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Effect of Anti-felting Treatment on Thermal Comfort Properties of Selected Wool Fabrics in Wet State

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Abstract

Wool fabrics both in dry and wet state exhibit high thermal insulation and dry touch, but their main disadvantage – felting, caused by exposition of the fabrics to mechanical action under hot-wet state, might limit their generally excellent properties. Therefore, antifelting treatment is often used to avoid the fabric felting. However, when the level of antifelting treatement is exaggerated, thermal comfort properties of wet wool fabrics might get reduced. In the paper, the effect level of various antifelting treatments on thermal comfort properties of wet wool fabrics was studied with the objective, to determine the levels of treatment, allowing the reduction of the felting behaviour and simultaneously maintain the excellent thermal insulation and thermal contact properties of wool fabrics.

Keywords: Wool Fabrics; Wet State; Thermal Comfort; Antifelting Treatment

1 Introduction

One of the main advantages of wool fabrics is that they offer high thermal insulation and dry contact feeling under high level of moisture, thus maintaining (at least temporarily) some degree of thermal comfort to the wearer even in highly moist environment. Merino wool garment, for example, can absorb up to 60% of its own weight before it feels wet to the touch [1, 2]. This unique property of fine wool fibre is provided by the scaly structure and properties of the surface of wool fibres. While the core of the fibres is capable of absorbing up to 30-40% of the fibre's weight in moisture, the overlapping scales of the wool fibres are covered with a hydrophobic layer which resists transverse penetration of liquid water or moisture. Water vapor, however, is absorbed into the core, through intercellular diffusion, between the overlapping scales. This makes wool fibre both water repellent and moisture absorbent.

Besides its wetting and moisture absorption properties, the cuticule cells or scales of the wool fibre are responsible for other important surface properties such as tactile properties and felting behaviour [4]. The overlapping scales result in the fibre having a coefficient of friction at the

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surface much lower in the root to tip direction than it is in the other direction. This directional friction effect is responsible for the felting of wool fibre assembly during wet processing.

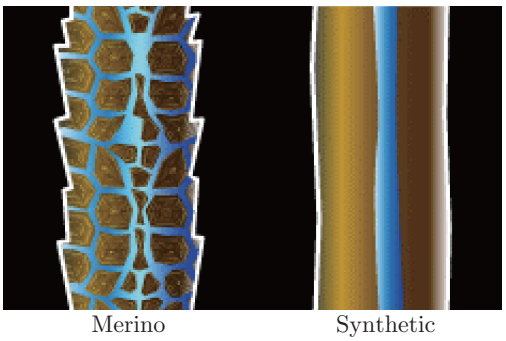

Fig. 1: Schematic representation of moisture absorption on the surface of Merino wool and synthetic fibre [3]

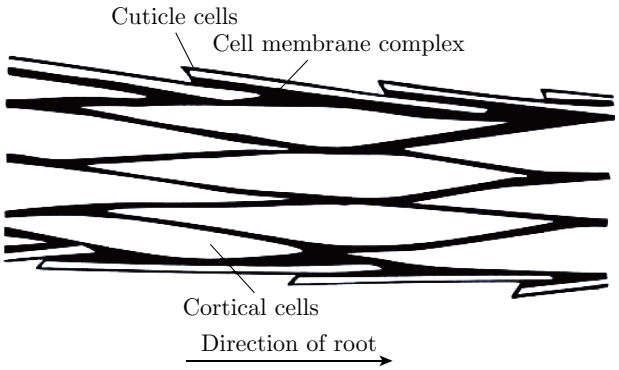

Fig. 2: Schematic diagram of the cuticle cells or scales of wool [4]

Wool fibre assemblies such as yarn, fabric or garment undergo both relaxation and felting shrinkage during wet processing. The irreversible felting shrinkage is attributed to the differential frictional effect of the surface cuticular scale [5] and is the major cause of shrinkage in wool. Felting is promoted by mechanical agitation in water, hot or cold, and the presence of surfactants [6]. These conditions are encountered when laundering wool in domestic washing machines. Much research has been undertaken in the area of shrink-resist technology in order to prevent woollen products from felting and make them fully machine washable [7]. Besides the scaliness of the fibre, the length of the fibre (fabric made from longer fibre shrinks more), the degree of fibre crimp (more crimp more shrinkage in fabric) and the fibre fineness (finer fibres produce more shrinkage), the ease of extensibility of the fibre and its ability to recover from extension are essential for felting [5].

With the increasing use of domestic washing machines with spin-drying, the development of a reliable shrink-resist treatment for wool was greatly needed [8]. The most successful approaches to commercially useful shrink-resist treatments are based on the following two principles:

I Reducing the 'scaliness' of the wool fibres by the action of chemical or other degradative treatments which leads to a reduction in the directional frictional effect;

II Binding the fibres together or masking the scales using polymers (additive treatment).