

J. Ströhle, G. Schramek Benninger AG, CH- 9240 Uzwil / Switzerland

## Open width mercerising of knitwear

### 1. Introduction

The process of mercerising knitwear changes the properties of the knitted fabric in a positive way. Gloss, dimensional stability and an increased bursting strength are the main goals of knitwear mercerization. Increased dye effectiveness is a further benefit. In particular, the lustre, clear and even appearance of the fabric is appealing to consumers. For the consumer, the improvements in terms of dimensional stability are apparent even from the first wash. Later on, the improved bursting strength also comes to the fore. Above all, consumers will be pleasantly surprised by how long a garment made with mercerised cotton retains its "as new" appearance.

In the past, knitwear was made with mercerised yarn, but this process was very expensive. Tubular fabric can be mercerised, but this process offers no control over the technological data of the finished fabric. In addition, the consumption of caustic soda, water and steam is significantly higher than with a modern, open width mercerization system. BEN-DIMENSA machines with the open width mercerization concept have been in use for over 20 years at leading knitwear finishers. Increasing requirements have now persuaded Benninger to develop the concept even further. Particular attention was paid to improving the uniformness of the weight of the fabric and coloration across the full width of the fabric.

### 2. History

The term "mercerising" is used to describe a process in which cotton is treated with 240 g/kg caustic soda, and it was invented in 1844 by John Mercer. Other parameters like the dwelling time, temperature and fabric tension are no longer applied in the same way as in the original invention. BENNINGER have taken a leading role in the development of modern mercerising plants, delivering many innovations which competitors have since tried to copy. The differences between knitwear mercerising and fabric mercerising have been acknowledged by Benninger, who have again delivered pioneering work in this field. The advantage of mercerising the grey product is that this offers an excellent opportunity to control and memorise the technical properties of the finished product already at the mercerising stage. As a result, grey-mercerised knitwear needs to be pre-shrunk in order to achieve the required final width. At the same time, the curling tendency is reduced and further processing is simplified. The best results in terms of lustre are achieved with grey mercerization. However, the potential risk associated with grey mercerization is that thickening can occur at the edges as a result of mercerising. The edge stretching unit developed by Benninger plays an important part in reducing this risk.

Yarn-dyed articles (e.g. hoops) are grey-mercerised in order to save further processing steps. The continuous wash is performed in a way which allows both caustic soda and knitting oil to be washed out.

Knitwear can be mercerised both hot and cold. Whereas in a hot-mercerising process the caustic soda penetrates quite easily into the knitwear, additional wetting agents are always needed for cold-mercerising. Reaction times can be halved or machine productivity can be increased with hot-mercerising. With yarn-dyed knitwear, there is a risk of variation in colour tone or bleeding depending on the dye used. Yarn-dyed articles are cold-mercerised for this reason.

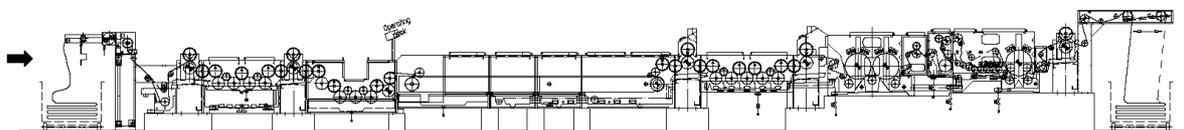
The mercerising of knitwear plays a particularly important role for the following articles:

- 100 % CO Piqué for POLO shirts ranging from 130 – 220 g/m<sup>2</sup>
- 100 % CO Interlock for underwear and outerwear ranging from 130 – 190 g/m<sup>2</sup>
- 100 % CO Rib articles for underwear ranging from 110 – 190 g/m<sup>2</sup>
- 100 % CO French Rib for outerwear up to 360 g/m<sup>2</sup>
- CO/Elastan Single 180 - 300 g/m<sup>2</sup> for outerwear

### 3. Layout of the plant

An open width mercerising plant comprises the following components (see Figure 1):

1. Fabric entry with fabric centring device, if required also with a correction device for straightening
2. Caustic soda impregnating compartment with facility for shrinking
3. Dwelling zone
4. Width stretching zone with conical and parallel stretching fields
5. Stabilising zone
6. Washing and neutralising zone
7. Fabric exit



**Figure 1: BENNINGER: DIMENSA mercerising plant for knitwear**

Impregnation takes place in an impregnating compartment, whereby the concentration and temperature are controlled fully automatically. The uncurling of the edges of the fabric is particularly important in order to minimise cutting losses.

The subsequent dwelling zone is set up as a roller section which transports the knitwear under low tension on transfer rollers to the stretching field. The layout of the transfer rollers ensures that the edges are not curled.

The stretching field is the heart of the *BEN-DIMENSA* machine. Here, the width and weight of the finished fabric are pre-determined and memorised.[ 1 ] . The knitwear is uncurled with the aid of plate decurlers and pinned up via overfeed rollers onto a vertical pin chain (see Figure 2). The stretching field comprises a conical field and a parallel field. The fabric is stretched in the conical area, whereby it is usually stretched beyond the width of the finished fabric. In the parallel field, the set fabric dimensions are stabilised by spraying on hot weak lye. The inlet into the stretching field can freely varied in relation to the speed of the tensioning chain. In order to achieve the best possible dimensional stability and minimise residual shrinkage, the machine is usually run with overfeed when processing knitwear. Knitwear can absorb up to 30% overfeed. The stretching field also offers the unique opportunity to correct thickenings at the edges. During mercerising, edge thickening is caused by the fact that width shrinkage can be triggered more easily in edge areas than in the middle of the fabric. Width shrinkage occurs immediately after impregnation with caustic soda as a result of swelling of the cotton. Edge thickening changes the appearance of the stitch structure and causes variations in colour (usually lighter). Whereas in the past, patterns were adapted to take this into account and greater cutting losses were accepted, the scope for tolerance is much smaller today. Benninger has developed a special edge stretching unit which is placed on the tensioning chain. Any thickening which arises at the edges is corrected and then memorised by spraying on diluted caustic soda. This particularly affects articles with a high level of lateral elasticity, such as Rib and Interlock articles, but also articles containing a mixture of Elastan. Results in practice have shown that use of the edge stretching unit reduces stitch compaction by at least a half.



**Figure 2: BENNINGER: Conical inlet field where the fabric is pinned-on in the stretching field**

The width stretching zone is immediately followed by a stabilising compartment, which is divided into individual chambers. Recirculating pumps ensure that the liquor is continuously recirculated through the chambers, with the flow set to counterflow in the different chambers [ 2 ] . The residual caustic soda content downstream of the stabilising compartment is less than 30 g/kg caustic soda, and the remaining caustic soda is washed out in TRIKOFLEX drum washing compartments. Immediately after mercerising yarndyed, knitted articles are softened directly on the stenter frame. The TRIKOFLEX reaction and washing compartment is suitable for the required core neutralisation. The fabric is plaited down in the front part of the compartment and sprayed with a pH-controlled recirculation liquor. The subsequent rinsing stage takes place on a washing drum.

#### **4. Consumption data - results**

BENNINGER is the only machine manufacturer who can design knitwear mercerising plants which are designed to meet all of the requirements of the process. This can be summarised as follows: [ 3 ] .

- DIMENSA: Shrinking of the untreated fabric with simultaneous mercerising under tension for ultimate lustre. In the past, piqué materials for polo shirts were double-mercerised, both as yarn and as fabric. Today, the BEN-DIMENSA system delivers optimum results in terms of lustre with just one mercerization stage.
- Stitch thickening at the edges of fabrics of less than 4 % result in 5 % lower cutting losses during garmenting.
- Stitch thickening below 2 % instead of 10 % for French Rib 350 g/m<sup>2</sup> (DIMENSA mercerisation of bleached fabric)
- Minimal consumption of resources: caustic soda 250 g/kg, water 4 l/kg, steam 0.4 kg/kg
- mercerization results in 40 % dye savings - as shown with the example of 4 % "Marine Blue" CPB dye applied to Single, Rib and Piqué (see Figure 3)

- Halved requirements for finishing resin for 100 % CO Single and Interlock in order to achieve the same dimensional stability as non-mercerised fabric
- Improved residual shrinkage figures: from – 6 % in length to – 3 % thanks to BEN-DIMENSA hot mercerization (Single Jersey) in comparison to rope mercerization.
- No post-washing or other subsequent processes required for yarn-dyed fabrics. The only process to follow is a stenter frame process which combines softening, finishing and drying.



**Figures 3: BENNINGER dye savings achieved with DIMENSA mercerization compared to unmercerised fabric**

## **5. Outlook**

Despite increasing cost pressure, the process of mercerising knitwear is set to gain increasing importance. With mercerised fabric, manufacturers can not only set themselves apart in terms of quality, but can also achieve steadily improving quality with increasingly poor quality grey materials. Fashion trends dictate the use of mercerised cotton in the field of polo shirts. As the potential cost savings which result from the reduced requirements for dyes and finishing agents easily outweigh the additional costs of mercerising, this means that the process will become even more attractive in the future. Causticizing of viscose and modal fibres will also gain increasing importance. The Benninger DIMENSA system can be used both for mercerising of cotton and for caustic soda treatment of viscose and modal knitwear.

## Bibliography

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Benninger AG

9240 Uzwil

Tel. 071 955 85 85

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