BENNINGER

Increasing the Process Reliability of Textile Finishing Processes

Jürgen Ströhle
Benninger AG, 9240 Uzwil/Switzerland

Quality and commercial success are closely related. Quality is influenced by the factors machines, methods, materials and men. Comprehensive quality management begins with the design of finishing machines and ends with servicing.

PIMS ([1]) studies state that there is a clear positive correlation between quality, market share and ROI ([2]) (Fig. 1). Quality leads to better prices on the market and promotes sales and profits. Quality can compensate for a low market share but generally leads to increased market shares. Costs reduce with higher market share. In addition, quality and a higher market share have an even more positive effect on profit ([3]).

Quality and quality costs

It is well-known that process reliability and reproducibility promote product quality. However, quality is also a product characteristic that the customers demand and cannot be copied by competitors. The producer alone is responsible for quality costs. The blame cannot be placed on competitors, customers or high labour costs. If quality costs can be reduced then the savings can be written on the positive side of the accounts in the form of profits. Quality is a guarantee of the commercial success of the company.

Quality concepts and the passage of time

In the 1950s and 60s quality was equated with technical perfection. Products were defect-free and impressed through their high technical standards.

In the 70s the label "Made in Japan" in the Hi-Fi, photography and car industry triggered a new wave of quality terminology. Cheaper mass-produced goods, which could be replaced frequently, were thought to represent a high quality lifestyle and were to be preferred to more durable articles.

In the 80s the euphoria of mass produced goods ebbed and the requirements of quality became clearly defined. The resulting products had relatively high quality at an acceptable price.

Today quality is precisely defined. The aim is to meet the exact expectations of the customer.

BENNINGER

Quality optimisation
Based on the cause and effect diagrams published by K. Ishikawa ([4]) there are four critical causes of quality defects (Fig. 2):

- Machines/equipment
- Methods
- Man (i.e. personnel)
- Material

Machines / equipment
With machines or equipment, quality deviations may occur because of inadequate maintenance or servicing. In terms of textile technology a breakdown in quality is said to have occurred if, for example, the required washing effect, degree of whiteness or absorbency of one of the fabrics being finished is not achieved. These are defects in the specification of the system because the expectations of the customer are not fulfilled.

Risk factor rubberised rollers
A known problem in wet finishing ranges is wear on the roller rubber, even if this happens to be outside the influence of the machine supplier. This is a potential source of risk of a reduction in quality. Two questions must be asked about a potential source of risk to quality:

- Is this component really necessary?
- Does the component have to be modified to suit the operating conditions, or can the conditions be improved to suit the critical component?

Rubberised rollers are critical components in the textile finishing industry. High temperatures and large amounts of chemicals lead to rapid and uncontrollable wear. It is well known that washing efficiency at boiling temperature is considerably higher than in cold washing water. Washing processes at boiling temperature create unfavourable conditions for rubber rollers. Cold washing would improve the operating conditions but make the textile results worse. This means that the critical component, in this case the first washing unit in a washing process, will have to be modified to suit the ambient conditions. The simplest way to do this would be to avoid using rubber rollers in such situations.

The FORTRACTA washing unit (Fig. 3) was developed specially for the removal of surface impurities and high levels of chemical concentration. The fabric is fed upwards in two narrow shafts. The washing liquor flows downwards under the action of gravity like a waterfall. The countercurrent principle in the shaft produces a good washing effect and a self-cleaning action on the washing unit. The liquor separation is performed by stripper rollers and flat spray nozzles at the outlet of the FORTRACTA compartment.

The prewashed fabric can then be further processed wash in conventional roller vats. As the chemical and dirt load has already been reduced by 50 %, then rubber rollers can also be used again. With the FORTRACTA prewashing unit a product was created that completely fulfils the quality objective "Avoid sources of risk".

Methods: Selecting the right process
The selected production sequence, formulations etc. often do not conform with the actual quality requirements. It is well known that knitwear made from cellulose fibers is still too often bleached and dyed discontinuously in jets or Soft flow machines. During the 6 – 9 hour long process the textile undergoes extreme mechanical surface finishing. As a result the surface is roughened and a hairy surface appearance is created (Fig. 4).

Associated with this is a high risk of abrasion marks. Both are quality defects. A hairy surface leads to a poorer market price, abrasion marks lead to price deductions. The continuous open -width finishing of knitwear, such as Cold Pad Batch (CPB) dyeing, does not lead to these quality defects. Benninger has the complete range of services for open -width finishing of knitwear, which includes bleaching, mercerizing, CPB dyeing and washing out. Particularly outstanding is the new Benninger Küsters "DyePad" (Fig. 5) which guides the fabric under optimum tension and on the shortest path. Reproducible dyeing using the nip dyeing process is equally suitable for small (< 30 kg) as it is for large production batches (> 1000 kg).

Man and Material
In whatever sector of industry, the end result of each process is always influenced by the quality of the raw materials used or the initial materials for the process. Today, the technically possible quality is frequently at a level which cannot be judged using human senses. Hence there are also fluctuations in quality which cannot be directly influenced by personnel and their actions or even recognised by them.

The problem
The following example of Cold Pad Batch (CPB) dyeing shows the influence that personnel and materials can have: With CPB dyeing there was always a difference between the start and end of a dyeing batch, which is referred to as tailing. The customer checked the dye-ready fabrics and found them to be good in terms of absorbency, degree of whiteness etc. The pick-up after impregnation and the squeezer was constantly uniform. The 4:1 dosing pump was operating absolutely correctly. In spite of all this the fabric at the end of the batch was always dyed darker than at the start.

The solution
The Benninger software "Scope Tool" brought the solution: during the dyeing process the liquor consumption reduced despite the liquor being evenly applied (Fig. 6). The top layers of the dye batches were preconditioned in the subtropical ambient air at 8% relative humidity while the lower layers contained less than 2 % relative humidity due to overdrying. This led to a 6 % higher dye addition. Perfect dyeing results were produced by preventing overdrying with stenter frame drying and cooling the fabric in a controlled manner. This example showed the influence on quality of the various materials and the influence of the personnel.

Even if the result and the effects on the textile results are clear in hindsight after each dyeing it is only thanks to a precise investigation of the causes and a systematic approach to problem solving were positive results achieved. In such a situation the weakest link in the quality chain are the personnel. It was only possible to discover the actual cause of the defect by using a modern software tool and sensors.

Increase of process reliability and reproducibility

Quality reveals itself in daily use and is defined by the user as the situation when the expected and the experienced quality are as close as possible. The important aspects of quality policy in textile finishing plan design are:

- Avoid potential sources of risk
- Built-in freedom from maintenance
- Monitoring of specified and achieved values
- Control of exceptional situations.

All these measures are intended to increase process reliability and reproducibility. Quality results in the customer gaining trust in the supplier and developing loyalty towards him, which benefits them both.

Figure titles

Fig. 1: PIMS Study relationship between quality and ROI.
Fig. 2: The 4 M factors for production reliability.
Fig. 3: The FORTRACTA prewashing unit.
Fig. 4: Hairy fabric surface, caused by the JET/Softflow dyeing process.
Fig. 5: Benninger Küsters Dyepad for cold pad dyeing of knitwear.
Fig. 6: Scope Analysis: Increasing liquor consumption in l/kg during a Cold Pad Batch dyeing lot.

Literature and sources

([1]) PIMS: Profit Impact of Market Strategies: well-known empirical market studies from the USA
([2]) Backhaus Klaus, Industriegütermarketing, 5. Auflage.
Munich 1997
([3]) Hopfenbeck Waldemar, Allg. Betriebswirtschafts- und Managementlehre, 4. Auflage.
Landsberg am Lech, 1991
([4]) Ishikawa, Kauro. What is Total Quality Control?
Prentice Hall, Englewood Cliffs, N. J. 1985

Benninger AG
CH 9240 Uzwil
Jürgen Ströhle
T +41 955 85 85
F +41 955 87 47
E-mail: juergen.stroehle@benningergroup.com
www.benningergroup.com