World Academy of Science, Engineering and Technology
International Journal of Materials and Textile Engineering
Vol:14, No:04, 2020

Investigating the Thermal Comfort Properties of Mohair Fabrics

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Abstract : Mohair, obtained from the Angora goat, is a luxury fiber and recognized as one of the best quality natural fibers. Expansion of the use of mohair into technical and functional textile products necessitates the need for a better understanding of how the use of mohair in fabrics will impact on its thermo-physiological comfort related properties. Despite its popularity, very little information is available on the quantification of the thermal and moisture management properties of mohair fabrics. This study investigated the effect of fibrous matter composition and fabric structural parameters on conductive and convective heat transfers to attain more information on the thermal comfort properties of mohair fabrics. Dry heat transfer through textiles may involve conduction through the fibrous phase, radiation through fabric interstices and convection of air within the structure. Factors that play a major role in heat transfer by conduction are fabric areal density (g/m2) and derived quantities such as cover factor and porosity. Convective heat transfer through fabrics is found in environmental conditions where there is wind-flow or the object is moving (e.g. running or walking). The thermal comfort properties of mohair fibers were objectively evaluated firstly in comparison with other textile fibers and secondly in a variety of fabric structures. Two sample sets were developed for this purpose, with fibre content, yarn structure and fabric design as main variables. SEM and microscopic images were obtained to closely examine the physical structures of the fibers and fabrics. Thermal comfort properties such as thermal resistance and thermal conductivity, as well as fabric thickness, were measured on the well-known Alambeta test instrument. Clothing insulation (clo) was calculated from the above. The thermal properties of fabrics under heat convection was evaluated using a laboratory model device developed at the Technical University of Liberec (referred to as the TP2-instrument). The effects of the different variables on fabric thermal comfort properties were analyzed statistically using TIBCO Statistica Software. The results showed that fabric structural properties, specifically sample thickness, played a significant role in determining the thermal comfort properties of the fabrics tested. It was found that regarding thermal resistance related to conductive heat flow, the effect of fiber type was not always statistically significant, probably as a result of the amount of trapped air within the fabric structure. The very low thermal conductivity of air, compared to that of the fibers, had a significant influence on the total conductivity and thermal resistance of the samples. This was confirmed by the high correlation of these factors with sample thickness. Regarding convective heat flow, the most important factor influencing the ability of the fabric to allow dry heat to move through the structure, was again fabric thickness. However, it would be wrong to totally disregard the effect of fiber composition on the thermal resistance of textile fabrics. In this study, the samples containing mohair or mohair/wool were consistently thicker than the others even though weaving parameters were kept constant. This can be ascribed to the physical properties of the mohair fibers that renders it exceptionally well towards trapping air among fibers (in a yarn) as well as among yarns (inside a fabric structure). The thicker structures trap more air to provide higher thermal insulation, but also prevent the free flow of air that allow thermal convection.

Keywords : mohair fabrics, convective heat transfer, thermal comfort properties, thermal resistance
Conference Title : ICNF 2020 : International Conference on Natural Fibers
Conference Location : Dublin, Ireland
Conference Dates : April 24-25, 2020