermal comfort properties [7-9]. It has also been reported that synthetic fibers improved the comfort properties of fabrics as well [5, 10-12]. Blends of natural and manufactured fibres potentially have the advantage of combining the desirable properties of both fibre components, such as comfort, durability and easy-care properties [13]. Polyester/wool fabrics are commonly used in many textile applications to improve the above properties. Therefore, this research used three types of plain woven fabrics; pure wool and two different polyester/wool blends.

2 Experimental

Three plain-woven fabrics used in this study were 100% wool, 63/37 polyester/wool (63/37 Pe/W) and 50/50 polyester/wool (50/50 Pe/W) as shown in Table 1. After dyeing to a black colour, the fabrics were given an Energy Reflection Chemical (ERC) treatment. Fabric performance was then evaluated.