FINISHING OF WOVEN AND KNITTED FABRICS IN MicroModal®

DYEING / FINISHING

PROCESSING GUIDELINES

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Finishing of Woven and Knitted Fabrics in MicroModal®

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 General: MicroModal® for Woven and Knitted Fabrics

As a result of the high rate of fineness of MicroModal®, very fine yarns can be spun by ring and rotor methods. Yarns of this type show the following properties:

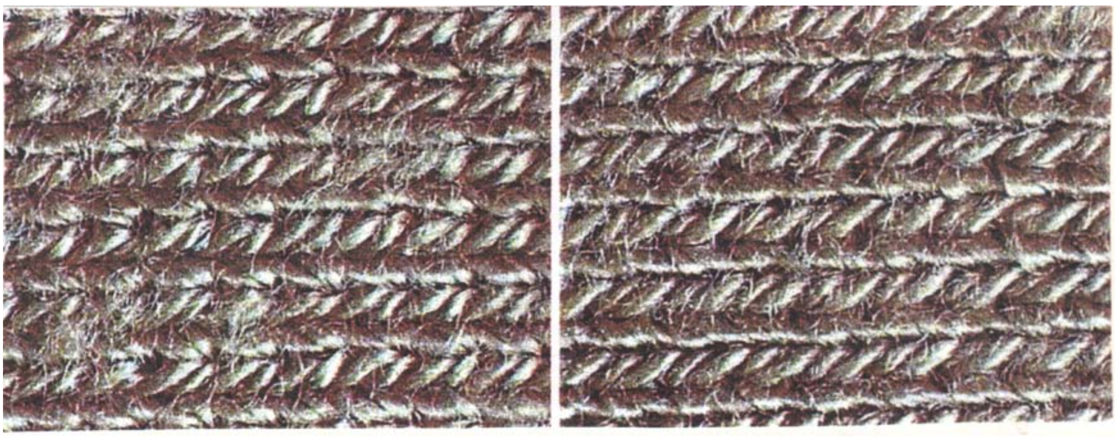
- good evenness
- high sheen
- soft character
- produce an exceptional handle and drape in both woven and knitted goods

As a result of the comparatively high number of single fibers in the yarn cross-section, these yarns show a good spinning stability and correspondingly high tenacity. However, the higher number of fibers in the yarn cross-section also means that the number of fiber ends which stand out from the yarn also increases, leading to an increase in surface hairiness and pilling tendency of the fabric.

This can be countered using normal methods such as yarn twist, fabric structure and finishing with cross-linking agents. Effective singeing of the fabric can reduce any surface hairiness to a normal level (See Figure 1). Also, alkali treatment can be effective (See Figure 2). More details on these processes are given in this document.

As with all cellulose fiber fabrics, the best fabric properties are obtained with MicroModal® when the fabric is processed with low tension and pressure.

Figure 1 *Effect of singeing on washing performance*

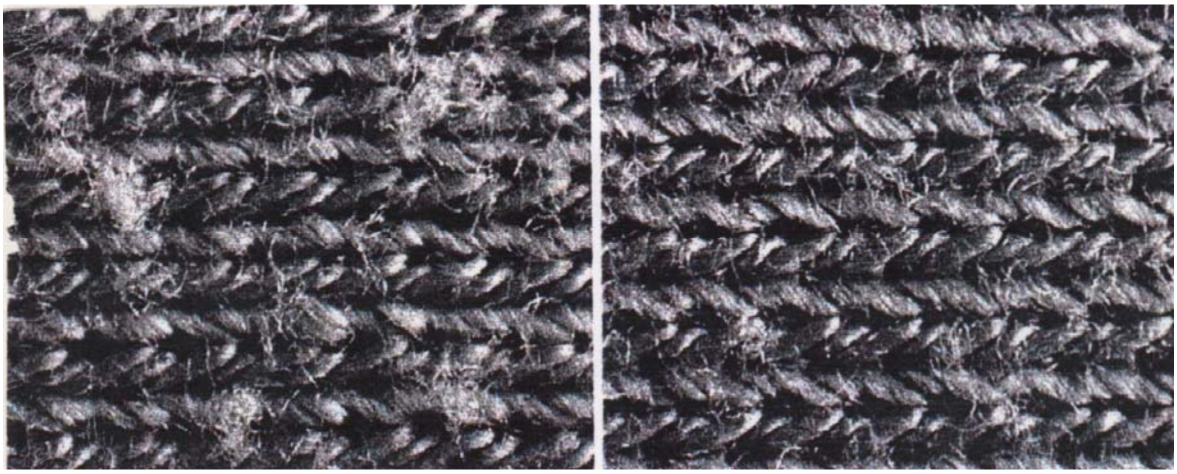


Not singed:
Finished fabric after
5 washing cycles

Singed (Dornier):
Finished fabric after
5 washing cycles

Figure 2 *Effect of Sandoflex A treatment*

Pilling test Empa (Martindale 2000 cycles)



Not singed
Washed and dyed

Not singed
Sandoflex A treated
and dyed

Yarns produced by other spinning systems such as Siro, Compact, Air-jet or Open End show a lower hairiness. Articles made from such yarns, especially knitted fabrics, generally show an improved pilling behavior but with a different handle.

3 Fabric Preparation

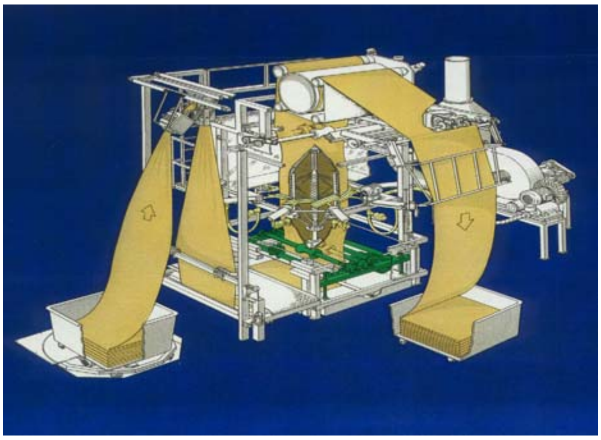
3.1 Singeing

To obtain a clean fabric appearance and reduce surface hairiness, fabrics made from MicroModal® should be singed. It is then generally possible to avoid any undesired pill formation during fabric processing or during use.

Depending upon the weight of the fabric and the blend, singeing is generally carried out on freely guided fabrics or with fabric against cooled rollers. With respect to circular-knits the possible effect on the fiber / yarn combination should be taken into consideration. For example, with elastane blends the cellulose side of the fabric is always flame treated.

Figure 3 *Example of singeing machine for knitted fabrics*

DORNIER Circular singeing machine Model SMA



3.2 Desizing / washing

In cold pad batch processing, care should be taken that the fabric is sewn with precise overcast seams using a finer sewing thread. Both of these measures should help to reduce seam marks to a minimum. The dye pick up should always be high and batch winding on should be performed at low tension to once again prevent pronounced seam marks and the formation of moirés. The fabric must be pre-cooled and have an even fabric moisture. It is also important that the total immersion time, from steeping the fabric into the treatment bath up to the squeeze rollers, should be kept constant and be in the range of 1.5 to 2 seconds. Batching fabric which is not completely swollen can lead to the formation of wrinkles which then can remain visible even after dyeing.

The influence of any treatments previously carried out on a fabric should be considered on the composition of the treatment baths. One-step processes for desizing, bleaching and alkali treatment (example: visco-combi batch) are in many cases a quick and reliable method of preparing the fabric and can also be readily applied to knitted goods. If knitted goods are treated in rope form, a high liquor to goods ratio should be used and the scouring / bleaching step should always be followed by hot water rinsing in order to completely remove the various yarn finishing agents.

3.3 Bleaching

For white goods, or for blends with cotton, hydrogen peroxide bleaching is recommended. For pure white or blends which are difficult to bleach - such as those with silk or wool - a second reductive bleach should give the desired degree of whiteness. In such cases optical brightening is carried out by including the brightening agent in the reductive bleaching bath with the addition of salt to increase the affinity of the optical brightener.

Since not all optical brighteners have a good affinity to MicroModal® the product selection must be made based on the products affinity and the chemical stability of the product.

4 Treatment with Alkali

Various alkali treatments can be applied to MicroModal® to give benefits such as increased dye yield, improved dimensional stability and reduced pilling tendency. Suitable alkali treatments are detailed below.

4.1 Causticization

Equipment: Padder or roller vat. Woven goods should be desized / washed before alkali treatment.

Standard formulation:

45 g/l	sodium hydroxide 100% (i.e. 7°Bé)
3.0 g/l	wetting agent for causticizing liquors (e.g. Leophen LG (BASF))

Temperature: 25 – 30°C, constant
Pick up: > 100%
Immersion time or dwelling time: 2 minutes. Low tension fabric cloth guidance
Rinsing: starting hot - neutralization

4.2 Sandoflex A treatment

Equipment: Padder or roller vat. Woven goods should be desized / washed before alkali treatment.

Standard formulation:

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

Temperature: 25 – 30°C, constant
Pick up: 100 – 110%
Batching time: 3 – 4 hours. Low tension cloth guidance
Rinsing: starting hot - neutralization

4.3 Visco-Combi-Batch process

Equipment: Padder or roller vat. Process example from CIBA / PFERSEE.

Standard formulation:

4.0 – 6.0 g/l	Invatex CRA or Invatex MD
8.0 – 12 g/l	Tinochlarite CBB
40 g/l	sodium hydroxide 100%
8.0 – 15 ml/l	hydrogen peroxide 35%

Temperature: 25 – 30 °C, constant
Pick up: 100 – 110%
Batching time: 12 – 16 hours. Low tension cloth guidance
Rinsing: starting hot - neutralization

In addition to bleaching, the Visco-Combi-Batch process gives some improvement in dye yield, dimensional stability and in the reduction of pilling.

In all the above mentioned methods of alkali treatment, a reduction in pilling tendency occurs. This comes from the fibers being very strongly swollen during the process and when in this de-stabilized phase can adjust to the twist along the yarn axis. Following de-swelling, the fibers are hydro-set in their new position to some extent and therefore better bound in to the yarn structure.

5 Drying

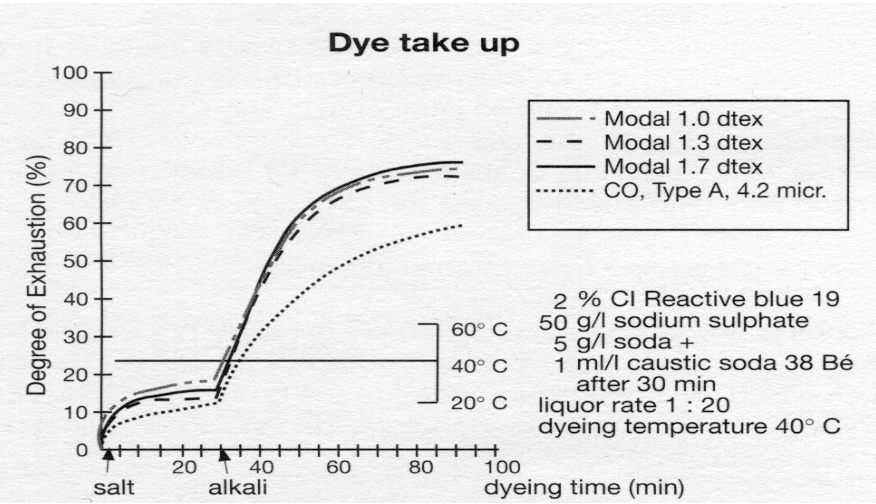
Fabric drying should take place at relatively low temperatures (up to 130°C) with a residual moisture content of 8.0 – 10%, depending on the blend. This applies whether the fabric is chemically finished or not. As with all man made cellulose fibers, it is important to monitor the dry shrinkage of the fabric in order to achieve a proper final fabric shrinkage. MicroModal® fabrics should be dried on machines operating with zero or minimal tension. The stenter frame offers advantages here with respect to setting a defined overfeed and width adjustment.

6 Dyeing

MicroModal® can be dyed with those dyestuffs intended for cellulose fibers. Reactive dyestuffs are particularly well suited as they offer the most extensive selection of dyestuffs with which it is possible to achieve good tone-in-tone dyeing on blends with cotton. Some exceptions to this rule are large-molecular dyes such as phthalocyanine dyestuffs which generally show a low affinity for MicroModal®. A large number of direct dyestuffs also show this property.

In comparison to various synthetic fibers, the fiber fineness of MicroModal® has only a slight effect on the speed of dye affinity and dyebath exhaustion (See Figure 4).

Figure 4 *Dye take up*



However, the influence of the fiber fineness is clearly shown by the light remission behavior of the dyed fabrics. Here one sees a considerably lighter color impression, particularly after the exhaust process, than for comparable fabrics made of normal titre fibers.

In order to balance out this physical effect from the micro-fiber, it is recommended to prepare the fabric with alkali, using one of the processes described, wherever possible. In this way, the dye affinity capacity and yield are increased, resulting in deeper dyeings on MicroModal® and an improvement in the abrasion resistance.

7 Printing

When printing MicroModal® with reactive dyestuffs the effect of increased surface remission leads to lighter color impressions. As with dyeing, this can be corrected by alkaline pretreatment of the fabrics.

The same basic rules apply to printing MicroModal® as for printing Lenzing Viscose® or Lenzing Modal® fiber fabrics. These are as follows:

- Addition of urea compounds to the printing paste (particularly for green and turquoise shades)
- Highly saturated steam should be used when fixing the dye

Additional moisture application to the fabric prior to entering into the steamer also has a positive effect on Lenzing MicroModal® with respect to dye yield and can lead to a corresponding reduction in the required level of urea compound. For 100% Lenzing Modal® fabrics, this additional moistening can be limited to 20%, with blends with cotton the limit is 15%.

8 Finishing

Due to the inherent swelling behavior of regenerated cellulose fibers, the final fabric is liable to show repeated changes in dimension on wet / dry treatments such as household washing. However, alkali treated fabrics are more dimensionally stable than fabrics not treated with alkali.

In order to limit the dimensional changes, the fiber swelling has to be reduced. This can be achieved by the application of cellulose cross-linking agents together with softeners.

General guideline recipe:

x ml/l	acetic acid 60% (check fabric pH value closely)
45 – 55 g/l	low formaldehyde resin (DMDHEU type e.g. Knittex FEL)
13 – 16 g/l	magnesium chloride-hexahydrate catalyst
20 – 40 g/l	crosslinking polyurethane (e.g. Dicrylan PSF, Ciba: anionic type)
15 – 30 g/l	polyethylene softener

Pick up: approx. 70 – 80%
Drying: 120°C – 130°C
Curing: 150°C, 3 minutes / 170°C, approx. 45 seconds

Compared to cotton, MicroModal® fabrics display no loss in tenacity (provided that any preliminary processes were carried out under low-tension treatment) and the finishing effects obtained are generally better than on viscose.

Regarding process control, the procedure should be that after padding, the fabric is dried with an optimum overfeed on a pin stenter at or below 130°C maximum. Resin curing is best done as a separate process. The fabric should be stentered with corresponding overfeed and the catalyst selected to enable curing (cross linking) to be carried out at 155°C to a maximum of 170°C.

Sanforization treatment (fabric compacting) has the same positive effect on MicroModal® fabrics with respect to fabric appearance, handle and washing stability as on cotton or viscose fabrics.

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