FACTORS AFFECTING FELTING OF WOOL : AN OVERVIEW

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This paper deals with felting of wool. Felts are in class of nonwovens as no thread enters into the composition of this fabric. This paper gives relationship between physical parameters and felting and processing parameters and felting.

Key words: *Felting, Scales, Crimp, Fibre length.*

INTRODUCTION

Felts are included in the class of nonwovens as no thread enters into the composition of this fabric. ASIM defines felt as a structure built up by interlocking of fibres by a suitable combination of mechanical work, chemical action, moisture and heat, without spinning, weaving or knitting. It may consists of one or more classes of fibres: wool, reprocessed wool or reused wool, with or without admixture with animal, vegetable and synthetic fibres.

Felt is formed when sheep wool or animal fur is subjected to heat, moisture and pressure or agitation. A unique property or wool fibre to produce an irreversible structure by rubbing under certain conditions is utilized to produce felt or non-woven products[1].

FELTING

The process of felting involves relative movement of the fibres which may be caused either by mechanical rubbing or by a series of compression-extension operation. Under the influence of these intermittent forces of squeezing, twisting etc., the wet fibres migrate in a preferential root ward direction because of the DFE, and at the same time they tend to curve, loop and entangle with each other. Because of the anchoring effects of the entangling and the differential frictional properties, this process proceeds irreversible[17].

Crimpiness, flexibility and hygrascopic quality combined with delicacy of fibres, are the most important factors in felting. Expanding with moisture contracting with dryness, responsive to alterations of temperatures and the scales of the wool undoubtedly contribute to the felting action[9].

Felting is a complex process, and the felting capacity depends not only on the inherent properties of wool, but also on the conditions of the felting process. Several theories have been developed dealing with the essence of the process and the relation existing between the felting capacity and other properties of wool fibres. The present paper deals with the review of work done and the experiences obtained so far in understanding the role of various physical and chemical properties and various other factors contributing to felting of wool.

RELATIONSHIP BETWEEN PHYSICAL PARAMETERS AND FELTING

According to Encyclopedia of Textiles "A difference in the wool supplied to the felting machines makes a different felt". Gupta (1987) also adds that different types of wool vary in their ability to felt depending on the scales length, fineness waviness and other physical properties.

SCALES

The extensive researches, which have been made in the last three decades on the felting properties of wool before and after various treatment, leave little doubt that the Directional Frictional Effect (DFE) of the fibres is the most important factor. According to Marsh (1979), felting depends primarily on the scale structure of wool. The overlapping of the scales is such that the free ends project outward and towards the tip of the fibre, giving the edge its characteristic serrated appearance. On this account, the fibres under pressure only move amongst its neighbour in the direction of its root, thus drawing other fibres together to form a close and compact mass.

The scale of wool are flat, irregular and vary in size and shape. Studies on the scale structure of wool of various Indian sheep breeds indicates that the scales outline is closely related to the diameter of the fibre than breed. Bumb (1973) studied the type and number of scales of some indigenous breeds with respect to their feltability and concluded that the aggregate scale effect in interlocking the fibre masses is prominent in chokla due to lesser fibre diameter and high percentage of pure fibre. Sule (1970) also suggests that the types and number of scales on the surface of the wool play a predominant role in making goods quality felts besides other properties like elasticity and swelling. The work of Nathusius in 1864, showed that the size of the scales is the same for various types of wool but that the extent of overlapping creates an apparent differences. The amount of visible scale is an important means of differentiating between different types of wool and their felting quality. Marsh (1979) further adds that merino wool, with well defined and projecting scales, felt much more rapidly than mohair with its less distinctive scales which adhere more closely to fibre. However, Speakman (1931) found that there is no strict relationship between scaliness and felting property except with extreme types of wool.

FINENESS AND MEDULLATION

Fibre properties such as fineness and medullation influence the felting significantly. A wool's fineness in indicated by thickness of the individual fibres of wool which are measured in microns. According to American wool Handbook, the average diameter of the wool is 17 microns for fine wool, 24-32 microns for medium wool and 40 for coarse wool Mahal (1982), suggests that the relative felting property of a particular breed will depend on the distribution of fibre diameter as well as medullation. Chokla having an average fibre diameter of 26.5 microns and medullation 47% will definitely be superior in felting properties than Malpura (diameter 41.4 microns and medullation 79%). The medullated fibres significantly influence the feltability of woolen felt and also influence the properties of the felt, Gupta (1987) reported that with the increase in content of medullated fibre in the felts, the thickness increase and the breaking strength decreases.

According to Shakyawar (1998) medullation in wool fibres significantly influences the performance of felts with respect to abrasion loss which decreases with increase in percent of medullated fibre in the product. Ince and Rydes (1984) also concludes that correlation exists between medullation and appearance of end product.

CRIMP

Felting may also be influenced by the tendency of wool to crimp. It is caused by considerable differences in the composition and structure of the internal cortex layer and the external scale layer of fibre, which is the cause of different resiliency of these layers[19]. Therefore, greater is the wool crimp; the stronger is the tendency of separate fibres straightened in the process to resume their initial waviness, which naturally accelerates felting and moreover there is a greater possibility of mutual entanglement with highly crimped fibres[11]. Scherman (1998) also ascertains that the most significant fibre characteristic in determining the rate of loose - wool felting are crimp and crimp frequency.

FIBRE LENGTH

Length of the fibre plays an important part in the felting process. Speakman, (1933) determined that when felting is done under identical conditions, the shrinkage was greater with the longer wool. Relation of the wensleydale wool fibre length with felting was also investigated by Speakman and Sun (1936), which reveals that the shrinkage caused by contraction of stretched fibres will increase with increase in fibre length and therefore leads to better felting.

RELATIONSHIP BETWEEN PROCESSING, PARAMETERS AND FELTING

The felting capacity depends not only on the inherent properties of wool, but also on the conditions of the felting process.

pH

Rate of felting increase with increase in acidity or alkalinity of the solution. Comparison between the effect of the active reaction of the medium on the felting process shows that an acid medium is good for felting while an alkali medium plays a positive role up to a critical value of pH. Speakman (1933) states that fibre swelling is associated with the behaviour and established that felting is most rapid at about pH 10 where as on the acid side of neutrality, the rate of felting starts to increase at pH4 and continue to increase with decreasing pH.

Shenai (1995), suggests that felting of wool in acid gives a better cloth without significant cloth damage. Bohm (1995) found that felting power of wool depends mainly on the magnitude of the D.F.E. in the milling medium, and the effect of pH on the felting power is due to influence of pH on the magnitude of D.F.E. Speakman, et.al. (1945) have also shown that the scaliness of wool increases with decrease of pH below 4, while above pH 9, it first increase and then, above pH 11 decrease[8].

TEMPERATURE

When temperature effects on felting process were considered then Harrison (1921), observed that the rate of felting is most rapid at 46°C and 49°C, increasing with rise in temperature and then falling the case of extension and sate of felting both increases with rising temperature up to 45°C, but with a further increase in temperature the felting capacity deteriorates. The case of extension in water continues to increase upto 100°C whereas the rate of felting decrease above 45°C. This is explained by the fact that there is a difficulty in recovery from extension of wool at temp above 45°C. Feldtman and Mephee (1964) reported that felting is maximum at 50°C in soap solution and from to 70°C in buffer solution, the actual temperature depends on the pH and the mechanical action of the felting machine.

Sherman and Whiteley (1968) found that felting properties of wool fibres are extremely sensitive to temperature variation upto 40°C. At higher temp., increase in the rate of felting are generally small, and it could be suggested that the rapid decrease in D.F.E. at higher temperature might effectively limit the process.

AUXILIARIES

Soap is a more efficient agent than alkali for felting which used in the solution provides for a higher shrinkage during felting. This indicates a specific property of soap, probably causing lubrication of fibres and thus facilitating their displacement. Shenai (1995), states that cationic detergent are strongly absorbed by the fibre surface through salt link, yielding a hydrophobic, essentially uncharged surface. As a result, shrinkage increases to that of the native wool. He further adds that an ionic detergent also influences the felting shrinkage of wool.

If the fibres have a highly developed and coarse scale layer, its strength is reduced by means of oxidizing agent, in order to attain a better relationship between the resilience of the scale layer and the cortex. As a result of this treatment, fibres tend to crimp, which improves the felting process[12].

Felling of wool is significantly enhanced by heat. Heat will make the wet fibre more elastic and plastic, easier and more likely to move, and it will make it distort and entangle itself with other fibres. Heat will also cause the fibre to swell more and this effect is more in acid or alkaline conditions. Increased swelling result in more inter-fibre contact and increased inter-fibre friction.

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