QUALITY STARTS WITH PREPARATION - LATEST DEVELOPMENTS IN THE PRODUCTION OF CARDED WEB

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The Problem

On the market for card webs there have been rapid advances aimed at improving card quality and dramatically increasing machine output.

The pressure on development is attributable to the increasingly widespread distribution of spunbonded web which is undergoing improvement in quality as well.

To boost the output of web carding equipment, the delivery speeds have been increased and the cards widened. Working widths of 5 metres are now being debated.

The set goals can only be achieved if adjustments and further developments are carried out upstream, on the preparation machines.

Holistic Approach

In any material processing system with a succession of process stages, a top-quality final product can only be achieved if all the process stages are properly coordinated and the best systems available are employed at each stage. In this paper I shall attempt to explain this with reference to practical examples from the production of carded web.

Starting with the opening of the bales, I shall look at opening, weighing and blending. I shall then present a newly developed card feeder which forms the last stage in the preparation process. What is presented here as preparation for web carding applies in the same way to preparation for aerodynamic web formation.

The holistic coordination of the process is easiest to demonstrate with reference to the correctly graduated opening from coarse to fine from the bale to the final fibre and can also be supported with figures. The same regularities also apply to the blending and homogenization of the web from the flow of material. To achieve good uniformity values in machine direction (MD) and in cross direction (CD) of the web, action has to be taken in advance at each stage to achieve uniformity in the flow of material. Here too, this is effected in graduations from coarse to fine.

Equipment

First of all I should like to give you a rough idea of he individual process stages as practised by our company's machines - both for the processing of individual components and for multi-component blends (Fig. 1).

The processes of opening, blending and homogenization are carried out in parallel and affect one another. If one follows the opening process, one can see that the material is gradually opened into increasingly finer units. Layers are lifted off the bales, broken down into tufts and then broken down again into superfine tufts. These are fed to the card until they ultimately consist of individual fibres.

Figures 2 to 6 present a diagram and elevations of such equipments. Fig. 7 highlights the multi-stage process of opening and blending.

Coordinated Graduation

On the basis of calculations of the theoretical tuft weight, this process of continuous refinement can be quantified. Fig. 8 presents the result of such a calculation. Calculations are based on the rate of material throughput, and the number of points of an opening roll and its corresponding speed. This method has proven extremely successful in the design of machines and equipment. The figures correspond well with the results obtained in practice.

From the figures one can see that a thoroughly homogeneous, graduated process can be achieved with the result that, given the right graduation, the number of opening stages is now lower than on earlier designs. It is worth noting that the theoretical tuft weight, or the degree of opening, is applied to a logarithmic scale.

Detailed investigations and extensive experience, including that in the processing of cotton, have shown that errors in the graduation can result in flaws in the product. This process of the theoretically correct design has yielded the development of today's high-performance systems which produce a top-quality final product.

The universal use of speed-controlled feed rolls facilitates a continuous flow of materials at all process stages. Compared to the earlier stop-and-go method, the advantage of this is that, whilst achieving the sam output, the throughput in each machine is lower, which results in more effective opening. A smooth, continuous flow of material at all stages is also essential for the achievement of maximum quality, and particularly for uniformity in MD and in CD of the web. The successive and increasingly finer clothings of the opener can be clearly seen in Fig. 9.

This thorough and uniform pre-opening is followed by tuft feed to the cards. The nearer the process to the final product, the more precisely the conditions for opening and calibration have to be maintained. This means that the card feeder has a key function in terms of the uniformity achievable in MD and in CD of the web.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:823-827 (1998)
National Cotton Council, Memphis TN

New Card Feeder

At this point I should like to present a newly developed card feeder. From the experience of the past and taking account of the ever growing demands for superior quality and higher output, a new overall system has been developed which with its holistic approach meets these higher expectations.

From experience with the individual components, a compact, integrated system has been developed. It is also distinguished by its use of high-tech components which have only recently become available. This applies particularly to the measuring techniques and to online quality control. The proven system of twin-chute feed with pneumatic compression in the chutes has been retained. With respect to opening and calibration, it again proceeds on the principle of coarse to fine in the two successive chutes. Since even with this procedure major errors at the first stage cannot be always be compensated for with sufficient accuracy at the next stage, the upstream stages always have to operate as accurately as possible. Consequently, a great deal of importance is attached to the preparation of the material before it is fed into the top chute. Top chute feed operates smoothly if the material is supplied with the right size of tuft with the right quantity of air in a uniform flow. Lumpiness in the material and constant fluctuations in the quantities o material and air must therefore be avoided.

To solve the problem the card feeder is preceded by a feed unit which is positioned immediately before the top chute (Fig. 10). It consists of an MAS Material Separator which separates the tuft-air mixture supplied by the upstream feed fan and deposits the material in the chute. The chute serves as a reservoir and can be used to compensate for fluctuations in the flow of material from the previous stage. The feed chute directly feeds a calibration opener whose speed-controllable drives ensure a continuous tuft flow.

The feed fan for the top chute of the card feeder withdraws material from the calibration opener. The short duct between the opener and the card feeder maintains the good mixture of air and tufts and prevents the agglomerations possible in long lines and also the large run-on of material after the supply of material has been switched off. The calibration opener's material feed drive is electrically linked to the corresponding drive of the card feeder. The air pressure in the top chute of the card feeder depends on the rate of air supplied by the feed fan and on the difference between the supplied and discharged quantities of material in the top chute. With the drives' linked circuit, the air pressure regulates the quantity of finely calibrated material supplied. The sophisticated start-up, acceleration and deceleration strategy of the drives combined with the cards helps to maintain the good operating conditions and reduces malfunctions.

The new card feeder is also distinguished by the integration of the web profile control, with its record of success on many production lines, in the card feeder.

Web Profile Control

For the sake of simplicity, I shall first explain the system employed until now before going on to the details of the further development of the new card feeder.

The diagram in Fig. 11 shows mechanical sensing systems across the width. They measure the web thickness on its emergence from the bottom chute and thus the web profile.

The idividual measuring zones are assigned to wall zones in the bottom chute. In these zones, the wall segments can be adjusted by pivoting. As a result, the web thickness can be modified in the forming zone.

With the aid of positioning motors the wall elements can be automatically adjusted in relation to the measured thickness in such a way that the desired corrections can be undertaken independently with the aid of suitable control systems. Fig. 12 shows the card feeder with the web profile control in its design hitherto.

I shall now continue with a description of the new card feeder. The tufts constantly supplied by the upstream calibration opener are deposited in the top chute to form a column of tufts. By means of pneumatic compression, this is fed to the feed table / feed roll system and the following opening roll which in turn supplies uniform tufts to the bottom chute with air support. Here again pneumatic compression is performed. Fig. 13 presents a diagram of the new card feeder.

The novel clothing of the feed roll and the new feed table with its spring-loaded sections create ideal feed conditions. Trouble-free starting is facilitated and reliable operation achieved even with high rates of throughput. This feature makes a major contribution to boosting output.

Until now the material from the bottom chute has been withdrawn by two discharge rolls. On the new version, this is effected with a feed table / feed roll system with the above-mentioned new special clothing. The advantage of this is that the discharged web is guided directly and without major deflections in the right direction for transfer to the card. Here again, spring-loaded feed tables are divided into sections across the working width. The individual sections in this case are smaller than those in the top chute.

Integration

The spring-loaded feed tables sense the thickness of the material between the end of the feed table and the discharge roll with the aid of inductive sensors. In the bottom chute adjustable chute walls are integrated in ections matching the sections of the feed table. This makes it possible to integrate the VPR Web Profile Control in the tuft feeder.

When the card manufacturer adapts the design accordingly, it will even be possible to integrate it directly in the cards. If instead of a feed roll an additional licker-in - i.e. a total of two lickers-in - is employed, the discharge roll of the card feeder can be positioned immediately above this additional licker-in (Fig. 14). As a result, the card dispenses not only with the feed roll but also with the usual feed table and the transfer table which, after all, is associated with draft and material flow problems. In such a case the tuft feeder is mounted on guides and is thus displaceable and positionable. This improves accessibility for maintenance. Positionability also permits adjustment to fibre length. As a result, it is possible to set the optimum distance between clamping points.

This type of direct link is already in practice in the DK 803 Cards in spinning preparation and has contributed to the huge international success of this machine (Figs. 15 and 16). From this we have been able to draw on the wide-ranging experience with the now tried-and-tested systems on cards and enable card feed to benefit from such special solutions even in the field of measurement and control.

Determining the Weight

The mechanical sensing of material thickness and its conversion into the desired weight has been common practice in spinning for a long time. The high standards demanded of yarn uniformity are met world-wide by mechanically sensing material thicknesses, i.e. by taking measurements and processing the readings in open-end closed-loop controls. In the web sector as well, this new system helps to meet the user's long standing desire for weight information obtained in-process.

Efforts in card manufacture with intermediate weighing conveyors for webs have, to our knowledge, only achieved moderate success. The inaccuracies at the points of transition, the feed behaviour and the necessay calibration are the sources of uncertainty when using this system. Any system for generating the actual material weight demands calibration for each material, and this also applies to the belt balance. From the vast reservoir of experience from applications in spinning, it has also been possible to come up with a practicable system for webs. The possibility of storing all the individual values for material thickness across the width and over time in the specially designed computer and the possibility of integrating values over long periods of time have made a solution to the problem possible. It is therefore possible to weigh large produced quantities, e.g. web coils, and assign them to the integrated values over production time. As a result of comparisons based on large quantities, the values are extremely accurate. Maximum accuracy is achieved if the edge losses are collected, weighed and referred to for correction.

After calibration, all the distribution and trend values can be visualized on a screen and outputted on a printer. The new card feed with the VPR Web Profile Control thus achieves accuracies in terms of width and length distribution which are impossible with any other system. The VPR Web Profile Control is the only system that can make thickness corrections across the working width. Experience with the VPR Web Profile Control employed so far has demonstrated this new quality of uniformity. For certain users, this yields the additional benefit of reducing material input by 2%.

Findings

In the first section of this paper, I attempted to explain our holistic approach in the design of equipment for the preparation of card web as a means of generating high quality. It is all the more important to pay attention to this if higher output is aspired to.

If one accepts these findings and intends to act upon them, one cannot expect to achieve significant improvements by installing a single new machine in existing, historically evolved equipment. This happens again and again. By doing so, it is not possile to achieve the optimum of reliability, throughput and quality. In addition to the technological coordination of the individual process stages, it is also necessary to balance the open- and closed-loop control technology if one wishes to achieve ambitious goals.

Even the new card feed with the web profile control depends on an appropriate environment. It should not be employed in an attempt to eradicate mistakes made elsewhere on the production line. Although it may improve results, it will never get anywhere near to the quality ceilings possible today.

Expert advice on equipment modernization can also help to achieve higher quality coupled with higher output.

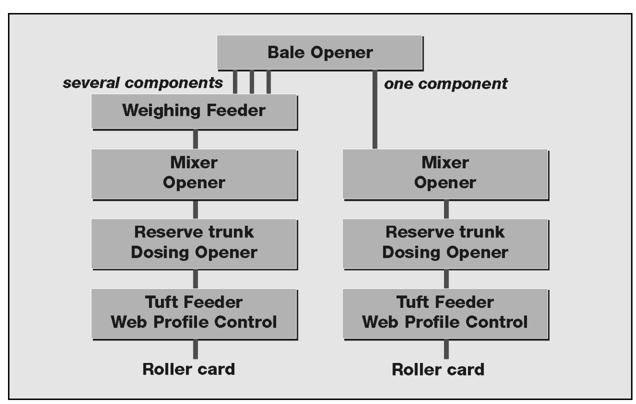

Figure 1. Web preparation.

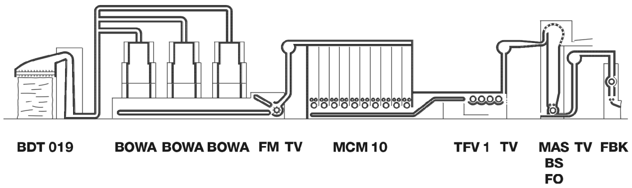

Figure 2. Multi-component system.

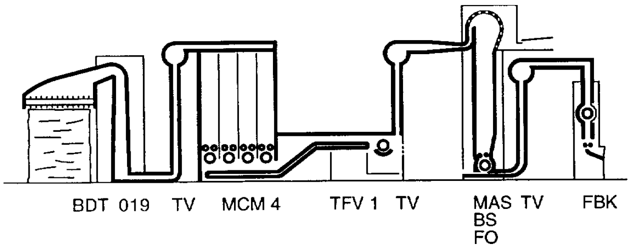

Figure 3. Sigle-component system.

Figure 4. BLENDOMAT BDT.

Figure 5. Tuft blender with BOWA.

Figure 6. Tuft Blender with PWSE.

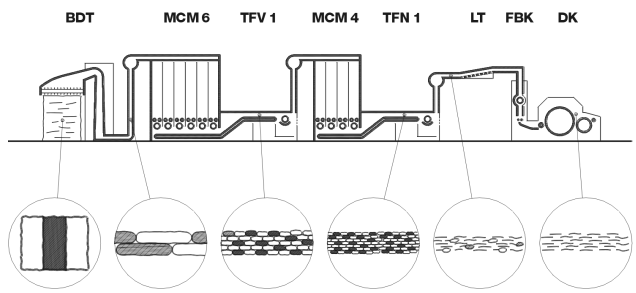

Figure 7. Opening and blending process.

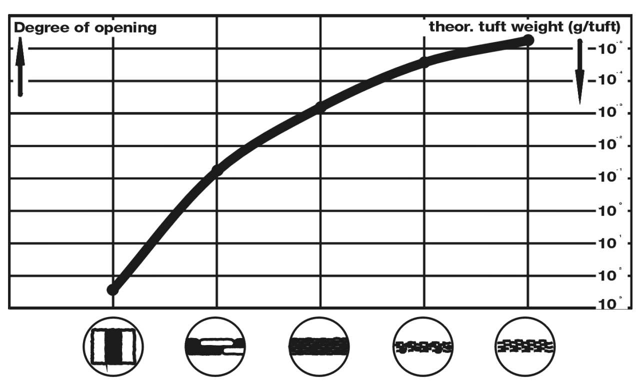

Figure 8. Theoretical tuft weight curve.

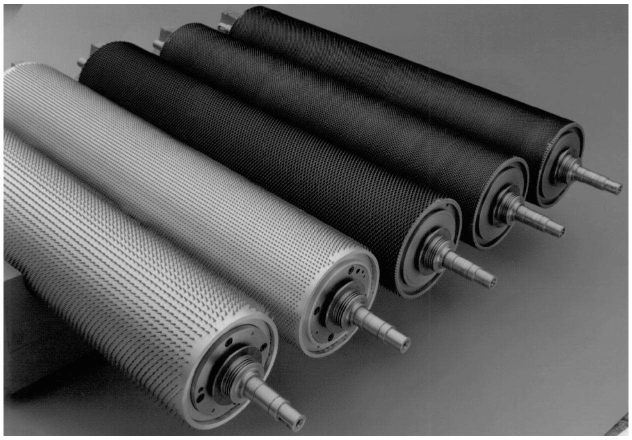

Figure 9. Succession of opening rolls.

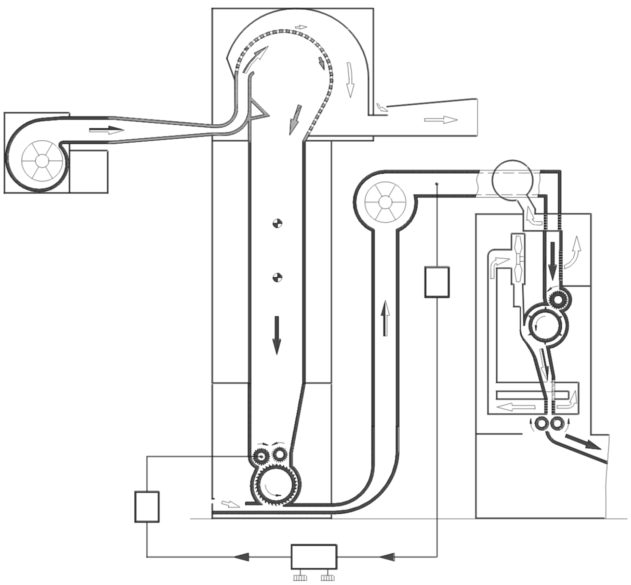

Figure 10. CONTIFEED CF.

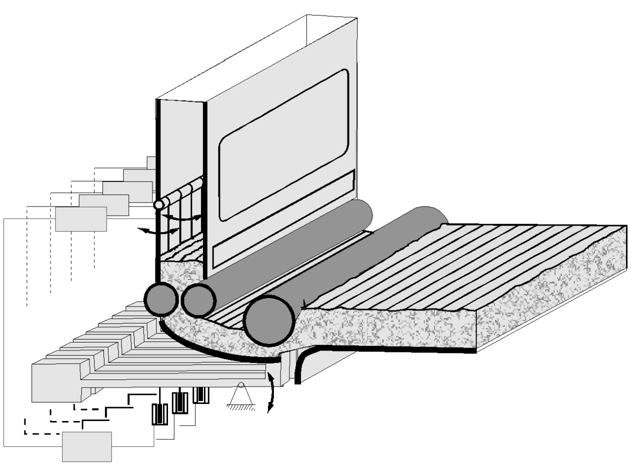

Figure 11. Web profile control.

Figure 12. Tuft Feeder FBK536 with VPR web profile control.

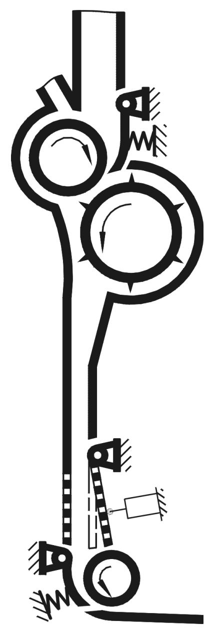

Figure 13. Integration of the web profile control.

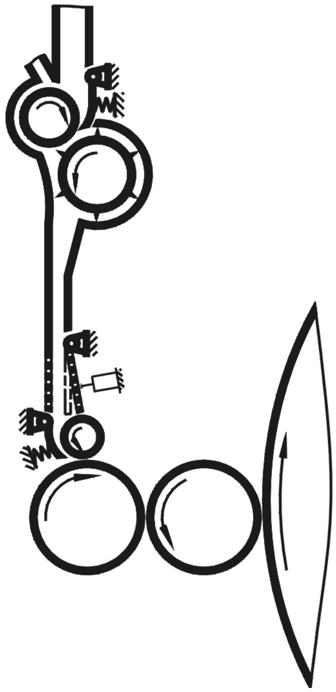

Figure 14. Integration of Card Feeder.

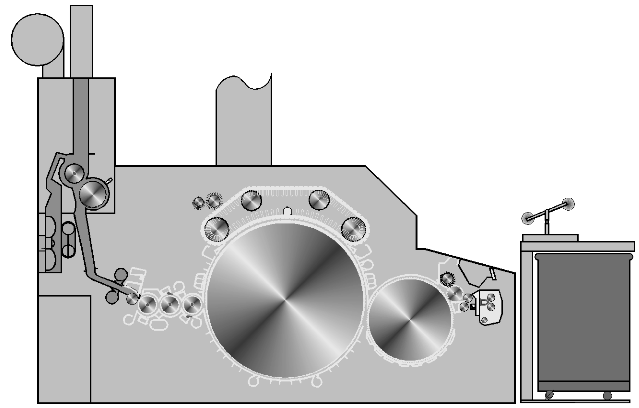

Figure 15. High-production card DK 803.