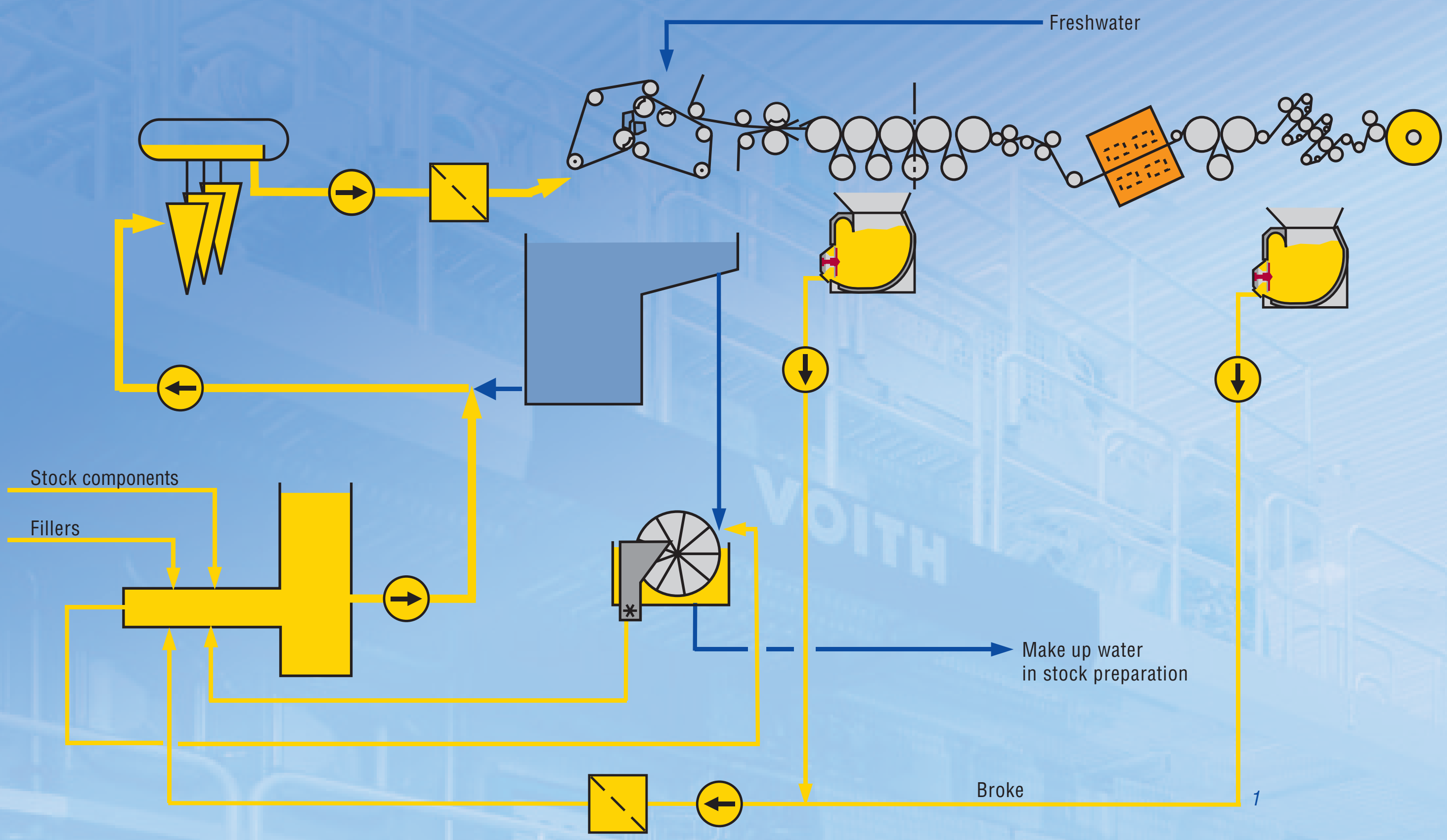

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Automation in the
Wet End Process™

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Graphic

The Wet End Process (WEP) is comprised of all machines and equipment around the wet end of the paper machine. The three main partial systems are: approach flow, broke treatment and fibre recovery. A simplified view clearly shows that not only the interplay between these three sections has to be taken into account, but also, in particular, their complex interfaces with the paper machine itself.

Immediately ahead of the headbox, all fluctuations – whether periodic or stochastic – must be avoided in order not to affect the finished paper product.

Chemical additives are used both for process stabilization and for paper quality optimization. The efficiency of these additives is due to their strong and direct effects on the fibres and fillers.

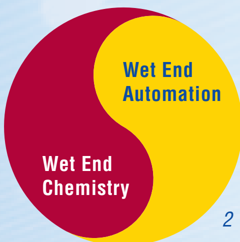
On the other hand, the active mechanisms of these additives charged mostly at the surface are in turn influenced by the properties of the fibrous stock. This interplay is extremely sensitive to fluctuations, which can only be mastered by efficient monitoring and optimal process control immediately before the headbox *(see Fig. 2)*.

Fig. 1: Wet end process: approach flow, broke treatment, fibre recovery.

Fig. 2: Automation and chemical additives in the wet end process – perfect match.

Fig.3: Online sensors and overall automation concepts.

Fig. 4: Retention control.



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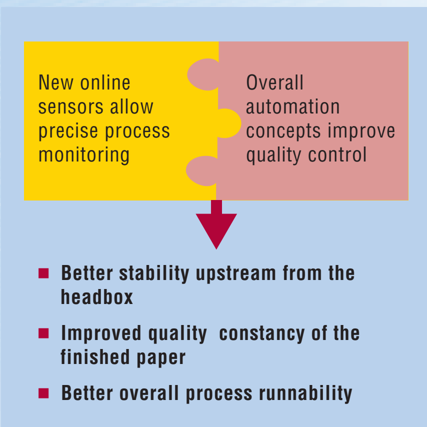

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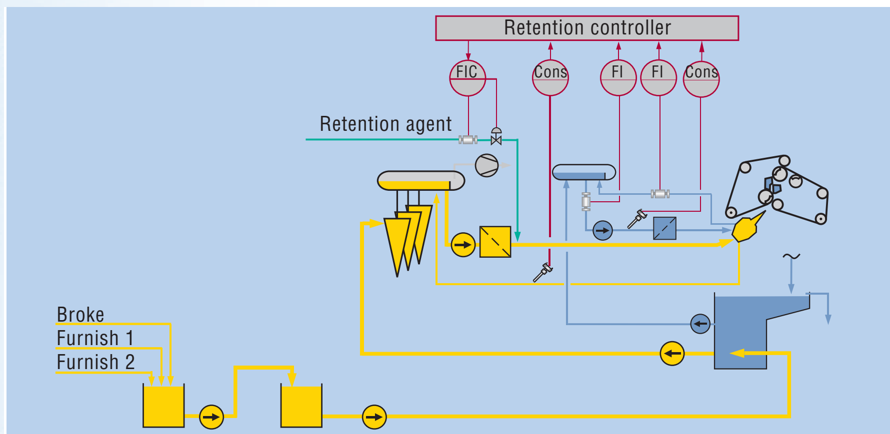

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Automation in the Wet End Process

Every efficient control concept depends upon reliable online sensors. However, the suspension parameters are far more difficult to measure than the finished paper characteristics. Even determining stock consistency places high demands on measuring technology, not to mention measuring chemical properties such as charge level or air content.

New findings in online measuring technology, and recent advances in existing techniques, have brought a decisive breakthrough in this direction. Significant improvements have been achieved both in absolute precision and in repetition accuracy, and particularly in the speed of measurement.

This opens up new possibilities for implementing control strategies. Impressive process control concepts are nothing new in theory, but so far they have been unsuccessful in practice due to a lack of reliable online sensors (repetitive, see last paragraph).

By further developing and optimising control concepts in conjunction with sensor systems, not only can paper quality constancy be improved, but significant costs can be saved by enhancing plant availability and reducing additive requirements *(Fig. 3)*.

The goal is to develop clearly defined control strategies for implementation separately or in combination with others.

Retention control

The central module of all controls in the Wet End Process is the control of retention via the various stock consistencies. Retention control is a rather confusing term, in so far as it is primarily not the retention itself, but the whitewater consistency that is kept constant.

Since retention is defined as the quotient of the difference between headbox and whitewater stock consistencies, the retention figure would assume the same value for an indefinitely large number of ratios between headbox consistency and whitewater consistency. Thus, a retention control would be impossible.

Measured for this reason is the whitewater stock consistency, which is maintained constant by adjusting the quantity of retention agent accordingly. The second measurement taken in the headbox intake enables retention to be computed precisely *(Fig. 4)*. This concept gives papermakers a tool for controlling retention as a function of formation, stock grade, lip flow, etc. while independently allowing the elimination of undesirable stock consistency fluctuations.

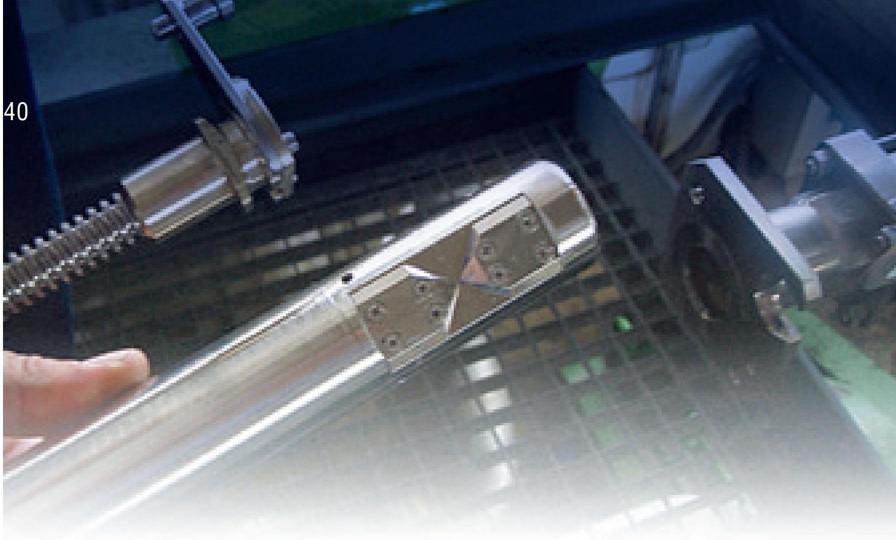

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Fig. 5: Newly developed stock consistency sensor TCT 2.

Fig. 6: Retention control with SC paper.

Fig. 7: Basis weight stabilisation by retention control.

Fig. 8: Charge control in fresh stock.

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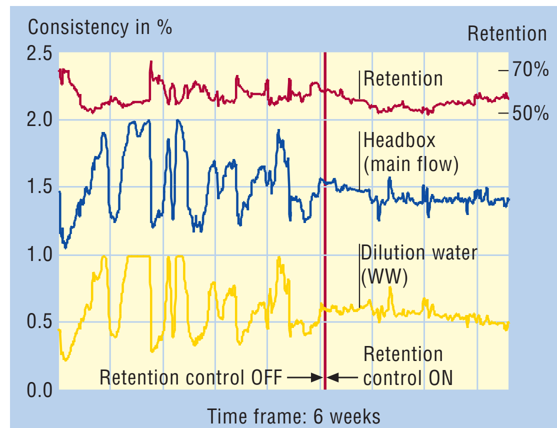

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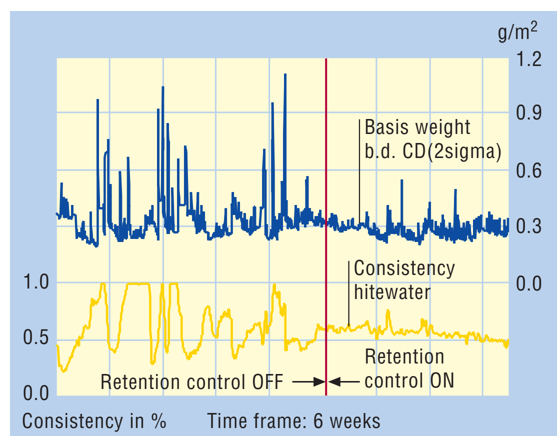

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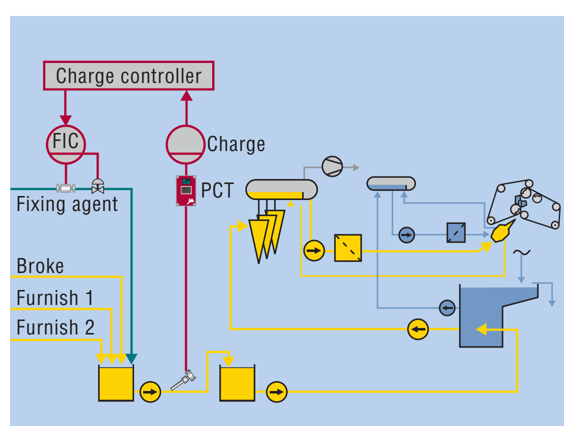

Together with our alliance partner, BTG, Säffle (Sweden), we developed the first new sensor enabling genuine inline measurement of total stock consistency and filler content separately. This finally eliminates the drawbacks of "continuous off-line" operation with its intensive maintenance requirements *(Fig. 5)*.

With these high-precision suspension sensors, full real-time balancing around the headbox and the former section is now possible. Retention control is thus fully integrated into the paper machine quality control system.

Comparison of the stability of various parameters before and after commissioning a retention control system gives very impressive results *(Fig. 6)*. This also shows why "retention control" is always based on the constancy of whitewater stock consistency rather than on the retention itself.

However, the main purpose is not merely constant stock consistency in the formation section, but more constant paper quality. *Figure 7* illustrates this in terms of basis weight.

Charge monitoring

Even with optimal stock preparation, furnish-related fluctuations cannot be entirely avoided. In order to ensure consistently good retention, charge fluctuations in the stock must be avoided or eliminated. A fluctuating charge level before the headbox would reduce the effectiveness of the charged retention agent, and the inorganic particle systems, leading to variable retention.

Online charge measurement now enables fluctuations to be detected at the earliest possible point right after the mixing chest. By regulating the input of charged additives (fixing agent), such fluctuations can be corrected accordingly. Therefore, stock charge measurements are taken directly after the machine chest, without sample dilution *(Fig. 8)*.

If, in contrast to this, charge is measured in the whitewater or in the headbox recirculation, there are two serious drawbacks. First the high whitewater flow has a dampening effect on the readings, and secondly only the sum effects of fixing agent and retention agent can be detected.

Extensive tests with parallel installed instruments provided by our alliance partner Mütek, Herrsching (Germany) have proved above impressively *(Fig. 9)*.

Online gas content measurement

Deaeration by applied vacuum reliably eliminates free and dissolved gas from

Fig. 9: Comparison of charge control in the headbox and after the mixing chest.

Fig. 10: Gas content control in whitewater.

Fig. 11: How gas content in whitewater affects pump speeds.

Fig. 12: Potential benefits of Advanced Controls in the Wet End Process.

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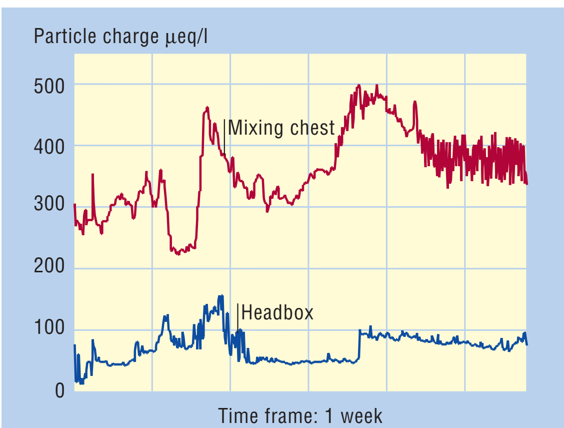

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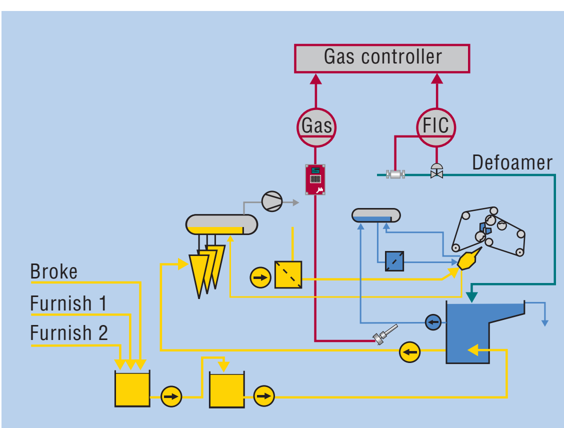

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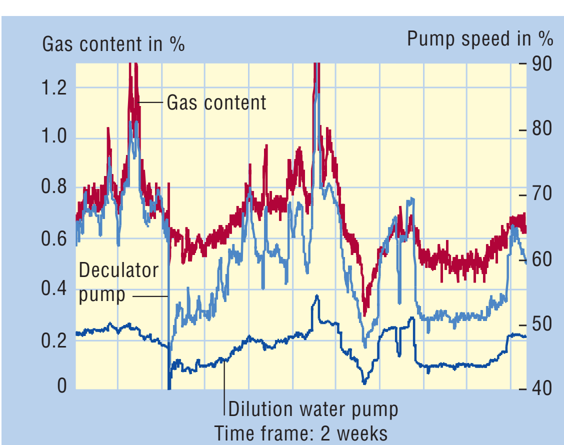

the suspension before entering the headbox. The residual gas content measured after the deaeration is less than 0.1 %.

In the closed, pressurised piping system ahead of the headbox, small pressure thrusts can then no longer intensify and build up into pulsations, and the feared gas pressure spring effect cannot occur. Sheet formation in the former area or on the fourdrinier is not disturbed by free air. Nevertheless, chemical additives are still required here in the whitewater for deaeration purposes to avoid pumping problems due to air in the whitewater, and also to prevent foam formation in the ducts *(Fig. 10)*.

These deaeration/defoaming additives are comprised of surface-active substances (such as fatty alcohol) which may react with other chemical additives. Furthermore, their cost is significant.

For each installation, there is maximum tolerance limit for gas content in the whitewater. If this limit is exceeded, pumping efficiency falls off sharply and in extreme cases the paper machine has to be slowed down. However, since the gas content can fluctuate considerably, enough defoaming agents have to be added to eliminate problems with excessive gas content even in the most unfavourable cases. Deaeration additives should, therefore, be minimized at all times to the smallest amount necessary.

12

	Quality improvement	Cost savings
Thick Stock	+ + +	
Retention	+ + +	+
Gas content		+ + +
Particle charge	+ +	+
Filler content	+ +	

This demands continuous monitoring of the gas content in the system.

As shown in *Fig. 11*, the pump operating speeds vary as a direct function of gas content. Clearly, regulating the defoaming agent input so that the maximum tolerable gas content is not exceeded can result in substantial cost savings.

Potential benefits of advanced control in the wet end process

The online measurements discussed above and the control concepts based on them can be applied either individually or in combination. They not only improve the paper quality in various ways, but also reduce production costs. These results are summarised in *Fig. 12*.