FINISHING OF JERSEY KNITS IN LENZING MODAL® / COTTON BLENDS

DYEING / FINISHING

PROCESSING GUIDELINES

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Finishing of Jersey Knits in Lenzing Modal® / Cotton Blends

1 Introduction to Lenzing Modal®

A unique man-made cellulose fiber produced by LENZING

The aim of this introduction is to familiarize the customer with the outstanding fiber properties of Lenzing Modal® fibers.

As the majority of textile processors are most familiar with processing cotton, the main differences in the wet processing behavior of Lenzing Modal® are highlighted in order to assist in obtaining the best possible result.

The main issues that should be borne in mind when considering dyeing and finishing of Lenzing Modal® cellulose man-made fibers are:

1.1 Swelling behavior

Lenzing Modal® has a higher swelling capacity than cotton fiber but swells considerably less than Viscose fibers. The issues related to swelling capacity are:

Winding density - Yarn dyeing
Shrinkage and the formation of creases in fabrics

1.2 Fiber tenacity - wet tenacity and wet elongation

During dyeing and finishing, both fibers and fabrics are subjected to mechanical stress during wet processing. This can result in the elongation of fiber and fabrics which influences the shrinkage values of the jersey knit or woven fabric. Where a customer requires specific shrinkage values it is therefore important to consider the fabric structure and low aggression wet processing to prevent fiber work up and minimize fiber extension.

All man-made cellulose fibers show a decrease in tenacity when wet, partly because of their high swelling capacity but also due to their lower crystallinity, compared to cotton. Cotton shows a different behavior with the tenacity increasing when wet. The tenacity of fibers correlates with the swelling of the amorphous parts of the fiber.

Physical fiber data:

	CMD
Tenacity cond. (cN/tex)	(34 – 36)
Tenacity wet. (cN/tex)	(20 – 22)
Elongation cond. (%)	(12 – 14)
Elongation wet (%)	(13 – 15)

1.3 Over drying of man-made cellulose fibers

As mentioned above, Lenzing Modal® fibers have more amorphous areas compared to cotton. This leads to a higher number of hydroxyl groups which can bind more water molecules than cotton. During textile finishing there are often several drying steps or heat setting / curing processes and the possibility of over-drying the fiber should be considered. Lenzing Modal® fabrics should not be over dried or cured for longer than is necessary. Massive over drying can lead to the fiber permanently loosing its soft silky handle.

1.4 Thermal effects

Both Lenzing Modal® and Viscose fibers can exhibit a thermoplastic like effect in wet, hot conditions, which in some cases, may lead to fiber and yarn damage. An example is the formation of permanent crease marks in discontinuous (rope) processes. Care should be taken to avoid large changes in temperature during rope processing such as cold rinsing after hot bleaching. Rapid cooling rates during jet processing can also cause problems. Similarly, high nip pressures at the pad mangle in continuous processes on hot wet fabric can lead to a change in handle.

1.5 Purity and whiteness

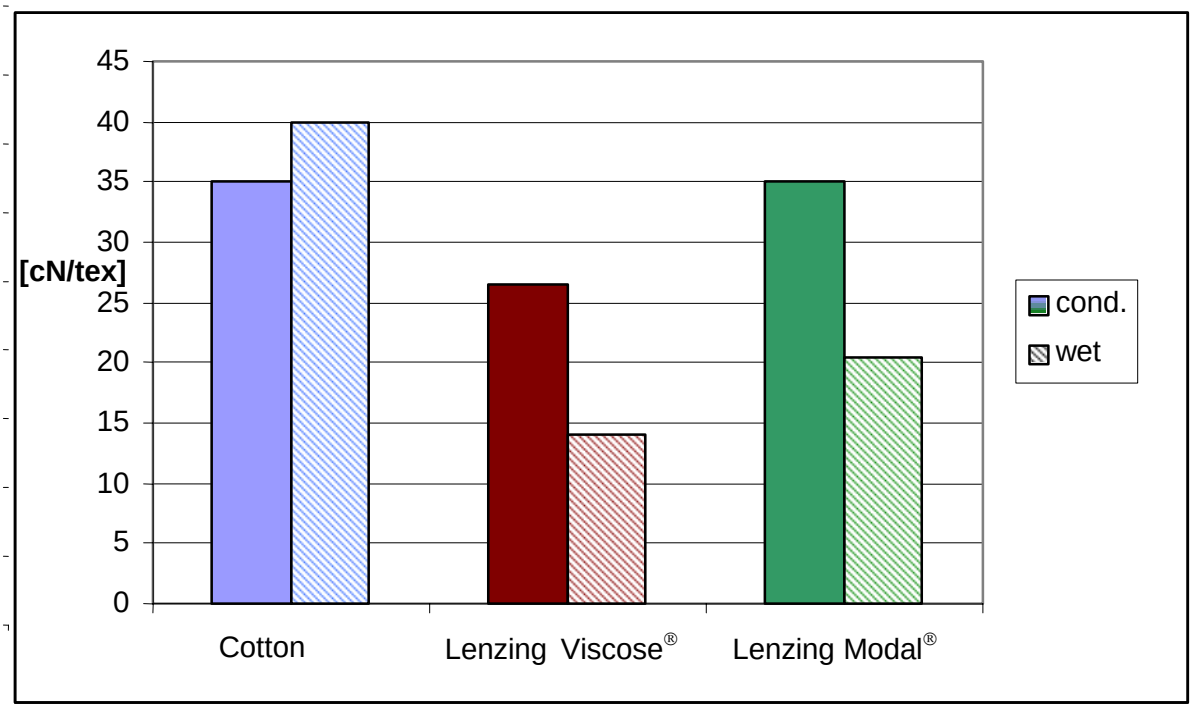
Lenzing Modal® has a very high purity and degree of whiteness as it is free from the impurities associated with cotton. In many cases bleaching as a preparation step is not required and a light pre-bleach is generally sufficient for full optic whites or brilliant / pale shades. The use of standard cotton bleaching recipes is not needed.

The subsequent processing guidelines are intended to assist the processor in getting the best start with their fabric development. Laboratory pre-trials are always recommended, as is consultation with auxiliary and dyestuff suppliers to obtain the desired product.

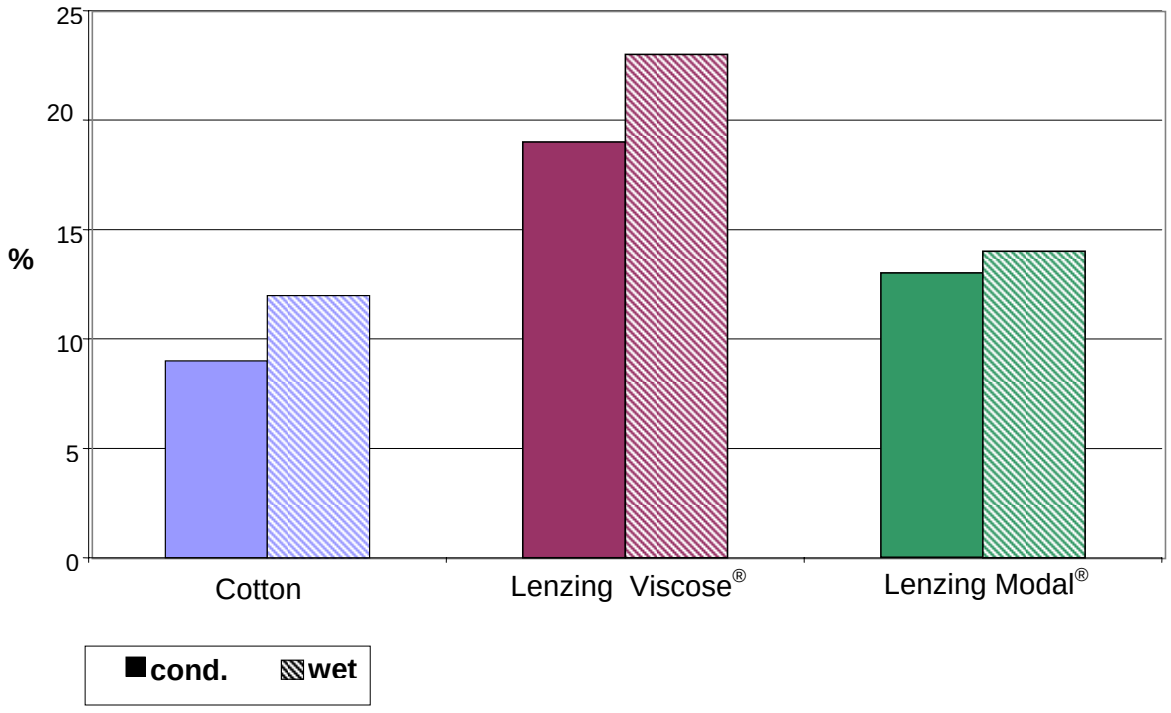
2 Comparison of Fiber Characteristics

Before considering the finishing of textiles in Lenzing Modal® it is worth noting the characteristics of Lenzing Modal® relevant to finishing which generally harmonize well with those of cotton.

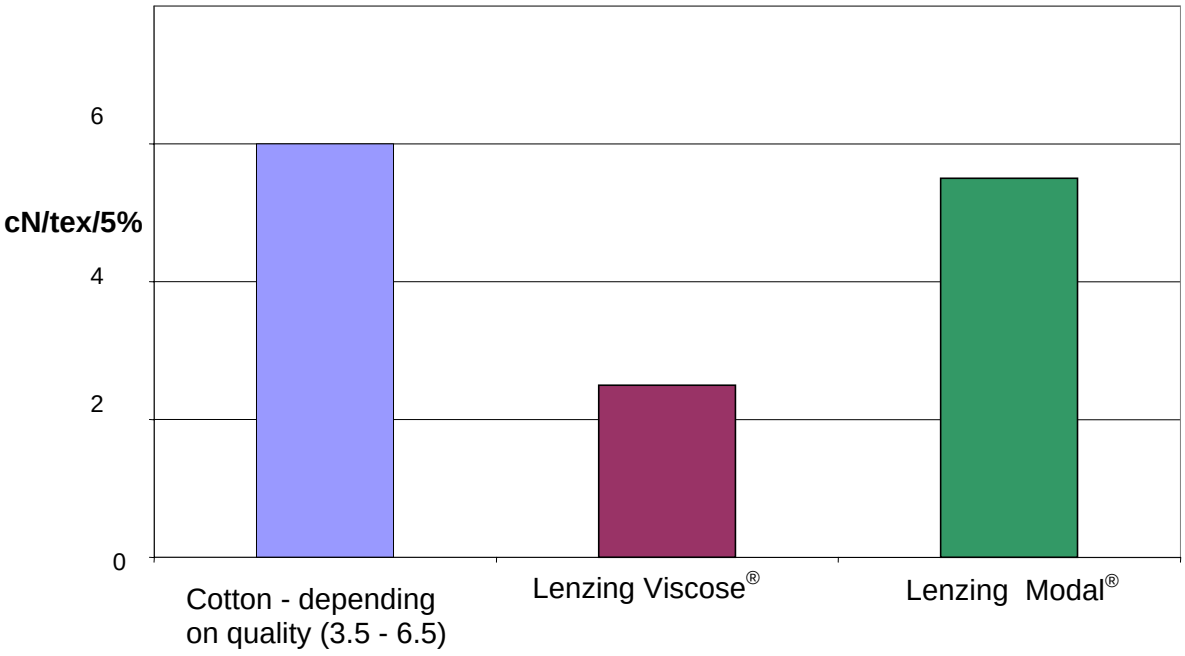
2.1 High dry and wet tenacity



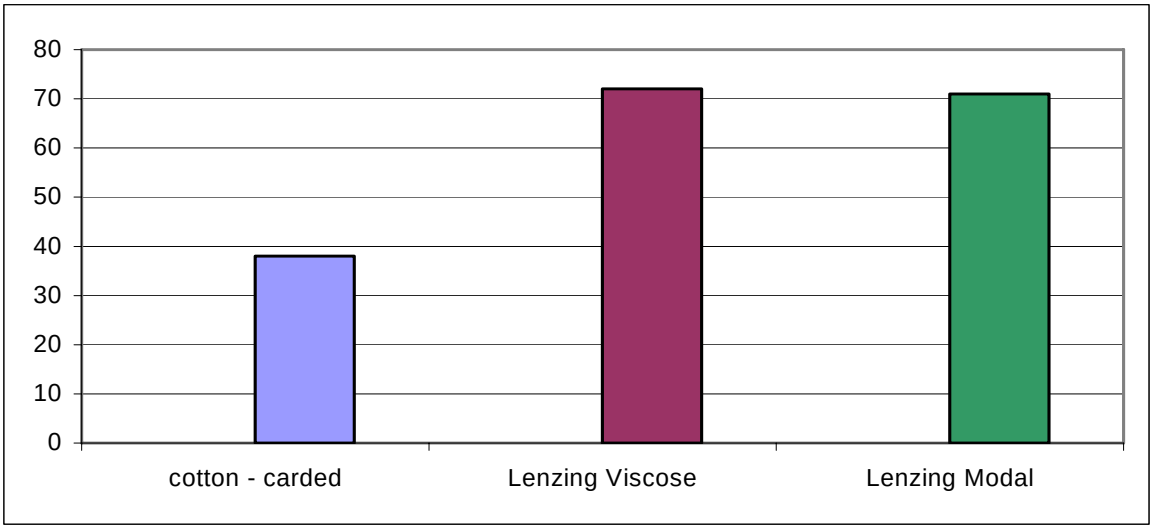
2.2 Low dry and wet elongation



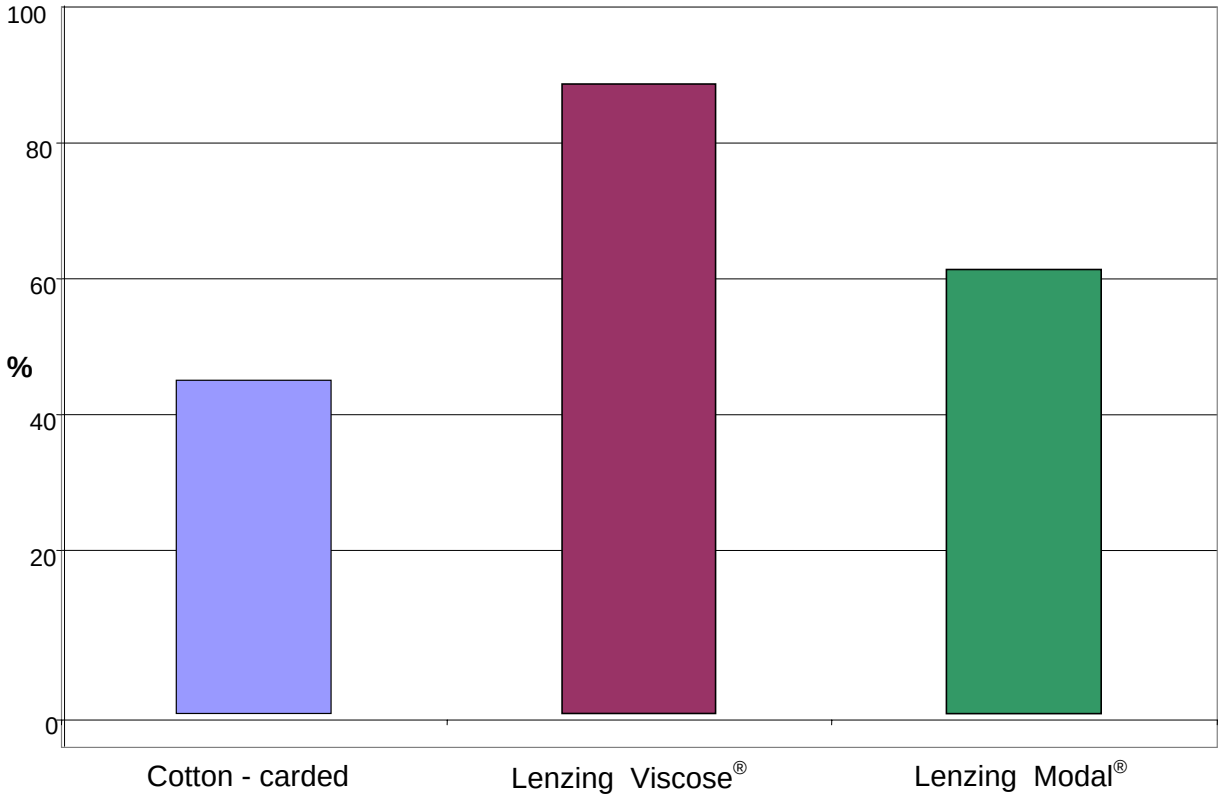
2.3 High wet modulus



2.4 Degree of whiteness (Berger)



2.5 Reduced water retention capacity



2.6 Raised alkaline stability

Treatment	Lenzing Viscose®	Lenzing Modal®
Causticizing (middle alkaline concentrations (4.5% = 7°Bé)	+	+
Mercerizing (high alkaline Concentrations) 27°Bé	-	+ (intimate CO blend)

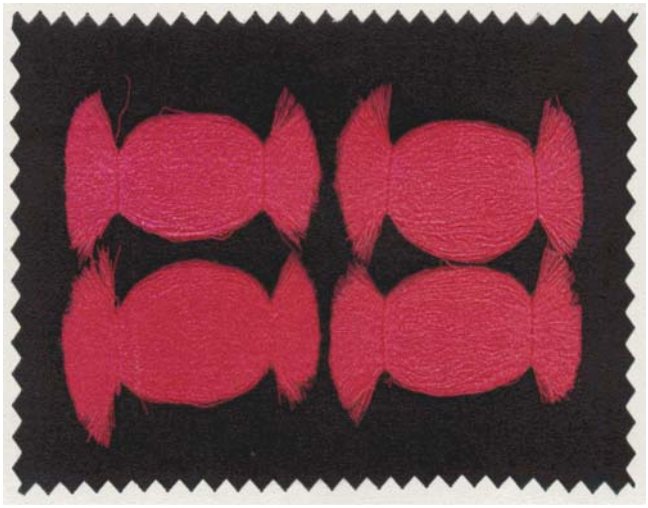
Mercerizing: Lye concentration:	27°Bé
Mercerizing agent:	3.0 – 5.0 g/l alkali resistant product
Lye temperature:	30°C
Contact time:	as short as possible but as long as necessary for good and even penetration
Recommendation:	no overstretching of the fabric
Rinsing temperature:	80°C minimum
Rinsing time:	as much hot water as possible to reach a lye concentration of approx. 6°Bé on the material in the shortest time
Post treatment:	(rinsing and neutralizing) as usual

2.7 Good dye affinity - durable color brilliance

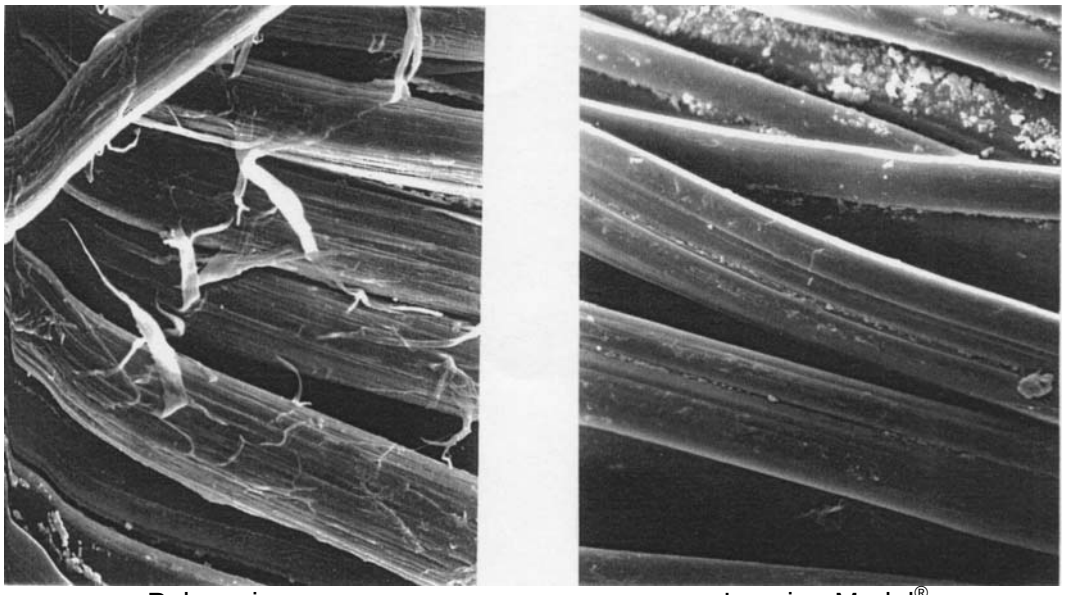
Lenzing Modal® cotton

1.0 dtex

1.7 dtex



2.8 Fibrillation of polynosic and Lenzing Modal® fibers



Polynosic Lenzing Modal®

3 Control of the Jersey Knitting Process

All knitted fabrics are sensitive textiles which require special care in production and subsequent processing. In order to prevent problems which can become apparent in dyeing and finishing, it is important to note the following points which we consider important when it comes to the production of jersey knit fabrics.

- The yarn should be processed from only one spinning batch.
- The yarn should be waxed and have a stable twist.
- The yarn should be stored for a sufficiently long period of time in the knitting department to help it acclimatize.
- The same cone diameter ensures the even appearance of the knitted fabric.
- The feed tension should remain constant in a range of between 3 – 5 g.
- If a needle crash occurs the broken needles should be replaced by needles from either side of the cutting line.
- Fabric draw-off should be carried out with a low and regular tension (Quadratex).
- The weight of the greige cloth should be checked and a wash test should also be made.
- With blends with elastane threads it is an advantage to work with a low pre-tension (slight fabric relaxation, low setting temperatures).

4 Influences on Fabric Performance

At 1.3 dtex for standard and 1.0 dtex for micro, Lenzing Modal® fibers are clearly finer than commonly used cotton (approx. 1.7 – 1.8 dtex). Due to the resultant increased number of fibers within a Lenzing Modal® yarn cross-section, the number of stand-off fiber ends increases. Also, Lenzing Modal® fibers do not have the same three-dimensional crimp as cotton. These factors, plus the relatively smooth fiber surface lead to a tendency for more fiber ends to move out of the yarn during wet treatments. This can then lead to increased surface hairiness.

The yarn manufacturer can counter this effect by increasing the yarn twist. Similarly the selected fabric construction should not be too loose. Successful fabrics can be produced using yarn types where the fiber ends are very well bonded in, such as Siro yarn.

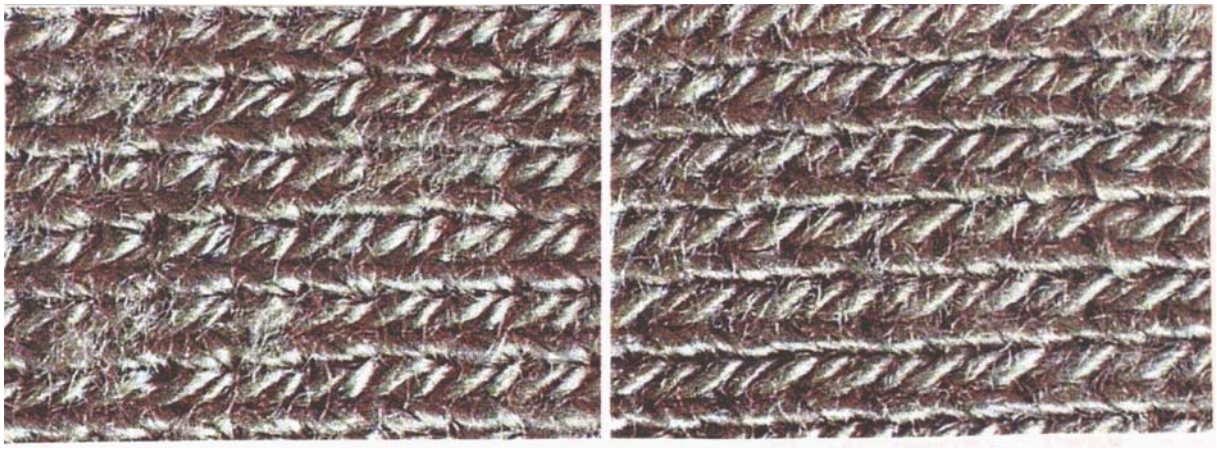
The finisher should take the above conditions into consideration by using machines which treat the fabric with the lowest possible mechanical action (e.g. overflow jet dyeing machines) for preliminary treatment, bleaching and dyeing.

4.1 General reduction in surface hairiness

A range of possibilities are available to reduce the fabric hairiness, such as singeing (see Figure 1) or the reduction in the moving out of fibers during finishing. This is known as the hydro-setting effect, where the fibers take on a new position, orientated more in the direction of the yarn axis as a result of the strong swelling action and are thus better bound into the yarn / fabric.

Figure 1 Influence of Singeing on Surface Hairiness

Finished fabric after 5 washing cycles



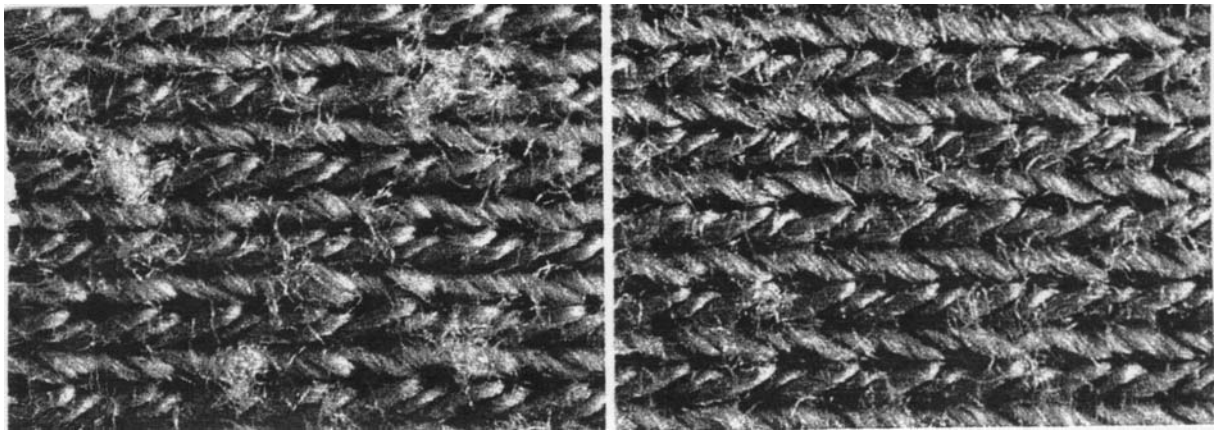
not singed singed (Dornier)

4.2 Influence of alkali on fabric surface

Alkali treatment can be done on 100% Lenzing Modal® fabrics by treating the fabric with alkali (sodium hydroxide treatment or the Sandoflex A process) either in tubular form or preferably in open width at the beginning of finishing.

Figure 2 Effect of SANDOFLEX A Treatment on the Pilling Behavior

Pilling - test EMPA (Martindale) 2000 cycles



Without Sandoflex A treatment (not singed, washed and dyed)

Sandoflex A treated (not singed, dyed)

Low level caustic treatments are not generally suitable for Lenzing Modal® / cotton blends since the dye affinity behavior can shift quite considerably in favor of the Lenzing Modal® portion. In such cases we can only recommend singeing and either mercerizing or Sandoflex A treatment, which improves the dye uptake of the cotton portion.

Example of Sandoflex A treatment (woven goods must be pre-scoured):

Padder or roller vat

Standard formulation:

330 ml/l	potassium hydroxide 50%
50 ml/l	Sandoflex A (Clariant)

Temperature: 25 – 30°C, constant
Pick up: 110%
Recommendation: Low tension cloth guidance
Batching time: 3 – 4 hours
Rinsing: starting hot
Neutralization

4.3 Influence of resin treatment

There is also the possibility of chemically setting the fiber in the yarn, respective to the fabric by using a resin finish. Low amounts of cellulose cross-linking agents, with zero or low level of formaldehyde, can be used, together with corresponding softeners to correct the handle. Examples of suitable softener types would be polyethylene compounds, reactive fatty acid amides, low amounts of silicon micro emulsions or crosslinking polyurethane.

Regarding delicate fabrics made of Lenzing MicroModal®; it has been seen that ring yarns with elastane in combination with singeing and finishing with cross-linking agents produce the best results.

4.4 Influence of enzyme treatment

Biopolishing, or Enzyme treatment, of Lenzing Modal® has no effect. It has been found that enzymes are not suitable to reduce the hairiness of Lenzing Modal® articles since the Lenzing Modal® fiber has a very compact skin. The medium pore diameter of this skin is smaller than the diameter of the enzymes, therefore preventing them from penetrating into the fiber and having a cleaning effect on the fabric surface.

It is possible to use enzymes on Lenzing Modal® / cotton fabrics where the hairiness of the cotton portion can be correspondingly reduced.

5 Dyeing and Finishing of Lenzing Modal® Jersey knits

As already mentioned, the preferred machines for the wet treatment of Lenzing Modal® jersey knits are those which normally exert a low mechanical influence on the fabrics.

In comparison to cotton, the liquor ratio should generally be higher for Lenzing Modal® and Lenzing Modal® / elastane fabrics at between 12:1 to 15:1, depending upon the fabric structure.

5.1 Preliminary treatment

With elastane blends we recommend the preliminary setting of the fabrics to reduce the material density and thus the danger of the formation of creases. In case of light weight fabrics, post setting is also possible.

For 100% Lenzing Modal® fiber fabrics, the use of about 0.5 – 1.0 g/l of a non-ionic detergent and 0.5 – 1.0 g/l of a slightly alkaline product for approximately 30 minutes at 70 – 80°C is normally sufficient as a preliminary scour / wash to remove the approx. 0.3% of fiber finish and 0.15 – 0.20% paraffin wax present on the yarn. Following the scour the fabric should be rinsed with hot water.

For blends with elastane, the chemicals used should be selected in accordance with information from the elastane manufacturer.

Blends of Lenzing Modal® / cotton are generally pre-bleached. The following recipe can be used depending upon the cotton quality:

Pre-bleach recipe:

2.0 – 5.0 m/l	hydrogen peroxide 50%
1.0 – 3.0 g/l	organic stabilizing agent
0.4 g/l	(optional) magnesium chloride-hexahydrate
0.5 – 0.8 g/l	sodium hydroxide 100% (*)
1.0 – 2.0 g/l	washing and dispersing agent

Temperature: 90 – 95°C
Time: 45 – 60 minutes
hot rinsing

(*) approx.:
1.1 ml/l sodium hydroxide 50°Bé = 1.7 g/l sodium hydroxide 50°Bé = 0.8 g/l sodium hydroxide 100%

Non-acid-sensitive products such as Uvitex RSB 150% can be recommended for the optical brightening of white goods.

5.2 Dyeing

With the exception of phthalocyanine types, the Reactive dyestuffs generally used in the dyehouse show good affinity with Lenzing Modal® and lead to good yields.

The use of reactive (warm + hot) dyes is recommend for 100% Lenzing Modal® fiber goods and Lenzing Modal® / elastane blends.

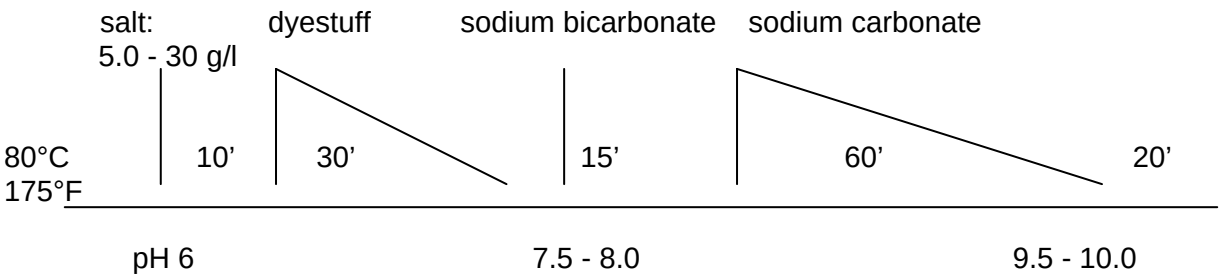
Dyestuff selection for exhaust dyeing of regenerated cellulosic fibers:

PROCION H-EXL - Dyestuffs		LEVAFIX (Dyestuffs)		
PROCION	Flavin H-EXL	LEVAFIX	Yellow	E-3RL
	Yellow H-EXL		Golden Yellow	E-G
	Crimson H-EXL		Orange	E-3GA
	Blue H-EXL		Scarlet	E-2GA
	Blue H-EGN		Brilliant Red	E-4BA
	Sapphire H-EXL		Brilliant Red	E-6BA
	Navy H-EXL		Brilliant Blue	E-B
			Brilliant Blue	E-BRA
			Brilliant Blue	E-FFN
			Royal Blue	E-BNA
			Brown	E-2R
			Navy Blue	E-BNA
			Olive	E-GLA
(eXcel Migration)		(including LEVAMETERING process)		

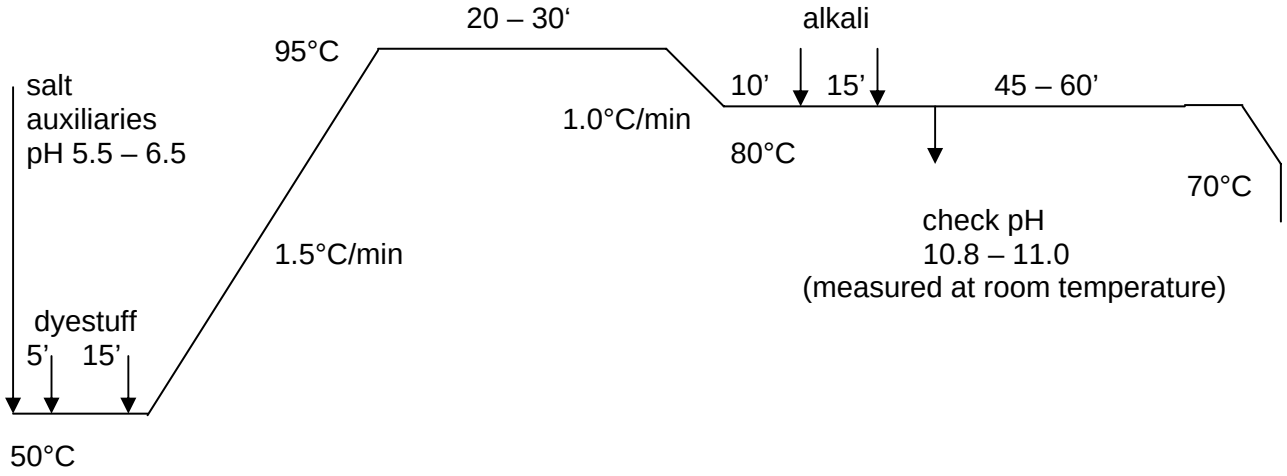
For black shades, dyers have different options depending in part on their customer's shade / fastness requirements. Trichromatic combinations are used as well as single dyestuffs such as Cibacron Black WNN or Remazol Dark Black N.

LEVAMETERING PROCESS (Levafix Dyestuffs)

Auxiliaries



eXcel MIGRATION (Procion Dyestuffs)



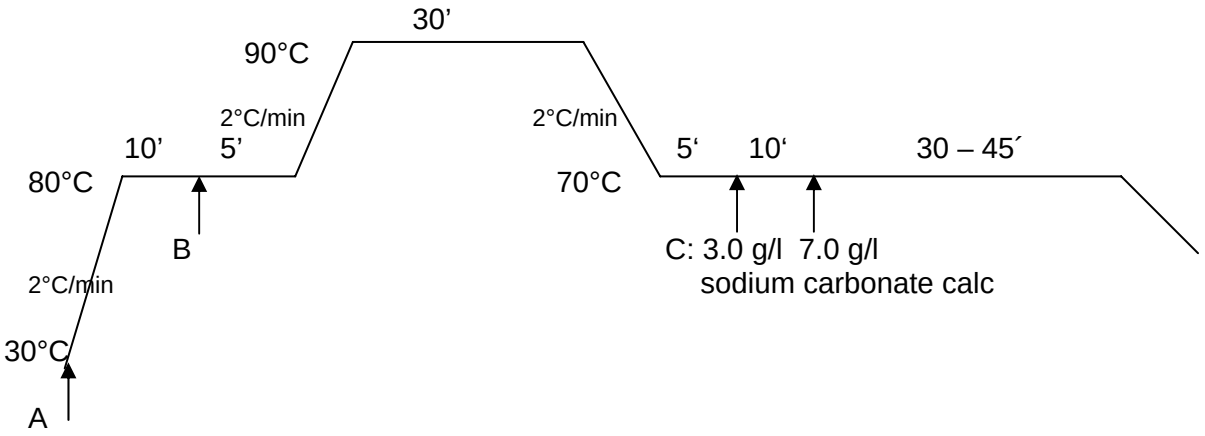
For Lenzing Modal® / cotton blends only selected reactive dyestuffs can be used for solid shades. As a result cold dyeable reactive dyes are often used depending upon the shade. Turquoise and green shades are generally dyed at temperatures above 80°C due to the lower affinity of Lenzing Modal® fibers, compared to cotton. An example of a tried and tested basic dyestuff for green shades is Drimarene Brilliant Green X-3G.

Examples of dyestuffs for good tone in tone dyeing of cotton / Lenzing Modal® blends (tested in type-dyeing only 50/50 Lenzing Modal® / cotton blends):

Cibacron Dyestuffs			Remazol (Dyestuffs)		
Cibacron	Yellow	LS-R	Remazol	br.Yellow	4 GL
	Red	LS-B		Yellow	RR
	Blue	LS-3R		Red	RR
				Red	RB 133%
				Brilliant Blue	R spez.
				Navy Blue	GG
				Black	RL
(standard method up to 90°C)			(exhaust process at 40, 60 and 80°C)		

The post treatment of the dyestuff is performed in each case in accordance with the recommendations from the dyestuff manufacturer.

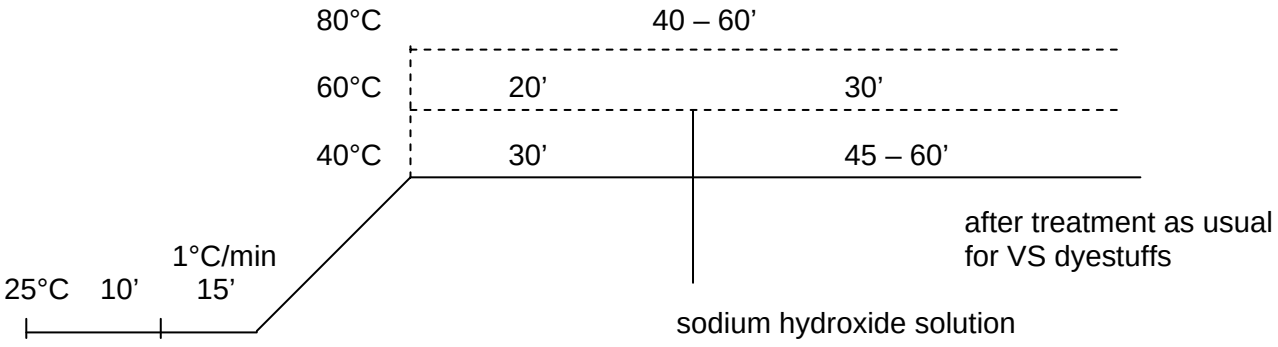
Dyeing method (from Ciba) for Lenzing Modal® / cotton blends:



post treatment as usual

A:	2.0 g/l 10 – 100 g/l	Lyoprint RG common salt
B:	x %	Cibacron LS – dyes
C:	10 g/l	sodium carbonate calc.

Dyeing method (from DyStar) for Lenzing Modal® / cotton blends:



salt dyestuff
sodium carbonate
0 – 0.5 g/l sodium hydroxide solution

For dewatering the fabrics, the centrifuge can be used. Squeezing on the other hand, has the advantage that there is less danger of creases forming and of changes in the structure.

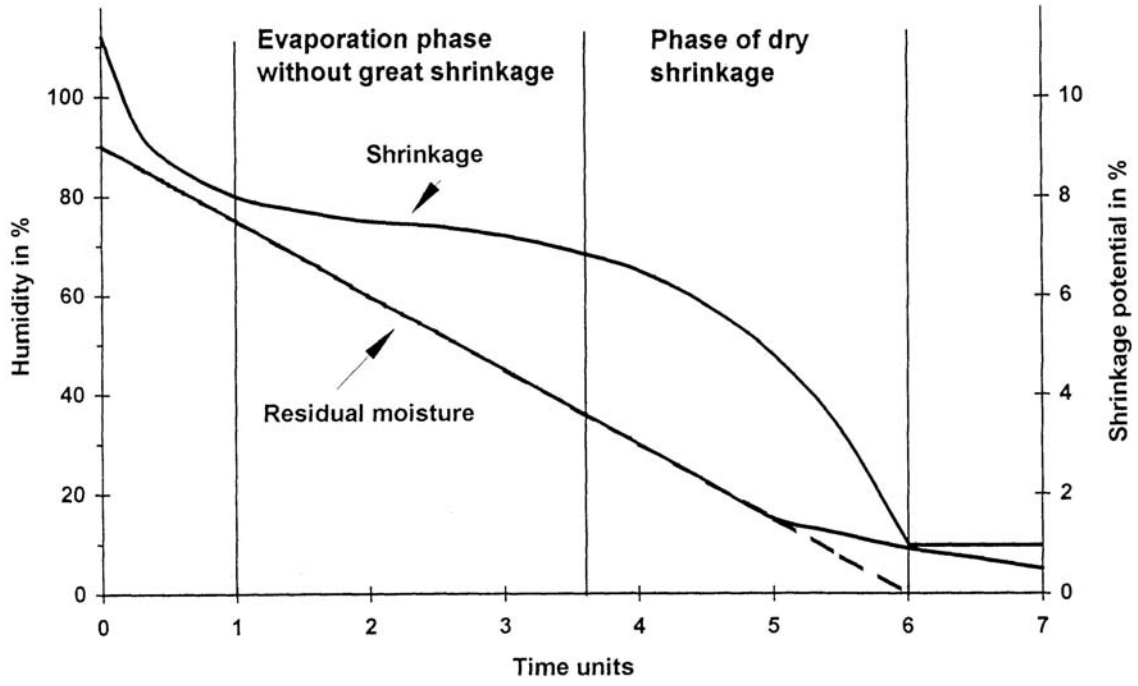
5.3 Drying

When cutting open the fabric, high tensions and tensile loads should be avoided so as not to over-stretch the wet fabric.

Drying the fabric can take place directly on the pin stenter with the over-feed and frame width being set on the basis of preliminary trials and washing tests.

Belt driers are ideal for fabric relaxation, however, care should be taken to avoid weight-related elongation while the fabric is still wet. Note that the real shrinking process starts when the moisture content is around 40%. See Figure 3 below which shows the course of drying and shrinkage in relation to both time and residual moisture at a constant temperature.

Figure 3 Shrinkage Effects



5.4 Finishing

Finishing with cellulose cross-linking agents (resins) is generally recommended to achieve wash stable fabrics. Cellulose fibers change their dimensions during wet / dry treatments as a result of swelling. The use of cellulose cross-liking agents reduces the extent of this change by reducing the swelling potential of the fiber.

In addition to the stabilizing effect from finishing with cross-linking agents there are advantages with respect to the durability of the fabrics visual appeal and the reduction in the pilling tendency of jersey knit fabrics.

In practical terms, finishing is carried out with medium amounts of zero or low formaldehyde level cellulose cross-linking agent with corresponding softening agents.

Examples for 100% Lenzing Modal®

50 – 60 g/l	Fixapret ECO
12 – 14 g/l	magnesium chloride-hexahydrate
0.2 g/l	sodium fluorborate
20 g/l	Siligen VN
20 g/l	Basosoft SWK
0.5 g/l	Leonil SR

0.5 – 1.0 m/l	acetic acid 60%
50 – 60 g/l	Knittex FEL
15 – 18 g/l	Knittex catalyst MO
20 g/l	Turpex ACN
30 g/l	Dicrylan PSF (anionic)
0.5 g/l	Leonil SR

Liquor pick-up: approx. 80%
Drying: 110 – 130°C
Curing temperature / curing time: 150°C / 3 minutes or 170°C / 45 – 60 seconds

Similar variants can be used for cotton blends whereby the amount of cross-linking agents can be slightly reduced.

Progressive shrinkage treatment of the fabric (using for example a Toptex W or Tubetex machine) generally gives better final fabric shrinkage values and an attractive handle variation with respect to the fabrics visual appeal.

Document Reference: W_CMDb_K_GEN_Cotton Blends_E_KMR_060704

The information published here is given in good faith and is based upon our experience to date when processing Lenzing Fibers. However these recommendations should be regarded as guidelines only, and it is the responsibility of the user to test the suitability of processes or products for a specific application.

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