

# Towards automation in pre-spinning

Alan Parker discusses opening and spinning preparation

Today I believe that one can quite legitimately consider the conversion of bales of fibre into packaged yarn as comprising only two stages, bale-to-sliver followed by sliver-to-packaged yarn, although each stage has separate machines which are increasingly being linked in one form or another. In this article I will discuss how the concept of converting bales of fibre into sliver suitable for spinning has changed and how it may change in the future.

## Opening

The present fibre opening process has been developed, by a series of evolutionary steps, from the start of the industrial revolution, to open up, and remove impurities from bales of cotton. Over the years the different machines which have opened up the bale, broken down the fibre clumps into smaller tufts and removed impurities, have been linked by mechanical conveying and airflow in order to automatically transfer the fibre from one machine to the next.

Linking the opening line with a bank of cards by chute feed, and automatic bale plucking, have been the final steps to allow laying down bales of fibre through to card sliver all being performed completely automatically.

Quite naturally this process was adapted for short staple synthetic fibres although the cleaning stages were able to be eliminated. Additionally, facilities were developed to allow blending of cotton with synthetic fibres and thus produce an intimate blend for subsequent carding.

The art of providing satisfactory opening is to

provide the maximum amount of fibre opening and cleaning, consistent with the minimum amount of fibre damage, and at an economically attractive cost.

As confirmed at the 1988 GATT cotton conference, held in Geneva, the trash content of cotton is increasing, and cottons are tending to become coarser. Even though, from some quarters, there is an attempt to encourage cotton growers to grow finer, cleaner cottons, to allow rotor spinning more effectively to move into finer

than by any major breakthroughs.

## Carding

The carding process has, as its primary objective, the conversion of small tufts of randomly oriented fibres into a web of individual and substantially aligned fibres. The web a card produces is not only condensed to form a sliver for use in yarn making but is the basis of a whole range of textile products, as for example non-woven fabrics, disposable pads etc.

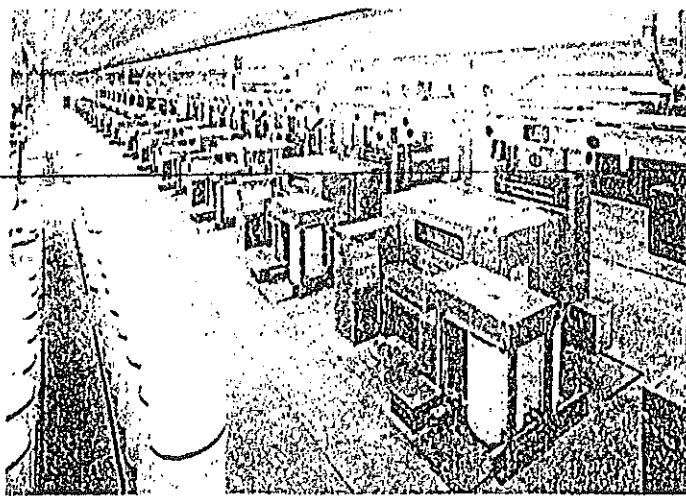
and different specifications to meet the needs of different fibres and yarns.

Cotton fibres pose special problems in that when a card is used for converting cotton fibre into a sliver of substantially parallel individual fibres, a further objective is to remove dust, short fibre, and trash from the sliver. An assessment of the effectiveness of a modern high production card in achieving this objective can be based on a number of different criteria:

- In comparison with other high production cards.
- In comparison with lower production cards that are being replaced.
- By examining not only the amount of trash, dust and short fibre removed, but also the amount remaining in the card sliver.

It is the third on criteria that represents the technological state-of-the-art and the one on which I will concentrate. Modern cards remove a large amount of dust, short fibre, and trash, but a significant level still remains in the card sliver. Anybody who doubts this, only needs to examine the amounts extracted when card sliver is combed, or passed through the opening roller of a rotor spinning machine. This is not a criticism of the card manufacturers, but expresses the difficulty of trying to combine two functions on one machine, with the inevitable consequence that one of the functions in this instance cleaning has to take second place to the primary function of forming a web of aligned fibres.

I feel that this is a crossroads in decision making for card manufacturers as to which developments to pursue, and that making the correct choice will be greatly influenced by develop-



An installation of 18 Ce-RR high-production cards, built by Swiss manufacturers Rieter.

counts there is no guarantee that this will be successful in the long term! There will also be an ever increasing demand for yarns with fewer and fewer faults, and therefore, future cotton opening lines will need to be able to increase the efficiency of cleaning and remove impurities, without an increase in fibre damage or a reduction in throughput rate.

I consider this will be achieved by refining and improving existing processes combined with a continually increasing level of automatically controlled quality monitoring, rather

There has been considerable cross-fertilisation between these different sectors and "carding technology development costs" have also been able to be spread across them. The greater volume required can also keep unit costs down.

I feel that following the massive advance in productivity over the last 20 to 30 years, which have been achieved following the introduction of metallic wire, there will be only modest production advances during the next ten years. Emphasis will instead be directed towards quality,

## Ring Spun Yarn

With the advent of splicing, plus an increased level of automation available for producing yarns by the ring spinning route there will, I believe, be an increase in interest in processing coarse count ring

spun yarns. To enable cotton ring yarns to be as clean as rotor yarns, without having to use cleaner, more expensive cottons, will place extra demands on removing impurities at the card.

In this instance the card will need to significantly reduce the existing levels of

trash and dust remaining in the card sliver. To achieve this will need a wide ranging re-appraisal of carding.

If this can be achieved, it may also prompt a re-think, for certain fine count applications, as to whether combed ring spun yarns can

be replaced by carded ring spun yarns. I consider this will be particularly important for polyester/cotton yarns when the improved fibre alignment and lustre associated with combing are less apparent, especially if fine denier polyester is used.

subsequent to carding. Conversely, the developments which take place at the card, may have a very significant effect on processes subsequent to the card, in particular, which spinning system is selected for a particular end-product.

I will attempt to indicate what I believe are the key factors in these decision-making processes:

- It has already been established that tandem carding is superior to single part carding, but is well short of producing a product equivalent to a combed one.

- Not unnaturally, some propose that combing can be the way for rotor spinning to move into fine count cotton yarns. There is no doubt that a rotor yarn from sliver containing combed rather than carded cotton is superior. If, however, one examines what combing

achieves much of this is lost when the fibres are released from the opening roller of a rotor spinner into an airstream. It is my view that the fibre parallelisation that comes with combing, and is a crucial advantage offered ring yarns, is more of a detriment rather than an advantage to rotor. A modern rotor machine cannot have all its cans placed for ideal withdrawal of sliver and frequently there is a somewhat tortuous sliver path.

Combed sliver has very low fibre cohesion and it is very easy for the sliver to ratch and produce thin places in the yarn. In addition the low fibre cohesion is not ideal for the input to a rotor beater.

- Rotor spinning has captured a large share of the coarse count yarn business. The principle advantages offered by rotor have been the combination of economic advantages with a much cleaner yarn, to offset the greater strength and softer handle of a ring yarn.

- The very nature of carding will always produce hooks in the individual fibres and both properly

controlled drafting and combing a card sliver will improve fibre alignment. I think that for all but very coarse yarns there will remain a need for an intermediate stage between the carding process and the spinning machine.

- To process satisfactorily and economically the ultra-fine polyester fibres of less than 1 denier — which could be crucial for rotor spinning to produce fine count polyester/cotton yarns — poses a great challenge to carding technology. Whether these fibres can be carded more or less satisfactorily in blends with cotton, could well swing the balance in favour of either blowroom or drawframe blending. If a blend form is essential this would preclude combing from polyester/cotton yarns containing fine denier polyester fibres.

I think that carding developments will have to be targeted to achieve certain objectives for specific yarns. For fine count 100% cotton, or cotton blend, rotor yarns to compete with a combed ring spun yarn, rotor is going to want all the cost advantages it can muster. A major factor could be whether further improvements in carding technology for cotton fibres, over and above those offered by tandem carding, can be economically achieved by means other than combing.

The primary objectives are, I feel, to develop a method of removing a similar level of short fibre compared with that removed by combing and improve fibre alignment. The levels of dust and trash remaining in existing card sliver can largely be removed by the opening roller on a rotor machine.

## Drawframe

The principal objectives of the drawframe are to parallelise the fibres by drafting, improve the regularity by doubling and,

when appropriate, to blend different fibres.

It was traditional to have three passages of drawing. The improvement in drawframe drafting and application of autolevelling at both the card and drawframe has permitted this to be reduced. Now for very coarse rotor yarns the drawframe stage can sometimes be eliminated altogether and only two passages are required for the finest count yarns.

Future improvements in both the card and the drawframe will require most carded yarns to receive only one passage of drawing by the year 2000.

In the last few years attention at the drawframe has concentrated on:

- Increasing delivery speed up to the present level of around 800 metres per minute.

- Automatic doffing of full cans of sliver and their replacement by empty ones.

- The application and refining of autolevelling.

- For those companies wishing to minimise frequency of creel changing and associated sliver piecing offering creels able to take input cans of up to 1000 mm diameter and up to 1300 mm in height.

With modern-draw frames able to produce up to 350 kg/hour, attendance at a drawframe for re-creeling is still required every couple of hours, or thereabouts, even with block creeling.

Thus while the actual labour content is very low, the need to have this labour available at a specific time is very inconvenient when wishing to operate with low staff levels. I expect to see a "link" established at the interface between the card and the drawframe. There are two ways to achieve this:

- The first option involves a combination of mechanical handling and automatic sliver piecing. As there is a need to have sliver piecing to complete the rotor-spinner automation line, a

similar technique, if and when developed, should also be applicable here.

The mechanical handling to transfer cans from the card to the drawframe is already commercially available.

As this system does not improve quality and the extra capital cost will never justify the "direct labour costs" saved, it will probably only occur on the back of a similar development for rotor spinning.

- A more elegant solution would be a technological link between a bank of cards and a drawframe.

The production rates are sufficiently compatible to believe that the essential requirements of sufficient doublings and a draft in excess of six could be achieved. There are many technological problems to be overcome, but it has many points in its favour:

- It eliminates piecings caused by can changing.

- It should improve drawframe efficiency.

- It will reduce labour and allow preparation to be fully automated.

- It will eliminate card can coiler and associated cans.

The technology and necessary sophistication of machinery and machine controls are now available to develop a system that allows both the cards and drawframe to operate at close to optimum production rates in a linked system.

## Combing

To many observers combing has always been the process that needed to be eliminated if ring spinning is to become a high productivity, low labour process. However, the improvements that combing gives, particularly with 100% cotton yarns in yarn quality and downstream processing improvements, have tended to increase rather than reduce the quantity of ring spun yarn

that are combed.

The improvements that have continued to be made in increasing productivity from the combing process and a reduction in labour content, have undoubtedly contributed to its continued utilisation.

For the future I would expect the major concentration to be on improving its performance on lower grade cottons and moving ever-closer towards full automation. I do not

expect to see combing used extensively for rotor yarn, and expect to see a diminution in its use in polyester/cotton blends but I do not expect it will be used more widely for coarser 100% cotton ring yarns.

## Conclusions

Before the end of the century I expect to see the establishment of a fully automated bale-to-sliver fibre opening and

preparation system as standard for carded yarns.

I also expect to see significant improvements in the quality of carded yarns as a result of improvements in opening and more particularly carding.

This will put increasing pressure on the manufacturers of combers to improve yet further productivity, and increase the level of automation. I do not expect to see, in the foreseeable future, a fully

automated fibre opening and preparation system incorporating a combing process.

In my opinion the selection of spinning systems will become far more product than count related. As such, I expect to see far more fine count open-end yarns, either rotor or friction, particularly in polyester/cotton, and more coarse count ring yarns and these will include combed yarns. ■



## French

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Breakdown of the various sectors of production activity of the French textile machinery industry in 1989.

	millions Ffr.	% of
Spinning preparation, spinning, twisting	1,521.2	30.4%
Weaving preparation, weaving	867.8	17.4%
Finishing	448.9	9.0%
Hosiery industries, machines for garment industry	623.4	12.5%
Accessories, spare-parts	847.8	17.0%
Miscellaneous machines (including nonwoven)	412.8	8.2%
Industrial laundry	279.3	5.6%
<b>Total</b>	<b>5,001.0</b>	<b>100%</b>

Breakdown of French Textile Machinery Exports in 1989 by sectors of activity (customs figures).

	millions Ffr.	% of exports
<b>Total exports</b>	<b>4,746.7 M. Ffr.</b>	
Spinning preparation, spinning, twisting	1,370.0	28.9%
Weaving preparation, weaving	1,128.9	23.8%
Finishing	1,106.1	23.3%
Hosiery industries, machines for garment industry	495.7	10.4%
Accessories, spare-parts	73.7	1.5%
Miscellaneous machines (including nonwoven)	200.1	4.2%
Industrial laundry	372.2	7.8%
<b>Total</b>	<b>4,746.7</b>	<b>100%</b>

## Exports

With exports running at Ffr. 4,747 M., compared with Ffr. 4,086 M. of imports (figures from French customs); the French association say that the French textile machinery balance of exchange once again shows a substantial

advantage with a "thoroughly encouraging" coverage rate of 116.2%.

The association conclude that the good performances recorded by French textile machinery manufacturers in 1989 are particularly encouraging with 1992 and the Single European Market drawing nearer. ■

## Printing

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presentation.

The Pastec 3000 MX Computer Design System of Dainippon was a CAD system, user-friendly through a combination of function keys, a digitizer tablet and an easy-to-follow menu sheet. Input and output work could be performed in parallel with actual design work. This multi-tasking ability was linked with special software packages, and a variety of options, e.g. optical disk unit, high resolution digital scanner, a variety of colour printers, modern communication capability, etc. The Pastec 3000 MX

could thus be used as a design work station for the Pastec 4100 fabric printing design and tracing system.

Giuseppe Massari (CIR, Italy) stressed that repeatability in the colour kitchen was the cornerstone to getting the colour right first time. The CIR cluster dispenser combined ease of control with high accuracy and repeatability as was designed with industrial plant conditions in mind. The metering valves had three different continuous flow rates with a long burst mode to approach the target weight rapidly and a short burst mode to attain the set weight without overshooting. The size of droplet dispensed was equal to the scale resolution on the

electronic weighing scale. The transition points for flow rates were calculated by a central controller and the valve bottoms were rinsed automatically at the end of each batch to prevent encrusting or blockage of the needle valves.

The new CIR Robotic sampling system and their chemical dispensing units exhibited many interesting features and a number of different types of actual installations were illustrated by video.

## Colour measurement

Mike P. Stothard (product manager, Kirstol, Ltd., Colour and Process Systems Group) then demonstrated the versatility and uses of a novel and completely portable hand-held colour measurement system, the Hunterlab Miniscan. He considered that its uses were limited only by one's imagination, for it could be used outside the laboratory for colour quality control in the plant, or used in customers' or suppliers' plants, or for complaints.

The unit utilises a pulsed xenon source rich in UV suitable for use with fluorescent brightening agents. It was powered by four size C rechargeable batteries capable of 200 - 300 measurements before recharging. A mains adapter was also supplied, the unit indicating when the battery power needed recharging.

The Hunterlab Miniscan weighed only 1.8 kg and its large LCD display (6.4 cm x 6.4 cm) could be rotated through 360° at 90° intervals relative to the hand-held position of measurement. Four models spanned a measurement area of 25 mm down to 3 mm diameter in 45/0° and diffuse geometries. An average of up to 25 readings could be stored and averaged and pass/fail indication given. Data could be output via an RS 232 ASC II outlet to a printer or computer. With a choice of four colour scales, ten colour difference scales and indices, illuminants A, C, D65, F and TL84 and 2° or 10° observer, the selectable features offered the potential user a broad spread of options. ■