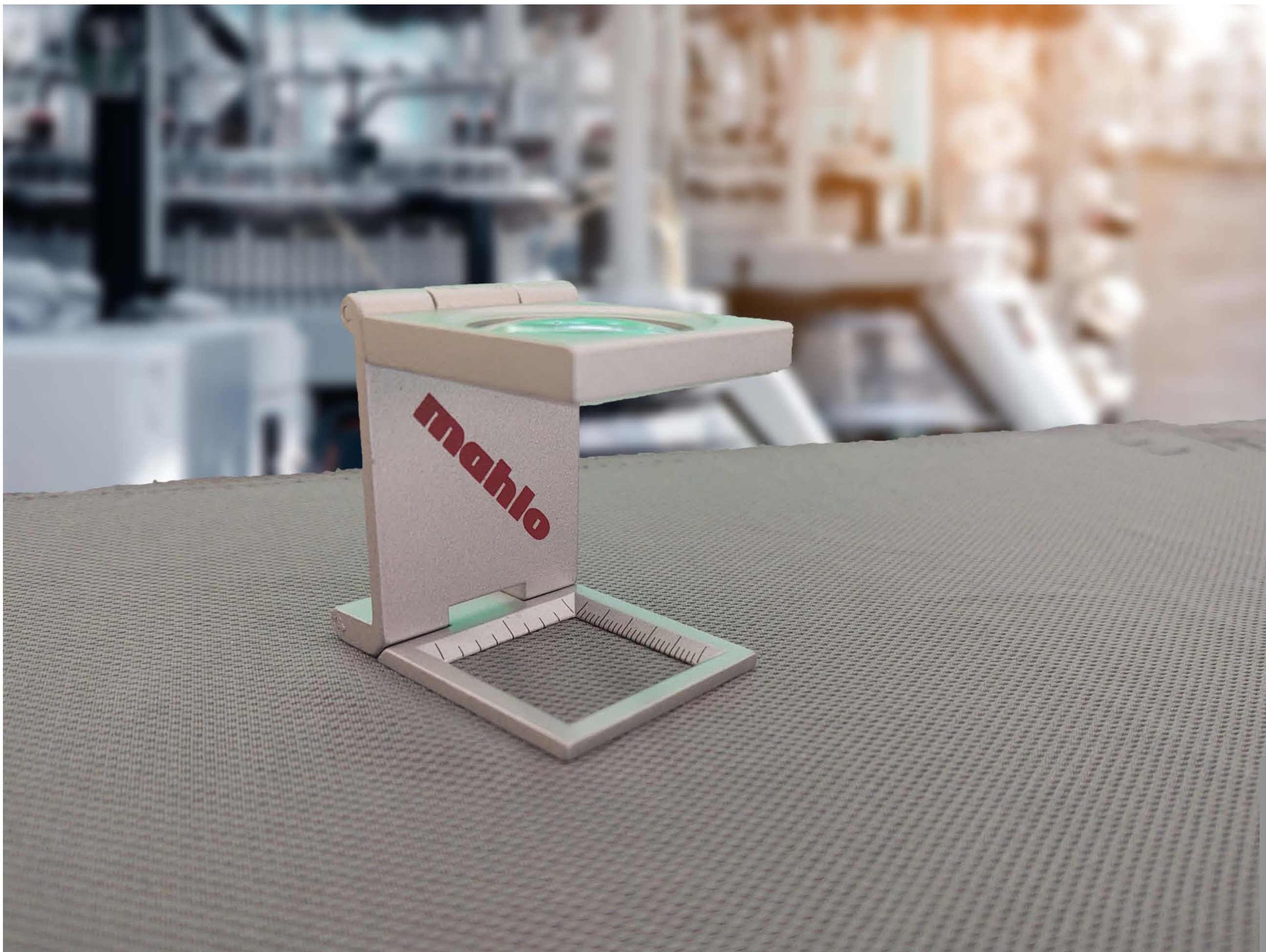
mApplication Famacont PMC

Process control for wovens and knits



mApplication Famacont PMC

Quality made in Germany

TEXTILE NONWOVEN COATING & CONVERTING PAPER EXTRUSION

Table of contents

MARKET OVERVIEW FOR KNITWEAR

In the textile industry, knitwear is becoming increasingly popular. The reason for this development is its versatility. While knitwear used to be synonymous with turtlenecks and fine-rib bodice in the past, three-dimensional knitted fabrics are now being produced to support modern buildings or extremely light sports shoes from the generations of the latest warp knitting machines. In medicine, the automotive industry and geotextiles as well, the versatile textiles have long since claimed their space. However, this should not hide the fact that the majority of knitwear production is still in the leisure and mass sports sector.

It is estimated that more than 7 million tons of knitwear are produced annually worldwide. As a result, the market reached a value of almost 56 billion dollars in 2018 and is the second largest segment of the textile manufacturing market. The Asia-Pacific region dominates here, with China and Bangladesh being the industry leaders. This is followed by North America, Western Europe and other regions in Asia.

Knitwear is also used for sports shoes.

PRODUCTION OF KNITWEAR

Production

Surface production

Just as with wovens, the textile surface is created first. A general distinction is made here between circular and flat knitting machines. In between, there are several other varieties that are currently used in the creation of three-dimensional knitted fabrics. The majority of production, however, still takes place on circular knitting machines. Courses are formed by interlocking thread loops with the aid of knitting needles. By controlling the course geometry and density, a wide variety of knitted fabrics can be produced. Compared to woven fabric, knitted fabric is characterized by higher stretchability, elasticity and thus less creasing.

Circular knitting machine

Finishing

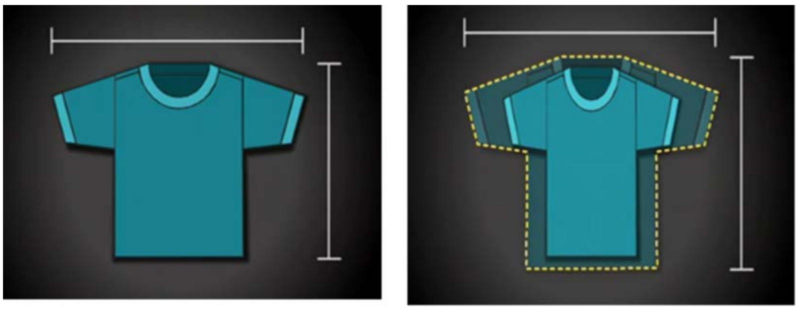
After surface production, the spinning oils are first removed from synthetic fibres and their blends, thereby fixing the fabric. The fixing process takes place at a precisely defined temperature/time mix on the stenter frame. Afterwards, the knitwear passes through exactly the same processes as the representatives from the woven guild. Bleaching, dyeing, possibly mercerising and repeated washing take place. All these steps, however, seriously differ to wovens: The absorption of water creates a fabric tension which can be many times its own weight. While woven goods are very relaxed about this fact, it is a cardinal problem for knitted goods: Lengthening.

Challenges and requirements

High distortion dynamics due to constantly varying thread density

The special feature of the production of knitwear is that the fabric is knitted at the beginning of the process with the thread density the final product shall have. As already described in the previous paragraph, knitwear is subject to many processes in the textile value-added chain which imply high fabric tension. The first step is the pull-off roller of the knitting machine. As the circumference of the wound fabric is constantly increasing, the circumferential speed and thus the tension during the winding process also changes. While this process is still continuous, the tensile stresses during wet finishing are much more arbitrary. Individual batches may be divided up among different jets with different loads. The position of the reel (or jet) for fabric transport can also be different, so the distance between floating fabric (in the fleet) and fabric drive (reel / jet) can vary between dyeing machines. Moreover, at times the treatment duration is not identical and sometimes winding and tangling reoccur, which leads to an additional immediate and undefinable increase in fabric tension.

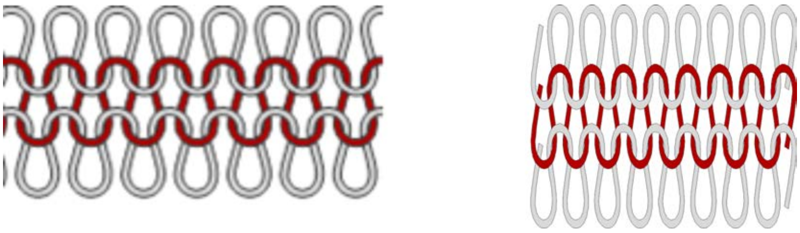
Due to the sum of the individual treatment processes, the fabric becomes thinner and thinner and thus receives greater so-called residual shrinkage. Residual shrinkage is the ratio of the dimension of the lengthened product to the dimension of the unlengthened product (raw material) in the relaxed state. Residual shrinkage of a fabric is an important parameter in terms of quality. It must be kept as small as possible. After all, customers do not want a product that changes its shape or size noticeably after washing and drying. It is therefore immensely important for the manufacturer to maintain tolerance limits.



The residual shrinkage of the goods must remain as low as possible.

Due to the conditions outlined above, knitted fabrics often exhibit a large so-called warping dynamic. This means that the course density varies greatly. This must be compensated for at the end of the process.

If fabric with varying course density enters the stenter frame, the fabric weight also varies. If one assumes an even squeezing effect at the Foulard, more or less moisture enters the stenter frame with the fabric, depending on the fabric weight. This in turn means that the drying process sometimes takes less, sometimes more time and consequently leads to constantly varying dwell times during fixing.



Courses with distortion dynamics

Any dwell time control system that is used will try to compensate for this and constantly slow down or accelerate the stenter frame. Desired dwell times cannot be maintained consistently. Differences in course density and fabric weight are also counterproductive when measuring residual moisture.

It is therefore essential to even out the course density if additional costs are to be avoided.

How can process control help

A uniform course density helps to maintain tolerances with regard to residual shrinkage. This saves trouble with customers and prevents complaints, claims or devaluation of goods.

If knitwear with a uniform course density and weight is presented to the stenter frame, the control system will set the optimum machine speed and any safety margins in terms of speed are no longer necessary. The stenter frame runs faster and requires less energy.

With suitable measurement and control technology, the result can also be recorded. Exact data acquisition is therefore always a safeguard against unjustified claims by the customer. In addition, the qualitative standards can also be made immediately available to partner companies.

Process control ensures quality standards

Process control

- ✓ *uniform residual shrinkage*
- ✓ *no complaints*
- ✓ *optimal machine speed*
- ✓ *regular result logs*

MAHLO SOLUTION: FAMACONT PMC

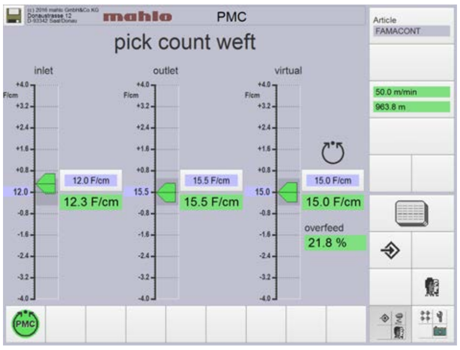
Measurement of basis weight and thread density

Famacont PMC

Continuous exact control of the weft thread or course density is an important factor for quality optimisation when finishing textile products and so is that of the basis weight. The Famacont PMC covers both tasks in one device. It determines the thread density in longitudinal and transverse direction without contact by means of an optoelectronic or imaging process. Knowing the thread density both of weft and warp thread the imaging process also allows for conclusions as to the basis weight of the product.

The Famacont PMC controls and regulates essential parameters such as weight, stretch or shrinkage of the fabric. Since linear density, basis weight and residual shrinkage values are directly related, online control of linear density ensures constant and low residual shrinkage values. This makes it an important tool for the finisher: Quality requirements of the customers are complied with; costs due to rejects and quality loss is minimised.

Area of application in line

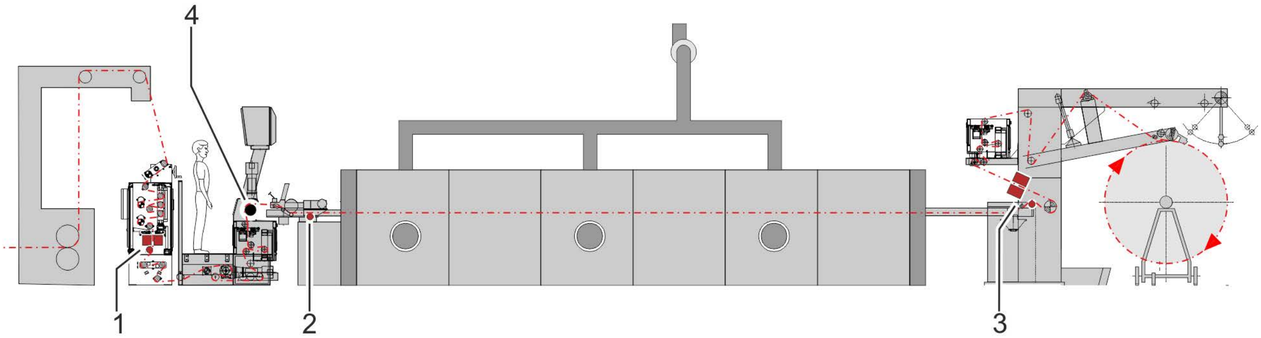


Thread count display

The Famacont PMC can be used at various stages of production, e.g. for incoming goods inspection, drying machines (stenter, oven, dryer), shrinking machines (Sanfor or Compactor) and inspection machines. However, the main area of application is the stenter frame, with one sensor at the infeed and one sensor at the delivery. While the front sensor regulates the density of the fabric, the rear sensor checks whether the result is satisfactory and creates corresponding reports. In case of continuous deviations, the result can also be used for corrections in the control behaviour of the front sensor.

Control strategy

The sensor at the infeed measures the density of the courses upstream of the stenter and compares it with the specification, which may be stored, for example, in recipe data management. Accordingly, the computer sends a signal to the over-feed roller in the infeed of the stenter, which regulates the pinning process onto the stenter chain while including the chain speed. With the help of the feed forward control algorithm, the resulting distortion is optimally compensated. Even with short-frequency changes in thread density the target value is immediately adjusted to the actual value as soon as the product arrives at the infeed. Another sensor at the delivery checks the result obtained and records the measured values in suitable logs. This closed control loop with auto correction offers outstanding reliability with fluctuating basis weights and prevents individual parties from having to run a second time with higher over-feed through the stenter. In addition, the combination ensures that a record of the achieved basis weight is available for each product. A constant laboratory test of the values obtained after drying is not necessary.



Famacont PMC Smart-Feed-Forward Control on the stenter

1 Infeed sensor
2 Reference chain speed
3 Delivery sensor
4 Over-feed roller

Example of Feed-Forward Algorithm

The target is 25 p/cm thread density for the end product. No problem with an average thread density of 20 p/cm and over-feeding of 25% at the stenter frame infeed. However, if the thread density drops by only 2 threads to 18 p/cm, the thread density would be only 22.5 p/cm with the same over-feed. As a result, the Famacont PMC corrects the lead to 27% to achieve the required result of 25 p/cm thread density.

Benefits

- ✓ *Two measurements in one system (thread density and basis weight)*
- ✓ *No beta emitters necessary, therefore no additional effort with permits etc.*
- ✓ *If only basis weights were measured, moisture would also be measured; the control would therefore be of little use*

SCANNERS TK, CK, CK-HF

Detailed description

Optoelectronic sensor TK

TK

The optoelectronic sensor determines the thread density in longitudinal direction without contact. With this process the threads or courses pass the sensor and are projected onto the photocell using a precision optical lens. This lens continuously aligns itself to always get an optimal signal. The signal is amplified, prepared and digitally processed. Depending on the type of product, the sensor can work with transmitted light or reflex light. The passing threads produce a light/dark modulation whose frequency is proportional to the thread count. By knowing the speed, the length of the measurement series is also defined, so that at the end an exact determination of the threads per centimetre is made. The calculation is based on the following principle: Threads/unit of time (measured frequency) divided by centimetres/unit of time (measured speed) = threads/centimetre (thread density), or: d = f/v. The TK scanner measures up to 220 T/cm.

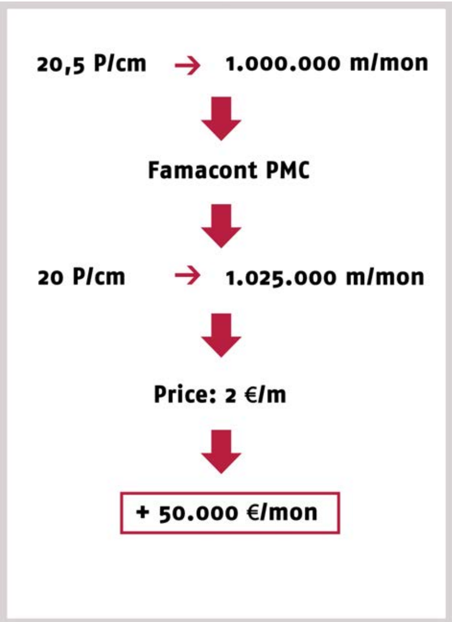
Camera sensors CK, CK-HF

CK, CK-HF

With the imaging process the thread density can be determined at the same time in longitudinal and transverse direction (weft and warp direction). Images of an area of 3x4 cm taken with a high-resolution camera are precisely evaluated by a coordinated software (Fast Fourier Transformation). The camera sensor is available in two versions: for normal thread densities up to 70 T/cm and for high thread density products up to 270 T/cm. Camera scanning is particularly interesting for contract finishers, as they work without a thread density specification, or for manufacturers of technical textiles, e.g. for air permeability of filters or water permeability. Often, they only receive the final dimensions of the goods from their customers. Thanks to Mahlo technology, this requirement can be easily converted and directly implemented.

PROFITABILITY

If a supplier produces 1,000,000 m per month with an average thread density of 20.5 threads/cm and can reduce this to 20.0 threads/cm by controlling the thread density, he will achieve a production increase of 2.5% in linear metres of the same amount of raw material. This means an additional 25,000 m/month at an additional cost consisting mainly in the depreciation of the PMC-15. If this article can be sold at EUR 2.00/m, it will earn an additional EUR 50,000.00 per month, i.e. the payback period of the Famacont PMC is less than three weeks in this case.



In addition, the costs for a second stenter frame passage, which would be necessary if the final weight does not meet the customer's specifications, are eliminated. Since the stenter almost always represents the bottleneck in production, this stenter determines the total productivity within the value chain (Theory of Constraints). In simple terms: What cannot be dried, should not get wet. If a fabric must be passed over this stenter frame a second time due to insufficient thread density, another part cannot pass through the production process. The costs are therefore much higher than just the additional energy and chemical costs during the second stenter frame passage, since additionally planned batches cannot be produced.

Finally, costs for customer complaints and lawsuits are eliminated, which is not only a monetary relief, but also goes hand in hand with a significant increase in reputation. The consequence: Less stress, better supplier evaluation and generally more balance.

trendsetting technology. worldwide.

Monitoring and control systems, automation

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