Modern Automation Technologies In Stock Preparation & Wet-End

Uniyal Rakesh, Tripathi Pravin, Pavlovick Bogdan, Peltomaki Teuvo

ABSTRACT

"Paper Records Its History". True! Most of the paper properties are set at the stock preparation and wet-end of a paper making process. Stock preparation is the section where refining of pulp slurry, blending of various pulp grades, additives, dyes is done in order to achieve a desired end product quality. Use of automation technologies in stock preparation can help achieving desired levels of freeness, pulp strength (by blends of various pulp types), brightness, colour shades and at the same time help keeping energy consumption (in refiners) and additives usage to a desired level, thus helping save the production costs & reducing environmental pollutants.

The next immediate challenge is to retain these valuable fiber & additives received from the stock preparation on the paper machine wet-end. Fixatives and retention-aid chemicals are used to maximize the retention of fibers & additives. The target is better formation, machine runnability, machine cleanliness, optimum usage of retention aid chemicals & fixatives, minimum wastage of precious fiber & additives through drainage, lesser wet-end sheet breaks and the targeted end product quality. Advanced measurement and control technologies are available and implemented in the wet-end in mills all over the globe. These technologies have helped in fiber, additives, chemical & fixatives savings alongside better formation, machine runnability, machine cleanliness, desired end product quality and a cleaner environment.

INTRODUCTION

The wet end of the papermaking process, where the sheet quality and uniformity is first established, is highly interactive and dynamic. Many of the possible process adjustments affect several variables at the same time. For instance, changing retention aid flows affects white water consistency and ash levels, drainage, drying rates and finally, at the dry end, the sheet's basis weight, ash and moisture. Wet end upsets, which can destabilize the entire machine, are often created by furnish or grade changes, by varying broke levels after web breaks, or by changes in wet end chemistry.

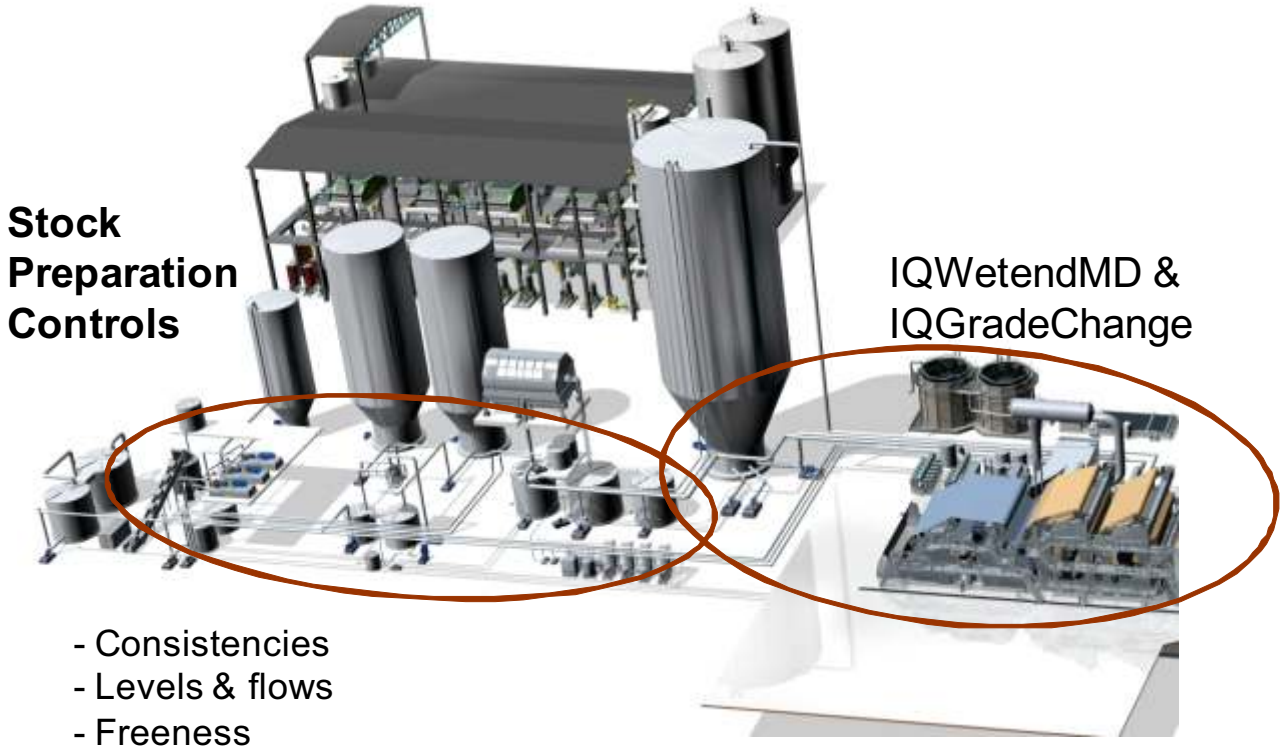


Figure 1 (Control concepts for better stock preparation management)

Metso Automation India Pvt. Ltd., Gurgaon.

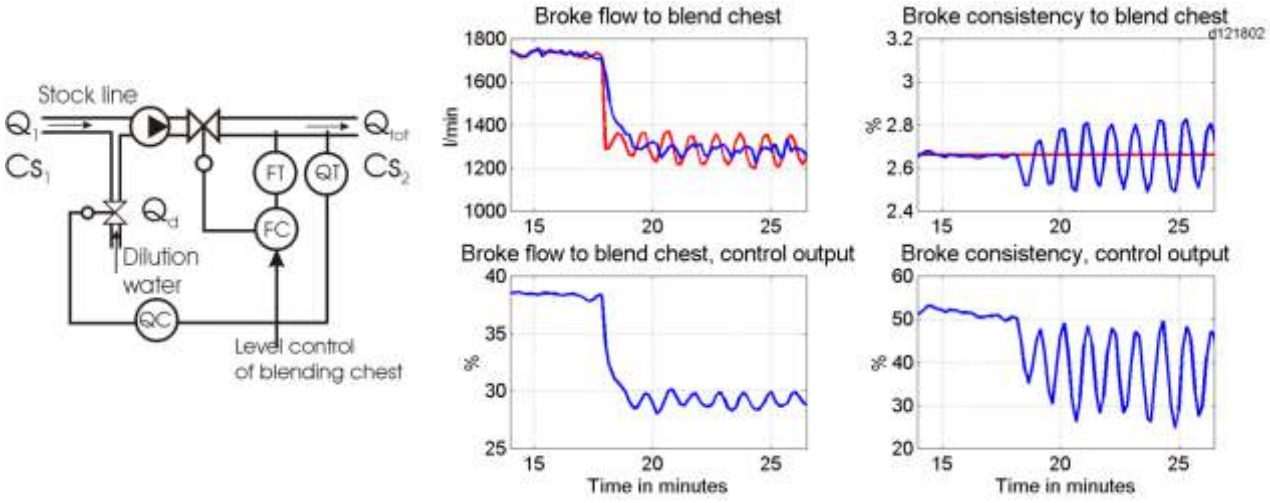


Figure 2 (With traditional consistency control, a change in stock flow causes consistency variations)

Until the 1990's, most quality control systems regulated only a handful of valves and wet end instrumentation was limited to a few flow meters and shear force consistency transmitters. MD and CD controls were based mainly on feedback, dry sheet measurements. Since the early 1990's, many wet end measurements have been developed and successfully applied. Microwave total consistency measurements, white water consistency and retention analyzers, and cationic charge demand analyzers have been used to stabilize the wet end operations. These developments addressed a simple, well-known fact: Many upsets or cycling problems originate at the wet end and must be controlled there. (fig - 1)

Achieving Stability

Based on studies performed, a number of disturbance sources are commonly encountered on paper machines that severely affect the runnability of the machine and the quality of the paper produced. These disturbance sources arise from the process and automation equipment commonly used.

In view of the fact that there are severe disturbances coming from various sources, and the papermaking process is highly interactive, the disturbances in one part of the plant propagate to other process areas in many ways, some of them quite non-obvious. Part of the problem stems from the fact that a very complex, multivariable process is often controlled with single variable control loops, resulting in loops fighting each other. Also changes in process conditions cause changes in process gain which further causes the control to oscillate (Figure2). In addition, there are strong interactions inherent in the forming process between the paper furnish components and the chemistry.

Using more advanced control strategies brings far better results (Figure 3). With a simple modification to the traditional control strategy, such as installing a new flow measurement and modifying the control algorithm, will bring stability to the whole production rate area and thus better stability to the

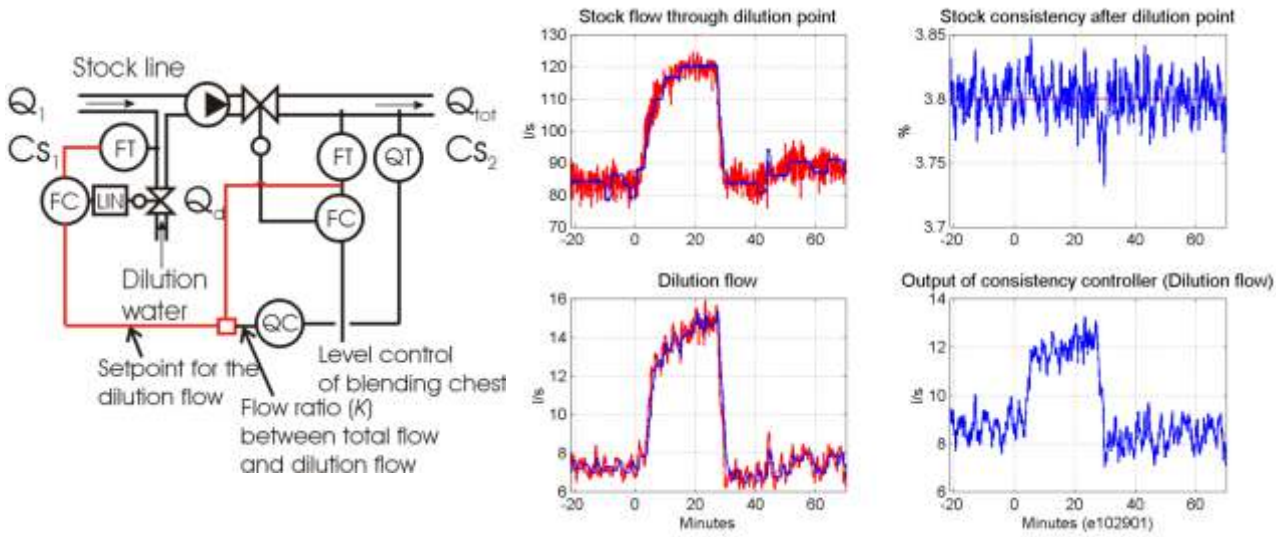
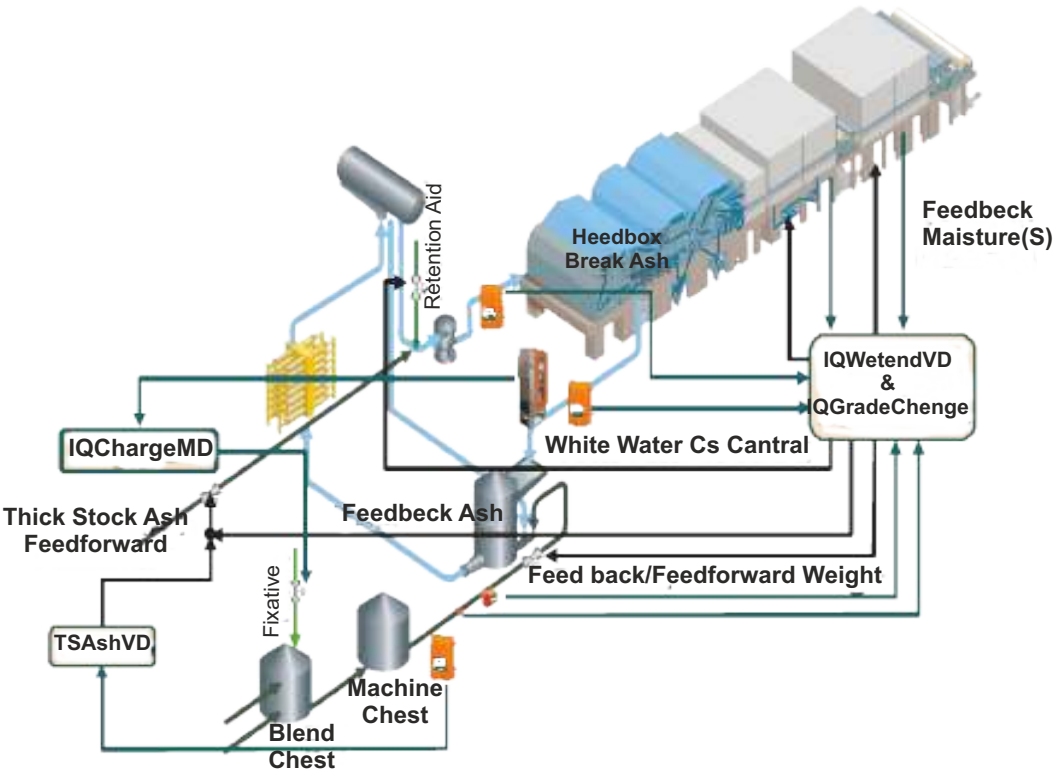


Figure 3. (With an advanced control strategy, the consistency is stable despite stock flow changes)

whole process. To achieve even more machine stability, wet end single-loop controls are being integrated with traditional dry end feedback controls in multivariable predictive controls. These MPC controls, model the interactions in the wet end and in the dryer section, then make coordinated control actions that predict how various changes affect each other and the final product. The result is better wet end stability, hence improved wet sheet runnability, and better uniformity of the sheet quality. Significant savings in chemical consumption are also reported.

Metso's multi-variable control strategy, called IQWetendMD, has been implemented with good results on a number of machines making SC, LWC, coated fine paper and newsprint. Many are world speed record holders or close to it. IQWetendMD coordinates the timing and degree of multiple control actions to achieve smooth transitions (Figure 4).

When quality targets or production rate changes are made, the control optimizes actions of all manipulated variables and thus avoids the cycling of single loop feedback controls when fighting against each other. For instance, paper ash can be affected simultaneously by thick stock flow, fresh filler flow and retention aid flow. The multi-variable control, models these interactions, anticipates the future effects of changes and optimizes the



Take in Figure 4. IQWetendMD with integrated grade change control

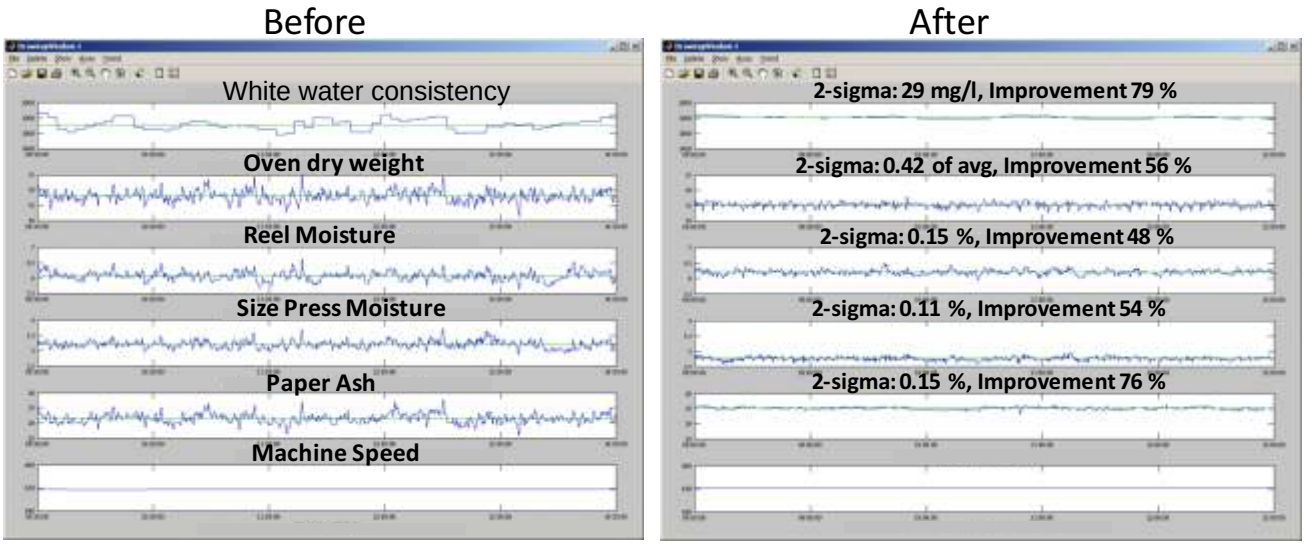


Figure 5. (Multivariable control outperforms traditional control, example from a fine paper machine)

degree and timing of control actions. The results, before and after control implementation with kajaaniRMi, show significant improvements, both in process stability and final quality (Figure 5).
Measurements and controls for furnish management ensure the functional properties of the sheet are maintained on-spec during steady state operation and during production changes. Furnish quality changes are made quickly, smoothly and with minimum waste. A consistent furnish forms and drains predictably, stabilizing quality and improving runnability.

The benefits of the advanced controls can be summarized as follows:

Stable furnish improves quality and runnability

Precise control enables furnish recipe optimization

Reduced variability in paper oven dry weight, moisture and ash.

Increased machine efficiency. A significant decrease in wet end breaks and faster recovery from breaks and other upsets is achieved.

Sheet quality is on target quickly after a break, increasing saleable production
Faster machine start-ups and quicker grade changes.

Savings in retention aid chemical consumption.

Stable sheet quality when broke content is changed.

Energy savings due to the reduced broke amount.

Conclusion

Constant change in today's papermaking calls for totally new strategies to achieve increased benefits in quality control and production line automation. New performance concepts can raise the level of quality by fully utilizing measurements and controls for furnish management. The stability of the short circulation system is crucial for producing a low-variability sheet with the potential for excellent surface property development. By staying in the window of stability that papermakers aim for, the machine will run for long periods at its top speed and efficiency. Fast responding wet end process controls plus absolute dry end feedback controls are integrated with multi-variable, predictive controls. The timing and degree of multiple control actions are harmonized to achieve smooth transitions and avoid process upsets. The extra value over traditional MD controls is realized especially when the machine is experiencing upsets, during planned changes, after startups or after long web breaks. Our customers report faster startups and grade changes, reduced dryer breaks and fast recovery when the sheet is rethreaded.