Retention Management

Active retention control is the cornerstone of wet end stability, with multiple proven benefits

The Challenge

How to increase papermaking productivity?

- Reduce costs by using cheaper raw materials and less chemicals
- Reduce broke by stabilizing the process
- Reduce breaks by minimizing variations in stock preparation & retentions
- Improve production predictability by avoiding unplanned washings and major process upsets
- Utilize PM speed potential to the full

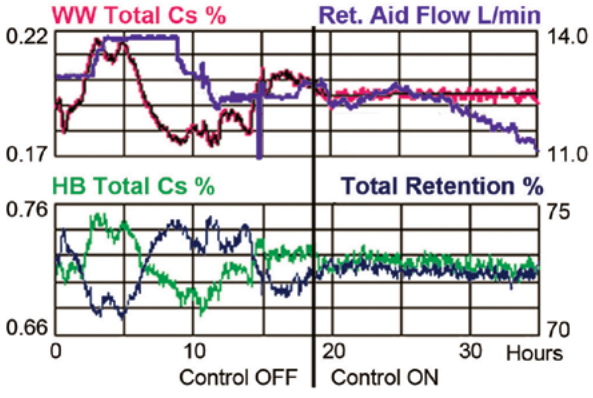
To achieve all this the process must be stabilized, and retention level and variation are crucial factors:

- Retention variation in the wet end is closely linked to paper machine runnability and to MD and CD variation of paper quality.
- Retention level affects the load on the water circulations – optimum retention level helps to optimize paper machine performance.

The Solution

Retention control is based on the stabilization of white water total consistency by using retention aid as the actuator.

White water consistency is measured with Valmet RM3 on-line analyzer. The control is tuned to act smoothly, preventing sudden changes in the retention chemical flow, and retention aid addition is regulated by low and high limits so as to keep the chemical flow always within the appropriate range.



Results

Standard deviations of important measurements for the same grade runs were compared with and without control. Typically from 5 to 10 manual vs. control run pairs were collected and studied on each individual paper or board machine. The average relative results are shown in the table:

Reduction of variation:

	Fine	Board	SC	LWC	News
WW Total	–80%	–71%	–68%	–57%	–80%
Basis weight	–9%	–5%	–19%	–14%	–30%
Paper ash	–22%	–38%	–20%	–22%	–25%

Why Valmet?

- Better quality:
  - uniform MD and CD paper quality
  - accurate operating point
- Increased production:
  - fewer breaks, higher productivity
  - higher machine speeds
  - quicker grade changes and start-ups
  - cleaner system
- Savings through optimized use of raw materials: additives, steam, water...
- Less variation in save-all system
- More efficient trials (chemicals, furnishes, etc.)

What our customers say

"This is paper machine cruise control."
"Earlier it was the sheet break alarm that whistled, now it's the operators!"
"Easy to use: like wash and go."
"We couldn't run the machine without retention control."

Valmet

Retention Management: Active retention control is the cornerstone of wet end stability – Read more detailed information on the topic here!

Why measure white water consistency?

First pass retention, calculated from headbox and white water consistencies, speaks volumes of how the wire section works: these consistencies indicate the stability of the short circulation. Consistency variations in short circulation are directly connected to paper machine runnability, and to MD and CD variations of paper quality in the dry end.
When the white water consistencies are under control, we are in effect controlling the retention level and optimizing the process:

- felts and wires last longer
- dewatering is improved
- chemical consumption is reduced
- machine speed can be increased
- fewer sheet breaks and faster grade changes

Behind the control

Retention can be controlled indirectly, by controlling the total consistency of the white waters. This is the most effective way to manage retention and to stabilize the entire wet end.
Continuous consistency measurement from the white water gives the papermaker a versatile, reliable and continuous new window to the wet end:

- Continuous measurement – process changes are quickly observed
- Supports decision making – problems can be identified, their sources found, and the right solutions to solve them can be made
- On-line response to all chemical and other test runs – faster test runs, faster process optimization
- More information of the process with less laboratory work

The retention controller controls the retention aid flow according to the white water total consistency, measured with a Valmet RM3 online analyzer: when consistency rises the retention chemical flow is increased, and when consistency goes down the chemical flow is decreased.
This control solution optimizes the retention program. It always uses only the necessary amount of chemicals, eliminating under- and over-dosing situations. It is the last active control before the furnish turns into paper, and its benefits in stabilizing the papermaking process have been proven over and again.

Control system

The principle of retention control is presented in Fig. 1. White water consistency is measured with Valmet RM3. Control actions are tuned smooth to prevent rapid changes in retention chemical flow, and retention aid addition is limited by lower and higher limits to keep retention response far from the saturation point. Alarm messages are generated for example from control loop errors.

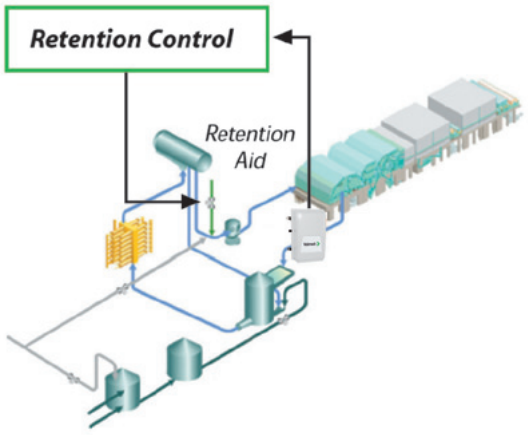


Fig. 1. The retention control system.

If two retention aids are used, a selection between strategies is available: either control one retention aid or retain the desired ratio between the chemicals. The control enables compensation from basis weight or ash content range. Setpoints are shifted for more optimum retention and consistency operation level.

The control runs in Valmet hardware: Valmet DCS or a smaller stand-alone system. This enables fast delivery and a short implementation and tuning time at the mill. The control system can be implemented on all paper and board machines that meet some basic requirements:

- closed loop control for retention aid flow
- retention aid has an effect on white water consistency
- The system includes the following components:
- handling of white water consistency measurement
- white water total consistency control loop
- upper and lower limits for retention aid flow, plus other safety features to ensure safe operation in all situations
- alarms and warnings for the operator

Results

The graphs in Fig. 2 below show results from a fine paper machine where automatic white water consistency control was switched off.

A clear difference can be seen: The automatic control keeps the white water consistency very stable. This in turn stabilizes also headbox consistency and total and ash retentions. So by controlling white water consistency we are able to stabilize the whole short circulation. When automatic control stops, it does not take long before the consistencies begin to fluctuate and the retentions soon follow suit.

Standard deviations of important measurements for the same grade runs were compared with and without automatic white water consistency control. Typically from 5 to 10 manual vs. control run pairs were collected and studied in each individual paper or board machine. The average relative results of the comparison are shown in the table:

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As the table shows, the control periods show great improvement both in wet and dry end stability, which means better runnability and improved paper quality. Also the relative improvements in different type machines are similar, showing that the same control idea can be successfully applied for different paper grades.

Reduced MD variation in paper also results in more uniform MD web strength, and through fewer web breaks and/or higher machine speeds this translates into higher production. More uniform paper quality gives also better customer satisfaction.

The performance of dilution headboxes, using white water for dilution, is sensitive to the level and short-term variation of white water consistencies. The gain of dilution depends on the consistency difference between headbox and dilution water, and thus white water consistency control plays a key role in ensuring excellent performance of the CD control.

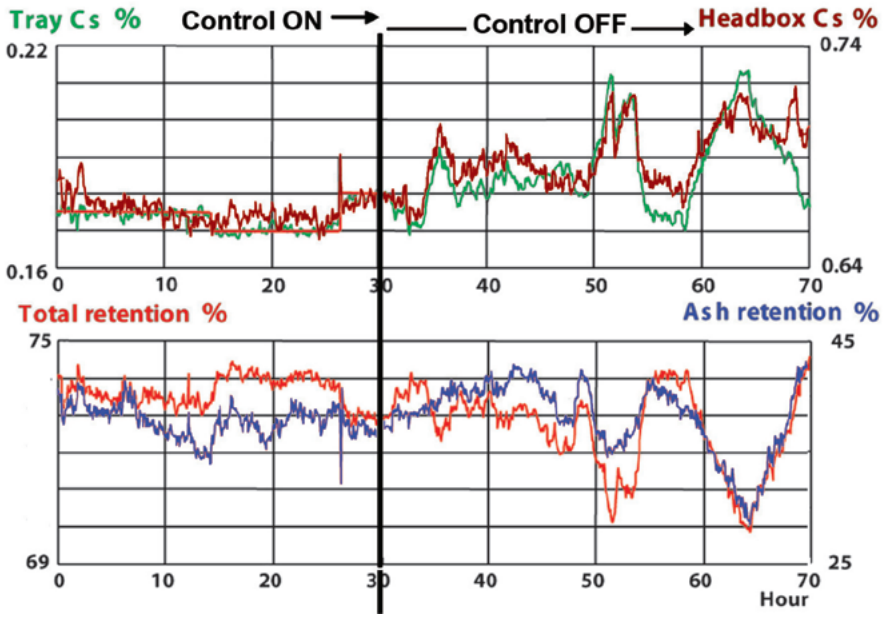

Fig. 2. White water and headbox Cs and total and ash retention variation with and without retention control.

Short payback time

• Fewer breaks, higher productivity

Improvements in the variations in consistency are reflected in the variability of paper ash, moisture and strength properties, thereby reducing its sensitivity to sheet breaks. Fig. 3 shows how stabilizing white water consistency immediately reduces sheet breaks on a 200,000 t/a fine paper machine.

The average time lost for sheet breaks was approximately 118 minutes per day before the control was implemented and 66 minutes day afterward. This mill reported 913,770 USD annual savings due to reduction in wet end breaks.

• Quicker grade changes and start-ups

Stable wet-end conditions are beneficial also for grade changes. The control stabilizes consistencies in the short circulation, enabling basis weight and paper ash targets to be achieved more quickly. In practice this means shorter grade change time and less off-spec production.

After implementing retention control 20 to 30 % less time is spent for grade changes. On a 100.000 t/a coated specialty papers machine, which produced tons of off-spec paper twice per day, grade change time was reduced by 20 %. The mill reported 170,000 USD annual bottom line benefits due to increased production.

• Higher machine speeds

Improved stability usually means that the speed of machine can be increased; another factor contributing to this is increased dryness before the press section. A stable wet end makes the machine more robust to process disturbances, ensuring better runnability even at higher speeds.

Fig. 4 from a 150,000 t/a fine paper machine shows how white water Cs control enabled an increase of 1.7 % in average speed. The mill reported 765,000 USD extra profit due to increased production.

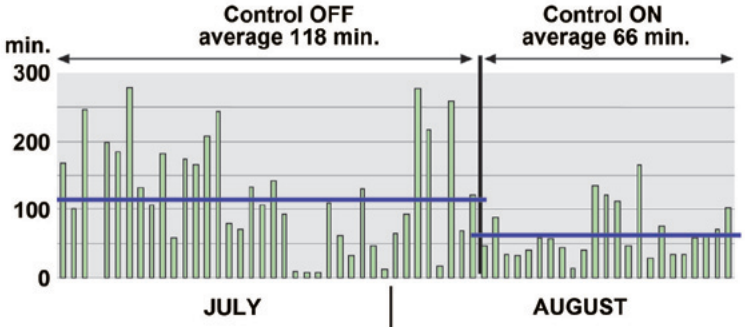

Fig. 3. Lost production time per day without retention control and with retention control.

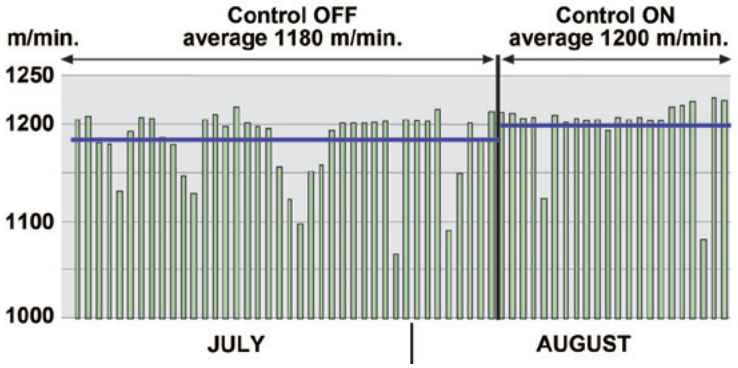

Fig. 4. Machine speed without retention control and with retention control.

For more information, contact your local Valmet office. www.valmet.com