LENZING MODAL® AND LENZING VISCOSE®
PRE-TREATMET, DYEING,FINISHING

DYEING / FINISHING

PROCESSING GUIDELINES

1 General Instructions for Pre-treatment

As with all textiles made of cellulose fibers the best results - luster / drape / handle - are achieved when all wet processes are conducted with low levels of pressure and stretching.

This is also true of Lenzing Modal® fibers which are however considerably less sensitive than normal viscose fibers

1.1 Relaxation

Hot water shrinkage of yarns and fabrics

Processing Condition		**Fiber Origin**	
	Lenzing Viscose®	**Lenzing Modal®**	**carded cotton**
Yarn / twisted yarn shrinkage (hot water 96°C) Fiber fineness Ring yarn Nm 50 Ring yarn Nm 70 Rotor yarn Nm 50 Rotor yarn Nm 40 Plied yarn (ring) Nm 40/2	 -2.0/-2.5 -3.0 -2.5 -2.5/-3.0 -3.5/-4.0	 -1.5/-2.0 -2.0 -2.5 -1.5/-2.0 -2.5/-3.0	 -1.5/-2.0 -2.0
Fabrics (warp shrinkage wash 60°C) Fabrics made of Nm 50 (Ring) Fiber titre **1.7 dtex** desized finished + sanforized (continuously)	 -3.0 -1.0	 -1.5 -0.5	
Fabrics made of Nm 50 (Ring) Fiber titre **1.3 dtex** desized finished + sanforized (continuously)	 -5.5 -1.5	 -3.0 -0.5	
Fabrics made of Nm 70 (Ring) Fiber titre **1.7 dtex** desized finished + sanforized (discontinuously)	 -12.0 -1.5	 -8.0 -1.0	 -6.0 +/-0

The fabric tensions at the preliminary textile stages should be reduced during the pre-treatment stage, i.e. the settings for washing or desizing should be such that the fabric can relax when in contact with the treatment bath.

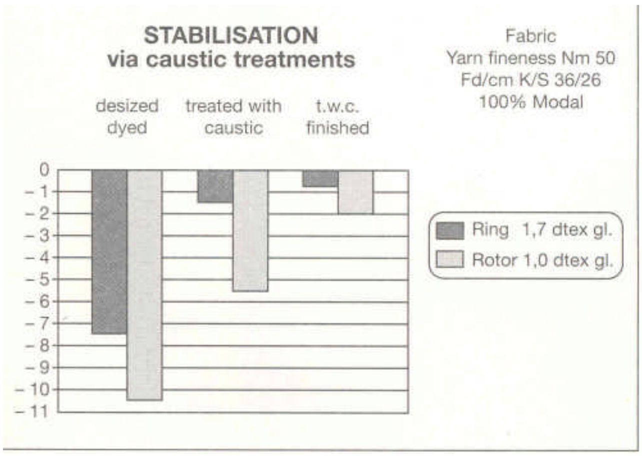
Due to the chemical agents applied during the various preliminary phases, both knitted and woven fabrics in 100% Lenzing Viscose® and Lenzing Modal® require preparation or scouring before dyeing or printing.

For this preparation or scouring phase, it is extremely important to determine whether the warp ends have been waxed. If waxes are not properly removed, streaky effects will appear in the warp. Taking this into consideration, it is normally considered best not to wax the warp after sizing.

Compared to normal viscose fibers, the alkaline treatment of Lenzing Modal® can be more intense. Using the appropriate concentration (6 – 7°Bé) the dye yield can also be positively influenced. At the same time causticizing leads to an improvement in dimensional stability.

1.2 Influence of alkali

Figure 1 Stabilization via Caustic Treatments



1.3 One step process

Various auxiliary manufacturers recommend a combined pre-treatment process for the preparation of printed goods in particular. This combines a number of previous treatments, including bleaching, into one phase. The typical handle of Lenzing Viscose® and Lenzing Modal® fibers plus their silky luster are not affected by such treatments.

1.3.1 Recipe

Cold Pad Batch

x ml/l	washing and wetting agent
x ml/l	sequestering agent
8.0 – 12 ml/l	organic stabilizer
20 – 40 g/l	sodium hydroxide 100%
10 – 30 ml/l	hydrogen peroxide 35%

batching time: 10 –16 hours
hot rinse
(batching tension should be carefully controlled)

Experience shows that this method is also well suited to the pre-treatment of dyed goods.

1.4 Polyester blends

Polyester blend fabrics can be pre-treated in a similar manner to 100% regenerated cellulose fabrics, including alkali treatments where required. To stabilize polyester blend knitted goods, the polyester element is frequently set after wet treatment (post-set). With blends made of fine titre fibers, a pre-setting treatment can be used, chiefly to retain the handle.

Woven goods are normally pre-set or the setting is carried out during the thermosol dyeing process.

1.5 Dimensional stabilization via addition of polyester

Figure 2 Dimensional Stabilization using Polyester

DIMENSION STABILISATION via addition of polyester

Batist Nm 70	% Warp shrinkage after 1 wash 60° C		
Blend ratio	Modal 100%	Modal/PES 67/33%	Modal/PES 50/50%
Treatment phase:			
desized, PES thermal set	8.0	3.0	3.0
finished	2.0	2.5	2.0
	sanforised	without sanforisation treatment	

Where subsequent finishing of the knitted goods is not required, pre-setting leads to a slight improvement in pilling behavior. Fabrics which are resin finished do not require this type of pre-treatment.

1.6 Blends with cotton

When pre-treating Lenzing Viscose® / cotton blends, the lower wet tenacity and the greater sensitivity of viscose fibers to alkali must be taken into consideration. In addition to its higher strength and resistance to alkali, compared to viscose, the dyeability of Lenzing Modal® is closer to that of cotton. This makes it possible to achieve better tone-in-tone dyeing effects with Lenzing Modal® / cotton blends than with blends of cotton / viscose.

Thus Lenzing Modal® is more commonly used in blends with cotton.

Blends of Lenzing Modal® fibers and cotton are generally pre-treated as pure cotton i.e. boiled off, bleached and, if necessary, also mercerized. The chemicals added to the boiling and bleaching phases are reduced correspondingly depending on the proportion of Lenzing Modal® fiber.

Due to the high swelling propensity of Lenzing Modal® fibers in lye of a higher concentration, special guidelines have been drawn up for mercerizing cotton / Lenzing Modal® blends particularly with respect to blend, fabric construction and machine construction.

Optical brightener:

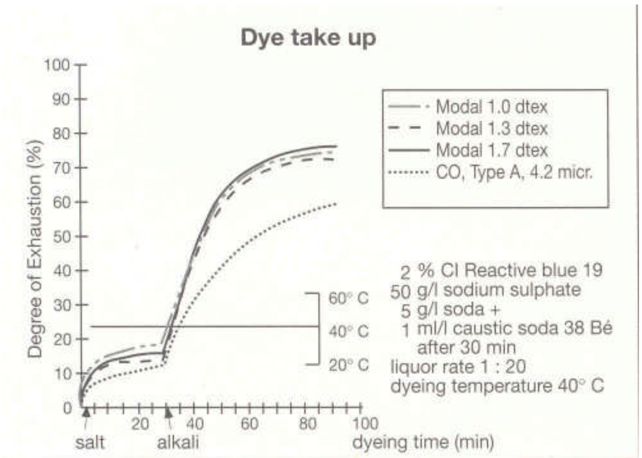
Whilst optical brighteners display a substantive effect on man-made cellulosics, a selection must be made when dealing with either Lenzing Modal® or Lenzing Viscose® to obtain good yields comparable to that of cotton.

2 Dyeing

2.1 The influence of fiber titre

The clear influence of fiber titre on dye color yield is seen especially when using exhaust dyeing methods. Here, Lenzing MicroModal® 1.0 dtex displays much lighter dye yields than Lenzing Modal® 1.7 dtex for example. Fibers with titres between 1.3 and 1.7 dtex also display differences in color intensity.

Figure 3 Dye Take up

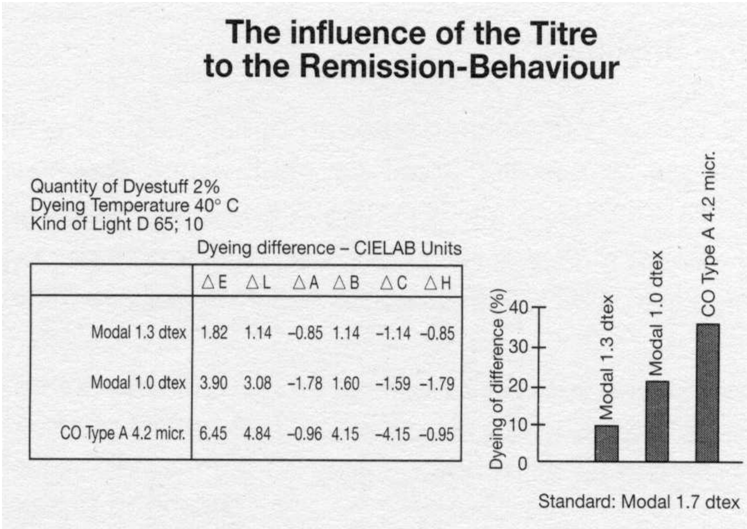


Because of this it is important that fibers of different origins or titres should not be mixed if the processor is to achieve a homogeneous dyed fabric.

In pad batch dyeing the differences in color between qualities of different viscose or Lenzing Modal® fine titre fibers are slight.

The apparent reduction in color yield as finer fibers are used is a physical effect and is present in both natural and synthetic fibers.

Figure 4 Influence of Fiber Titre



	ΔE	ΔL	ΔA	ΔB	ΔC	ΔH
Modal 1.3 dtex	1.82	1.14	–0.85	1.14	–1.14	–0.85
Modal 1.0 dtex	3.90	3.08	–1.78	1.60	–1.59	–1.79
CO Type A 4.2 micr.	6.45	4.84	–0.96	4.15	–4.15	–0.95

2.2 Influence of delustering agents

Since only very small amounts of delustering agents are incorporated into the fiber, these have no direct influence on the dye affinity of either viscose or Lenzing Modal® fibers.

However, the addition of the white delustering agent will reduce the apparent depth of shade due to internal reflection. This physical effect gives a lighter apparent shade for dull fibers compared to bright fibers for the same amount of dye in the fiber.

The reflection behavior of dull fibers results in different visual effects being perceived by the human eye. To avoid apparent color variations, fabrics from matt yarns must have a high rate of homogeneity. This is particularly true of yarn titre, yarn twist and fabric construction.

2.3 Selection of dyestuffs

The dyeing behavior of regenerated cellulose fibers will depend upon the dyestuff group, the dyestuffs, dyeing method, the type of fiber and the fiber titre. Lenzing Viscose® and Lenzing Modal® fibers can basically be dyed using all dyestuffs suitable for cellulose fibers.

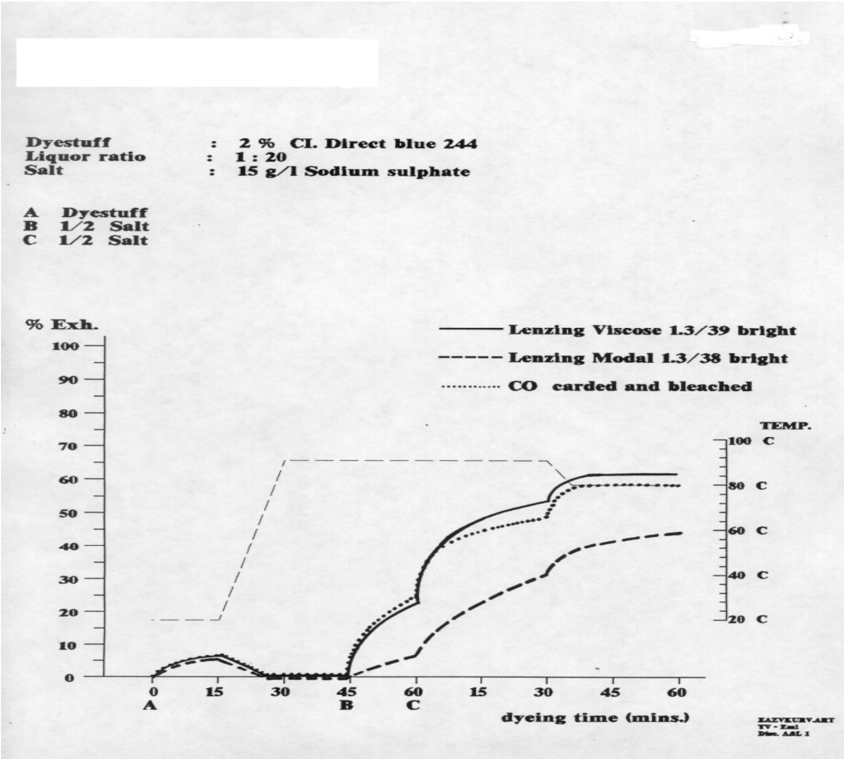
The following dyestuffs are often used:
- direct
- reactive
- sulfur
- vat

and occasionally:
- leuco vat
- indigo
- napthol

2.3.1 Direct dyestuffs

These have a comparatively higher affinity to viscose fibers and cotton than for modal fibers. Only a few dyestuffs are thus available for blends of cotton / Lenzing Modal® which produce sufficient color yields in the exhaust process and thus good tone-in-tone dyeing results on both fiber types.

Figure 5 Direct Dyestuffs



Rate of exhausting: (Praxitext100, without filter)

Dyestuff: 2% C.I. Direct Blue 244
Salt: 15 g/l sodium sulphate

Liquor ratio: 20:1

A: dyestuff
B: ½ salt
C: ½ salt

2.3.2 Reactive dyestuffs

These generally show higher absorption and fixation rates when applied to Lenzing Viscose® and Lenzing Modal® fibers than is the case for cotton (exceptions occur in connection with phthalocyanine dyes). For dyestuffs with higher fixation speed, alkali metering is recommended.

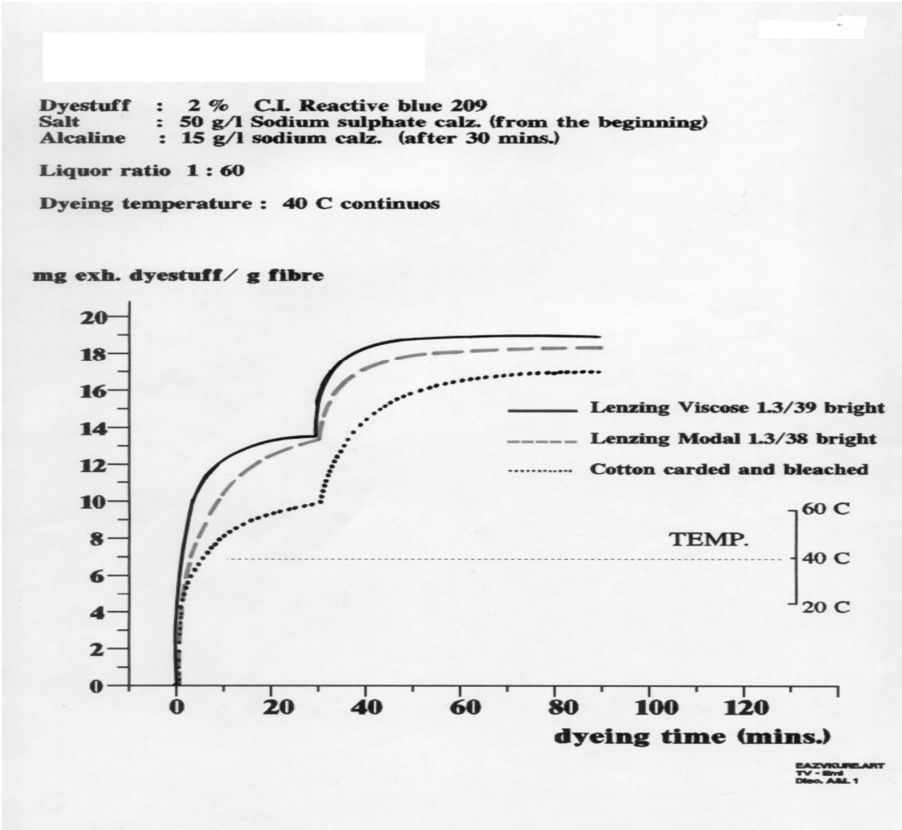
Rate of exhaustion: (Praxitext 100)

Dyestuff:	2% C.I. Reactive Blue 209
Salt:	50 g/l sodium sulphate (from the beginning)
Alkaline:	15 g/l sodium carbonate (after 30 minutes)

Liquor ratio: 60:1
Dyeing temperature: 40°C continuous

Reactive dyestuffs are considered well suited to dyeing blends with cotton as with the right dyestuff selection and recommended processes, good tone-in-tone dye effects can be achieved by exhaust and cold pad batch methods.

Figure 6 Reactive Dyestuffs



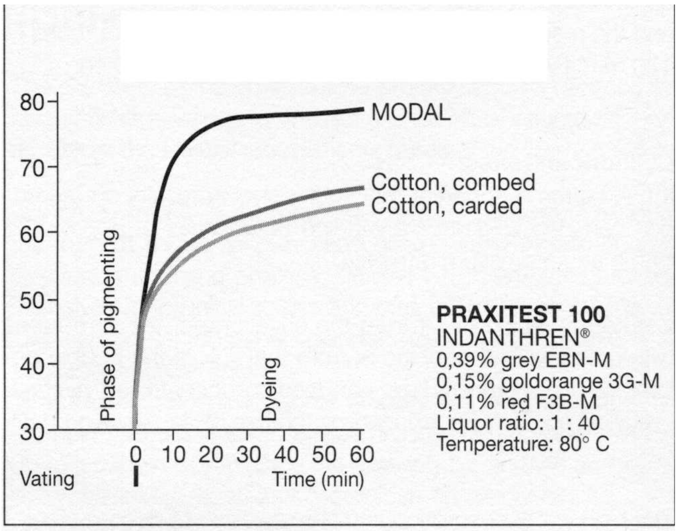
2.3.3 Sulfur dyestuffs

These dyestuffs, which are often used on ladies outerwear fabrics must be applied very precisely and handled carefully during after treatment to avoid damage to the cellulose fibers. In the exhaust process the sulfur dyestuffs tend to have a stronger affinity to the regenerated cellulose fibers than to cotton.

2.3.4 Vat dyestuffs

Vat dyes tend to have a higher affinity to Lenzing Viscose® and Lenzing Modal® fibers in the exhaust process than to cotton. Light shades in particular should thus only be dyed using a semi-pigment or pigment process.

Figure 7 Vat Dyestuffs



2.3.5 Leuco vat dyestuffs

Leuco dyestuffs show a higher substantive effect on Lenzing Viscose® and Lenzing Modal® fibers by exhaust application than on cotton. In a continuous process, the influence of the substantive effect of the dyestuffs is reduced so much that good tone-in-tone dyeing effects can be achieved with blends with cotton.

2.3.6 Indigo dyestuffs

Indigo dyes also have a higher affinity to Lenzing Viscose® and Lenzing Modal® than to cotton. Denim effects can thus be strengthened in blends with cotton. The intensity of the wash-out effect is lower because of the more intensive dye penetration.

2.3.7 Napthol dyestuffs

Clearer and partly lighter shades can be obtained on Lenzing Viscose® and Lenzing Modal®, compared to cotton. It is however possible to dye bright shades with good tone-in tone effects and good fastness values using corresponding Napthanilid combinations on blends of Lenzing Modal® with cotton.

2.4 The discontinuous dyeing process

Due to the relative high speed of dye take up (and fixation speeds) it is recommended to work on fully flooded dyeing apparatus with alternating dye bath circulation.

2.4.1 Yarn hanks

Yarn hanks made from Lenzing Viscose® and Lenzing Modal® fibers, in the finer titre area in particular, tend to stick together when the dyebath is drained (i.e. after the pre-treatment phase). This sticking together of the hank is partly irreversible and often produces unevenness in the coloring in the centre of the hank.

We recommend producing the hanks with the smallest diameter possible and operating with a higher pump capacity (which also helps lift the hanks away from the distance rods). Overflow rinsing prevents the hanks sticking together and helps to avoid unevenness and insufficient wash-off.

2.4.2 Yarn bobbins

Conical Cones:
The cones must be homogeneously wound to ensure an even dye result and the bobbin edges should be carefully rounded off.

The winding hardness should be approx. 25 Shore. Taking the relatively high swelling of the material into account this equals a volume of approx. 360 – 380 g/l.

Due to the higher swelling of the material we recommend that the winding diameter is limited to 160mm. Dyeing problems have been experienced where the yarn tube diameter has reached 170mm (approximately 850 g / cone).

Cylindrical Cones:
Lighter dyeing results on the edges can be avoided by using a winding hardness of approx. 25 Shore and a pressure rate of 20%.

Leakages can result from the shrinkage of the yarn tubes with cross-wound bobbins or from the sinking of the bobbin columns with cylindrical laps. Such uncontrolled dyebath leakages can be reduced by the use of a drop locking device.

The high water absorption and fiber swelling of Lenzing Viscose® fibers and to a lesser extent Lenzing Modal® fibers, means that they can be deformed to a certain extent (hydroplastic effect) during package dyeing. As a result of this, as the dyebath circulates from the inside to the outside, the yarn layers are carried by the dyebath i.e. float and are more easily dyed than is the case with circulation from the outside to the inside. With a dyebath flow outside to inside, the yarn layers are pressed together by the flow and the dyebath throughput is reduced.

Pump cycles should be set to avoid dyeing problems, at for example 4 / 5 minute cycles in / out and out / in. The machine load should be adjusted to match both the dyebath throughput and the affinity of dyestuff for the fiber. The pump capacity should also be adjusted to avoid compressing the yarn package.

Twisted yarns are difficult to dye on cross-wound bobbins due to deformations at the yarn cross points and insufficient dye penetration at these cross points. Preliminary trails are recommended.

Note: The flow issues mentioned above concern not only dyeing but also the application of any post-treatment products to improve wet fastness. If post-treatment products are unevenly distributed this can lead to shade shifts between the inside and outside yarn layers.

2.5 Dyeing on rope dyeing machinery

The marked wet swelling of both Lenzing Viscose® and Lenzing Modal® can a give tendency to form creases. This generally results in the need to use a liquor ratio of 20:1 on jet dye machinery. Heating and cooling the dyebath slowly also has a positive effect in avoiding creases during processing. The addition of crease prevention agents / lubricants is recommended for all processing baths.

Closely woven fabrics and heavy weight fabrics can prove difficult to dye on this type of machinery due to the material developing crease marks. These restrictions do not generally apply to knitted or toweling goods.

The required fabric turnaround speed depends on the fabric construction and on the affinity and reactivity of the dyestuff. Constructions which are both open and sensitive to distortion, as is the case with some knitted goods, should employ the lowest possible turnaround speed to avoid the fabric becoming hairy (and stretching longitudinally) due to the mechanical actions of the dyeing process.

2.6 The semi-continuous dyeing process

The main process here is pad - batch dyeing with reactive dyestuffs. This produces good color yields on both Lenzing Viscose® and Lenzing Modal® fibers with the majority of dyestuffs available, although some limitations exist with the application of phthalocyanine dyestuffs.

Prior to the dyeing process the material must be evenly cooled and display a residual moisture content of 10%.

The processing assembly should ideally be arranged so that an air passage (skying) is available after the padding process to allow sufficient time for the material to swell completely. The winding device should operate without any tension and be equipped with a central drive. Friction winders can produce fabric shifts around the edges which can produce unevenness in the material.

The fabric speed must be kept constant such that the contact time between the fabric and dyebath (dip to nip) should be 1.5 seconds or greater.

2.7 The continuous dyeing process

2.7.1 Pad - dry

This method does not achieve good dye yields with reactive dyestuffs on Lenzing Viscose® and Lenzing Modal®. The use of air / vapor mixtures does not give a great improvement as the color yields generally remain below the level reached on cotton.

2.7.2 Pad wet - steam

Up to medium shades can be achieved using selected reactive dyestuffs to produce good color yields. In general, better color yields are obtained on Lenzing Viscose® and Lenzing Modal® than on cotton, for example.

In the pale to medium shade range the color yields are comparable with the yields obtained in the pad - batch process.

The pad wet - steam process has proved suitable for cotton / Lenzing Modal® terry fabrics on ranges fitted with the Kuster flexnip.

2.7.3 Pad dry - chemical pad - steam

The pad dry - chemical pad - steam process may be applied with either vat dyestuffs or reactive dyestuffs. However, the use of reactive dyestuffs should be limited to cotton / Lenzing Modal® blends since there is a danger of frosting effects on 100% regenerated cellulose fabrics.

2.8 Spun-dyed fiber types

Lenzing offers a number of color shades, particularly in viscose fiber types. These spun dyed fibers offer high to maximum fastness values.

Spun-dyed fiber types are generally not classed as color fast to over dyeing procedures. The fastness behavior depends on the type of spin dye used and the procedures it is exposed to. Similarly, not all dyestuffs are resistant to the reduction agent used when cross-dyeing with vat dyestuffs. In such cases preliminary tests are recommended.

Lenzing is able to supply its spun-dyed fibers with the highest cross-dye fastness levels. However, any fastness requirements must be indicated on the order. Spun black fiber types are in general considered cross-dye resistant

3 Fabric Finishing

3.1 General information

Cellulose fibers and regenerated fiber types in particular absorb relatively high amounts of water and will swell to a lesser or greater extent. Fabrics made of cellulose fibers show a low level of dimensional stability in their swollen state and a higher propensity to crease than in their dry state.

In order to stabilize woven and knitted goods made of cellulose fibers and increase the fabric performance values it is beneficial to reduce the swelling capacity of the fibers. This can be achieved through the use of cellulose crosslinkers.

The type of crosslinker (low formaldehyde or zero formaldehyde) and additive to be used depends on the fabric construction, desired effect and fashion requirements.

One important factor for ensuring the efficiency of the crosslinker is that the fabric should not contain alkali and that there should be sufficient time for the crosslinker to diffuse into the fibers and exchange with the swelling water already present.

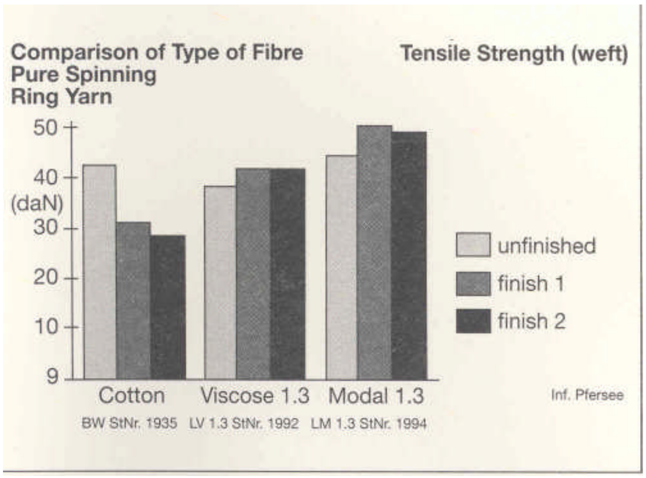
Similarly, it is important not to dry the padded fabric at too high a temperature in order to prevent migration of the crosslinkers to the fiber or fabric surface. Resin migration leads to a higher surface concentration of the crosslinker which is contrary to the desired effects and can give a reduction in abrasion behavior.

3.2 Crosslink processes

Lenzing Modal® and Lenzing Viscose® require a higher amount of crosslinker for easy-care finishing than cotton fabrics to achieve a comparable effect. Lenzing Modal® fabrics tend to give better performance than viscose, due to their specific properties. The higher amount of crosslinker required can lead to a corresponding reduction in abrasion resistance.

Compared to cotton, articles made of Lenzing Viscose® and Lenzing Modal® fibers display much lower losses in tenacity due to crosslinkage. As shown below (See Figure 18), no losses in tenacity result from crosslinking providing the goods are given low tension treatment in the proceeding stages.

Figure 8 Comparison of Tensile Strength



The selection of the crosslinking process should be done by taking shrinkage values for the ready finished fabric into account as well as the special requirements made for the finished article.

Dry crosslinking is normally employed either in the form of shock condensation or with an intermediate holding stage after the drying process. Articles which are over stretched in the initial stages and so have high shrinkage values, can be sanforized at this intermediate stage followed by subsequent crosslinking.

To achieve good dimensional stability note that a final sanforization process can only be effective to a certain extent since the relatively flat surface and already crosslinked regenerated cellulose fibers cannot be compacted to the same extent as cotton.

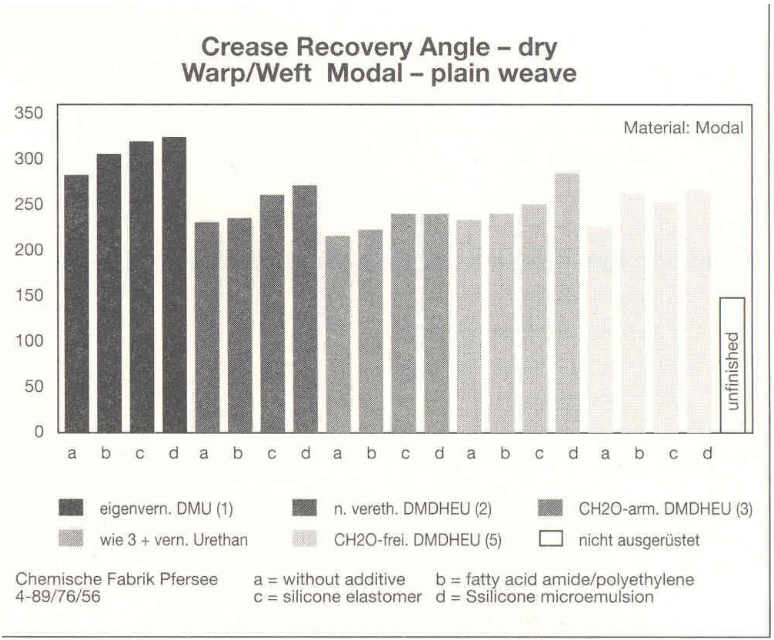
Example: For a fabric with 8% shrinkage after crosslinking, sanfor compact to a residual shrinkage rate of 4% to avoid elongation at the making up stage or in usage.

Where the shrinkage rate is greater than 12% after crosslinking, the process route should be switched to intermediate sanforization. Higher shrinkage values, as already mentioned, cannot be permanently limited via a final sanforization process and the fabric will otherwise tend to extend at the making up stage.

For items where good abrasion resistance is demanded, moist crosslinking can be recommended. This type of crosslinking is discontinuous and demands a high level of measuring precision with respect to residual humidity prior to intermediate storage. This method is recognized as one of the best ways of maintaining good abrasion values.

3.3 The effect of different crosslinkers and additives

Figure 9 Crease Recovery Data



It is possible to reach the fabric performance levels of a conventional reactant crosslinker using modified low formaldehyde or zero formaldehyde crosslinkers. This is shown by the results in Figure 19 of the crease recovery angle for a Lenzing Modal® plain weave fabric. The crease recovery effect is positively influenced by the addition of film formers and additives which also improve handle.

4 Processing Instructions

General comments

4.1 Tension

Starting with the winding process through knitting, warping and sizing, all wet stages in the finishing process should be done with low tension.

In the pre-treatment of woven goods, note that loomstate products may have a wet shrinkage level of over 20%. Therefore it is beneficial to allow the product to relax the first time it comes into contact with water.

With knitted goods sensitive to wet tearing it is advisable to place the goods in a scray after the pad mangle and from there into the stenter frame.

4.2 Drying

To reduce any tension present from individual finishing stages, articles made of regenerated cellulose fibers should generally be dried on pin stenters.

To achieve good re-wetting properties the fabric should be dried to a residual moisture content of 8 – 10%. Drying temperatures of 100 – 130°C are recommended. Excessive drying produces a danger of forming a hard fiber crust which can lead to a change in both the water retention capacity and the wetting properties.

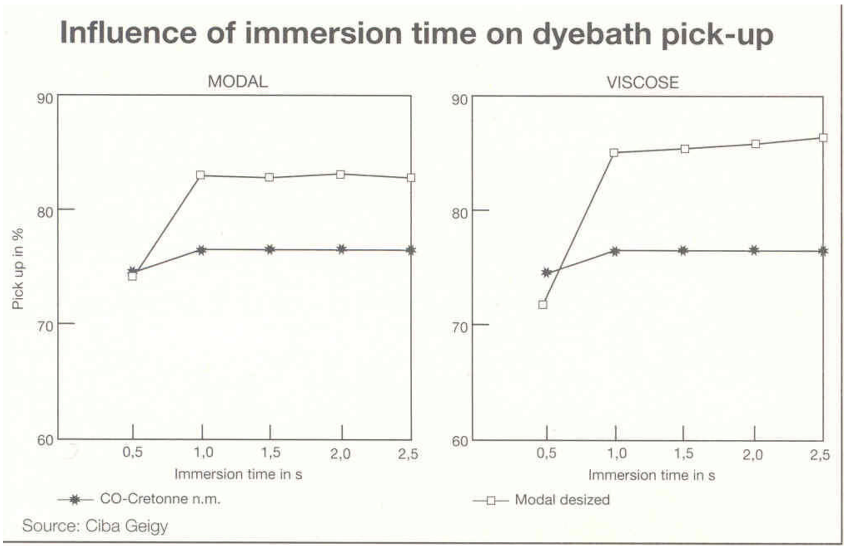
In pad application processes the drying stage has an effect on both dyeing and finishing results. Intensive drying can lead to the substance applied migrating.

Drum or can dryers are not to be recommended for the above reasons. Also, cans tend to flatten the goods thereby losing their flowing hand.

4.3 Padding

As the regenerated cellulose fabric enters the pad bath, the first stage is for the fibers to absorb water from the dye or chemical bath, followed by absorption of the larger molecular substances, which usually take longer to diffuse into the fibers. To allow for sufficient time for this exchange to occur, the contact time (dip to nip) for the goods in the bath should remain constant at approximately 1.5 seconds.

Figure 10 Influence of Immersion Time



An air passage after the pad process (skying) promotes diffusion of the dyestuffs and chemicals and gives the fiber time to continue the swelling process. This is particularly important for pad batch processing with a precisely regulated pick-up.

Padding of dyestuffs should be done in combination with a corresponding batching device preferably with an adjustable direct drive, this helps avoid fabric deformation, moiré marks and uneven dyeing results.

Document Reference: W_CMD_O_GEN_Properties Applied to Finishing_E_SCW_950102

(Related to: W_CV_O_GEN_Properties Applied to Finishing_E_SCW_950102)

The information published here is given in good faith and is

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