Dilution Control Technology For New or Existing Headboxes

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ABSTRACT

The BTF™ dilution control technology consists of a central distributor, which replaces the headbox tapered header, and a dilution water system, which replaces slice lip profiling to control the basis weight profile. This system can be retrofitted to almost any type of existing headbox, or it can be supplied with a new hydraulic headbox. The technology has been installed on more than 140 paper machines worldwide and has provided substantial improvements in CD profile and in sheet quality.

INTRODUCTION

Customer requirements for improved paper quality mean that paper mills need to produce paper with less variation in basis weight profile, and with improved fiber orientation uniformity. Conventional headbox profile control by slice lip bending is limited in its ability to meet these demands. Mechanical restrictions limit the precision of the basis weight profile control, and slice lip bending causes changes in the local flow rate, jet velocity, and jet direction resulting in non-uniform cross machine fiber orientation[1]. Dilution control systems can provide much better CD basis weight control, without interaction with the fiber orientation angle.

The BTFTM dilution control technology was developed in Germany in the 1990's, and installed on many paper machines in Europe. Since 2001 this technology has been installed on more than 75 paper machines in North America and worldwide. These installations have provided substantial improvements in CD profile and sheet quality.

DESCRIPTION

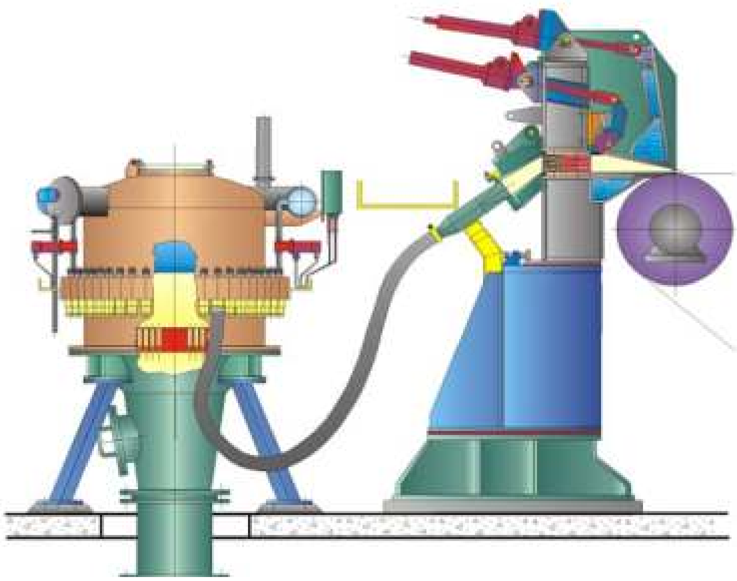

Fig.1 The BTF™ system

The BTF dilution control technology consists of a central distributor and a dilution water system, see Figure 1. This system can be retrofitted to almost any type of existing headbox[2], or it can be supplied with a new hydraulic headbox with high micro-turbulence tube banks and a fixed and parallel top slice lip.

The central distributor delivers the stock to the headbox at consistent pressure and flow across the width of the machine. It replaces the tapered header and produces an even basis weight profile from edge to edge.

A conventional headbox tapered header requires adjustable recirculation to achieve an even pressure distribution across the headbox inlet. When it operates outside its optimum flow range the pressure distribution is no longer correct and other adjustments must be made that negatively affect the sheet characteristics. By its design, the central distributor compensates for this shortcoming without the need for any recirculation.

The central distributor is shown in Figure 2. The stock coming from the pressure screens enters at the bottom of the central distributor through a transition piece, passing through a tube bank that breaks up any flocs that may have formed in the approach flow piping. The stock then goes to a large stilling chamber, with an air pad for pulse attenuation, and is distributed into flexible hoses. The hoses are equally spaced around the perimeter of the distributor, and are connected to the back wall of the headbox. All the hoses are the same length, and being fed from the same source they maintain equal pressure and flow across the entire width of the headbox, independent of throughput. This is the key design feature that separates this system from conventional tapered header feeds. The dilution water is introduced individually to the flexible hoses, which connect the central distributor to the headbox.

This technology has been installed on grades from kraft board to lightweight tissue, on furnishes from groundwood to market pulp, on machine widths from 0.8m to 9.8m and machine speeds from 15 m/min to 1700 m/min. These installations include both new headboxes and retrofits to existing roll

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Fig. 2 The Central Distributor

and hydraulic headboxes from more that a dozen different suppliers.

In recent years the technology has been further developed to provide additional improvements in performance and in operational flexibility. Improvements have been made to the central distributor, the dilution control system and the headbox itself, based on both extensive mill experience and pilot machine trial work.

The BTF automatic dilution control system uses valves with smart actuators, which can be run from a PLC or linked to an existing DCS system. The actuators are controlled by signals from the dry end scanner, and are compatible with all existing scanner platforms.

The BTF headbox has an electro-polished, thin wall tube bank with stepped round-to-square tubes and replaceable inserts. These tubes provide a high degree of controlled micro-turbulence, and are key to the excellent formation achieved by the box. The performance of the tubes was studied in detail in pilot machine trials over a wide range of flow and furnish conditions, to fine tune the stock velocity ranges in the tube components, to fully optimize the tube bank performance.

The headbox nozzle design has been optimized to provide the best sheet formation with the widest range of control over MD:CD ratio, to control sheet strength characteristics. The nozzle design eliminates the need for slice vanes by maintaining the correct degree of micro turbulence at the jet delivery. The nozzle length, angle of convergence and shape have been designed to both maintain the micro turbulence generated by the tube bank and to provide the widest range of control of MD:CD ratio. BTF headbox installations can achieve MD:CD TSI ratios of 1.8:1 or lower, a major advantage for grades requiring high CD strength properties or low sheet curl characteristics.

The headbox incorporates a double knuckle in the top slice hinge that allows the top slice body to move horizontally, as well as providing vertical adjustment of the slice lip. This allows the L/B ratio to be adjusted on the run, independent of slice opening. The L/B ratio is the relationship between slice opening and the

Fig. 3 BTF™ installation on a 9.8m wide linerboard machine

projection of the bottom slice lip beyond the top slice lip. Controlling this ratio gives the papermaker control of the jet landing point. The double knuckle arrangement provides smooth, repeatable adjustment, and is more reliable over time than systems that move the bottom slice lip to adjust L/B. Digital readouts give precise indication of both the L/B position and slice opening.

The top slice lip of the headbox is provided with set-up rods that are used to adjust the top slice lip prior to initial start-up, so that it is accurately parallel to the bottom slice lip. These adjustment rods are then locked, and covered with a hinged stainless steel panel during headbox operation. This results in the long-term maintenance of the optimum slice set-up for CD sheet characteristics, allows the dilution system to fully control the CD weight profile, and provides a very clean front surface on the headbox. Figure 3 shows a new headbox installed on a 9.8m wide linerboard machine.

RESULTS

When the dilution control system is first started the dilution valves are all set to 50% open. Within a few seconds the valves will start to respond to the signals from the dry end scanner. In high basis weight areas the valves will open up further, diluting the headbox stock in that zone. In low basis weight areas the valves will close a little. Within 2 to 3 minutes the profile will be dramatically improved.

Figure 4 shows the on/off results of a BTF dilution control retrofit installation on an Escher Wyss headbox on a fine paper machine at Cascades in Thunder Bay, Canada, running a 44.5 gsm grade. The profile is shown in the upper part of each photograph, and the dilution control valve positions are shown in the lower part. In the photograph on the left the dilution control system is off, the valves are all at 50% open, the 2-sigma variation in dry weight is 2.4 gsm. In the photograph on the right the dilution system is on, and the dry weight 2-sigma is now just 0.18 gsm.

A similar retrofit to an existing headbox on a fine papers machine at Rolland Inc. St. Jerome, Quebec, Canada improved the average 2-sigma on their 75 gsm printing and writing grade from 2.8 gsm before the installation to 0.28 - 0.5 gsm after[3]. The peak to peak variation reduced from 3.8 gsm to 0.75 gsm. The improvements in CD profile and in fiber orientation substantially reduced the incidence of wrinkles, ridges and curl problems in the sheet and reduced rejects caused by these problems by 95%.

In addition to improving CD profile, fiber orientation and formation, automatic dilution profiling provides a much faster response to basis weight signals from the dry end scanner than slice lip profiling. This not only improves CD basis weight control; it also significantly reduces the time required at grade changes to adjust to the new basis weight. For example a fine papers mill in the USA installed a BTF system on their 4.6m wide machine, making 250 tons/day. This mill changes grades 300 times per year and grade changes before the rebuild took an average of 30 minutes to reach the new CD basis weight target.. After the BTF headbox rebuild the mill reduced their average time to reach CD weight target after a grade change from 30 minutes to 90 seconds (excluding time required for stock preparation changes).

SUMMARY

The BTF dilution control system can be retrofitted to existing headboxes, or supplied with a new hydraulic headbox. This technology can provide improvements in CD profile control and can also help improve sheet quality and reduce grade change interval time.

REFERENCES

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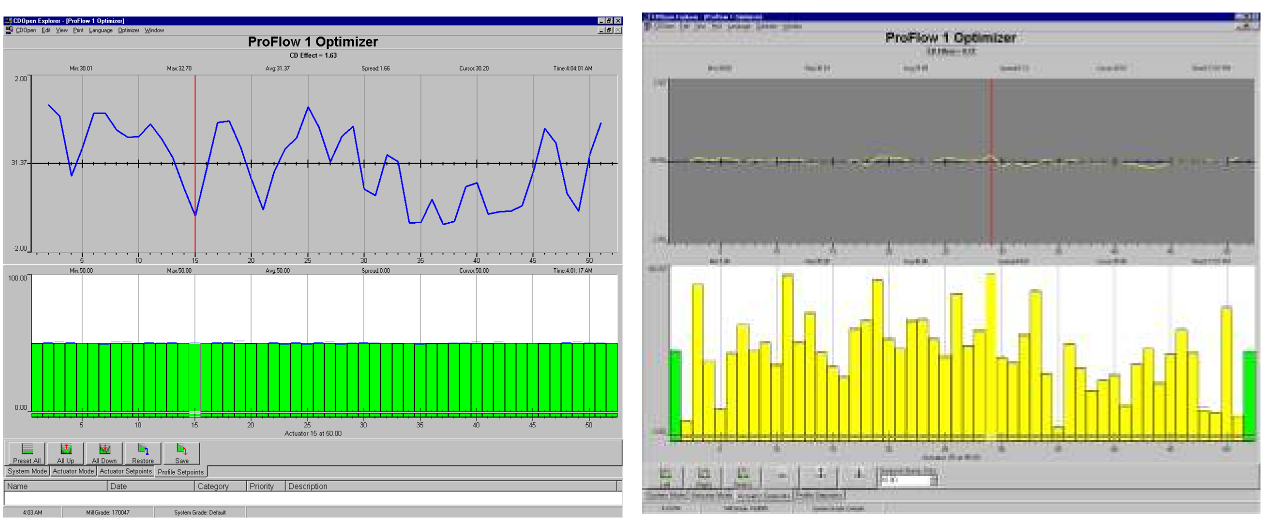
3. Bernier D., Berube S., Gelinas C., Gelinas P. "PM No. 8 Headbox Rebuild for Rolland Inc, St. Jerome Mill", CFP Conference, Quebec, Canada, June 2002.



Dilution Off **Dilution On**

Fig. 4 On/off results at Cascades, Thunder Bay