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THE CHARACTERISTICS OF CARPET WOOLS IN RELATION TO PROCESSING AND PERFORMANCE

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SUMMARY

The characteristics of wools used in carpets are reviewed in relation to their performance during processing and in the finished carpet. Emphasis is placed on the fact that any one wool may have very different values to different manufacturers. A simple answer cannot be expected to an enquiry on the carpet-manufacturing merit of a certain type of wool. Manufacturers combine wools into blends and it is the blends which must be suitable. A guide is given to the blends used for New Zealand carpet yarns and to what is considered to be an "ideal" carpet wool.

INTRODUCTION

Questions on the merits of a particular wool for carpet manufacture are often asked by producers who naturally wish to grow those carpet wools which are desired by manufacturers and which will command financial premiums. Because the producer usually gets a "maybe" rather than a "yes" or "no" answer, he tends to interpret this as meaning that textile manufacturers do not know what properties they require in the wools they use. This interpretation is not correct and this review paper should show why.

Any one carpet wool will have very different values for different manufacturers and even to the one manufacturer at different times. This alone is reason enough for a non-specific answer to a general question. While an individual manufacturer may not know in detail the exact value of specific physical characteristics of a wool type in relation to his own processing equipment and products, nevertheless he is continually making decisions on the purchase of wools from which to manufacture his products. As the performance of these products is in general satisfactory, his knowledge of the wools he buys must also be satisfactory.

Carpets are not made from individual wools but from blends of different wools which are combined so that the characteristics of the blend are suitable for both the manufacturer's system and the appearance and performance of the final product. As different carpet manufacturers, for good reasons, combine very different wools to make carpets which to the consumer are identical, it

follows that one wool has different values to different manufacturers. The personal preferences of manufacturers are very important in this regard.

GENERAL CONSIDERATIONS

While a wool producer may consider wool characteristics as being limited to the physical characters of a wool, to the manufacturer other characteristics such as availability, location, price, and delivery are also of importance. The manufacturer will consider the type of carpet he wishes to make, such as loop-pile or cut-pile, high-twist or shag, as these are all made from different blends. Different processing machinery also requires different wools for yarns with different characteristics. The manufacturer decides his maximum clean blend price which largely determines the price he pays for the individual components of a blend. Finally, the manufacturer must also consider what suitable wools are available with a satisfactory delivery time; to the overseas manufacturer this may mean considering wools from very many different countries.

Most mills will have some 5 to 15 main wool types which they blend together in different proportions for making different carpets. From experience mills build up a reservoir of knowledge on what blends are satisfactory for their products and they are therefore very reluctant to change to other wools. Nevertheless, mainly for reasons of price and availability, other wools sometimes have to be substituted into a blend. However, manufacturers do not consider all blend components to be of equal value so they are less likely to introduce substitutes for the more valuable components of their blends.

The wools used in blends for carpets fall into three general categories:

- (1) Price Premium — Specialty carpet wools, which may be medullated and bulky and for which the manufacturer will pay a premium.
- (2) Medium Priced — Wools such as New Zealand crossbreds which have other virtues such as good colour, strength, and spinnability, and are able to “carry” poor-quality wools in the blend through processing.
- (3) Low Priced — “Filler” wools which are used because of their cheapness. (New Zealand manufacturers have no cheap filler wools available so they use poorer style, but relatively expensive, crossbreds to fill out their blends.)

TABLE 1: CHARACTERISTICS OF WOOL USED AND PRODUCTS PRODUCED BY WOOLLEN AND SEMI-WORSTED SYSTEMS

<i>Property</i>	<i>Woollen</i>	<i>Semi-worsted</i>
RAW WOOL		
Types	all types can be used; particularly suitable for short wools; not suitable for high proportions of very long wools; more oddments	requires wool with an average staple length of about 70 mm; more fleece wool used
Medullated fibres and kemps	higher	lower
Blend cost	lower	higher
Vegetable matter	can be handled	not suitable
Tender wools	can be handled	depends on length after carding
YARN		
Strength	lower	higher
Tufting efficiency	lower	higher
Bulk	higher	lower
Yarn hairiness	higher	lower
CARPET		
Pile cover (bulk)	higher	lower
Resilience	higher	lower
Appearance retention	higher	lower

WOOL CHARACTERISTICS AND YARN TYPE

The two major carpet yarn manufacturing systems are woollen and semi-worsted, for which different wool blends are used. The relative raw-wool, yarn, and carpet characteristics are shown in Table 1.

WOOL AND FIBRE CHARACTERISTICS OF NEW ZEALAND WOOLS

These have been reviewed in more detail by Ross (1971) but are summarized below.

FIBRE DIAMETER

In general, carpet manufacturers prefer wools of Romney type (Romcross) to be as coarse as possible, but they are not too concerned with mean fibre diameters over the usual 44s-50s count range (more than about 32 micrometres).

FIBRE DIAMETER VARIABILITY

A wide variability of fibre diameter is considered desirable. This is associated with medullated wools, which give a commercially desirable handle together with increased bulk and resilience.

FIBRE LENGTH

This affects:

- (a) Processing system — very long wools are not very suitable for the woollen system, while short wools are not suitable for the semi-worsted system.
- (b) Yarn strength — the longer the fibres, the stronger the yarn.
- (c) Shedding — short fibres may result in excessive shedding from the carpet pile during wear.
- (d) Bulk — this varies inversely with fibre length.
- (e) Yarn hairiness — this also varies inversely with fibre length.

FIBRE LENGTH VARIABILITY

This is increased so much during processing that the natural variation within a staple or fleece is not important.

COLOUR

The importance of the natural colour depends on the colour to which the wool is to be dyed.

Pigmented fibres such as are found in Scottish Blackface wool are undesirable.

HANDLE

This is important at the point of sale of carpets. A crisp or harsh handle is associated with a good floor performance.

CRIMP

This is useful as an indicator of fibre diameter, bulk, and resilience. Helical fibre crimp is associated with high bulk.

LUSTRE

Fashion affects the demand for lustre wools.

STRENGTH

A tender region in the staple is of no importance if the fibre length after carding is satisfactory.

Fibres of good intrinsic strength are required to withstand the forces imposed by modern processing equipment; otherwise high fibre breakage rates and wastage result.

MEDULLATED FIBRES

Commercially a desirable attribute of carpets, medullation is associated with a desirable handle, resilience, good yarn bulk and carpet pile cover, and good soil-hiding properties.

KEMPS

These are in general undesirable as they result in high fibre wastage and low yarn yields, and because of their poor dyeing and printing properties they may give an undesirable appearance to the carpet.

STYLE

This is unimportant in itself but it relates to the particular fault which causes a wool to be downgraded.

VEGETABLE MATTER

Contamination is a bad fault, particularly in wools for semi-worsted processing and for use on high-speed machinery.

SPINNABILITY

This is a wool characteristic which is not very apparent but it is a very important feature of Romcross wools which have good spinning properties.

SETTABILITY

Romcross wools have good setting characteristics and therefore they are very suitable where carpets with a well-defined tuft appearance are being made.

WOOL BLENDS FOR NEW ZEALAND CARPET YARNS

Many of the points made in this review are illustrated in Table 2 which gives a guide to the blend compositions of New Zealand carpet yarns for a wide range of carpet types. The kinds of wools used in these carpets are as follows:

Specialty carpet wools and hairy crutchings.

Fleece and second shear body wools.

Crutchings, pieces, and other oddments with a low overall level of medullation.

Table 2 shows that there are wide variations in the proportions of the blend components for making the different yarns.

- (1) Woollen yarns compared with semi-worsted yarns have
 - (a) A higher percentage of specialty carpet wools.
 - (b) A lower percentage of fleece wools.
 - (c) A higher percentage of oddments.
- (2) The ratio of the maximum to the minimum percentage of the blend components is:
 - (a) Specialty carpet wools — 6:1 woollen Axminster to semi-worsted high-twist.
 - (b) Fleece wools — 3:1 semi-worsted tufted to woollen Axminster.
 - (c) Crutchings and oddments — 2.2:1 woollen loop-pile tufted to semi-worsted cut-pile tufted.
- (3) Specialty carpet wools:
 - (a) Woven-carpet yarns contain more than yarns for tufting.
 - (b) Cut-pile yarns contain more than loop-pile yarns.

TABLE 2: GUIDE TO THE PERCENTAGE OF WOOLS OF THE THREE MAIN TYPES USED IN VARIOUS NEW ZEALAND CARPET YARNS

	Woollen Yarn						Semi-worsted Yarn					
	Woven		Tufted				Average	Tufted				Average
	Axminster	Wilton	Loop	Cut	Shag	High twist		Loop	Cut	Shag	High twist	
Specialty carpet wools and hairy crutchings	30 highest	20	15 < 25	15	15	20	10 < 15	10	5 lowest	10		
Fleece and second-shear body wools	20 lowest	45	30	30	40	40	34	50	60 ← highest → 60	60	58	
Crutchings, pieces, and other oddments with a low overall level of medullation	50	35	55 > 45 highest	45	45	46	40 > 25 lowest	30	35	32		

- (4) Loop-pile compared with cut-pile — loop-pile yarns contain more oddments than cut-pile yarns.

CONCLUSIONS

While the manufacturer may find it difficult to specify the exact significance in processing and performance of small differences in carpet wool characteristics, nevertheless he has clear guidelines which he follows in buying suitable wools to combine for manufacturing carpets of acceptable performance. As a result of his need to use very different blends for different carpets, the value to him than others, and it is these wools that, within the requirements of individual manufacturers at the particular time. Within his blends a manufacturer has some wools of greater value to him than others. and it is these wools that, within the limits set by the foregoing discussion, New Zealand must aim to identify and grow.

Fashions in carpets change as do methods of manufacture and both these factors will affect the demand for particular wools.

With some trepidation one might try to give a specification for a premium wool component of a carpet blend in the following terms:

- (1) Staple length of about 100 mm.
- (2) The percentage of medullated fibres should be as high as possible, provided that the degree of medullation within fibres does not markedly reduce their strength and elasticity.
- (3) Free from kemps.
- (4) The mean fibre diameter should be as high as possible.
- (5) The fibres should have helical crimp to give maximum bulk and resilience.
- (6) Good colour and low lustre.
- (7) Reasonably sound.
- (8) Free from vegetable matter and other contamination.

At present, New Zealand does not produce such a specialty carpet wool, though it could do so if this specification was accepted as the aim for a carpet wool breeding programme.

REFERENCE

Ross, D. A., 1971. *Wool Res. Org. N.Z., Rep. No. 7*. 111 pp.