

Optimization of the charge level in a secondary fiber-based operation can improve stickies/pitch control, wet-strength resin effectiveness, fiber retention

By JOHN B. STITT

Charge Control Helps Tissue Producers Achieve Quality, Productivity Benefits

CHARGE CONTROL IS NOW BECOMING recognized as a highly significant factor in tissue manufacturing in order to achieve optimum product properties and productivity. The increased use of secondary fiber has resulted in product quality variability, a loss of operating efficiency, and an erosion of profitability. Some of these problems are related to charge level and variation in the stock preparation system. Charge control can have an impact on several significant operating parameters, such as stickies/pitch control, optimization of wet-strength resin effectiveness, softness enhancement, retention, creping adhesion, and the ability to optimize creping geometry.

Tissue industry production managers want both quality and productivity, but in the real world there is often a trade-off between the two. Understanding the real priorities of these trade-offs will allow managers, engineers, and technical sales representatives to work together and use the following information and techniques to benefit their business and improve their mill's profitability.

Charge control can achieve one or more of the following benefits:

- Reduction in stickies problems and the resulting downtime
- Reductions as high as 30%, in the cost/amount of wet-strength resin
- Improved first-pass retention
- Dye fixation
- Improved creping control
- Improved sheet softness
- Higher machine efficiency
- Reduced cost per ton of production.

BETTER PRODUCTIVITY, QUALITY. Control of the charge of the fiber throughout the stock system is important in both quality and productivity-driven operational strategies. Tuning the application, however, to achieve desired results and provide maximum benefits differs with the strategy.

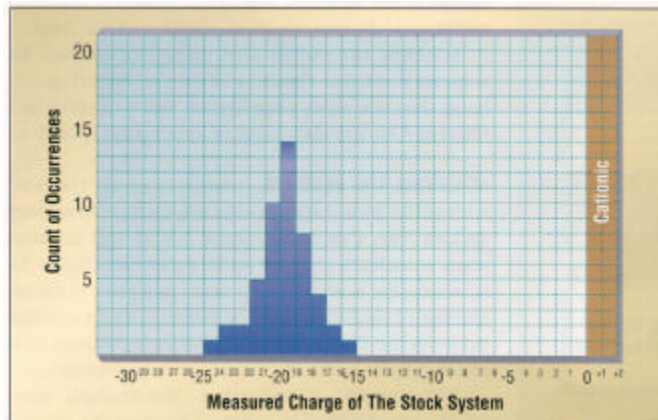
Charge is a property of all fiber. The nature of the charge of the system, anionic (-) or cationic (+), affects deinking effectiveness, water clarification, washing efficiency, stickies and pitch deposits, wet-strength resin efficiency, sheet softness, Yankee coating development, creped sheet properties, and consistency of creping. These are all factors that affect the quality of the tissue.

Small materials, such as fines, hemicelluloses, and fillers, carry a higher charge density than larger materials such as fiber. The ideal situation for secondary fiber tissue production is for the stock charge at the headbox to be mildly anionic and stable. However, most secondary fiber systems, without modification, are significantly anionic and highly variable over time.

A useful method of measuring the combined intensity and quantity of anionic charge is cationic demand. A diluted high-charge density cationic material is used to titrate a given quantity of the slurry to neutral charge. The endpoint of titration can be found either with a chemical indicator or with a charge measuring instrument.

Secondary fiber furnishes tend to be highly anionic due to the fillers, fines, and hemicelluloses in the system.

FIGURE 1: A histogram of a number of untreated system charge measurements over time shows the central tendency toward an average value, and the variation in measurements.





A particle charge detector can be used to measure the charge of a sample from a secondary fiber stock system.

FIGURE 2: Graph showing the effect of adding a fixed quantity of cationic material to a stock system. Note that the adjusted curve is merely the initial curve shifted upward with peaks in the cationic zone.

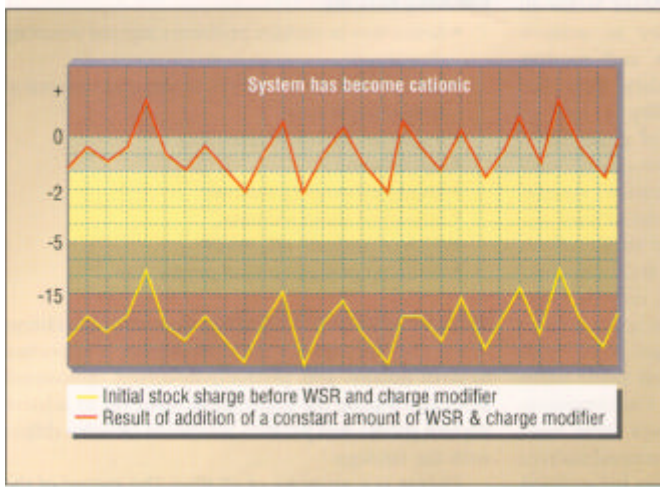
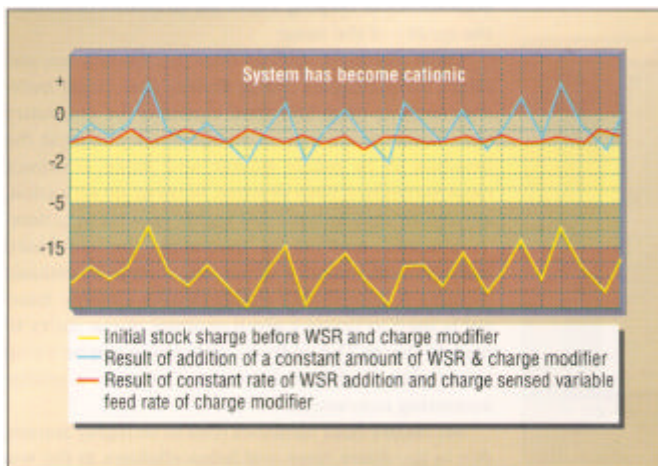


FIGURE 3: Graph showing results of continuous measurement of system charge controlling feed rate of a cationic polymer. Note that the variation is smoothed and that the system is maintained with a slightly anionic charge.



"Stickies" are highly anionic, and the anionicity of a system will vary widely depending on the fiber furnish and the chemistry of the system. But taking a number of measurements of the system charge over time will show normal distribution with significant variations, as shown in figure 1 .

Charge control is achieved by adding a cationic material to the system. Alum, which has commonly been used, can cause deposits and can seriously affect tissue softness. However, low molecular weight high-charge density cationic polymers (LMWCPs) can provide the needed cationic source without the problems associated with alum.

First attempts at charge control involved feeding a fixed amount per ton of LMWCP to the stock system. However, sometimes the fixed feed rate was not enough and sometimes it was too much. As shown in Figure 2, at times the low points are below the green "ideal" range, and at other times the addition drives the system cationic. When a system goes cationic, the following phenomena are experienced

- Loss of adhesion control on the Yankee dryer
- Reduction in wet-strength development
- Excess foam due to free-floating excess wet strength resin
- Inconsistent formation and retention
- Unrecoverable felt filling
- Color variation.

Based on results from those early attempts, a better system for controlling charge through a variable feed rate of LMWCP was obviously needed.

Several companies now produce automated charge measurement systems capable of providing an output signal to control a chemical metering pump either independently or through a distributive control system (DCS). For charge control in tissue, it is recommended that a unit capable of measuring the charge in thick stock be used, rather than one that measures thin stock, or whitewater. These units are expensive, but payback calculations against benefits show a return of only a few months. Daily cleaning of the measurement apparatus is required, but the benefits justify the attention.

Figure 3 shows the results achievable though automated charge control. With the automated charge measurement and varied feed rate, the resulting charge at the headbox and to the Yankee is relatively stable and falls into the ideal, slightly anionic zone

Selecting the proper feed point is important for achieving results. Figure 4 shows a typical direct entry dual-line stock prep system and will serve as a reference for the discussion of application specifics.

ACHIEVING THE BENEFITS. Stickies control. "Fixation" with LMWCPs is the most effective method to remove stickies from a secondary stock system that contains many anionically charged stickies particles (Figure 5). By adding the polymer one process step prior to the beginning of agglomeration, the polymer forms a bridge between the filler and the microscopic particles This attaches them to the filler and blocks agglomeration

Wet-strength optimization. Wet-strength resin attaches to the fiber in a system because the resin is cationic

and is attracted to the anionic fiber, as well as to all nonfibrous "anionic trash." Addition of an LMWCP prior to the addition of wet-strength resin will consume the charge on these high charge density particles of anionic trash. Then, when the wet-strength resin is added, it will not be consumed by the anionic trash, but will be primarily used to produce a water-proof linkage between the strength-imparting fibers.

For effectiveness, the LMWCP must be added prior to the wet-strength resin. A fixed amount per ton of wet-strength resin is added one stage further down the system, and the charge of the thick stock system is measured after addition and mixing of the polymer and wet-strength resin. The signal from this measurement is used to control the flow of LMWCP.

The LMWCP not only neutralizes the anionic trash, but also fixes the stickies. In addition, any dyes in the system prior to addition of the polymer will be seen as anionic trash and will be fixed to the filler.

Dye Fixation. Most dye fixatives are the same LMWCPs used for wet-strength and stickies fixation. Fixing the dye to the fiber improves dye retention and will shift the colors of dyed products. Dye feed rates, therefore, may have to be reestablished. The benefit will be a reduction in dye costs.

Improved retention. Improved retention can increase profits by reducing yielded fiber cost per ton of product and by reducing loads to the clarifier and effluent systems. But, they can also reduce quality by increasing the stiffness of the sheet and reducing softness. It is vital, therefore, to know the company's business strategy. Volume-driven companies will welcome improved retention, but quality driven companies will see im-



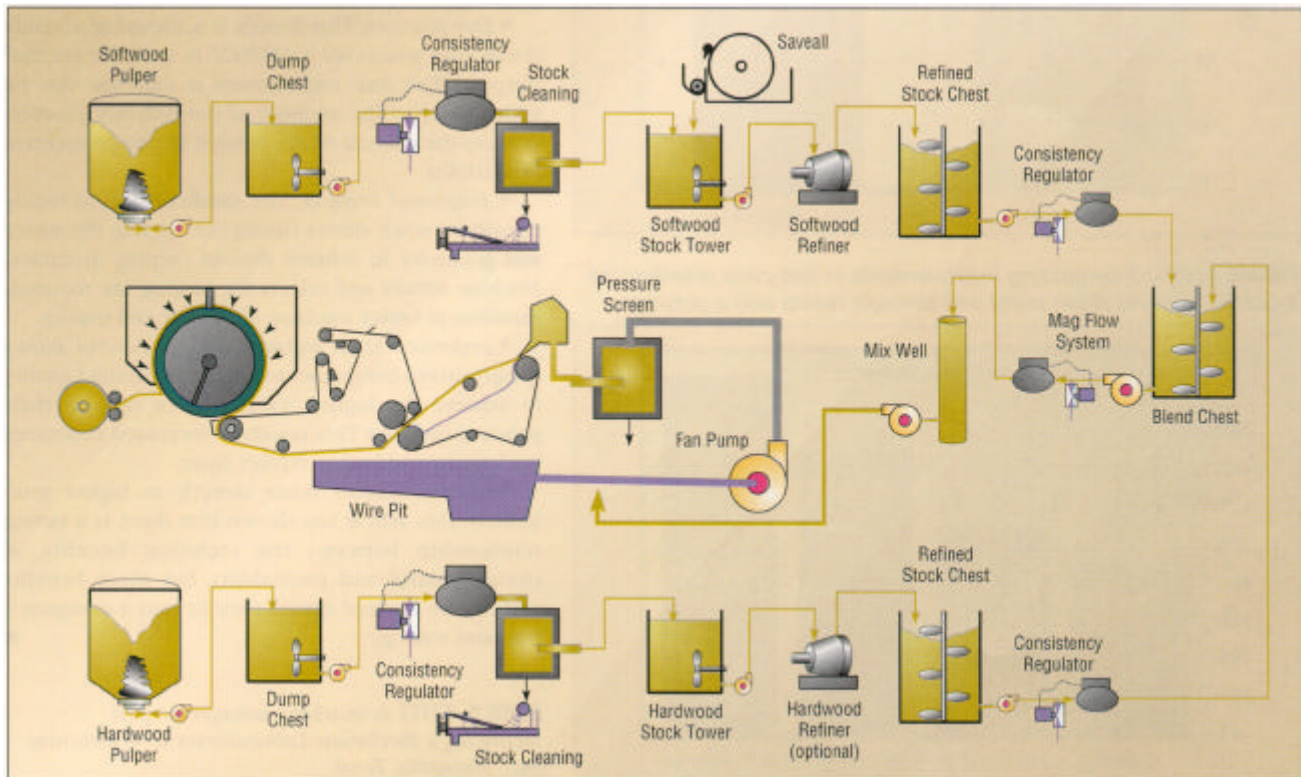
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proved retention as a problem leading to loss of consumer preference and decline in market share.

The negative benefits of improved retention can be countered to some extent by using chemical softeners/debonders. Usually a balance between retention and chemical softening is required to meet the needs of any specific company

LMWCPs are very effective coagulants and, when used alone, increase retention moderately. In wet-strength resin systems, the wet-strength resin also acts as a coagulant and further increases retention. In

FIGURE 4: A process-flow diagram of a split hardwood and softwood tissue stock preparation system feeding a blend chest.



systems where the maximum possible retention is desired, a flocculant can be fed between the fan pump and the headbox to coagulate the solids and result in first pass retentions over 90%.

Improved creping control/improved softness. Optimizing creping is a complex process that requires a focus on the entire

FIGURE 5: Graph of stickies count in the stock slurry when treated with from a to 4 kg/ton of a highly effective, low molecular weight cationic polymer (LMWCP).

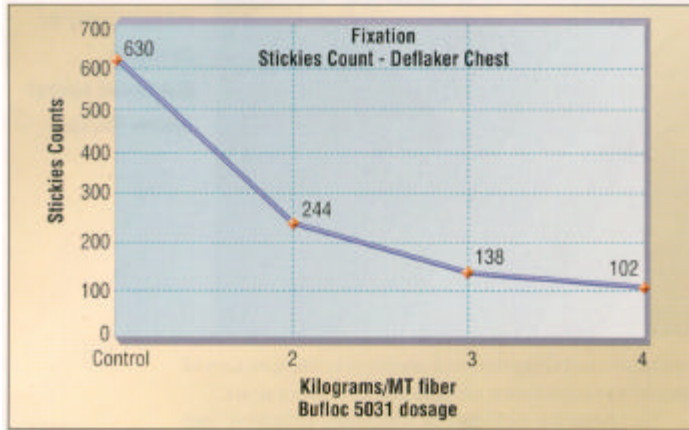


FIGURE 6: Graph showing wet-strength resin cost savings achieved through the use of a low molecular weight cationic polymer.

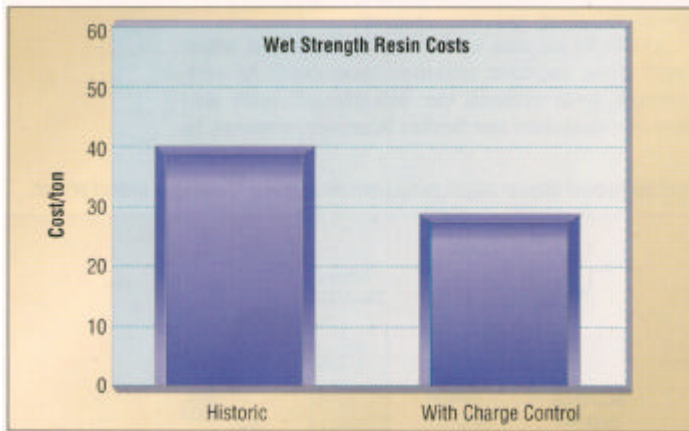
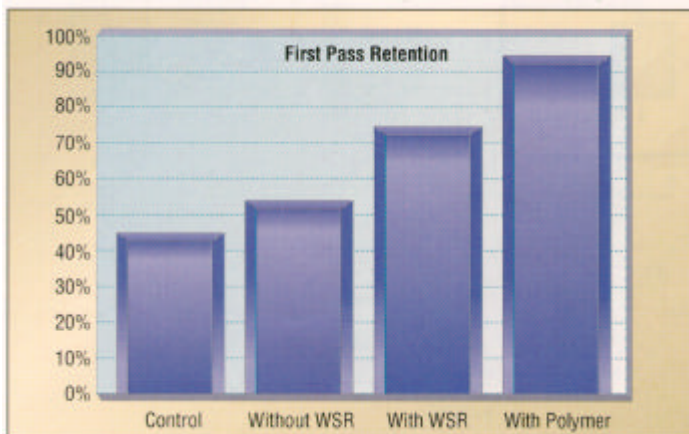


FIGURE 7: Graph comparing improvements in first-pass retention on a tissue machine when using wet-strength resins and a polymer.



system from raw materials to process and coating chemistries and creping geometry. Most creping is dependent on anionic fiber adherence to the cationic coating, which coheres to the anionic dryer surface during the glass transition phase. The difference in the charge between the coating and the fiber influences the level of adhesion. Too little adhesion and the sheet floats; too much and picking occurs.

Changes in the charge of the fiber through time prevent tuning the system for optimum creping. Charge control allows stabilization of one of the factors that hinders creping optimization. Presenting the dryer with a relatively stable, slightly anionic fiber adds consistency to the process and results in higher quality, higher machine efficiency, and higher profitability.

IMPROVED PROFITABILITY. Charge control can result in technical advantages that translate into improved profitability.

Stickies/pitch control. Less downgrade for holes and dirt, higher machine run time, and less cost for chemical cleaning of the clothing translates into higher quality product, lower cost per ton, and higher tonnage produced.

Wet-strength optimization. Can reduce the cost per ton by 15% to 30% for the amount of wet-strength resin needed to achieve a target wet tensile; or can improve market position by increasing the level of wet strength. Either case can mean improved profitability.

Improved retention. Mills that can work with the negative effects of improved retention on tissue properties can gain a 10% to 40% reduction in raw material costs through charge control and improved retention.

Dye fixation. This benefit is achieved at no additional cost whenever a LMWCP is used for another purpose. The one requirement is that the dye be added prior to the addition of the polymer. Fixation reduces the amount of dye needed and helps increase profitability.

Improved creping. The predictability of highly consistent stock allows tuning the creping chemistry and geometry to achieve desired creping dynamics. Machine breaks and rejects for picking are reduced, resulting in better machine efficiency and quality.

Improved sheet softness. Charge control allows quality-driven companies to tune their product quality to achieve the highest value-to-price ratio in their product category. This results in increased consumer preference and higher market share.

Technical factors relate directly to higher profitability. This article has shown that there is a strong relationship between the technical benefits of charge control and profitability, but these benefits will not be realized unless they fit into a company's business strategy.

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