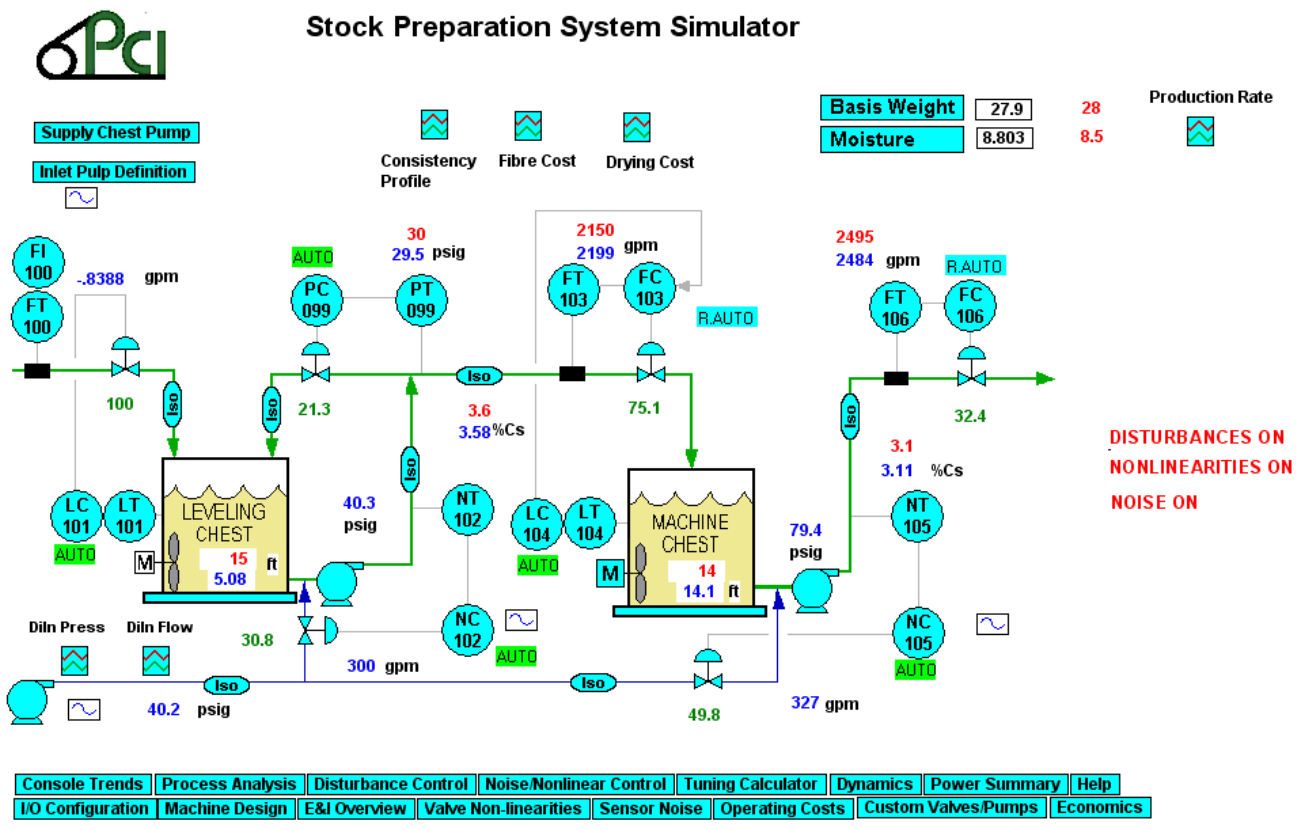




Operator Process Control Troubleshooting Training

It is generally recognized that high process variability compromises the economic performance of pulp and paper processes through higher operating costs and lower production rates. The primary activity of process operators and supervisors is to monitor the process from the operator interface. They are therefore the first point of attack in identifying and troubleshooting process variability problems. However, they often lack the understanding of process variability and control loop performance issues necessary to effectively identify or troubleshoot these problems. The intent of this course is to give operators the tools to more effectively identify and communicate variability issues.

The operator course is a practical, results oriented course designed to give the attendees the basic skills and tools to identify process control and variability problems. Approximately 40% of the course is devoted to a computer-based DCS-like process simulator, where the student practices the concepts presented during the lectures.





Operator Process Control Troubleshooting Course

Day 1

Lecture 1 Introduction & process variability basics

08:00 – 9:30 What is process variability, measuring the variability, impact on business performance, review of process control and variability terminology, overview of control loop components

Lecture 2 Introduction to process dynamics

9:30 – 10:30 Understanding flow, pressure, consistency, and level loop dynamics

Lab 1 Process dynamics

10:30-12:00 Measuring the process response to controller output step tests
Symptoms/causes of poor/unacceptable process dynamics
Impact of control valve problems on process variability

Lecture 3 Understanding control loop performance

1:00 - 3:00 Understanding / measuring control loop performance - level loops versus flow, pressure, consistency loops
Impact of the controller on process variability
Limitations of the control loop
Symptoms of poor control loop performance
Process response to setpoint changes and disturbances in closed loop
Impact of tuning constants on control loop performance

Lab 2 Control loop performance

3:00 – 4:30 Investigating the impact of tuning on control loop performance
Investigating the impact of control valve problems on control loop performance

Day 2

Lecture 4 Troubleshooting control loop variability problems

8:00 – 9:30 Documenting the problem
Is the problem caused by the control loop?
 Conducting auto / manual tests
 Conducting open loop / closed loop step tests
Recognizing controller tuning problems
Recognizing control valve problems

Lab 3 Troubleshooting control loop variability problems

9:30 – 11:30 Identifying problems / solutions of control loop problems

Lecture 5 Reducing variability through process mixing

11:30-12:00 Is the stock chest agitation adequate?
Impact on stock consistency variability

Lecture 6 Understanding the sources of product variability

1:00 – 2:30 How does variability propagate through the process
Techniques to identify the sources of product variability
Quantifying the impact of variability on process performance

Demo

2:30 - 3:30 **Tracking the sources of product variability**

Wrap-Up and Discussion

3:30 – 4:30



Operator Process Control Troubleshooting

Target Audience:

- Process operators, Shift supervisors, Production Engineers.

Learning Outcomes

- The overall objective is to strengthen the ability of the operator in the following areas.
 - Identifying and characterizing process variability
 - Understanding the sources of process variability and how variability propagates through the process system
 - Understanding the functioning and capabilities of the control loop in reducing variability
 - Recognizing poor / unacceptable control loop performance
 - Poor loop dynamics such as excessive deadtime
 - Control valve problems such as backlash and stiction
 - Controller tuning problems
 - Excessive filtering
 - Communicating process control and variability problems to engineers and technicians
 - Troubleshooting of control loop problems
 - Understanding the role of stock chest agitation in reducing high frequency variability
 - Understanding the impact of process variability on product quality

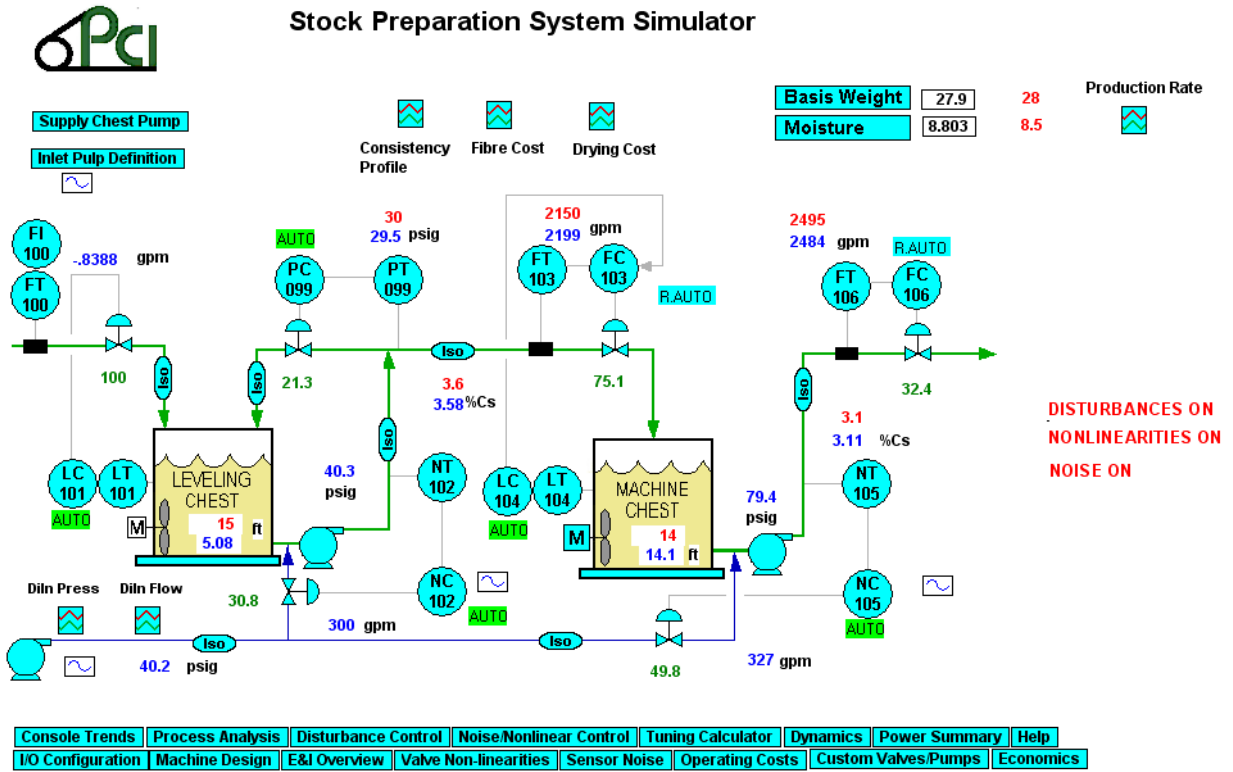
Concepts that will be covered

- Definition of process variability
- Sources of process variability – raw materials, process equipment, control loops
- Economic impact of process variability – production rates, operating costs
- Control loop fundamentals and terminology
- Overview of process dynamics for the most common loops
- Control valve problems (backlash and stiction) that compromise control loop performance
- Function of the control loop
- Tuning methods / Lambda tuning
- Analytical control loop troubleshooting procedures
- Impact of process mixing on variability – measuring the effectiveness of stock chest agitation
- Linking process variability to product quality
- Troubleshooting product quality problems



Problem and Solution Examples

Approximately 50% of the 2-day course is spent in the stock preparation area process simulation lab. A lab follows each lecture, where the concepts presented in the lecture are applied. There is a major control loop-troubleshooting lab where the students are required to investigate the ultimate source of a process variability problem. The diagnostic procedures introduced in the troubleshooting lecture are used to identify the source of the problem.



Problem 1

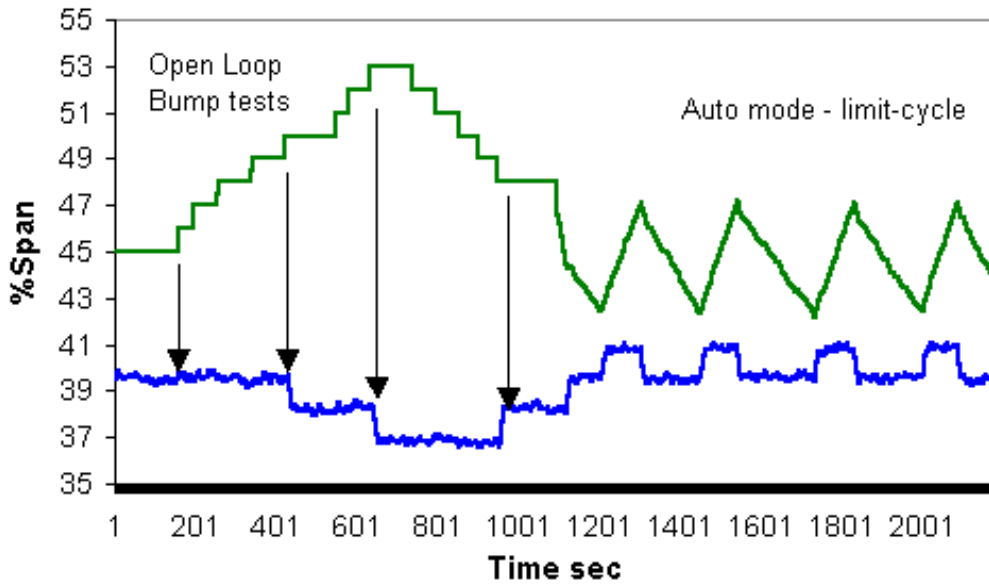
Description:

Operations have noticed a high degree of variability in the Machine Chest Consistency loop NC-105. The loop appears to cycle under normal operating conditions.

Solution:

The square shape of the consistency cycle in auto mode indicates that the problem is related to the control valve. By placing the loop into manual mode and conducting a series of bump tests, the valve is found to be 'sticky'. The operator recommends that the valve be repaired on the next shutdown.

Stiction-Induced Cycle



Problem 2

Description:

In the past, the Flow to the Machine Chest loop FC-103 has been reported to be very sluggish, with the flow taking a long time to reach Setpoint. When the flow loop is in Cascade mode both the Flow to the Machine Chest FC-103 and the Machine Chest Level LC-104 appear to have a cycle with a period of several minutes.

Solution:

The level and flow loops cycle continuously in normal operating conditions. The flow to the machine chest (blue) is not tracking the remote setpoint (red) adequately. When the level controller is placed into manual mode, the cycling in both the level and flow stops. This indicates a tuning mismatch between the level and flow loops. The flow controller setpoint response test indicates that the flow tuning is unnecessarily slow. The operator recommends that the control loop be retuned so that it is fast relative to the level loop.

