

The background features a repeating pattern of interlocking gears in shades of light green and grey. On the right side, there are several overlapping, semi-transparent green geometric shapes, including triangles and polygons, creating a modern, industrial aesthetic.

# SHARP INDUSTRIES LLC

CONSISTENCY MEASUREMENT AND CONTROL



The background features a repeating pattern of light gray gears of various sizes. On the right side, there are several overlapping, semi-transparent green geometric shapes, including triangles and polygons, creating a modern, layered effect. The overall color palette is dominated by shades of green and gray.

# CONSISTENCY MEASUREMENT and CONTROL

Reducing Consistency Variations

## CONSISTENCY CONTROL IMPROVEMENTS

- Consistency Control is designed to eliminate short term variations in fiber flow through a stock line.
- Consistency Control can be simple Ratio Control.
- First Step is to eliminate the source of Cs loop variations in the process.
- Then focus upon improving the accuracy of the consistency measurement.
- Look beyond the Cs loop for sources of Consistency Variations.
- A new approach to effective sampling will help.
- Sharp Industries can help!

## Consistency Measurement Today:

- Repeatable Consistency measurement and control is crucial to the manufacturing of high-quality, uniform pulp and paper products.
- The Consistency Transmitter is a small, but important, part of a consistency control loop.
- Mills need to make Consistency work well to help your company reach its business objectives and keep your manufacturing costs down.
- Consistency can be well managed and controlled today.
- Sharp Industries has extensive consistency experience.

## Consistency Problems Today:

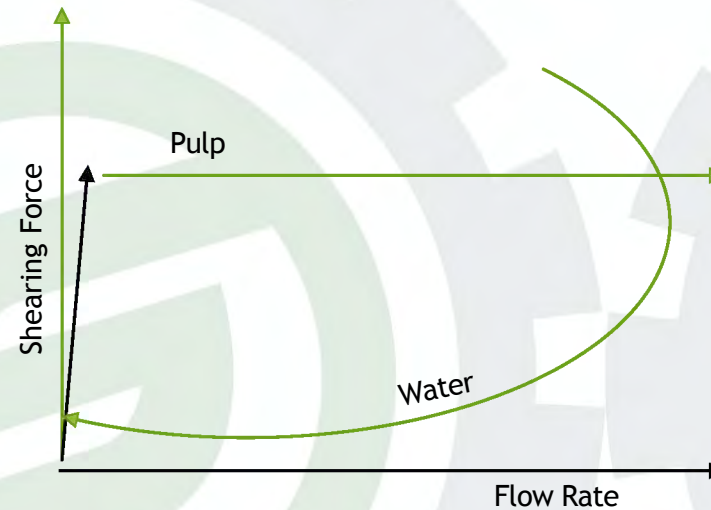
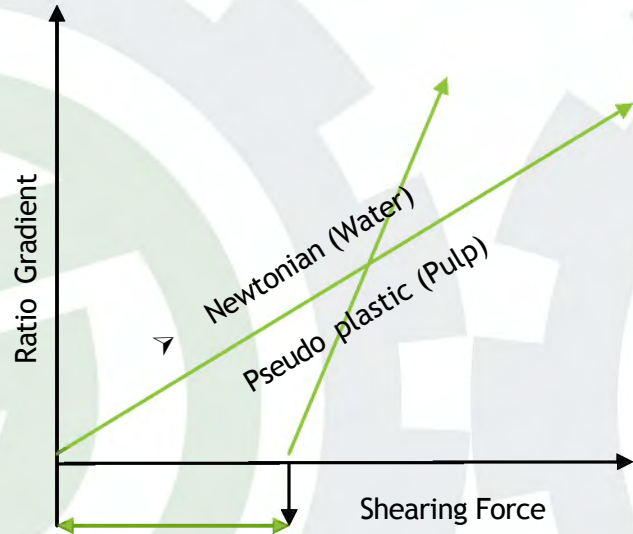
Less than 10% of all consistency measurement problems are related to the transmitter:

- Maintenance Issues
- Transmitter Performance Issues
- Application Issues
- Installation Issues
- Set Up issues
- Control loop tuning
- Calibration Issues

## OTHER CAUSES (90%) OF CONSISTENCY PROBLEMS:

- Incorrect selection of transmitter for application
- Stock Velocity / Flow variations - Demand
- Dilution Water Pressure (varies of too high)
- Incorrect Loop Tuning for the application
- Insufficient Chest / Tower Agitation / Retention time
- Process Response & sum of all loop Dead times
- Sample Extraction and Sample Handling
- Time Lag due to Transmitter Placement & Signal Dampening
- Valve Selection, Positioner & Performance
- Excessive Dilution Water velocity in pump Suction
- The Dilution Water Distribution System itself

# BEHAVIOR OF A PULP SLURRY



- Newtonian Fluid (Water, Syrup)
- Low internal friction
- Low Viscosity
  - Molecules move easily
- Flow can be achieved with a low differential pressure

- Pseudoplastic (Pulp, Ketchup)
- Entangled fibers
- Three Dimensional network
- Fibers bind in suspension
- Fibers prevent internal flows
- Fibers flow as a plug in the pipe

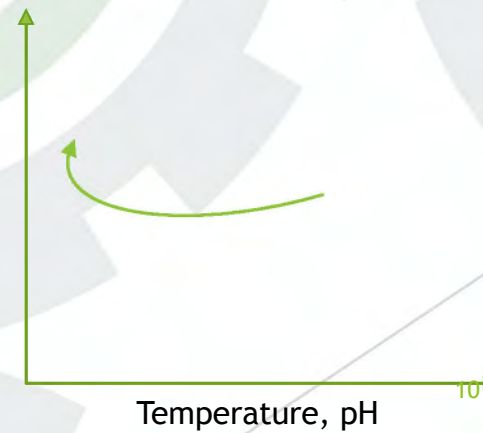
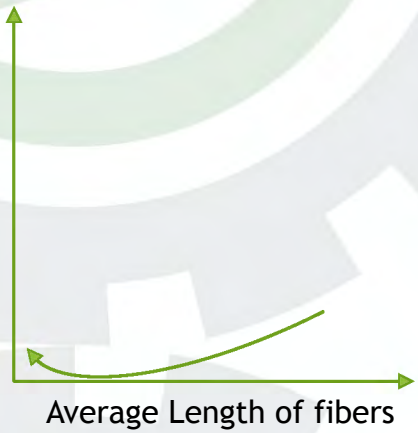
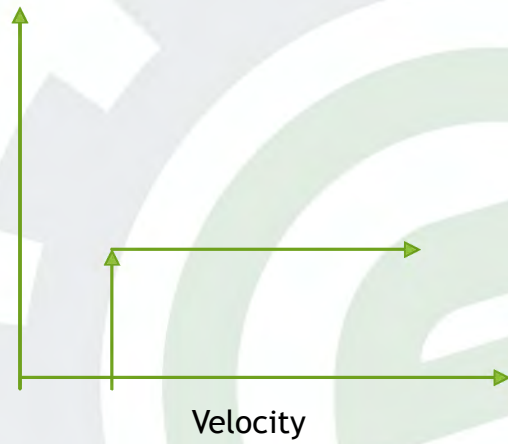


# MEASUREMENT PRINCIPLES AND TECHNOLOGY

- ❖ Shear Force
  - ❖ Rotary
  - ❖ Static Blade and Active Blade
- ❖ Optical
  - ❖ Absorption of Light
  - ❖ Transmission
  - ❖ Reflection
  - ❖ Polarization of Light
- ❖ Microwave
- ❖ Nuclear Energy
- ❖ Lasers
- ❖ Absorption of Ultrasonic Energy
- ❖ Others ??????

*Each of these technologies have their own interferences that must be accounted for in the Consistency loop design.*

# FACTORS THAT CAN AFFECT SHEAR FORCE



# TYPES OF CONSISTENCY TRANSMITTERS ON THE MARKET TODAY:

**Note: None measure Pulp Consistency !!!**

# MEASUREMENT PRINCIPLES, SENSITIVITIES

## ▶ Shear Force Principle - Blade & Rotary

1. Measures Fibers Only
2. Does not measure Fillers
3. Kappa / Freeness affects to measurement slightly
4. Wood type / Species sensitive
5. Flow Rate limits (rotary not as sensitive)

## ▶ Absorption / Reflection of Light

1. Fillers sensitive
2. Freeness sensitive
3. Fiber length sensitive

## ▶ Absorption of Nuclear Energy

1. Air
2. Density of liquid
3. Atomic No.

## ▶ Microwave

1. Conductivity limitations
2. Air effects

# ROTARY TRANSMITTER INSTALLATION

- ▶ Rotating type consistency transmitter does not need as long calming length as blade type transmitter because it is installed in installation one just side of main pulp flow.
- ▶ Low consistency 1.5 to 8%:
  - ▶ Calming length  $L_{\text{before}}(\text{mm}) = 3 * D$ , or at least 1 m, whichever is longer
  - ▶ Calming length  $L_{\text{after}}(\text{mm}) = 1 * D$
- ▶ Medium consistency 8 to 16%:
  - ▶ Calming length  $L_{\text{before}}(\text{mm}) = 1,5 * D$  or at least 0.5 m, whichever is longer
  - ▶ Calming length  $L_{\text{after}}(\text{mm}) = 1 * D$
- ▶ Select always installation point thinking about good measurement, not only easy access for maintenance.

# MICROWAVE TRANSMITTER INSTALLATION

- ▶ Microwave consistency transmitter measures consistency across the whole pipe and is not sensitive for turbulence.
  - ▶ It can be installed just after the pump so that antennas are in 90 degree angle to the Pump shaft and valve shaft
- ▶ If transmitter is not installed just after the pump, the calming length is as follows:
  - ▶ Low consistency 1.5 to 8%:
    - ▶ Calming length  $L_{\text{before}}$  (mm) =  $3 * D$ , or at least 1 m, whichever is longer
    - ▶ Calming length  $L_{\text{after}}$  (mm) =  $1 * D$
  - ▶ Medium consistency 8 to 16%:
    - ▶ Calming length  $L_{\text{before}}$  (mm) =  $1,5 * D$  or at least 0,5 m, whichever is longer
    - ▶ Calming length  $L_{\text{after}}$  (MM) =  $1 * D$
- ▶ Select always installation point thinking about good measurement, not only easy access for maintenance.

# RECOMMENDATIONS

- ▶ Control Flow Variations
- ▶ Proper Agitation is critical
- ▶ Constant Dilution Water Pressure mandatory
- ▶ Max. Consistency Reduction 0.5%
- ▶ Dilution Water Velocity limit below 1,2m/s (4fps)
- ▶ Dilution Valve operating Range & Type
- ▶ Reduce Dead time-location / choice transmitter
- ▶ Select Cs Measurement Device by application
- ▶ Choose Good Sample Valve & Procedures
- ▶ Design Cs loop to work well - Tune accordingly

# BLADE APPLICATIONS

- ▶ Measures fiber consistency 2 - 14%
- ▶ Suitable for one type of pulp without filler
- ▶ Different wood species have different calibration lines
- ▶ Needs laminar flow min 0,5 m/s
- ▶ Insensitive for flow rate, pressure and temperature



# ROTARY APPLICATIONS

- ▶ Measures pulp consistency 1,5 - 14%
- ▶ Different wood species have different calibration lines
- ▶ Measures also in turbulence and slow flow
- ▶ Insensitive for flow rate, pressure and temperature
- ▶ One point Calibration

# MICROWAVE APPLICAITONS

- ▶ Gets more justified closer to the Paper Machine and in accurate pulp production measurement
- ▶ Most accurate solution
- ▶ Not sensitive for flow changes
- ▶ Mixed Pulps and fillers
- ▶ Broke
- ▶ Recycled Pulps



## SATRON Strobe Consistency Measurement

SETTING A NEW PERSPECTIVE ON THE MANAGEMENT AND CONTROL OF CONSISTENCY AND OTHER ANALYZERS!