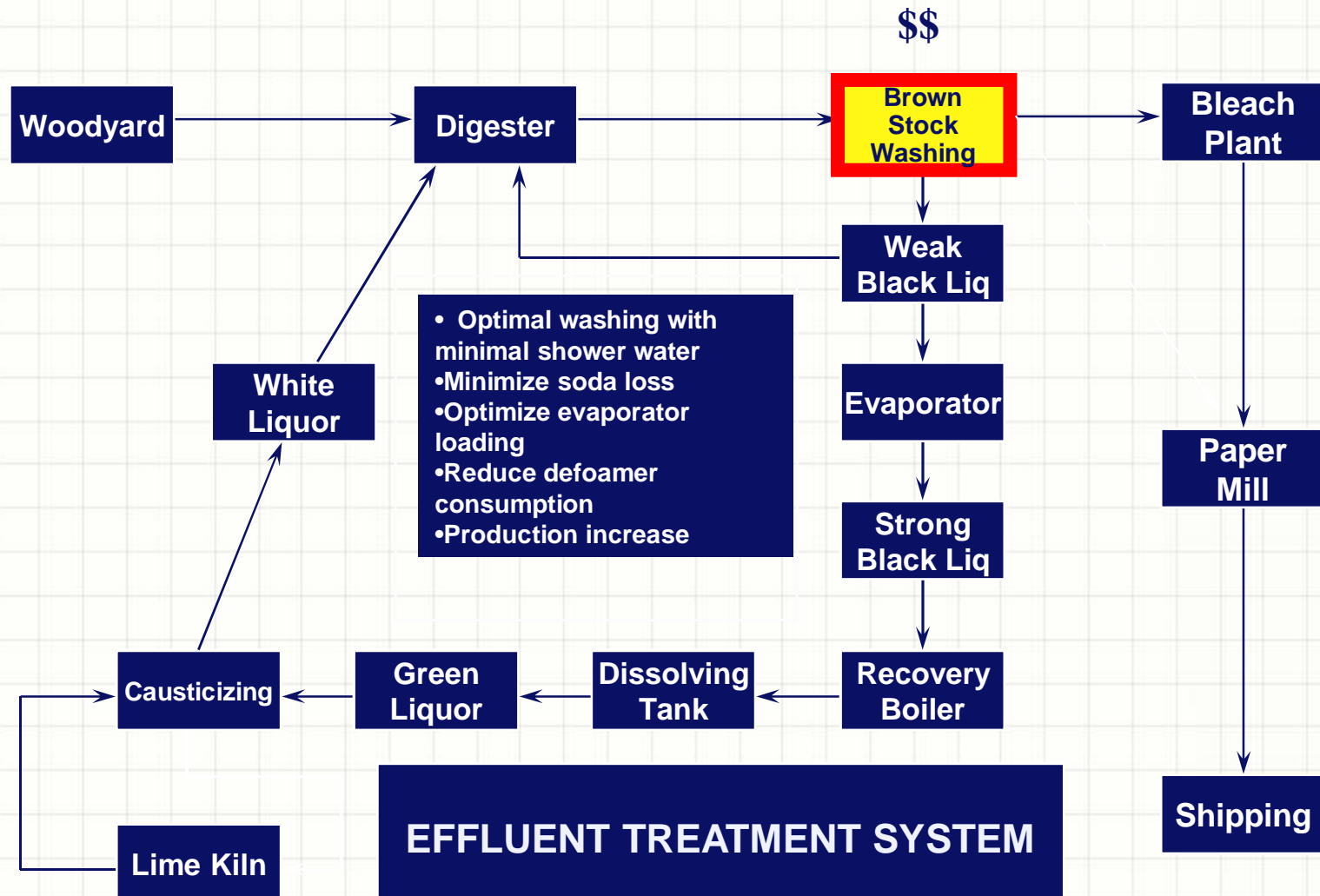


A NEW SENSOR BASED APPROACH TO BROWNSTOCK WASHER OPTIMIZATION

Rick Van Fleet



Why Improve Control of Brown Stock Washing?

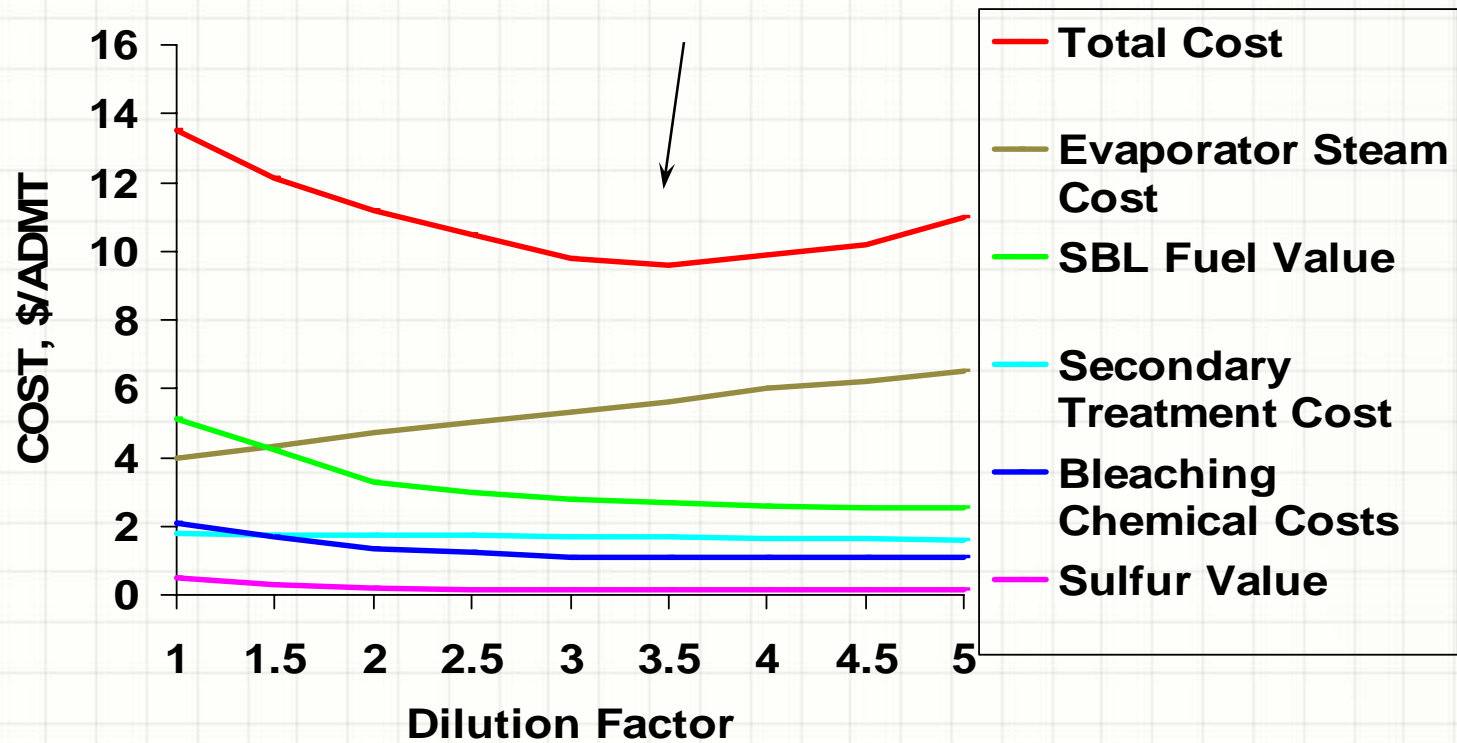


Washing Objectives

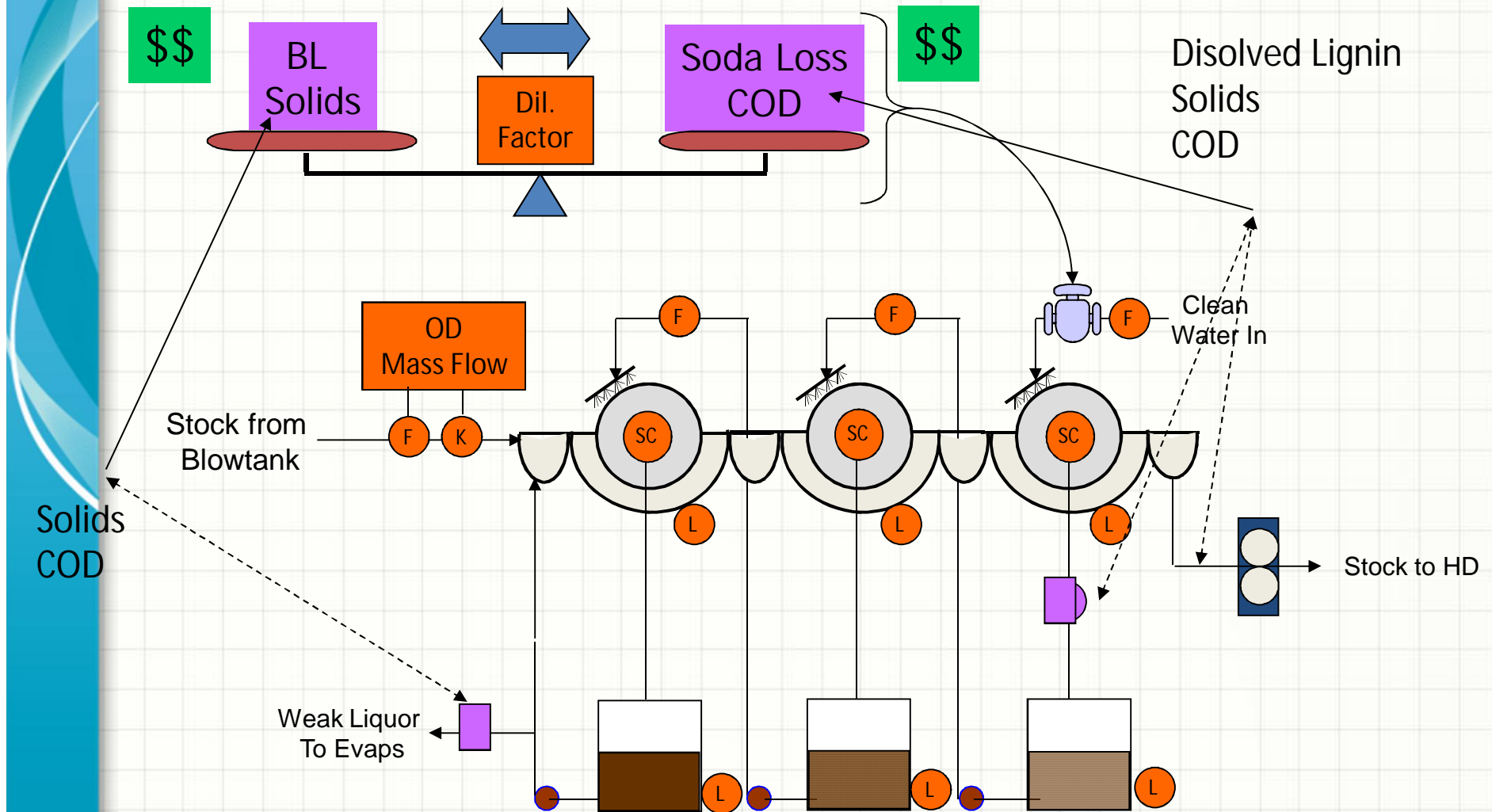
- The overall objective of the Brownstock washing operation is to remove the maximum amount of dissolved black liquor solids, with a minimum amount of water used.
- Minimizing the water input will maximize the black liquor solids to the evaporators, which will result in steam savings.
- Minimizing losses to the bleach plant will benefit the bleaching operation.
- Overall objective is to find the optimized dilution factor which benefits the cost of make-up chemicals, lowest bleaching cost, and maximize the efficiency of the recovery process.

Washing Control Objectives

Optimum
Dilution
Factor



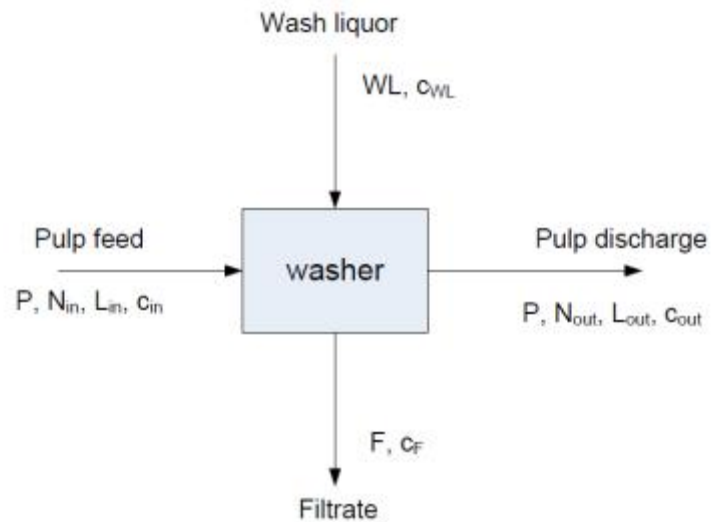
Balancing Between COD and BL Solids



Key Operational Variables

- Production Rate
 - Flow X Consistency is involved in all calculations
 - Mat profile impacted for both rotary and press type washers
- Shower Water Control
 - To control DF, must be a manipulated variable
- Black Liquor Solids to Evaps
 - Constraint variable for optimization

Washer Efficiency Calculations



$$\text{Dilution Factor - DF} = \frac{WS - WL_{out}}{P}$$

$$\text{Wash Yield - Y} = 1 - \frac{L_{out} * C_{out}}{L_{in} * C_{in}} = \frac{F * C_f}{L_{in} * C_{in}}$$

$$\text{Displacement Ratio - DR} = \frac{C_{in} - C_{out}}{C_{in} - C_{wl}}$$

$$\text{Nordic Efficiency Factor - E} = \frac{\log \left(\frac{L_{in}}{L_{out}} * \frac{C_{in} - C_f}{C_{out} - C_{wl}} \right)}{\log \left(\frac{WL}{L_{out}} \right)}$$

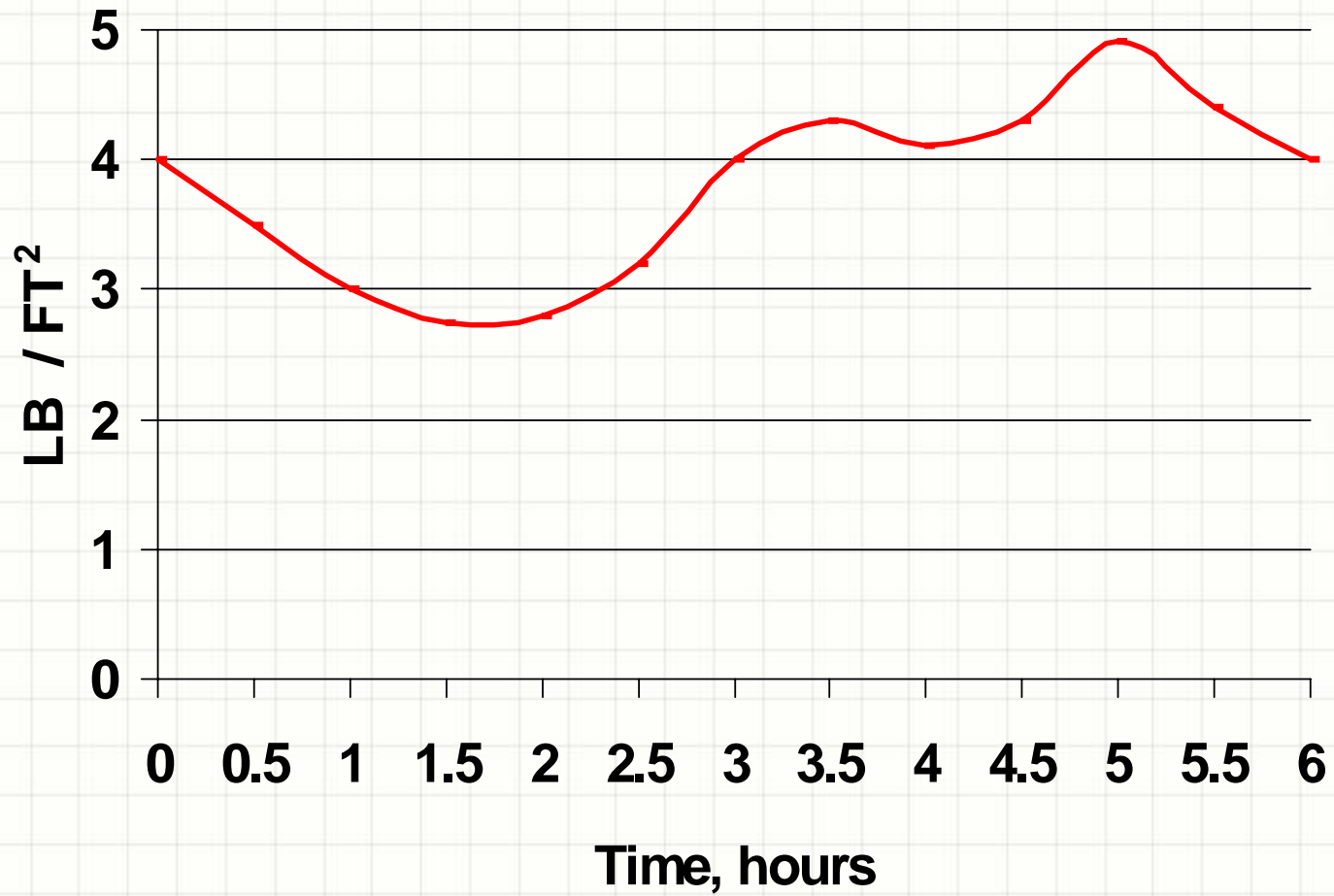
$$\text{E in standard 10\% consistence - E10} = \frac{\log \left(\frac{L_{ib}}{L_{out}} * \frac{C_{in} - C_f}{C_{out} - C_{wl}} \right)}{\log (1 + DF/9)}$$

$$\% \text{ COV} = 1 \text{ sigma S.D} / \text{mean}$$

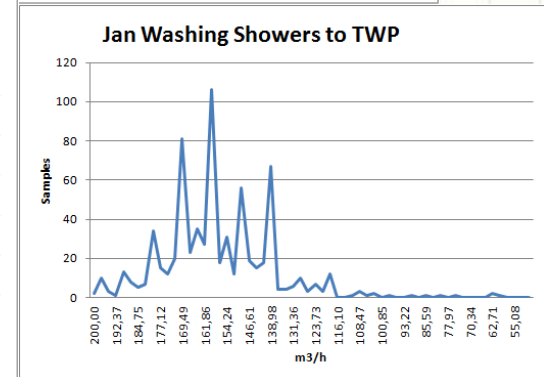
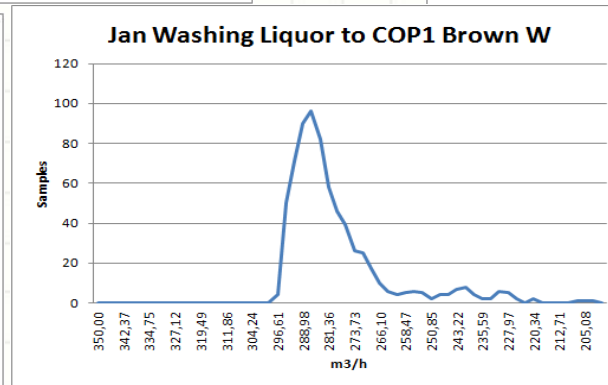
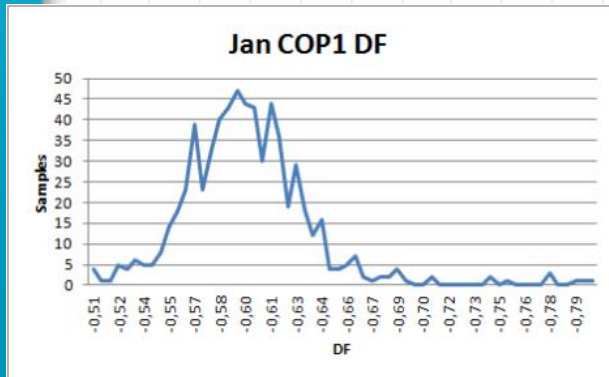
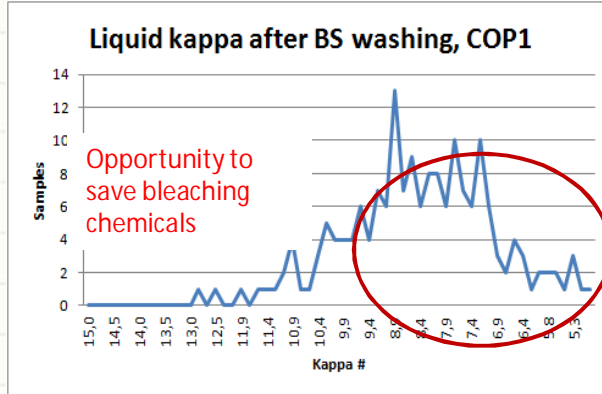
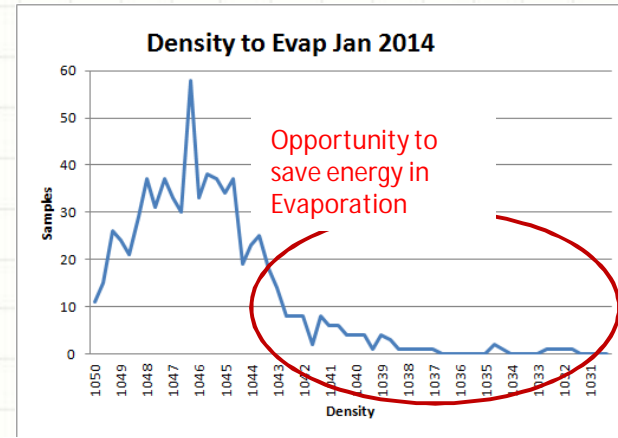
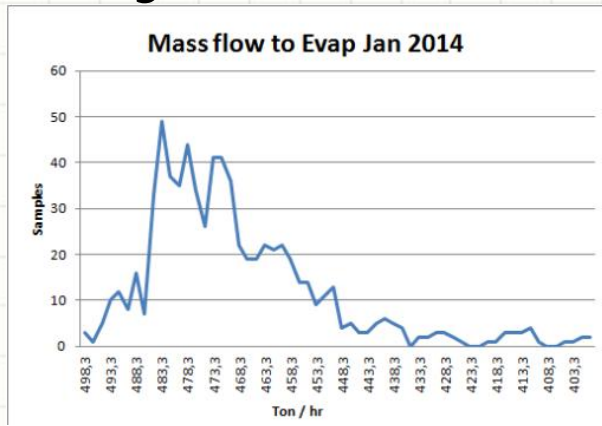
In Systems Where Dilution Factor is Uncontrolled.....

- Analysis of variance: Dilution factor has the largest effect on the solids leaving the washers (soda loss and organics).
- Largest contributor of water into the weak liquor system is from the dilution factor.
- Dilution factor is normally the largest contributor to the variability of the evaporator feed liquor solids

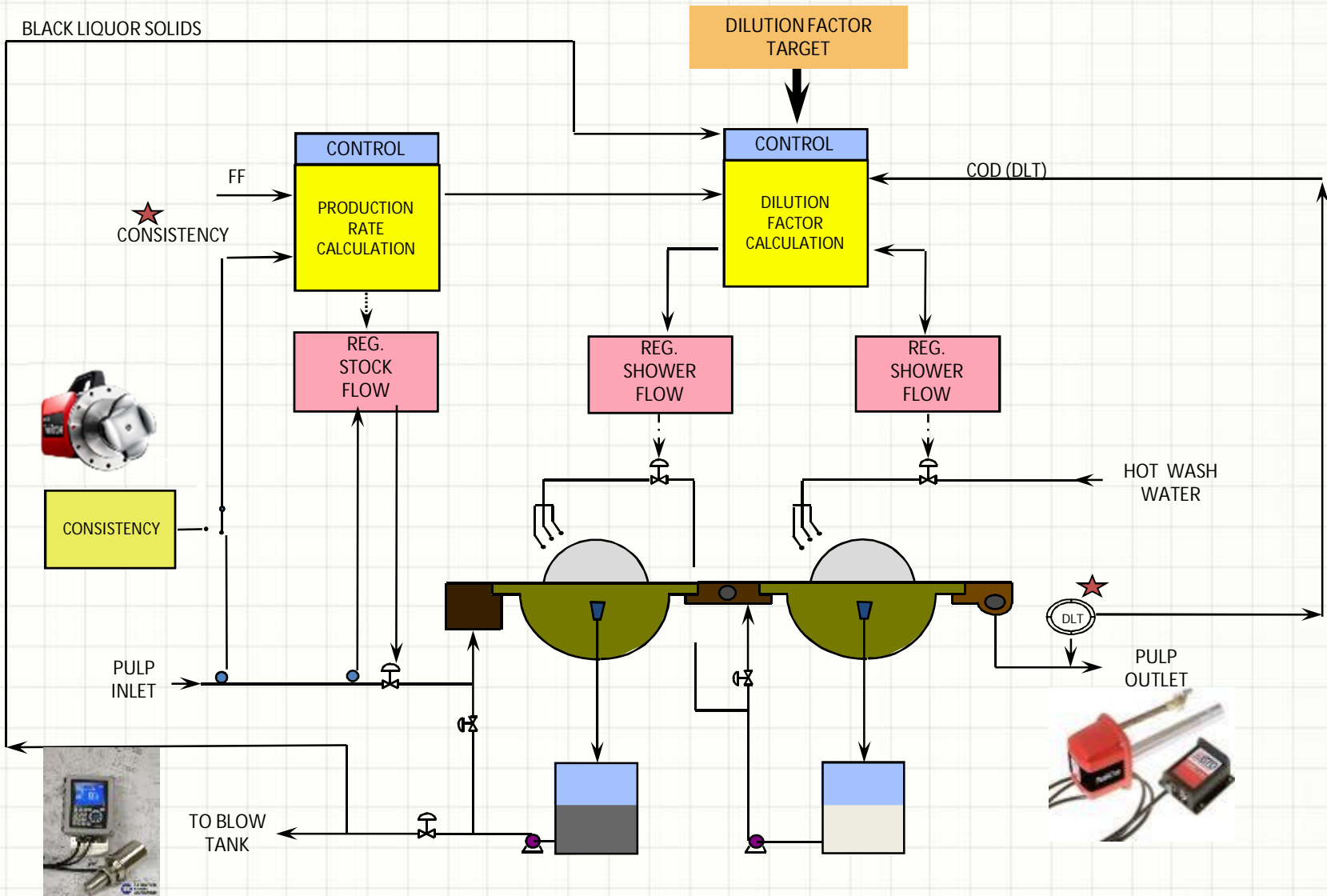
Typical Pulp Mass Variations on Last Stage Washer



January Observations



New Sensor Based Approach to Washer Control

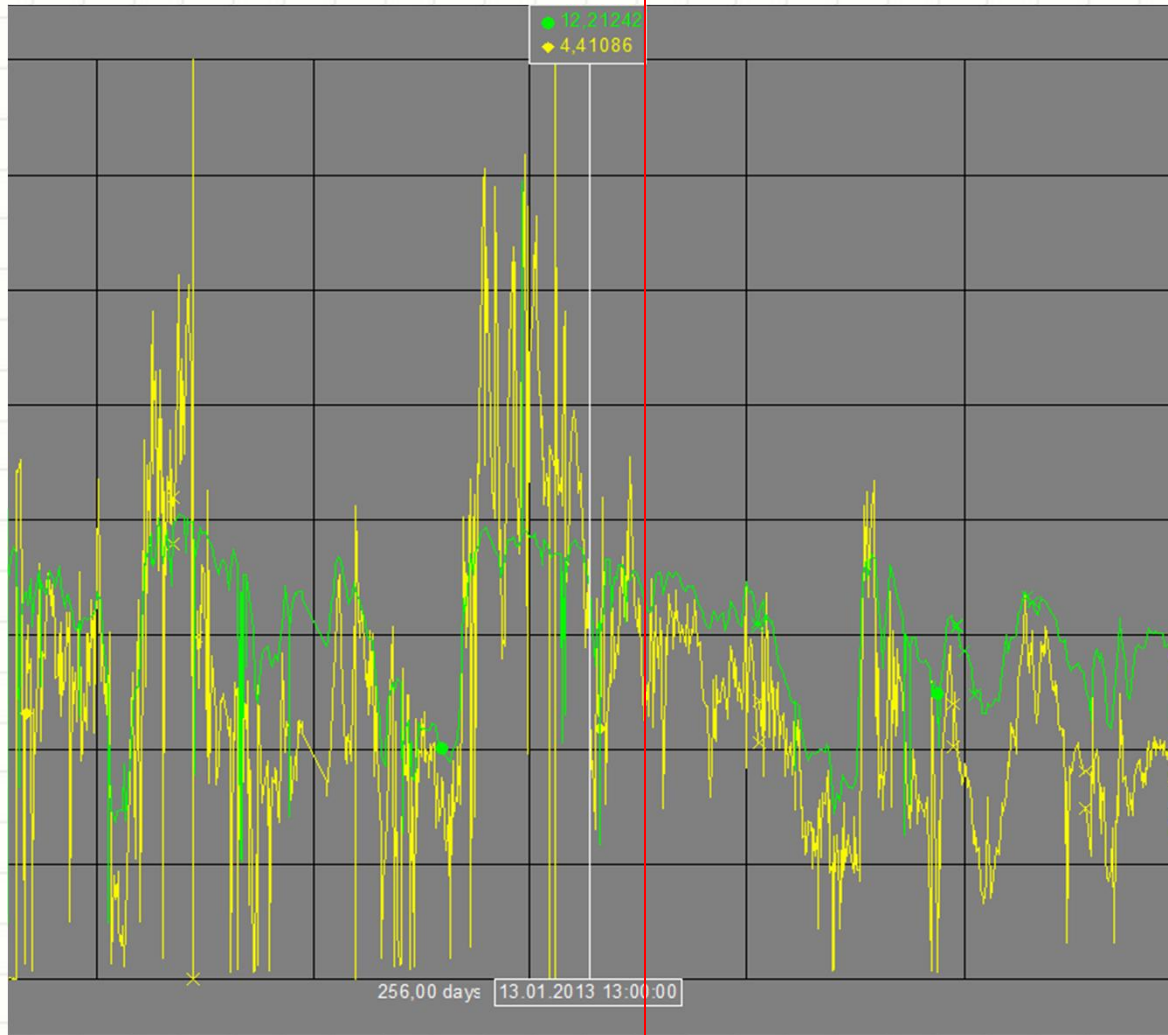


DLT- Dissolved Lignin Transmitter

- Measures UV absorption in filtrate portion of pulp suspension
- Correlate absorption to filtrate kappa, COD
- Correlation is excellent
- Applications:
 - Do Feed
 - Brown Stock washing
 - Board machine head box
 - Sulfite & Continuous digester recirculation
 - Pre O2 Delig
 - Waste water



Application Result



MANUAL CONTROL

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DF WITH DLT CONTROL

Benefits of Improved Control

- Minimize chemical losses to sewer
- Reduce chemical carryover to bleach plant and paper machine
- Control COD
- Optimize evaporator loading
- Lower use of defoamers
- Increase production
- Reduce operations demand

Savings in the range of \$2.00/ADT



QUESTIONS?