Optimization And Troubleshooting Techniques For Forming And Press Sections

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ABSTRACT

In order to optimize dewatering and to avoid extra costs, measures must be taken in the forming and press section which is something that pays for itself quickly. For this to be possible, the fabrics have to be measured and analysed. The typical and most important measuring parameters here are de-watering measurements of the wires and the moisture and permeability profiles of the press fabric. With new technology, it is now possible to visualise the variations in moisture and permeability in the form of detailed 2D and 3D graphics, with which any problems in the fabrics can be found. Other characteristics that are measured and displayed at the same time are frequency analysis and fabric length.

Introduction

Regular measurements of fabrics in the forming and press section of the paper machine are an effective way of discovering any faults in the paper web at an early stage. Faults that might otherwise lead to large financial losses in the form of substandard paper quality, frequent web breaks or increased energy consumption. Experience from paper mills show that it is possible to dramatically reduce the number of unplanned stoppages by constantly keeping a precise check on the condition of the felts. It is then easier to optimize dryness during the transition from the press section to the dryer section so the dryer section can run as energy efficiently as possible. Even though most felt and chemical suppliers carry out the measurements, more and more paper mills are beginning to use felt measurements as a strategically important production tool.

Forming section

All paper grades have different dewatering characteristics. In order to obtain the correct fibre orientation, formation and fine particles, dewatering at the beginning of the wire must take place in a controlled manner. Further on after the wire, it becomes important to optimize dewatering, with-out losing other qualities, such as porosity.

Energy consumption can be minimized by not using more vacuum than necessary in the dry suction boxes, and yet ensuring that the material arrives in the press section as dry as possible. In order to learn how all the dewatering elements are to be correctly adjusted, it takes measuring experience of how they have been set to produce maximum quality.

Moisture of Press Felt

Moisture measuring of press fabric began to be used as a standard method about 40 years ago. The equipment at that time was difficult to use. It was bulky and heavy, and the various parts were interconnected by thick cables, which meant that it took two people to perform the measurements. Despite this, it turned out to be the only realistic way to assess how efficiently the press could dewater paper and other products. At that time, the instrument was purchased and used by process and production people out in the mills.

Today it is the press fabric manufacturers' service teams who carry out most of the measurements. Both methods have their advantages. Mill staff can perform measurements more often and continuously optimize dewatering, while suppliers cannot be on-site all the time. On the other hand, the suppliers can most probably contribute with greater expertise, since they are able to compare performance with other mills and recommend new solutions to improve the situation in the long term. It can sometimes be difficult to interpret the measurements if one does not know the complete background of a certain machine or of a press position. In a case such as this, it would be advantageous to have more continuous information in order to be able to see what has happened previously and predict what will happen. (*Fig. 1*) Taking just one cross direction measurement can be greatly misleading if it is not placed in context.

Machine directional profiles are usually easier to understand and, together with frequency analysis, they can provide a very clear explanation as to where in the process a problem has arisen. The question is how often must one measure the moisture in a press fabric? There is no easy answer, but more frequent measurements naturally provide a better basis for optimization and troubleshooting. The need for measurements also increases when the fabric running time is reduced at high machine speeds. However, it is most important to ensure that the measurements can be performed quickly and are easy to understand by the production staff.

Water permeability of Felt

The measurement of water permeability in press fabric is a method that has been developed by Paprican in Canada. About 15 years

ABB AB/Lorentzen & Wetter, Sweden

ago a portable instrument was made available that used this method for press fabric analysis. The method measures the relative changes of the void volume of the press fabric where water has been injected into the fabric and is described in Tappi TIP 0404-43. This instrument is used in the same way as a moisture content instrument, i.e. CD and MD profiles are registered while the instrument is held against the fabric. The only difference is that it is necessary to carry a pressurised water container to the instrument, or the water can be supplied via a hose connected to a water outlet on the machine.

Water permeability in different fabric structures can vary a great deal, and in this case it is particularly important to note the permeability developments for certain specific positions and fabrics, to have something to compare with from case to case. Once this point of comparison has been determined, the measured results are relatively easy to understand. Water permeability is reduced when the fabric structure is compressed and contaminated. The CD profile water permeability reflects the press roll crown profile very well. This information, together with measurements of the water content before and after the press make it possible to optimize individual presses so that they produce a web with uniform strength, stiffness and moisture content.

Measurement of the press fabric water permeability is otherwise used to find problems in the conditioning equipment such as high pressure spray nozzles and oscillators, in suction boxes and when optimizing chemical cleaning. The measured information is presented in the same way for both instruments, with CD and MD profiles and the possibility to compare individual profiles and follow trends over long periods. Most companies use the already built-in frequency analysis, and this will become an increasingly important part of the total analysis of press functions in the future.

Why both Moisture and Permeability?

The moisture content and water permeability of the felts give valuable information as to how the press section is working. Basically the moisture profiles highlight the press nip and suction box problems while water permeability profiles show the condition of the felt during operation. By measuring both properties it is possible to make proactive decisions rather than wait for runnability problems to occur., *(Fig 3)* Those deriving the greatest benefit from measuring moisture profiles and water permeability are mills that produce fine paper and paper grades based on recycled fibre, i.e. paper and contaminants that clog the forming fabrics and felts. Measurements are also vital for the fast new paper machines, especially the ultra-fast tissue machines.

The felts that are important to measure are those that contribute the most to the dewatering process and those in the final press that directly determine whether the press section will release a web with moisture streaks.

Not only for fault diagnosis

Felt measurements should not only be used for fault diagnosis, but also to determine how the felts are working when everything is normal. Then it is easy to detect errors and take corrective action in time.

Measurements should also be carried out frequently and regularly so that it is possible to monitor trends and tendencies. (*Fig. 2)* The feedback from paper mills that are committed to checking felts regularly is unequivocal: the more often felts are measured and analyzed, the longer the time span between unplanned stoppages and quality problems related to press section performance. Today, however, it is the felt and chemical suppliers who carry out the felt measurements for most mills. This is not due to lack of interest on the part of the mills. People recognize the benefits of carrying out measurements. But many mills do not make their own measuring a priority, even though most of them realize that they could save a considerable amount of money. The reason is often lack of resources simply because there is no staff available to measure and analyze the felts.

One of the disadvantages of having others carry out all the measurements is the fact that it is not the same individuals doing the measurements. Instead, the different suppliers take turns in measuring, which leads to varying results. Furthermore, suppliers are rarely available when there is a need for the mill to check the felts.

Suppliers generally visit on regular intervals, but are not on-site all of the time. In addition to this, the measurements are generally used to follow up results rather than for preventative maintenance.

Optimization is a critical task

Press felt conditioning, nip load profiles, felt wear, and felt filling all have a significant impact on these profiles. Minimizing profile variations is directly related to improved machine performance.

These tools can also be used in the press section for the purpose of long-term process improvement. Trials on chemicals, press rolls and press fabrics must be properly evaluated in order to justify changes. Comparing the dewatering efficiency and profile variation in the press section relative to clothing or equipment modifications clearly demonstrates the effects of these changes. For example, benefits from new technology advancements in press belts and sleeves for increasing press efficiency can be seen by trending the water removal rates and profile uniformity. *(Fig 5)* These comparisons can be made through the life of a press fabric as well as from one change to the next. Trend analysis is also a good way to predict effective press fabric life.

The source of the problem

Moisture streaks in the paper webs and other profile problems are recurring headaches in many paper machines. (*Fig 4)* The fault almost always originates from the press section. It is possible to even out minor profile faults by using steamboxes or adding moisture after the drying section, but it is always better to try to find the cause of the problem and eliminate it. Simply measuring the moisture or the permeability is not enough to see how well the press section is operating. Both methods must be used in parallel to get a good picture.

Results and Discussion

Fig. 1 Machine Stop Problem

Below is a moisture measurement of a felt in a liquid board machine in Sweden. The interpretation is that when they stopped the machine for temporary maintenance the press was not completely unloaded and when they restarted the compression of the felt during the stop remained as a permanent density change in the felt, causing uneven density in the board.

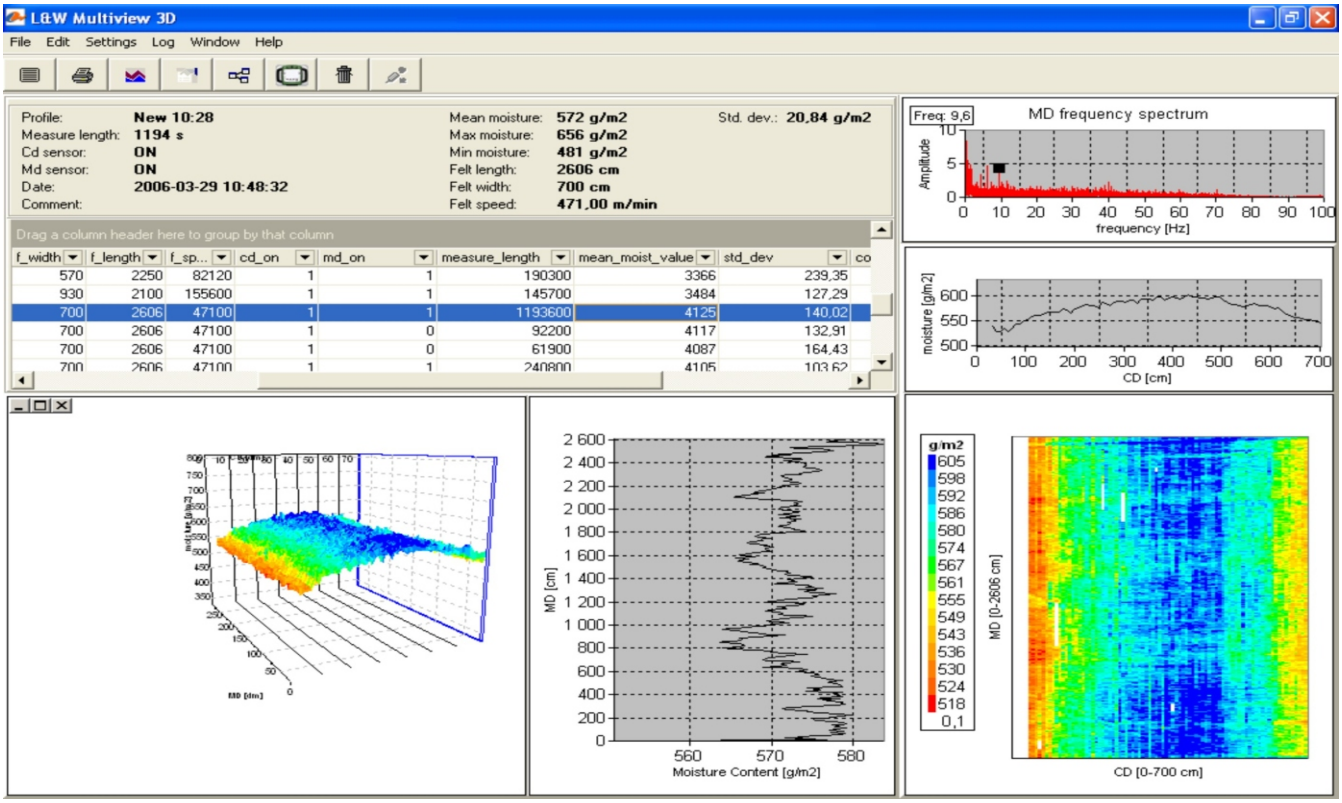


Fig. 2 VIBRATIONS -

The measurement below shows the result of felt moisture variations of a vibrating 4th press in a high speed newsprint machine in Western Europe

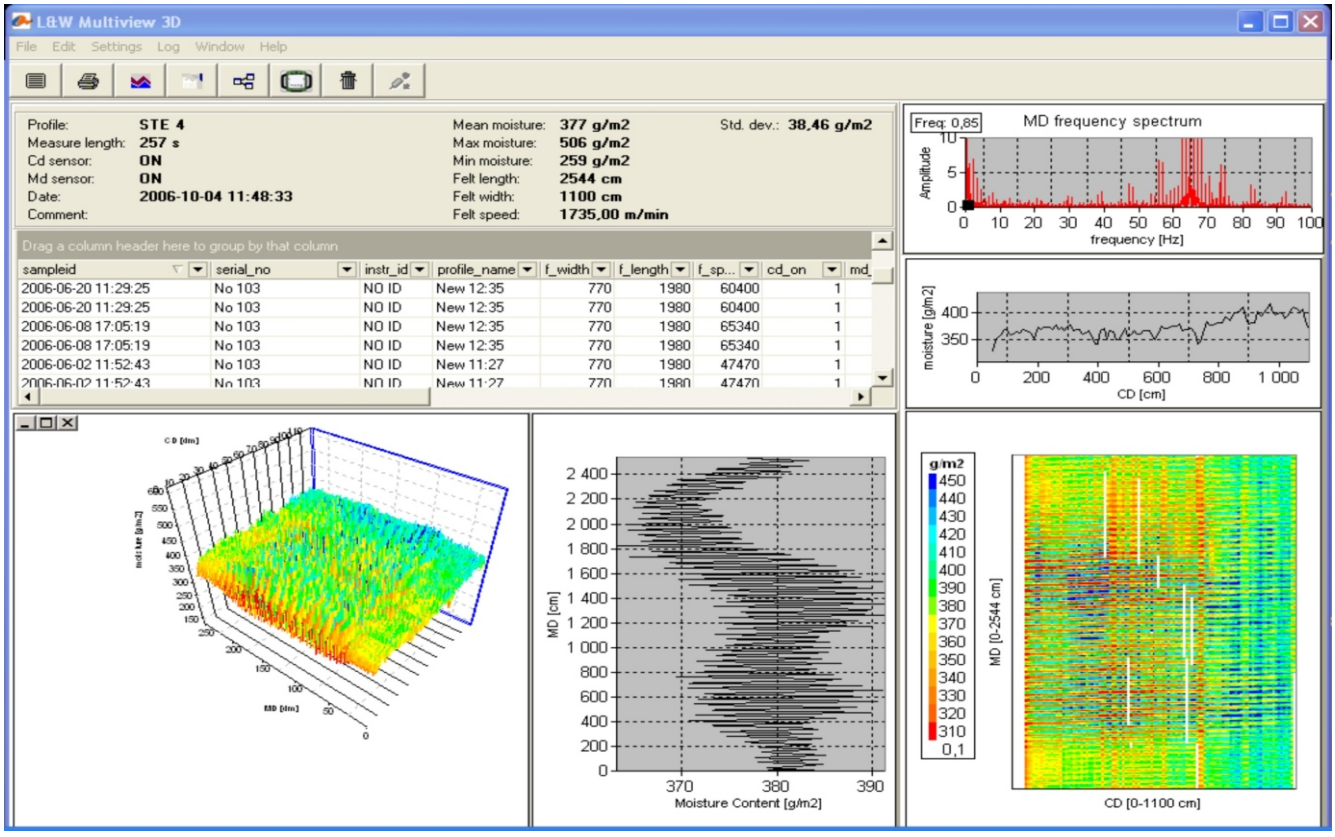


***Fig - 3* MOISTURE STREAKS** - 2D Measurements of both moisture and permeability from a pick-up felt in a SC-machine in central Finland. Clear moisture indications from density changes at the seam and also at half distance caused by felt the manufacturing procedure. This can cause density/moisture changes to the paper and in the worst case both paper quality and runnability issues with sheet breaks.

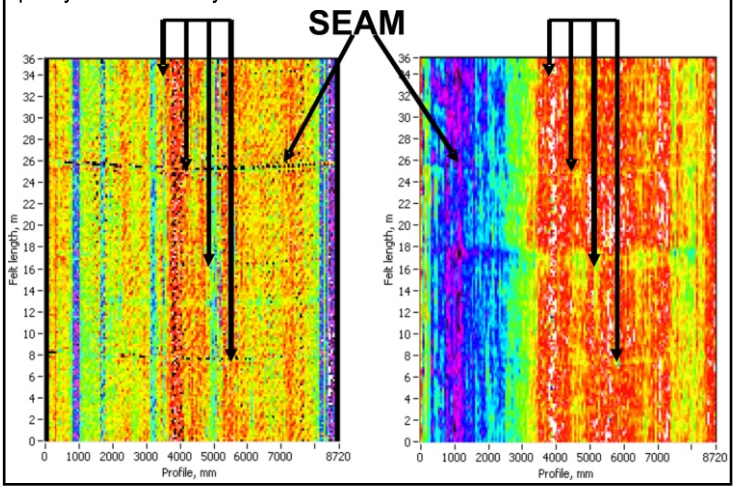


Fig 4 3D Measurements of permeability from a pick-up felt in a SC-machine in central Finland. The measurement indicates vibrations in the press causing density changes to the felt, and the paper.

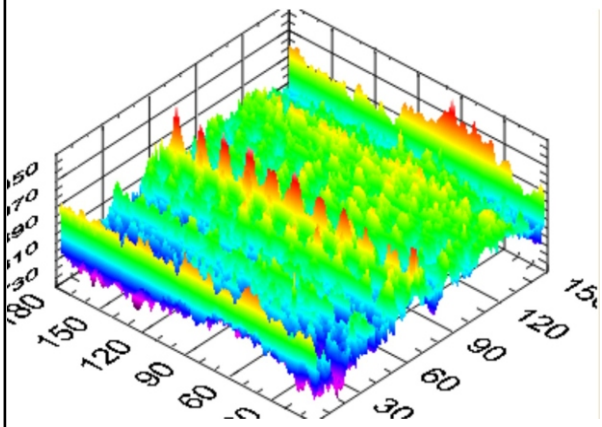
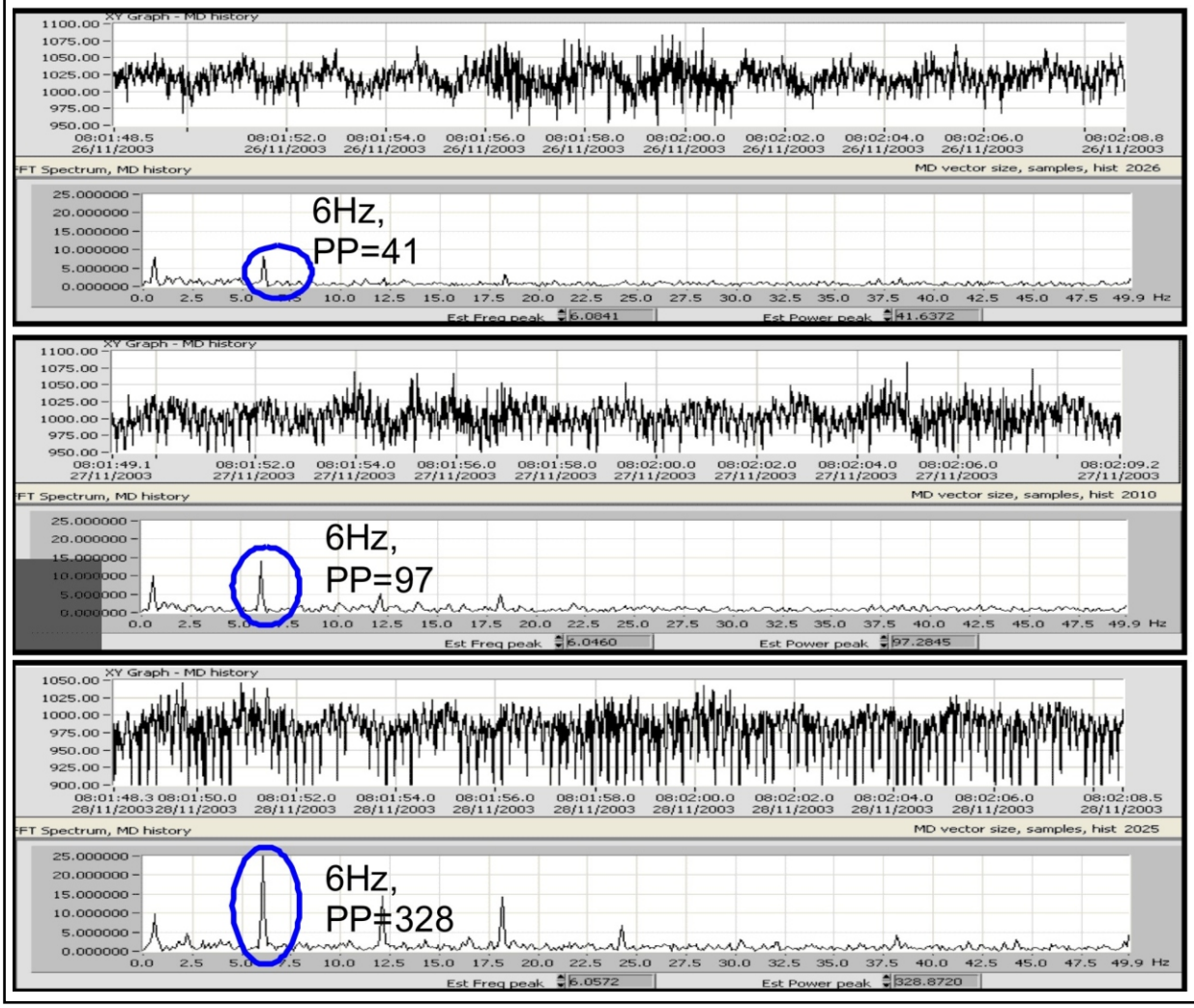
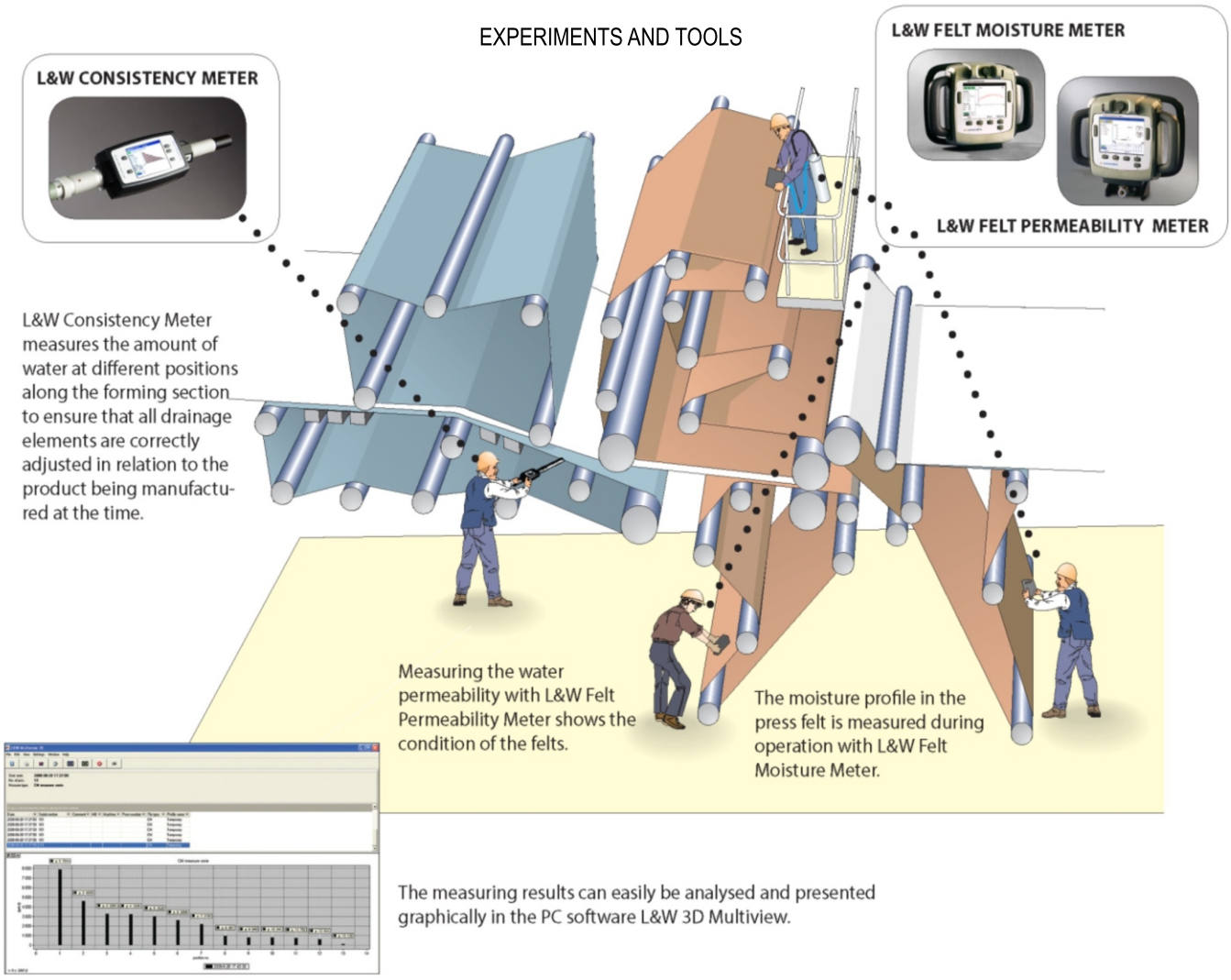


Fig 5. Three measurements with FFT (frequency) analysis of moisture from the pick-up felt in a SC-machine in central Finland. The measurements are from three consecutive days and one can see that the vibration increased dramatically day by day. The story ended with that the PU-felt and the bottom first press felt burst with a 16 hour machine stop to clean out the machine and put in new felts. Both destroyed felts were less than a week old. A big loss for the mill.





Improved analysis

New versions of the instruments, with new functions, have recently been launched. These new functions are very important to provide improved analysis. One difficulty has been integration of the measured results due to the low measuring frequency and high machine speeds. In order to improve sensitivity, two things have been changed. First and foremost the moisture sensor measuring area has been reduced to about 25% of the original size. It is now 1.5 x 1.5 inches. And also, the measuring frequency, that is now at 1000 Hz, which is necessary for reading small variations in high speed machines and for making it possible to perform frequency analysis.

Repeatability during different measurements is very important, and with L&W Consistency Meter, all measurements are saved in a database, so that one can at any time download earlier measurement results and use them for comparison with new measurements. By being able to see the previous results in the measurement display at the same time as taking new measurements, it is possible to immediately see whether any part of the dewatering has changed or needs adjustment. This saves time and means that errors can be quickly rectified. The results are shown in both numerical and graphical form on the built-in, well lit colour display. Normally the average of the measured position is displayed, but it is also possible, in appropriate cases, to measure and display CD profiles. The program also contains built-in frequency analysis that can be used to identify variations caused by pumps or vacuum, for example. Uneven wires and wire vibration are other causes of production variations. All measured data is transferred to L&W Multiview 3D PC program and saved in a database for analysis and reports to be printed out. The transfer usually takes place wirelessly, either using WiFi or Bluetooth. It is also possible to use a USB connection. The information can also be coordinated with measured data from the press section, and all measured data can, if desired, be exported to other file formats such as Excel.

Reading of the CD position

It was not previously possible to read the CD position. When performing CD scanning, the operator had to go in cross direction of the machine at a steady speed to get the most accurate possible measurement. In order to know exactly where the measurements of a CD profile have been carried out in relation to the machine, or to the press fabric width, an ultrasonic technique is now used. The instrument's CD position is measured at the same time, to get

precise individual measurements across the entire fabric. This means that operators can move at the speed they wish, stop, go back and/or continue from any position.

Reading of the MD position, analysis of the fabric length and frequency

Another function is the instrument's built-in trade line detector, which is an optical unit that synchronises the measurements in the direction of the machine. If the fabric speed is known, an exact calculation of the fabric length is carried out. This is important, since the fabric will gradually stretch, and the point where the fabric breaks must not be exceeded. In addition a frequency analysis that is based on variations in the machine direction is carried out.

2D and 3D presentations

When the reading of both the MD and CD positions is activated, it is now possible to display the moisture and/or water permeability in two-dimensional and three-dimensional graphic representations of the fabric, where the moisture and permeability variations are shown in different colours. The 3D graphic can be rotated so that it is possible to see the variations as topographical variations in the image. Frequency analysis is also shown on a graph, together with the individual MD and CD graphs. All this information makes it easy for anyone to see exactly where on the fabric there may be unacceptable variations, and to understand what may be the cause of such variations in moisture and water permeability.

With the new meters, it is quicker and easier for anyone to perform a fabric analysis, thanks to improved user friendliness and personal safety, better sensor technology and new functions for measuring the MD and CD positions, with the capability to show variations in moisture and water permeability at every part of the fabric. Frequency analysis of variations in a press fabric can not only explain problems in a press section or in a fabric, but also other process problems such as pulsations in the headbox or forming section. This is something that hopefully will lead to more rapid corrections, the avoidance of future problems, and an increase in the overall efficiency of the papermaking machine. Troubleshooting in the press section has now improved, but to be able to utilise the advantages of optimized dewatering, to save energy, have fewer breaks and to improve the paper characteristics, the measurements must be taken often and continuously.

Conclusion

Both the moisture level and the water permeability in fabrics provide valuable information on how the press section is working. To sum up: Moisture profiling reveals problems with the press nips and suction boxes, and the permeability profiles indicate the condition of the fabric. By measuring both moisture level and permeability of fabric it is possible to make proactive decisions instead of waiting for problems that lead to operational difficulties.

References

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