BENNINGER

Continuous Open Width Treatment of Knitwear

– A Case Study Based on Economics and Quality

By:

J. Ströhle, P. Brändle,
Benninger AG, CH- 9240 Uzwil / Switzerland

Continuous open width treatment of knitwear
A case study based on economics and quality

By: J. Ströhle, P. Brändle, Benninger AG, CH- 9240 Uzwil / Switzerland

Introduction

The worldwide demand for knitwear is increasing. Approx. 70 – 80% of this knitwear is tubular knitted goods. Today the majority of knitwear is bleached and dyed in the rope in classic softflow machines using the exhaust process. The extremely long process times, the high water and steam consumption figures combined with quality and reproducibility problems are rendering this method obsolete. Just how obsolete is demonstrated by the fact that the same change took place in the woven fabric sector some 30 years ago. Based on a case study, this article compares the economic advantages of modern continuous open width treatment against rope treatment.

Case study

Using the following case study based on fictitious companies in Central Europe and South Asia, the finishing costs are compared for high-quality knitwear in continuous open width treatment (in the following referred to as **open width treatment**) and in classic discontinuous rope treatment (in the following referred to as **rope treatment**) based on softflow dyeing machines. The comparative calculation is consciously based on practical data and not on optimised results achieved once in exceptional circumstances. Such data are often published by a number of interest groups but are of little relevance to practice.

Basic data

Article: 100 % cotton single jersey Ne 30; 130 g/m2, 1800 mm (final width)
Dyeing: 20 g/l medium shade evenly distributed between red, yellow, blue and black
Production: 10 ton/day

Machinery:

Table 1: Machinery for the case study[1]

Continuous open width treatment	**Discontinuous rope treatment**
1 slitter	1 slitter
1 combined open width bleaching and washing machine for 30 m/min	10 softflow dyeing machines with a total capacity of 4.5 tons divided into various sizes
1 CPB dyeing centre for up to 50 m/min	
1 stenter frame with 10 fields and indirect gas heating (in Asia closed circuit oil heating)	1 stenter frame with 5 fields and indirect gas heating (in Asia closed circuit oil heating)
1 compactor with felt and/or rubber belt	1 compactor with felt and/or rubber belt
Investment costs 100 %	**Investment costs 93 %**

[1] The authors are aware that there are various ways of designing the machinery that can vary depending on the situation.

Process

The process for the methods compared is shown in Figure 1. At first glance it can be seen that the open width treatment requires seven work steps, while rope treatment is completed after five steps.

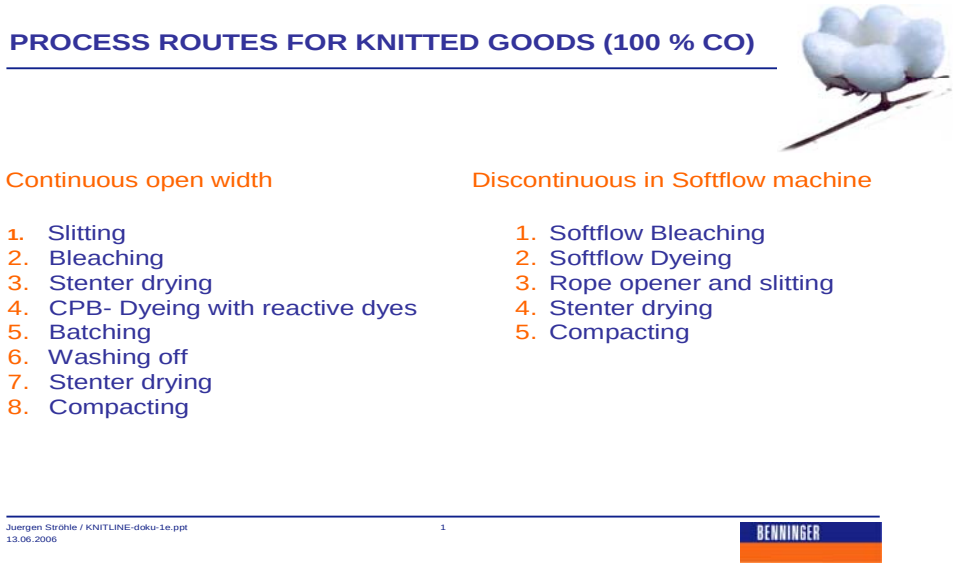

Fig. 1: BENNINGER process comparison for the treatment of knitwear

Results of the comparative cost calculation

Method used for the calculation of the manufacturing costs

During the calculation of the manufacturing costs, only those manufacturing costs that have a significant effect on the comparison of the two process variants were taken into account. These are the variable consumption costs for chemicals/dyestuffs, water, steam, electricity, gas (coal) and personnel. The capital costs (investment costs for equipping with the machinery and related infrastructure) vary between rope and open width treatment and are therefore taken into account with dynamic interest for the comparative calculation. The maintenance costs were also taken into account as fixed costs. Company-specific costs with no direct effect on the comparison calculation are not taken into account. Such costs are, e.g., costs for supervisory, laboratory and sales personnel, or for management.

Cost drivers for the treatment of knitwear

We start with the search for significant cost drivers.
A cost breakdown does not, however, indicate an absolute saving. This fact is due to the calculation and not whether there is a saving or not. Nevertheless, the cost breakdown does provide information on whether cost savings are worth pursuing. The primary objective must be to optimise large cost blocks. Steam and water represent 10% of the total costs for open width treatment, while for discontinuous rope treatment they represent 25% or more. In other words: water and steam are significant cost drivers in softflow rope treatment. Machine technology, the method and the results on the fabric do not permit any further optimisation. The chemical/dyestuff costs for both methods are around the same at 35%. Savings in chemicals and dyestuffs are worthwhile with both methods. The investment costs represent 15% of the costs for open width treatment and 10% for rope treatment. The personnel costs have the same effect on the total costs for both variants. Particularly worthy of note here are the regional differences of 2% in South Asia and up to 24% in Europe. The breakdown of the costs drivers will not be further pursued in the remainder of the analysis.

Cost comparison for the open width processing of knitted goods. Example: Europe

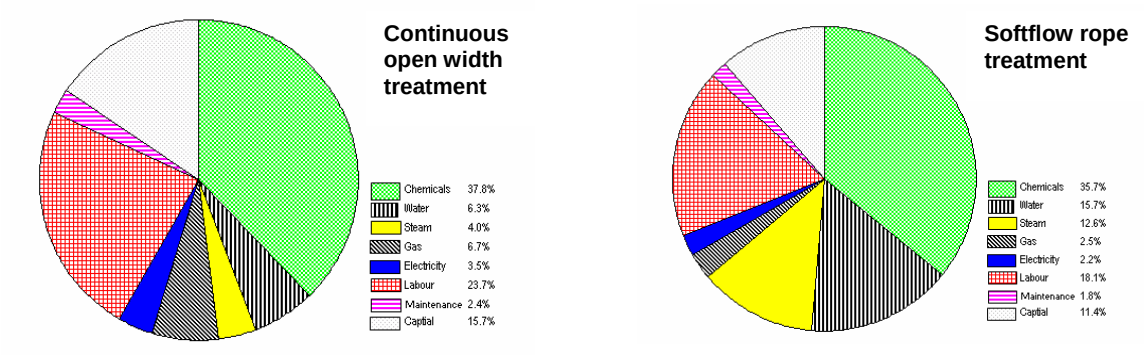

Fig. 2: BENNINGER: Breakdown of the cost drivers for cont. open width finishing in Europe

Cost comparison calculation

Continuous open width treatment is cheaper in all cases. Despite higher investment costs and the resulting high capital costs, based on the reference article a saving of 24% can be made in Europe with open width treatment and 20% in South Asia. The savings are even greater for cotton/elastane articles or viscose. Figure 3 shows the cost saving for the reference article. If you consider the variable costs in isolation, the saving with open width treatment in Europe is 29% and in South Asia 25%.

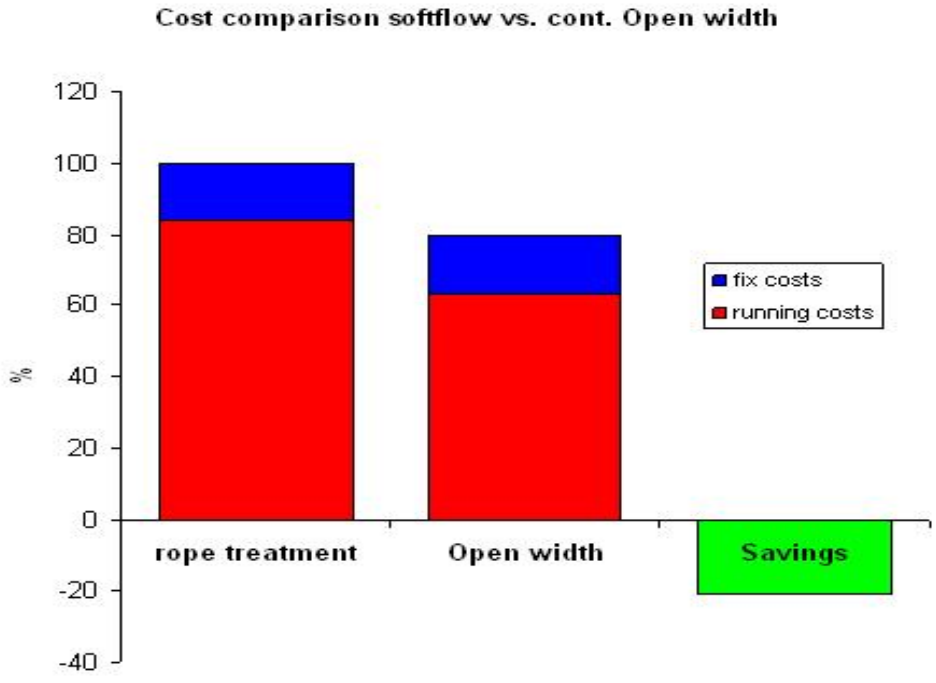

Fig. 3: BENNINGER: Cost comparison between cont. open width treatment and softflow rope treatment

A rule of thumb for continuous finishing states: the larger a finishing machine, the lower the variable costs (running costs). The variable costs are, however, always considerably less for continuous open width treatment. The saving on water (- 70%) and steam (-75%) is particularly pronounced. The saving for the chemicals at -20% is still certainly noticeable, especially as the cost block "chemicals / dyestuffs" is the largest element in the total cost calculation. The energy costs (gas or coal) for drying operation are somewhat lower for rope treatment. But the saving of energy in the open width processing due to less steam consumption is all in all still more than 50% of the consolidated energy consumption. If you consider the total costs including the investment and related capital costs as per Table 1, the total cost advantages for open width treatment are still clear with 20% in South Asia and approx. 24% in Europe (Fig. 4). The additional costs for a processing house with open width treatment are amortised in 12 - 20 months.

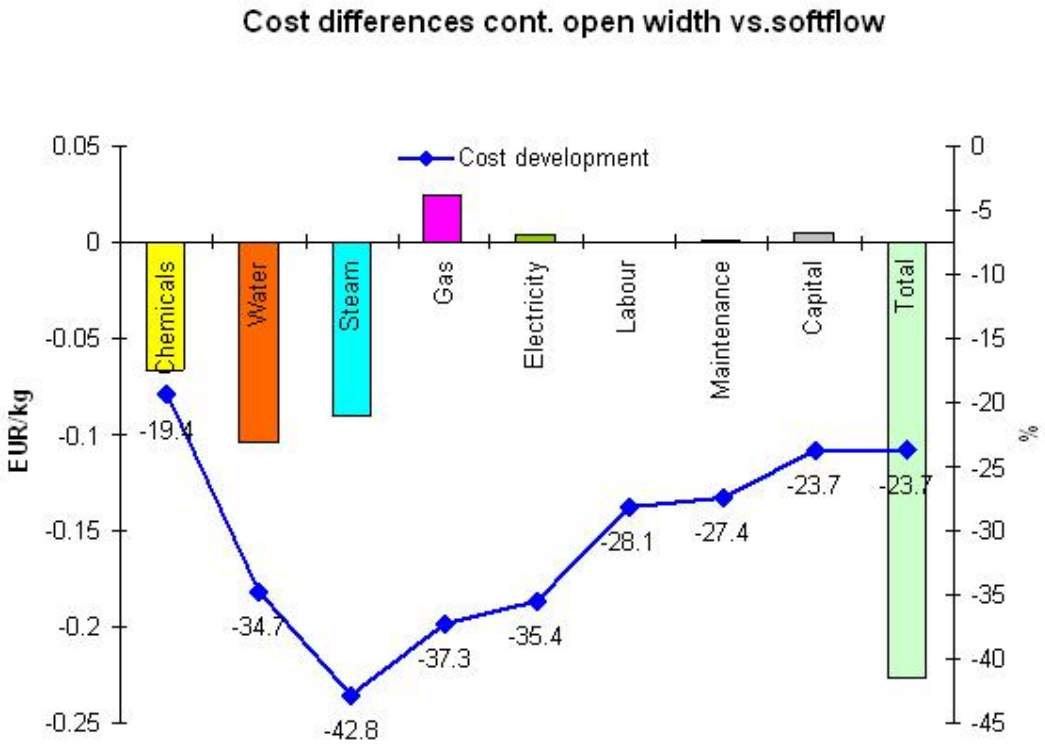

Fig. 4: BENNINGER: Cost saving for the continuous open width treatment of knitwear

Other results

In addition to the information given above, there are other advantages

Production-related advantages:

Each production increase of 1 ton/per day reduces the manufacturing cost of the open width process by further 1.5 % (from 10 ton/d upwards)
If mixtures with elastane fibres are processed, the cost advantages of open width treatment increase by a further 6-9%. During processing on classic softflow machines, grey heat setting must be used almost without exception to prevent streaks and other irregularities. During open width treatment the heat setting is economically combined with the intermediate drying prior to the CPB dyeing.
There are notable advantages for washing after printing with the continuous method:
Printed goods are in principle always already open width. There is no risk of staining and rear soiling
Highest possible brilliance and definition of the printing thanks to smooth surface
An optimal process sequence is also possible with vat printing

Regional advantages

The higher the costs are for water and energy, the greater the costs savings with continuous open width treatment.

Quality-related advantages

The fabric appearance is smoother with less hairiness. The fabric is identified by the consumer as higher quality and the price that can be obtained is 2 - 3% higher. As a result an additional increase in margins can be achieved.

There are no abrasion marks, rub marks or holes, as are familiar to every rope treatment practitioner (Fig.: 5). Abrasion marks and rub marks cause average quality costs of 1-2% a year. These quality costs are not incurred with open width treatment.

On the cutting table open width treated goods curl less than rope and/or tubular treated goods. The fabric web utilisation is better and the cutting loss less.

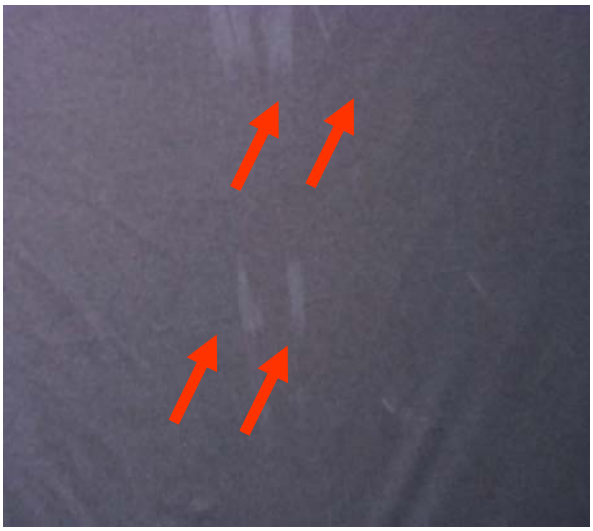

Fig. 5: Friction marks and rub marks from rope treatment cause annual quality costs of 1 -2%

Environment-related advantages

It is forgotten all too easily that costs savings are actually only the consequence of the use of less resources. Every saving signifies less pollution of our environment and the conservation of our scarce resources. A 60 % saving in fresh water also signifies 60% less waste water. 70% less steam consumption signifies a 70% less pollution due to exhaust fumes from steam production. And finally, 20% less chemicals also signifies 20% less waste water.
While our fictitious company consumes 4000 kg of salt per day for softflow rope treatment (which as a consequence is fed to the drains), in a modern CPB dyeing works no dyeing salt is needed.

Machinery for continuous open width treatment

Continuous processes are always designed for the required production capacity, the results of which are a production speed guaranteed by the machine supplier. At the same time, reputable machine manufacturers can guarantee very precise technological results and consumption data in advance.

Benninger supplies four main lines for the open width treatment of knitwear:

- Open width bleaching machines with the process stages demineralisation and PAD STEAM bleaching,
- Open width washing machines for the processes rinsing, soaping, oxidising, neutralising,
- Open width dyeing centres for CPB dyeing and/or the application of a CPB bleach.
- Mercerizing machines with the unique DIMENSA layout concept: an integrated stenter frame between the roller mercerizer and stabilisation zone along with a special selvedge expansion device for evening out the number of wales over the entire width of the fabric

A proposed factory in the fictitious company is shown in Figure 6.

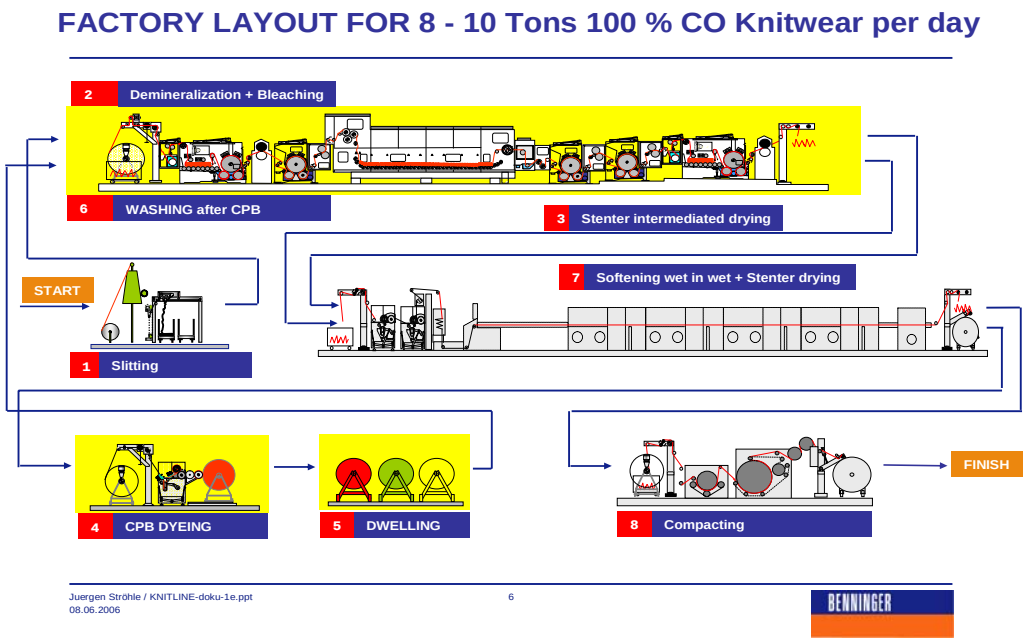

Fig. 6: BENNINGER flowchart for the continuous open width treatment of knitwear

Even if Benninger does not supply any machines for the dry finishing of knitwear, the integrative approach to the finishing process is in the foreground. The portfolio from the Swiss machine manufacture includes, along with customised machines focussed on high requirements in relation to quality, costs and sustainable protection of our environment, also considerable know-how on the continuous finishing of knitwear.

Conclusions

The case studies show clear cost and quality advantages for the open width treatment as can be summarised below in Table 2.

Table 2: Possible savings during the open width treatment of knitwear for the comparison with the softflow rope treatment

100% CO single jersey dyed (10 ton/d)	- 20 to -24%	
Additional production 1.5% per additional to/d	- 3%	E.g. add. 2 ton/d
CO /elastane mixtures 6% - 9%	- 2 to -3%	1/3 of the production
Lower hairiness	- 2 to -3%	Higher market price (quality)
No friction marks or rub marks	- 1 to -2%	Quality costs
Lower cutting loss	-1 to -4%	
Less use of resources		Environmental responsibility
4000 kg/d salt reduction		Environmental responsibility
Total saving incl. investment costs	-26 to -39%	
Payback	12 – 20 months	

With a production capacity of less than 10 ton/day, the cost advantages reduce. From a daily production of 5 ton/day the cost advantages of open width treatment are only 10% and the machinery should be reduced. Here the Benninger "Starter Kit" is ideal and increases the cost advantages back up to 15%. From a production limit of 2 ton/day or less, the cost advantages are the same. The quality is always better with open width treatment. Every company can influence the quality costs and the quality costs are independent of changes in the surroundings.