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Physical and Compressional Behaviour of Bharat Merino and Magra Wool

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ABSTRACT

Physical properties of fibres are important to know the quality of the wool. Resiliency is the important property of carpet, doormat etc. In wool industry it is important for suitings made from fine wools as well as carpets and felts made from coarse wool in which wool is compressed. Due to environmental and nutritional management conditions wool quality varies within animals of same breed and among different breeds. There is a need to study the physical and compression properties of wool. An experiment was conducted for the measurement of compressibility and other physical properties of Bharat Merino and Magra wool samples. These samples were compressed to 100 kg load. It was observed that compressibility decreases and resiliency increases with the increase in number of cycles. Also, both these properties are negatively correlated with diameter and medullation of wool.

Keyword : Wool, Compressibility, Resiliency

Introduction

Physical properties of fibres are important to know their processing quality and end use suitability. Evaluation of fibre quality is of paramount importance in quality improvement research, commercial transactions and in processing fibres into optimum quality yarn capable of producing quality fabrics. Fibre quality evaluation involves measurement of all physical properties by suitable means. These parameters include diameter, medullation, breaking strength, staple length, compressibility and resiliency etc. Compressibility and resiliency of wool are inherent fiber properties and are dependent on factors such as fiber diameter, medullation and tenacity. Among the various properties length is most important as fibre shorter than a minimum length are difficult to be handled on spinning machines. Spinability is basically decided by the fibre length and its variability. Uniform long stable fibre performs better in spinning than the shorter ones. The durability of textile materials depends greatly on the mechanical strength of the fibre. In a textile mill operations like spinning, winding and weaving also depend on the strength of the raw material, as otherwise breaks will occur leading to frequent interruptions. Due to environmental and nutritional management conditions there is variation in wool quality within animals of same breed or among different breeds. So there is need to study the physical and compression properties of the wool of different breeds for different end use.

Behaviour during compression is an important characteristic of a mass of fibres (De Macarty *et al.*, 1955). With wool in particular, the handle of a bulk of fibres is of special consideration when the wool quality is estimated. Such an assessment of quality often involves operation of squeezing by physical dimensions of the wool fiber and produced excellent types of apparel wool through systematic breeding and improvement of the sheep flock and intensification of the undercoat portion (increases fleece density) of the primitive sheep breed. The results are the various types and breeds of domestic or improved sheep. Magra sheep breed is found in the dry northwestern region of India. Magra wool is coarse having good length and luster and is used for carpet. Bharat Merino sheep breed developed at Central Sheep and Wool Research Institute Avikanagar, Rajasthan by crossbreeding indigenous Chokla and Nali sheep with Rambouillet and Merino rams and stabilized at 75% exotic inheritance, has the potential as an import substitute for exotic fine wool. As wool is a biological product man has very little control over the chemical and physical structure of the fiber. However the frequency distribution of fibres of different diameters varies from sample to sample. Compressibility and resiliency of wool are inherent fiber properties and are dependent on fiber diameter, medullation and tenacity (DeMacarty *et al.*, 1955 and Demiruren *et al.*, 1955). Chaudri *et al.* (1968) conducted a number of compressibility tests on wool and concluded that fibre bulk does not wholly or elastically reverses the deformation; there are decreases in volume of wool with pressure. Several authors have described the compression characteristics of fibre in bulk (Bogaty *et al.*, 1953; Parthasarthy *et al.*, 1999 and Khali *et al.*, 1999). There are a large number of related parameters that might be used in compression analysis, although the most direct are resistance to compression, cyclic effect, work to compress and resilience (Bogaty *et al.*, 1953). Several types of systems mainly a hollow container and piston was used to know the change in volume or thickness with load or pressure (Busse *et al.*, 1953 and Chaudri *et al.*, 1968). In the present study conducted at Central Sheep and Wool Research Institute Avikanagar, Rajasthan samples of Bharat Merino and Magra were analyzed for compressibility, resiliency and other physical properties. The compressibility and resiliency of wool of two breeds upto fifth cycle were estimated. However in one samples of Bharat Merino and Magra wool, the observations were made upto 25th cycle considering the fact that wool fabrics undergo several compression and relaxation in their lifetime.

Materials and Methods

Samples were collected from twenty-four animals each of Bharat merino and Magra. These samples were cleaned carefully with petrol, dried at room temperature, combed uniformly by laborimixer and then 4 g of these samples were compressed at 100 kg load upto fifth cycle of compression in cylindrical block of diameter 4 cm and height 4 cm by Instron (System ID 4465-H1864). At the end of each cycle the samples were immediately unloaded and a rest period of one minute was allowed between two successive cycles. The crosshead speed was 60 mm / min. The compressibility and resiliency were calculated for all five cycles using the formula: -

$$\text{Compressibility} = \frac{D\,V}{V} \times \frac{1}{D\,P}$$

Where, V is the initial volume, D V is the change in the volume and D P is the change in pressure

$$\text{Resiliency (\%)} = \frac{\text{Energy recovered}}{\text{Energy Spent}} \times 100$$

$$\text{Hysteresis (\%)} = \frac{\text{Energy spent} - \text{Energy recovered}}{\text{Energy Spent}} \times 100$$

The diameter was observed using projection microscope at 250 X magnifications by standard methods (IWTO-8-66 (E)). Tenacity and extension were estimated using stelometer at 1/8" gauge length with three replicates per sample as per standard method (Annual Book of ASTM Standards, 1966 Vol. 7.01. P.P.402-407.). The results were statistically analyzed (Snedecor and Cochran, 1967).

Results and discussions

The compressibility and other physical parameters of Bharat Merino and Magra wool are shown in Table 1. It is evident that compressibility of Magra wool is slightly less than Bharat Merino wool, because Magra wool is coarser having more diameter and medullation percentage than Bharat Merino wool. Resiliency of Bharat Merino wool is more than Magra wool which is significant at P = 0.05. It may be that after several compressions Bharat Merino wool becomes a cohesive mass with more elasticity. Hysteresis of Bharat Merino wool is significantly (P = 0.05) less than Magra wool. The compressibility decreases as the number of cycle increases whereas resiliency increases with increase in number of cycles when samples of Magra wool and Bharat merino wool were taken together (Fig. 1.). This is because after one cycle the cohesion increases and the wool mass behaves with more coherence resulting in decrease in compressibility. Table 2 shows the correlation coefficient of different physical parameters. Compressibility and resiliency

Table 1. Physical parameters with respect to breed

(Mean ±S.E.)

Parameters	Breeds	
	Bharat Merino	Magra
Compressibility (M^2 / N)	0.347±0.009[c]	0.336±0.01[c]
Resiliency (%)	49.69±0.776[b]	47.10±1.002[b]
Hystersis (%)	50.31±0.008[b]	52.90±0.01[b]
Diameter (m)	21.70±0.105[a]	33.77±0.549[a]
Hetro fibres (%)	0.0±0.0[a]	14.47±1.100[a]
Hairy fibres (%)	0.0±0.0[a]	30.09±1.906[a]
Medullation (%)	0.0±0.0[a]	44.54±2.088[a]
Tenacity (g/tex)	8.61±0.148[c]	8.83±0.180[c]
Extension (%)	18.86±0.373[c]	18.91±0.574[c]

[a]significant at P = 0.01, [b]significant at P= 0.05, [c]nonsignificant

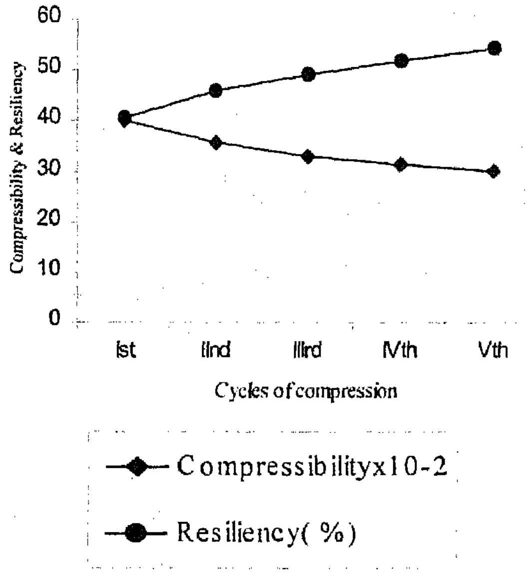

Fig. 1. Compressibility and resiliency of Bharat Merino wool and Magra wool taken together with respect to cycles of compression

Table 2. Correlation Coefficient of different Physical Parameters.

	Compressibility	Resiliency	Hystersis	Diameter	Hetro	Hairy	Medullation	Tenacity	Extension
Compressibility	1.00	-0.68[a]	-0.68[a]	-0.08	-0.14	-0.12	-0.13	0.18	0.22
Resiliency		1.00	-1.00	-0.24	-0.17	-0.21	-0.21	-0.17	-0.001
Hystersis			1.00	0.24	0.17	0.21	0.21	0.17	-0.001
Diameter				1.00	0.81[a]	0.96[a]	0.97[a]	-0.11	-0.18
Hetro					1.00	0.72[a]	0.87[a]	-0.08	0.11
Hairy						1.00	0.97[a]	-0.08	-0.18
Medullation							1.00	-0.08	-0.09
Tenacity								1.00	0.58[a]
Extension									1.00

[a] significant at P = 0.01, [b] significant at P= 0.05, [c] nonsignificant

are negatively correlated with diameter, medullation, hetero, hairy percentage and tenacity, because coarser fibres are more rigid and resist compression more. Fig. 2 and 3 show the compressibility and resiliency of Bharat Merino and Magra wool upto 25th cycle of compression. It is clear that compressibility decrease with increase in number of cycles. However, resiliency increases with increase in number of cycles of compression. It is also seen that there is still scope for reduction of these properties when the wool is further compressed.

Conclusions

The physical parameters such as diameter, medullation, hetero and hairy percentage affect compressibility and resiliency of the wool. The compressibility of wool of different breeds is

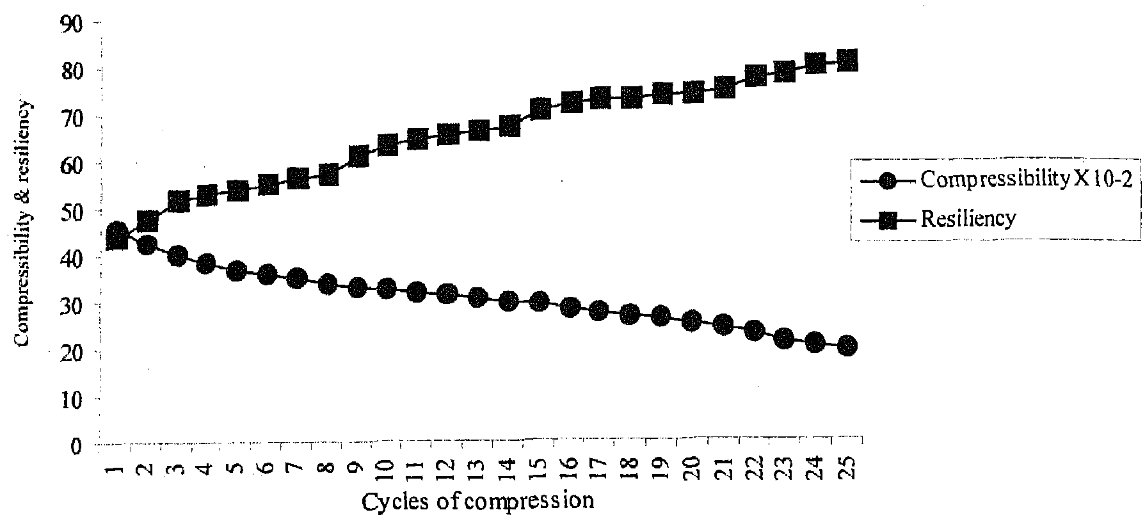

Fig. 2. Compressibility and resiliency of Bharat Merino wool upto 25th cycles of compression

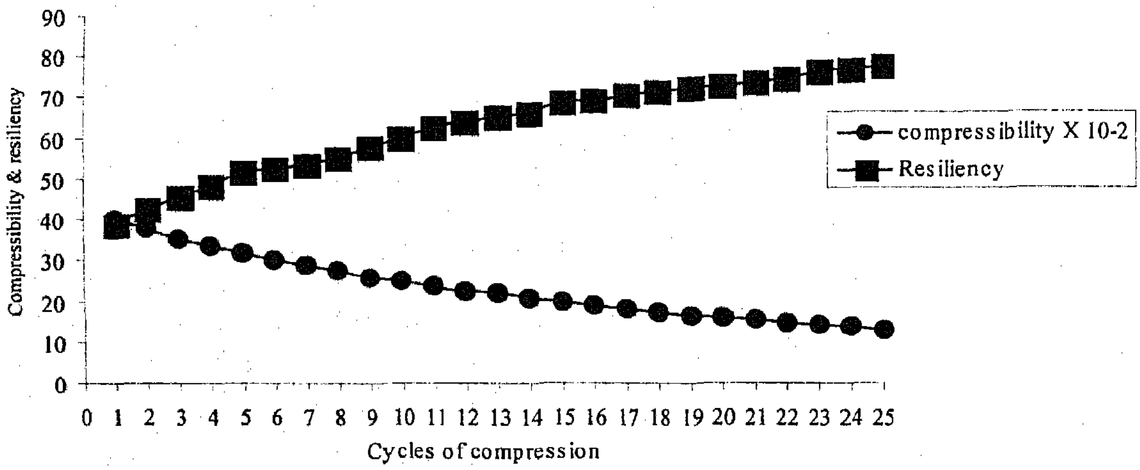

Fig. 3. Compressibility and resiliency of Bharat Merino wool up to 25th cycles of compression

different and in general decreases with increases of number of cycles of compression, whereas resiliency increases with increases in number of cycles.

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