Fiber Properties-Paper Quality Multidimensional Fibre Characterization

Ojvind Sundvall

ABSTRACT

This paper deals with the methods of characterizing fibre properties in order to get defined paper properties. The reasons for on-line real time measurement will be discussed as well as the advantage of pulp characterizing methods based on single fibre properties compared with traditional laboratory measurement on a hand sheet.

Discussions of some applications involving on-line fibre analysis.

A completely new on-line measuring system based on the state-of-the-art today will be presented.

By combining knowledge from next generation analyzers and use of new tools for control applications a supervisory control system for optimization of fibre quality will be presented. This contributes to an added value from both lower production cost and more stable quality.

Some typical applications set up by using this new analyzer in combination with adopted control package will be presented.

INTRODUCTION

Paper has developed to be a highly specialized material. Just think about the very different capabilities of Tissue, Board and Newsprint, etc. The variety of functionality is created through the engineering of paper sheets with different structures and compositions. To do this, the papermaker must have access to fibres with different and well-defined and well-known properties. Parameters like length, width, wall thickness, curl and kinks are examples of fibre properties that are important in order to lend the different paper qualities their special features.

Some of these fibre properties are basically already established in the tree, others are developed in further processing in the mill.

But, it is still the same fibre from the tree to the end-used, printer, or whatever. But in this chain fibre properties are changing and each level has its own specification for optimum result. The demands and requirements for the properties changing of the fibre are going in the opposite direction, i.e., from end-user to wood handler.

The requirements and demands are completely different depending on which interface we look at. To be successful it is important that both parts at every interface are using the same language.

Eurocon Analyzer AB, Box 279, 891 26 Örnsköldsvik, Sweden

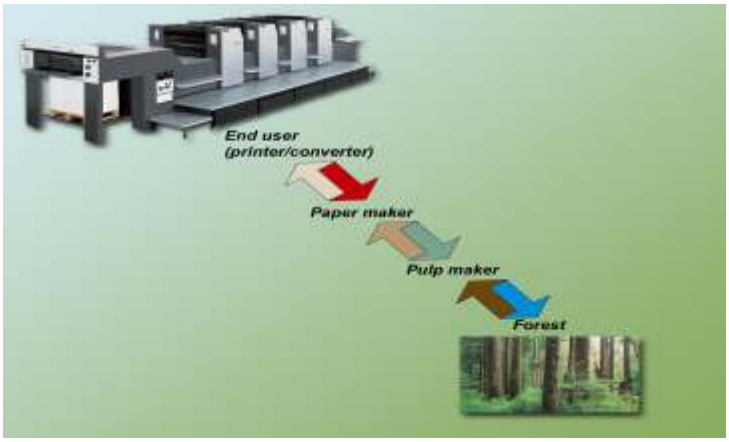

Fig. 1 The same fibre from tree to end-user, fibre demands the opposite direction from end-user to tree

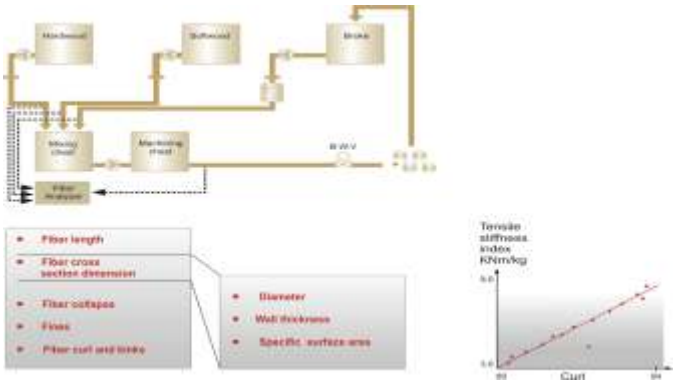

Fig. 2 Fibre analysis for process control for market pulp specification for paper quality control

FIBER ANALYZERS

Harsh mill environments demand a robust analyzer with few moving parts. Features like modularity make it easy to maintain and adapting new measurement modules to meet future customer needs.

The use of a state of the art equipment as PulpEye guarantee reliable and accurate fiber measurements. The use of fiber length distributions and the result of every single fiber open up new possibilities for multidimensional evaluation of fiber measurements compared with the traditional use of average results.

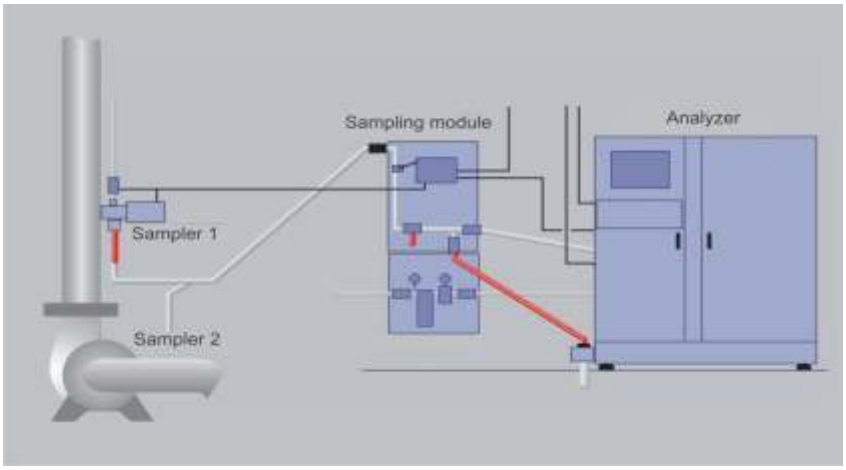

Fig. 3 Principle of layout

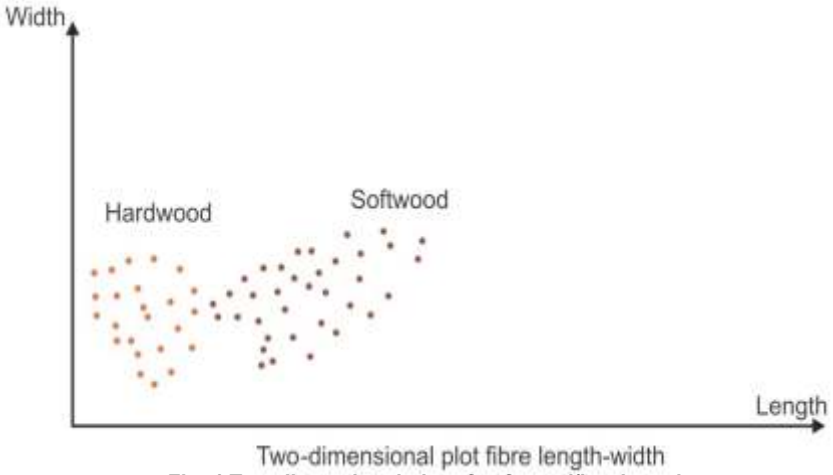

Fig. 4 Two-dimensional plot of softwood/hardwood

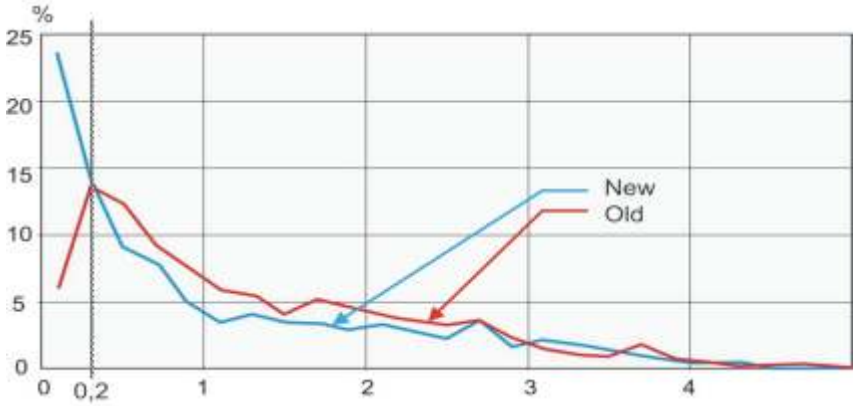

Fig. 5 Fibre length distribution older systems compared to modern systems

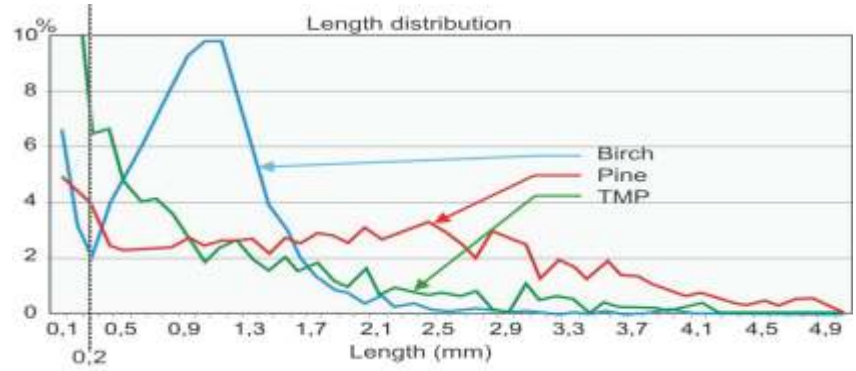

Fig.6 There are relevant information also at fibre lengths below 0.2 mm

The multidimensional fiber analysis makes it possible to combine the traditional lab methods for predicting product quality. The road is open for new innovative pulp and paper quality index. The quality index can be used to form a control strategy which optimizes fiber properties with energy consumption as a restriction.

Fibre length distributions are normally presented as length weighted. But all other types of distributions are available. The high-resolution camera systems give more information on small particles compared to old analyzers. Instead of using filtering function all data is stored for giving more complete information about the fibre properties. For mean fibre length calculations a selectable cut-off is used (normally 0.2 mm according to exiting standard).

Besides a very fast image processing, high-resolution pictures can be produced on a single element like fibres or shives.

The example Fig 7 shows how high resolution pictures can be used. (Note the difference in fines between blow line and reject samples.

APPLICATIONS

A good analyzer, that automatically performs accurate measurements at high speed, is a necessity for supervising and controlling important quality properties in the production line.

- **Alarm limit for shives in stock preparation application**

Figure 8 is a good example of the use of PulpEye as a guard to discover deviation in shive content. During a long period of time the refiner plates caused fiber bundles which caused high content of shives in the pulp

- **Prediction of HW/SW ratio**
- **Savings accruing from reduction in furnish change time**

The PulpEye is accompanied with **control strategies**, ControlEye, for advanced control based on MPC (Model predictive control) or similar structures.

TMP refining control with the purpose to minimize energy consumption for a specific product quality.

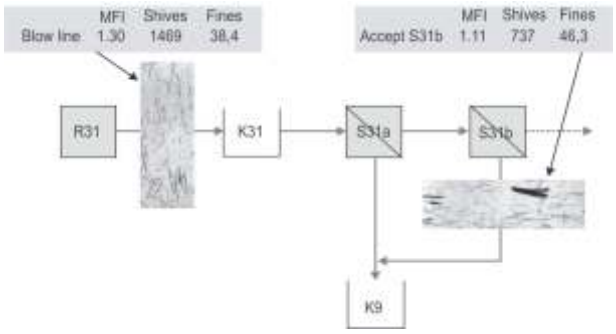

Fig. 7 High resolution pictures can be used for investigations of different streams around refiners and screens for example

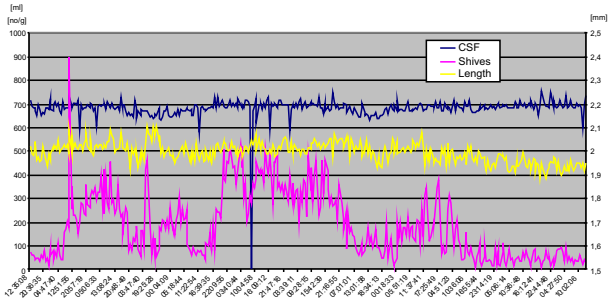

Fig. 8 Alarm limit for shives

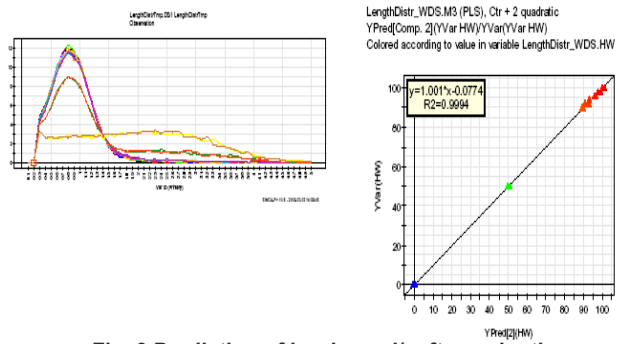

Fig. 9 Prediction of hard wood/soft wood ratio

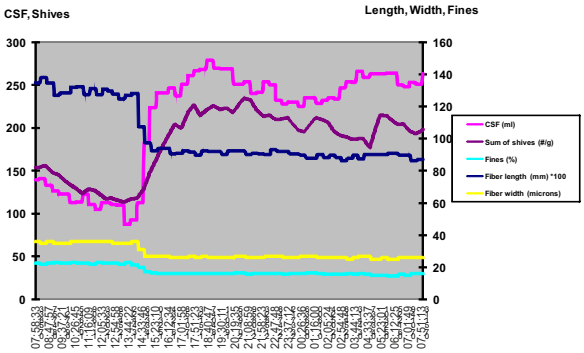

Fig. 10 Reducing transition times saves money

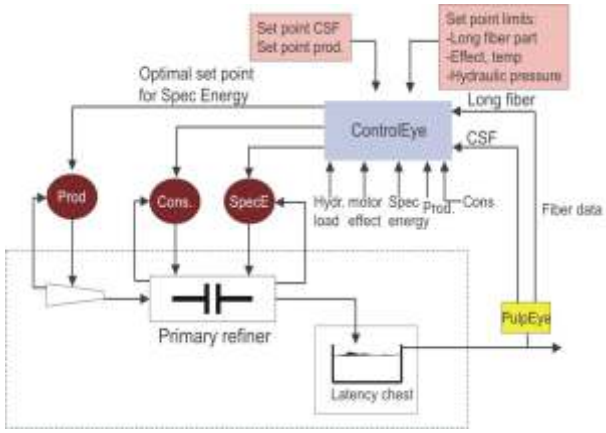

Fig. 11 Principle layout for controlling a TMP process

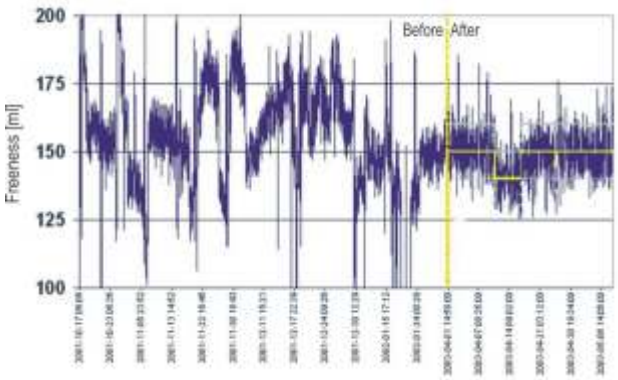

Fig. 12 Trends freeness before and after control

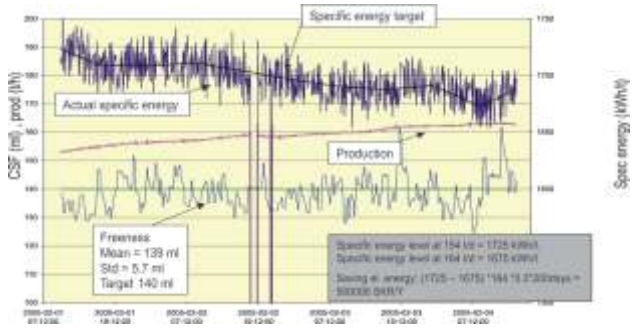

Fig. 13 Trends showing the effect of ControlEye implementation

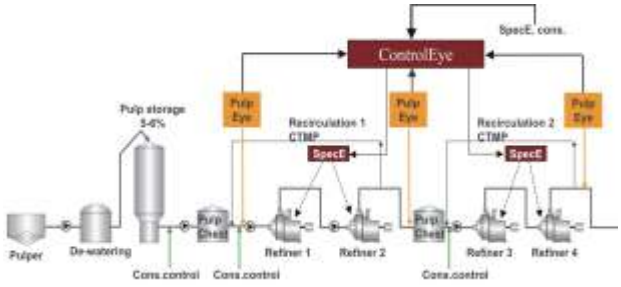

Fig. 14 Possible layout for stock prep control using Pulp Eye

The main objecties of the TMP control were:

- Minimize freeness variations
- Avoid low long-fiber content
- Maximize production and decrease specific energy
- Avoid high load on feeder

Result from the trends showing energy consumption before and after installation of the control.

The trend in Fig 12 shows how the control system maintains a constant freeness level with a minimum of energy and at the same time maximizes production.

There are of course other applications where the new generation of fiber analyzer can be used. An example from the stock preparation area is shown below.

SUMMARY

The demands of fibre quality in modern papermaking and the methods to measure and control are very important for all parts of the manufacturing process.

On-line real time results are needed to fulfil demands on controllability and this can be applied in the whole process chain:

- Monitoring changes in raw material
- Monitoring fibre deformations in bleaching
- Specify market pulp quality
- Refining properties
- Control of fibre blends in stock preparation
- Quality control of blends during recycle operations

REFERENCES

1. Shida Yuzo. High performance of high consistency refiners.
2. Strand, B.C. Quality control of high consistency refiners.
3. Fossum, E.R. 1885 CMOS image sensors: Electronic camera on a chip. IEDM (1995)
4. Forschheimer, R. Ingelhag, P.; Jansson, C. Mapp2200 - a second generation smart optical sensors. SPIE, San Jose, CA (Feb. 1992)
5. Fossum, E.R. Active pixel sensors: Are CCD's dinosaurs? SPIE vol. 1900.
6. Page, D.H., Seth, R.H.,