Consistency Measurement and Control In a Tissue Mill

The Often Neglected Parameter

May 1-4
PaperCon 2011
Northern Kentucky Convention Center
RETHINK PAPER:
Lean and Green

What is pulp consistency?

The weight of suspended solids per liter of liquid

$$\text{Total cons. (\%)} = \frac{\text{dry weight of sample}}{\text{total weight of sample}} \times 100$$

Units used:

1 % Cs = 10 g/l

1 g/l = 1000 mg/l

Why measure pulp consistency?

- **Simply to be able control it**
- **Controls basis weight of paper**
- **Optimum performance of process equipment**
- **Mass flow calculations. (Cons x Flow)**
- **Maintain ratio between fiber types**
- **Dosing of additives:**
  - *Fillers*
  - *Size*
  - *Chemicals*

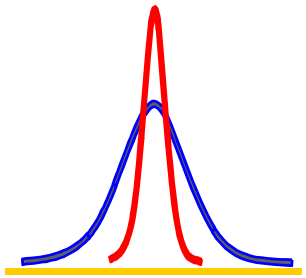
Or put another way……..

- Improve the bottom line
  - Reduce fiber usage
  - Optimize fiber blending ratio
  - Reduce energy usage
  - Reduce chemical usage
  - Improved process stability

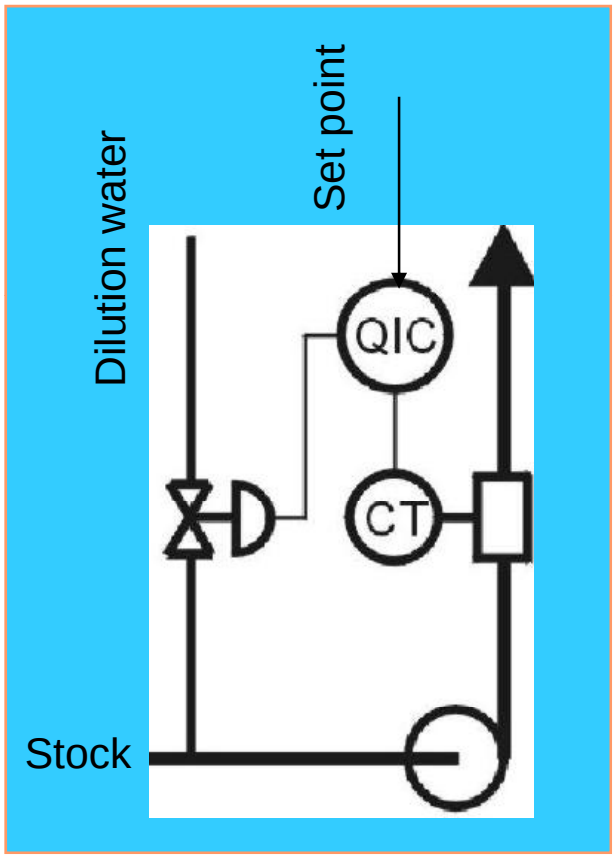
- There are no “Silver Bullets” in process control……
  - It all starts with consistency and flow control
  - Everything else builds off of and further improves control

Benefits of Consistency control

- **Adjust to optimum consistency:**
  - Process plant efficiency ($ & Tonnage).
  - Final product specifications.
    - Basis weight, Formation, Physical strengths.
- **Remove process variations:**
  - Optimum equipment performance.
    - Runnability, Paper machine MD & CD variations

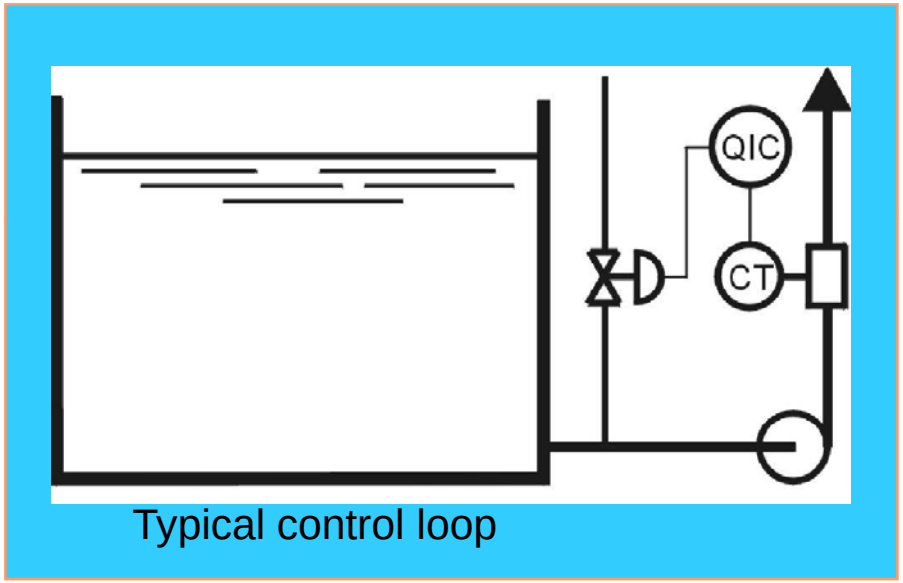


How consistency control works



- Consistency of the stock in the pipe is measured
- Measured result is compared to a set point in a controller
- The output from the controller affects an actuator on a dilution water valve
- The amount of dilution water is varied to alter the consistency to the set point

Consistency control loop



Typical control loop

- Pulp chest with agitator
- Stock pump
- Dilution water supply
- Dilution control valve
- Water injection
- Consistency transmitter
- Controller
- Sampling valve

All parts are important

The weakest link will decide the result!

Rules for good consistency control 1/4

- Dilution steps should be small:
  - The consistency should be reduced by no more than 20% in one step
- Ensure good mixing:
  - Correct mixing of the suspended solids and the water is essential
  - Design the system around the pump to take advantage of the pumps mixing ability

Rules for good consistency control 2/4

- Ensure good dilution:
  - The time required for the dilution to reach the pump should be short
  - The dilution water flow must not interfere with the free flow of stock to the pump
  - Dilution header pressure must be constant
    - A dilution water pressure change from 2.4 to 2.5 bar (35-40 psi) will change the Cs from 3.50 to 3.45%
  - Use a dilution control valve with a high resolution and suitable range

Rules for good consistency control 3/4

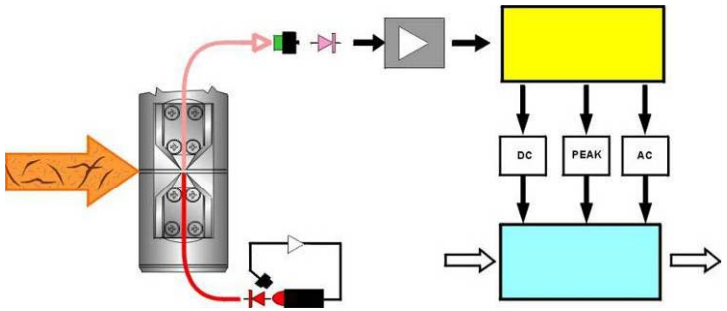
- Minimise dead time lag (transmitter type and position):
  - 2-3 sec Short
  - 6 sec Normal
  - 15 sec Too long

- Ensure good chest agitation:
  - The pump will mix stock and water when they arrive at the impeller together. The pump can't smooth out stock variations which are strung out along the suction line, which is why chest consistency variations travel.

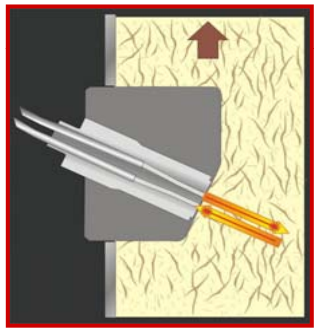
Rules for good consistency control 4/4

- Locate consistency transmitter correctly:
  - Follow the manufactures instructions for the piping run for the transmitter
    - Distances, velocities, pipe angles
- Mount consistency transmitter correctly:
  - Check if turbulent or plug flow is essential for the transmitter function
  - Mount the transmitter according to the manufactures recommendations
    - e.g.. Mounting is critical for blade transmitters which must be parallel to the stock in both planes

Comparing the techniques ……..

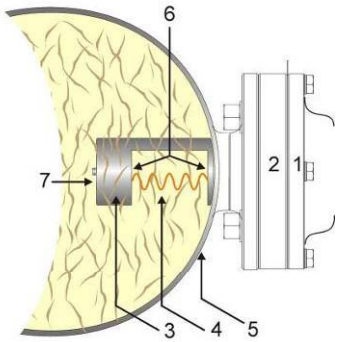


Optical - transmitted



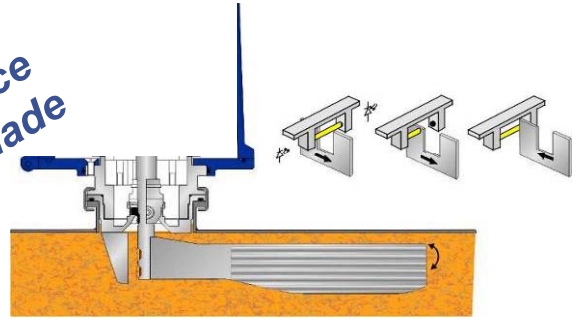
Optical - reflective

Microwave

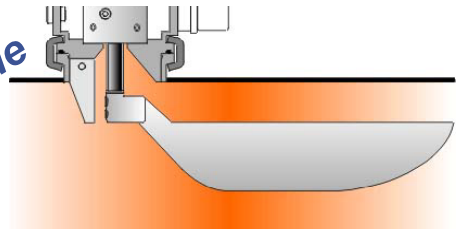


Shear force rotating

Shear force active blade



Shear force static blade

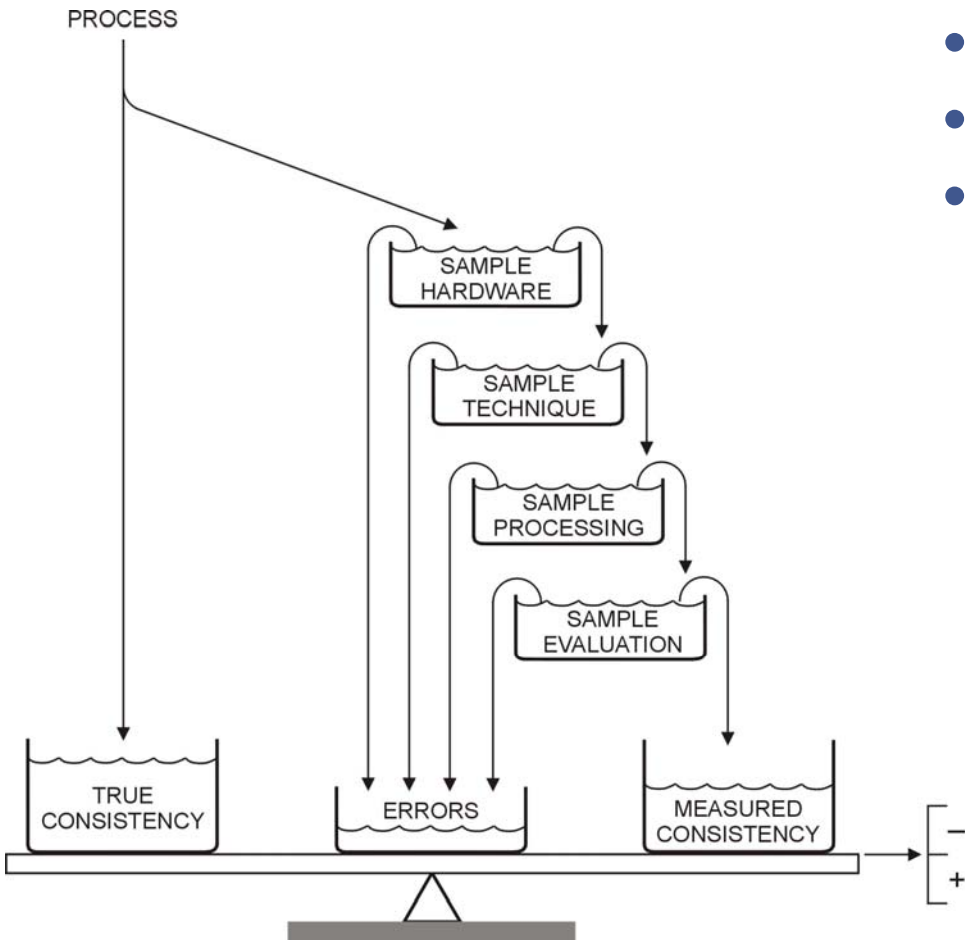


Selecting the right transmitter

- Consistency range
- Desired repeatability & accuracy
- Screened pulp
- Line pressure
- Conductivity
- pH
- Chemicals
- Gas content
- Flow & velocity
- Are fillers present and is their measurement important
- Calming distance available

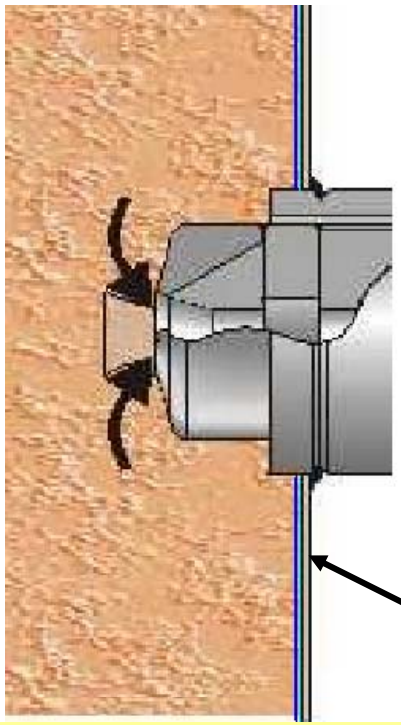
- Remember…….no transmitter type is best for all applications

Accuracy of sample



- Sampling method
- Sampling technique
- Lab equipment
- Lab repeatability
- Transmitter repeatability

A reliable sampling valve



- Takes the sample well inside the pipe wall – inside the water film!
- Always fully open
- Not depending on operator
- Safe and comfortable

The location of the sampling valve is important, it should extract the same sample as the consistency transmitter is measuring on

Thank you

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