Always in Shape

RESILIENCE

A carpet's ability to spring back after compression is its resilience.

Resilience is the ability to return or 'spring back' to the original form or position after being bent, compressed or stressed and is used as a measure of the elastic properties of a material. This concept is depicted in Figure 1.

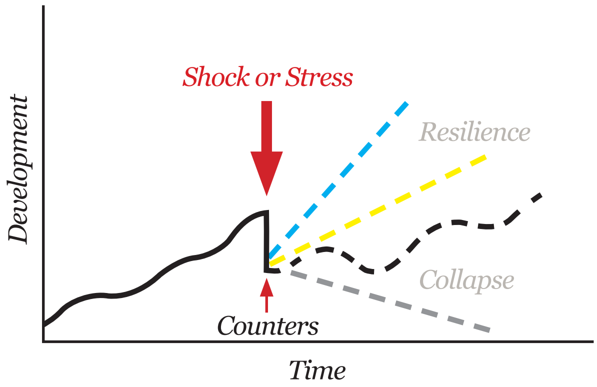

Figure 1, Concept of resilience

This elastic or stretch behaviour is a key criterion for many materials such as interior textiles, industrial textiles, technical textiles and apparel.

Resilience has a huge influence on carpet walking comfort and performance. A carpet that has elastic properties feels soft, comfortable and supportive underfoot.

Resilience can be related to two important performance criteria in a textile system:

- *User Comfort*
- *Extensibility and wear performance*

USER COMFORT

Comfort in a carpet is extremely important for both under-foot walking support and wear appearance.
Continued walking comfort after wear and use is a key criterion, particularly for high traffic and busy areas within the home where repeated stress, bending and extension is exerted on the carpet pile.

EXTENSIBILITY AND RECOVERY

Extensibility and resultant recovery on a repeated basis is very important in the longevity performance of carpet and is a key factor in determining how the carpet will wear and per-form over time. The ability for a carpet system to be flexed or extended repeatedly and then to return to its original posi-tion or shape is also a governing factor of carpet appearance over time.

LIMITATIONS OF OTHER FIBRES

There are a number of man-made synthetic fibres on the market that offer a range of very good technical properties such as strength, durability and abrasion resistance in comparison to wool fibre. For example a nylon fibre is stronger than a wool fibre of similar thickness, in that it requires a higher stress to break it whether it is wet or dry, (Figure 2). However, nylon is not capable of stretching as far as wool without breaking, and it breaks at only around 10% of extension. Similarly, polyester fibre also demonstrates much reduced extension properties than wool (Figure 3).

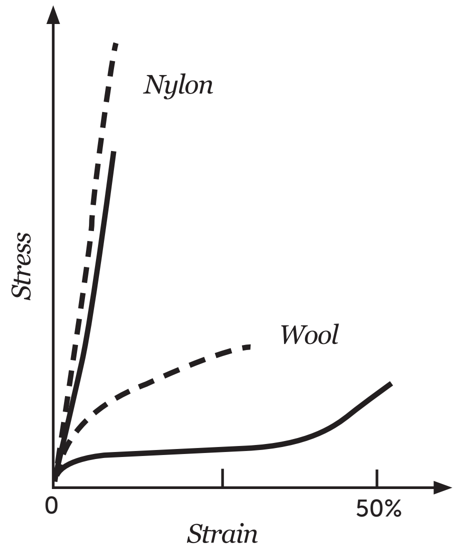

Figure 2. Stress strain curve for wool and nylon, wet fibres are represented by solid lines and dry fibres are represented by dashed lines.

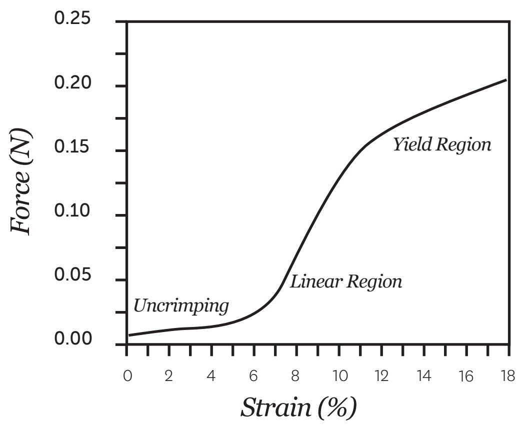

Figure 3. Force versus dimension change for virgin polyester fibre.

Wool has good stretch and extensibility properties which can be related to the internal spring-like structure of wool. In proteins such as wool, about 20 different amino acids are combined, giving an enormous amount of variation in the order in which they are placed to form the protein chain. The protein is composed of a backbone of amino acids linked together and around this backbone are side chains of amino acids. The backbone is twisted into a helical path called an alpha helix which is the basic structure of wool Figure 4.

The ability of wool to stretch can be related to this spring-like behaviour of the alpha helix. The hydrogen bonds which link consecutive turns of the helix are broken under tension, thus enabling the coils to stretch more readily. The natural resilience of wool, which enables the fibres to readily return to their original shape, mostly arises from the strong, covalent disulphide bonds (-S-S-) that link adjacent helices. These give some rigidity to the structure and help it to resist stretching.

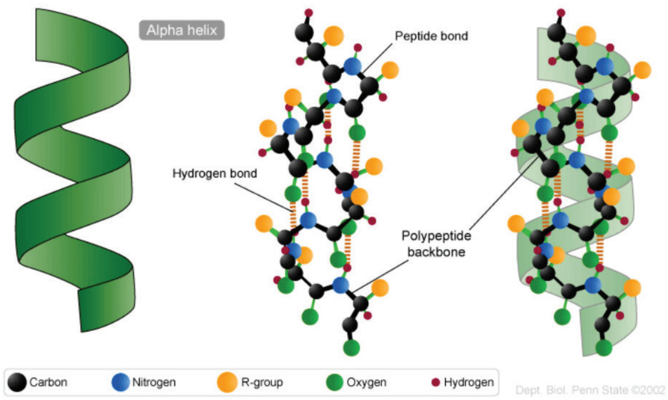

Figure 4 Wool alpha helix

This translates into an important physical property of the wool fibre in its ability to be extended by more than 30% of its length without breaking and in turn, can recover from extensions of approximately 20% (Wood 2009).

CRIMP

Wool fibre also has a natural crimp (Figure 5) which contributes to its resilience performance. This wavelike pattern is due to its extremely complex internal structure. This structure serves to create air spaces, and as such provides a very soft and 'springy' handle. This is an intrinsic property of wool fibre, compared to synthetic fibres which have to be specially manufactured to impart an artificial crimp.

Figure 5 Wool fibre crimp

SUMMARY

- *ZQ Premium wool has good stretch and extensibility properties which can be related to the internal spring-like structure known as the alpha helix.*
- *Wool fibre has very good extensibility properties and can be extended by more than 30% of its length without breaking and in turn, can recover from extensions of approximately 20%.*
- *Wool has superior extension properties compared to nylon and polyester.*
- *Wool fibre has an intrinsic wavelike structure called crimp which contributes to its resilience properties.*

REFERENCES

Wood, E., 2009, Tangling with wool, A resource book of information and activities about wool and textiles, AgResearch

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