

Omni Process Solutions

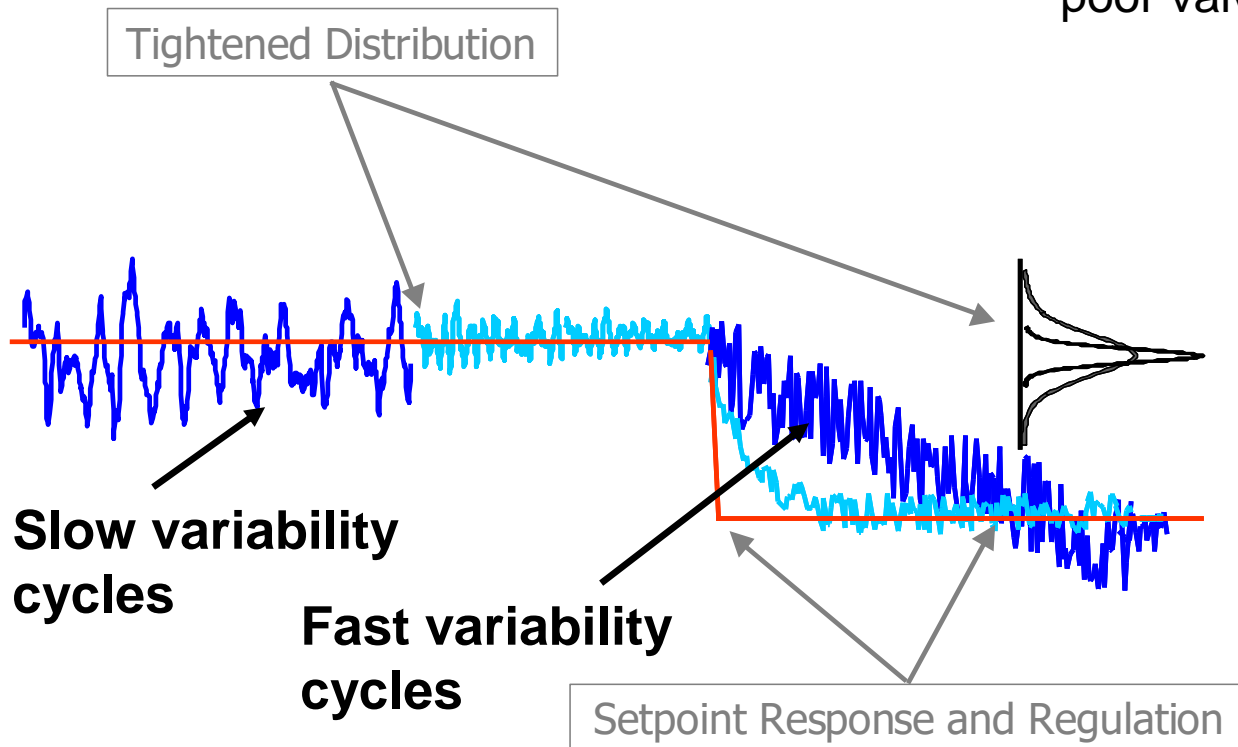
“Dedicated to Optimizing Process Operations”

Process Optimization Surveys

Introduction - Sources of Process Variability

There are many sources of process variability.

- **Raw material inputs**
 - Material input
 - Energy Input
- **Process Equipment**
pump/screens, cavitation, agitation, pipeline design
- **Control Loop Performance**
poor valves, oscillatory tuning



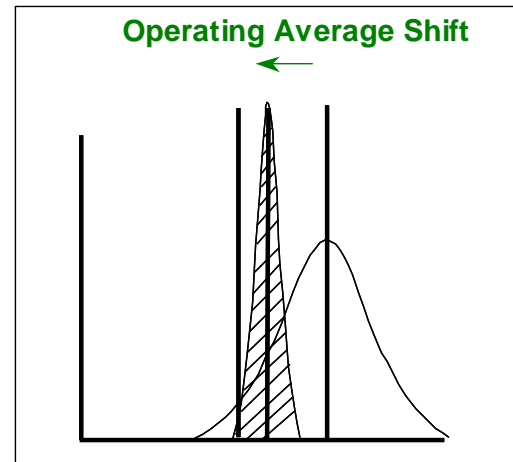
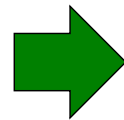
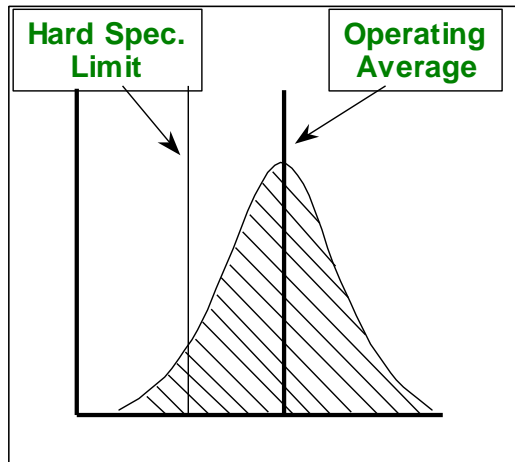
Introduction – Why Reduce Variability?

➤ *Variability reduces production rate through*

- Increased Off Grade
- Reduced Operating Efficiency
- Exceeding Equipment limitations

➤ *Variability increases operating cost*

- Raw material application is unnecessarily high due to conservative targets
- Raw material usage inefficiency

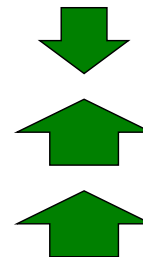


Minimizing variability creates the potential for production increases and operating cost reduction through target shifting

Chemical, Material and Energy Cost

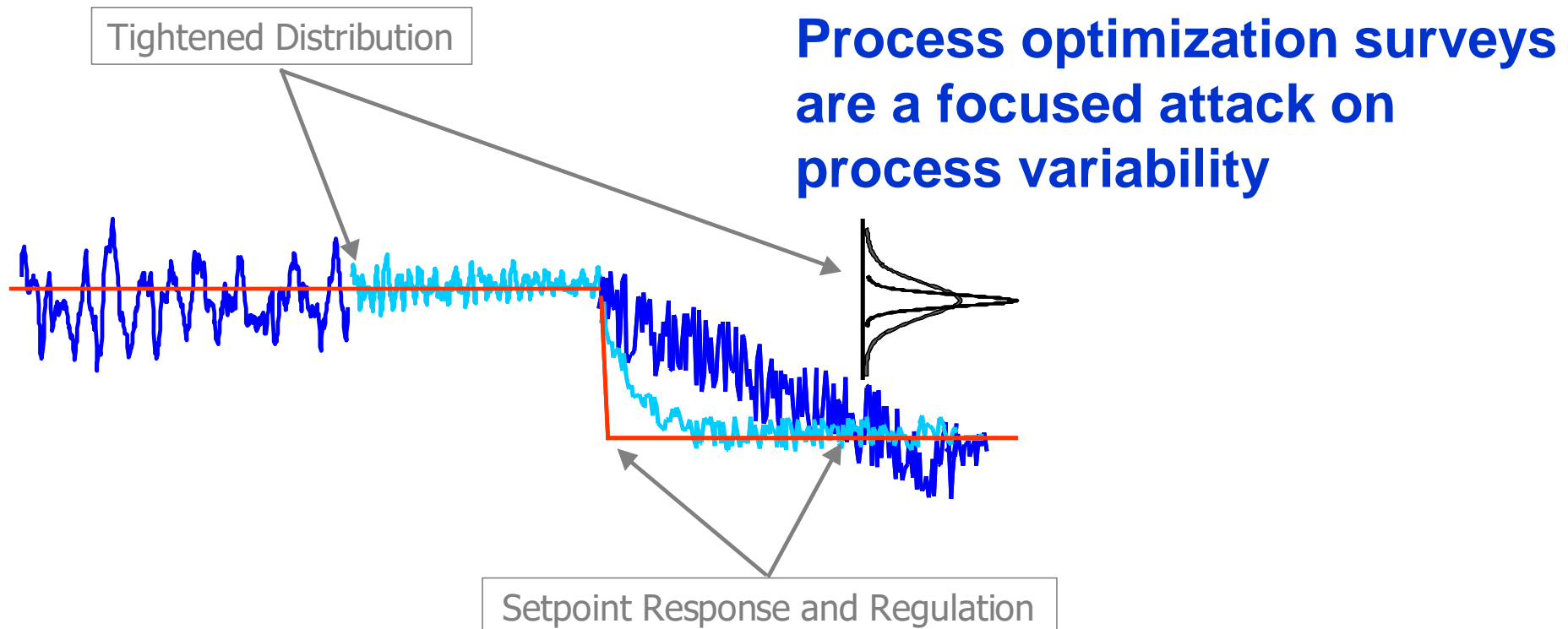
Productivity and Yield

Product Quality



Introduction – How to Reduce Variability?

- Eliminate the source of the variability - if possible
- Optimize control performance to minimize slow variability
- Optimize process mixing to minimize high frequency variability



Process Optimization Surveys

What are the Objectives?

- **Improve overall process performance**
 - **Reduce variability in the key process variables**
 - **Improve product quality**
 - **Improve operating efficiency**
 - **Improve maintenance efficiency**

Process Area Optimization Surveys

What's involved?

- **Document process / product variability**
- **Identify the sources of variability in the product**
 - Product variability is caused by process variability at the same frequency
- **Identify the ultimate sources of process variability**
 - Auto/Manual tests, Open loop bump tests, Setpoint bump tests
 - Retune control loops where appropriate to improve performance
- **Document Findings and Prepare Summary Report with a Path Forward**

What are the Sources of variability? Process Equipment

- **The process equipment is usually a significant contributor to process / product variability.**
 - **Poor tank mixing**
 - **Pump cavitation**
 - **Piping design**
 - **Rotating elements**
 - **And many others**
- **The source of the variability needs to be identified before the problem can be fixed.**

What are the Sources of variability?

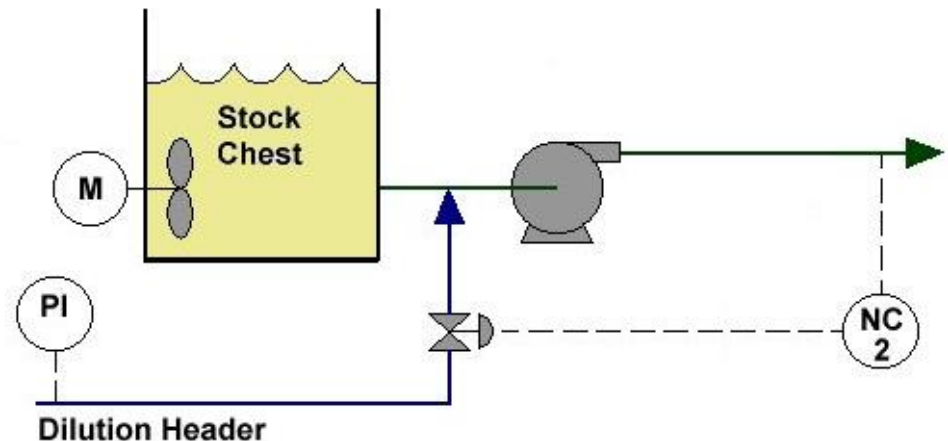
Poor Control Loop performance

The majority of control loops do not perform to their potential.

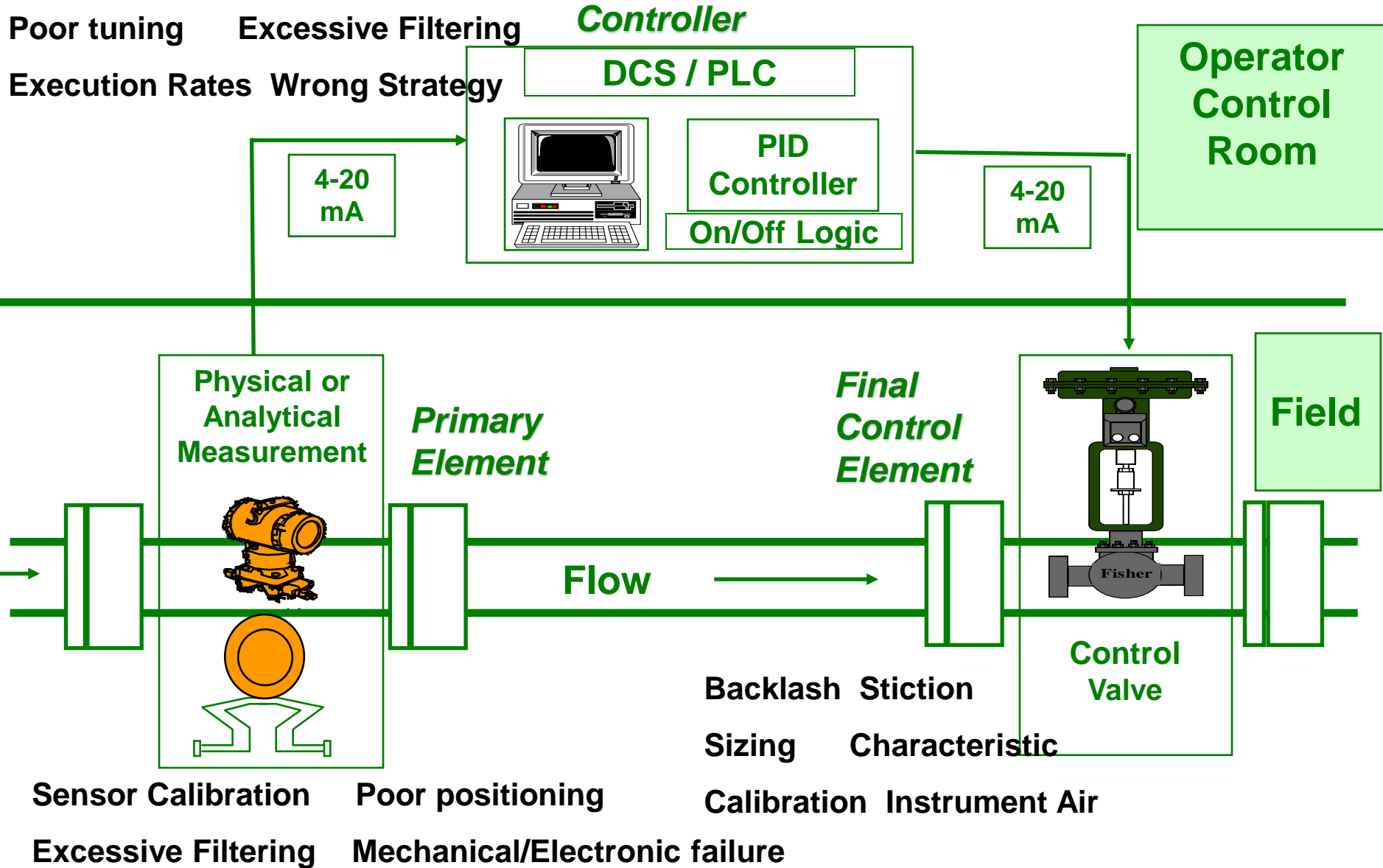
- A significant fraction of control loops actually *increase* process variability.

The main reasons for this - in order of importance:

- **Loop Health (mechanical issues backlash/stiction)**
- **Poor Tuning**
- **Loop design problems**
- **Control strategy design**

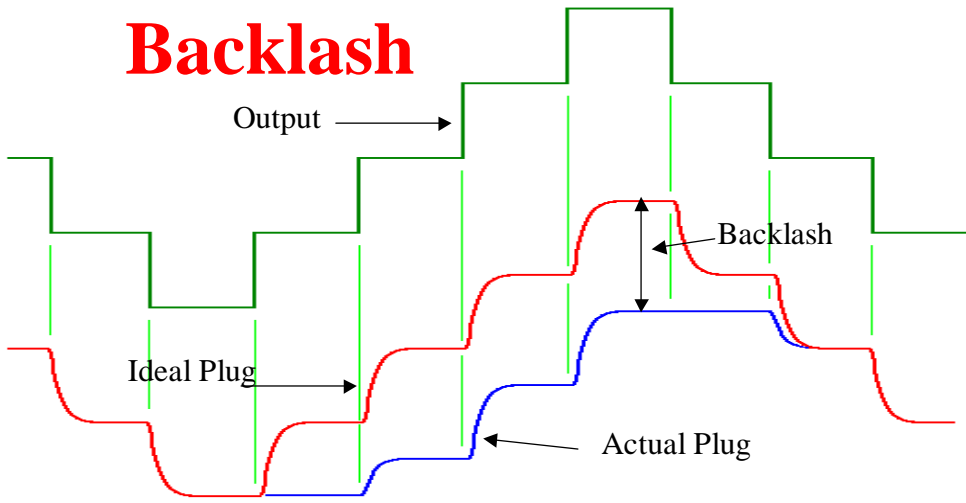


Poor Control Loop Performance – primary causes

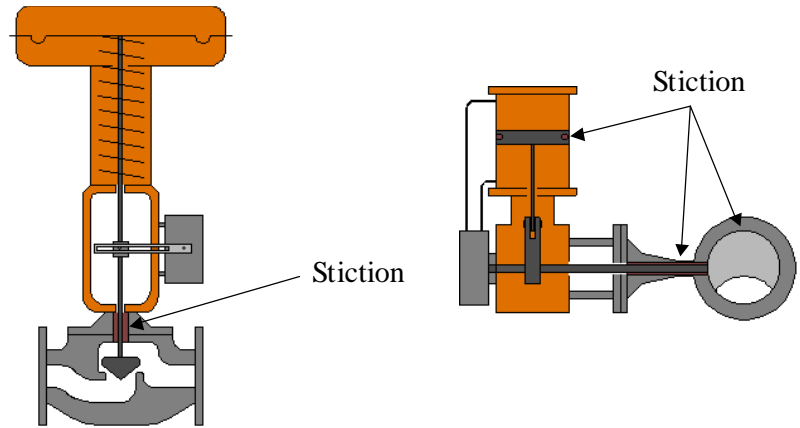
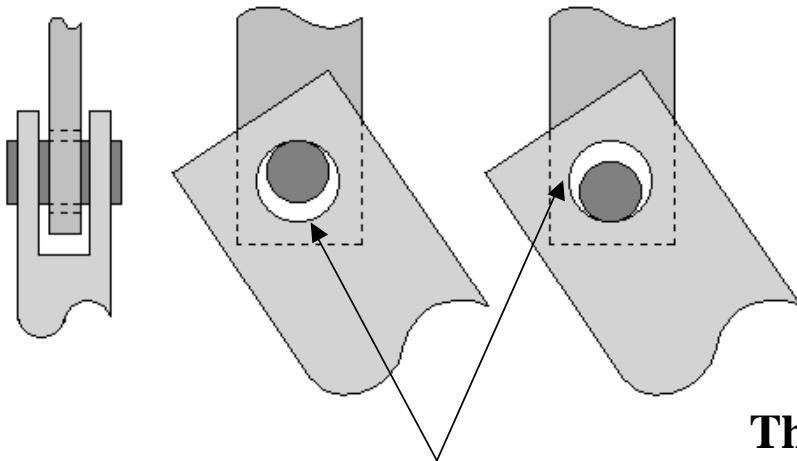
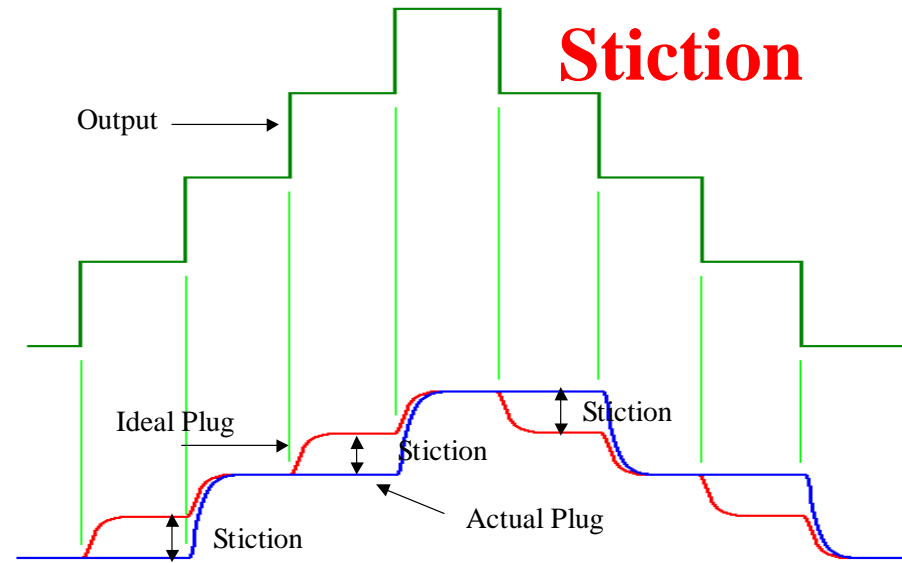


Poor Control Valve Performance

Backlash



Stiction



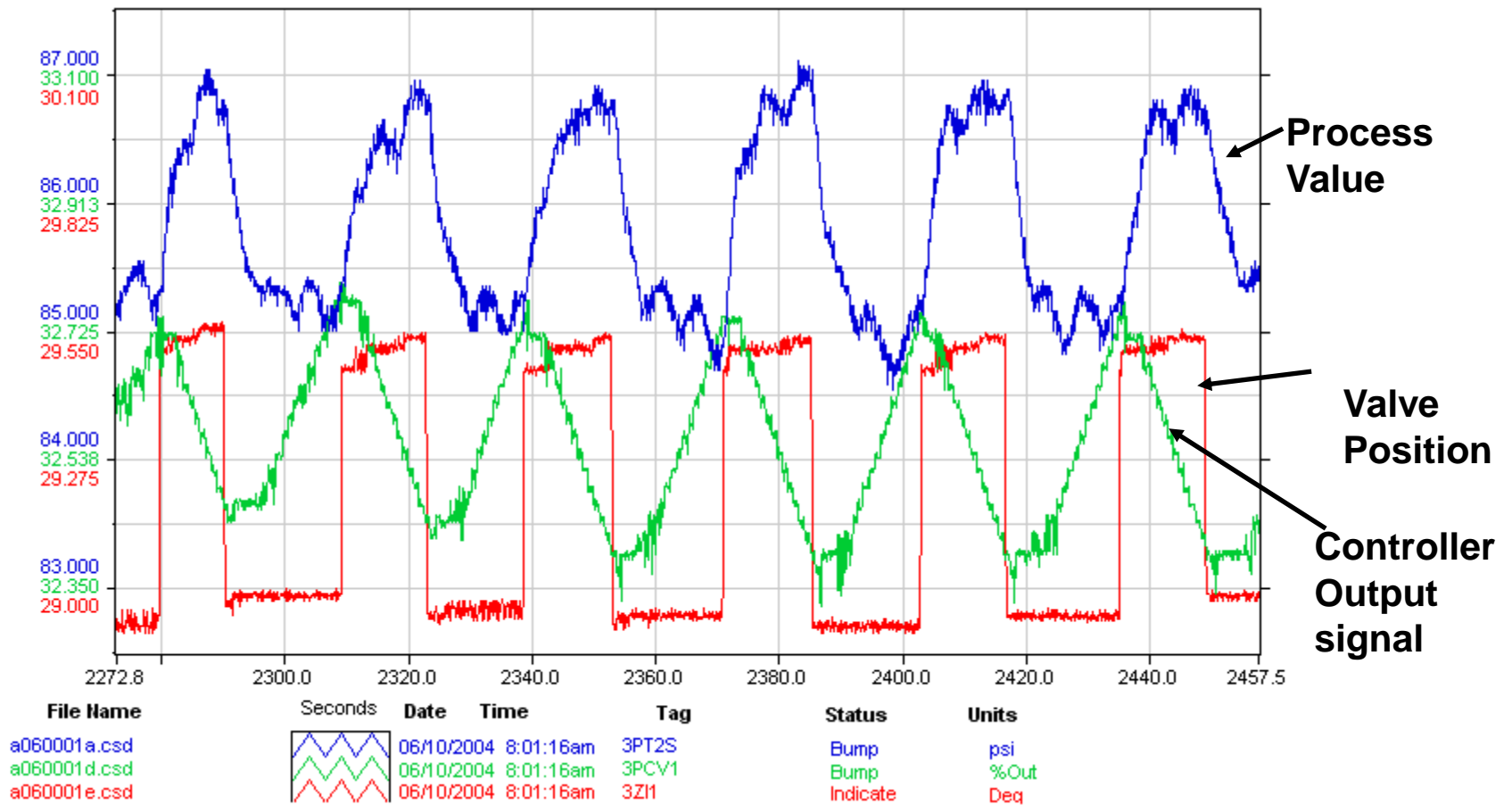
Distance actuator shaft must move before valve plug will start to move

The metal to metal or metal to packing contact is not frictionless. The valve must overcome the static friction before it will move.

Poor Control Valve Performance

The control valve problem is generating process variability.

1/ Identify the problem with the pressure control valve shown below

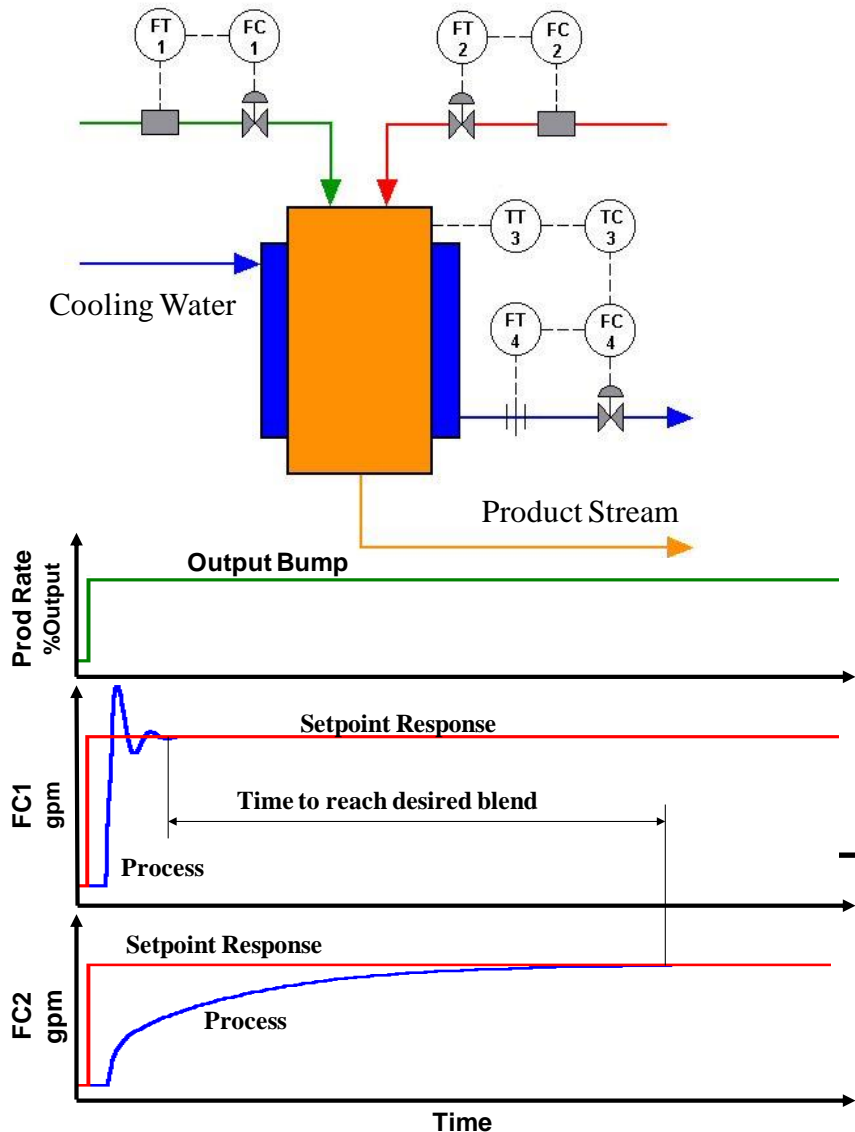


Poor Controller Tuning

Controller Tuning (P I D)

- **Optimized controller performance cannot be achieved by guesswork**
- **A scientific, structured tuning method is required**
- **Lambda tuning is recommended**
 - **Produces a smooth response without cycling or overshoot.**
 - **Allows the user to choose the closed loop time constant (Lambda).**
 - **Allows multiple loops to be tuned to have the same response.**
 - **Allows cascaded loops to be properly matched.**
 - **Allows interactive loops to be decoupled by tuning one slower than the other.**
 - **Allows the maximum non-resonant band-width to be selected for disturbance rejection.**
- **Improving control loop performance by retuning is low hanging fruit.**

Poor Controller Tuning



The tuning is optimized when it supports the process objectives. Often the tuning of several loops has to be coordinated to achieve the best overall result.

The E&I mechanic needs to understand how to calculate tuning constants to achieve the desired response.

The *Lambda* tuning method is recommended. It allows the tuner to select a speed of response.

Different flow responses mean that the fibre ratio is not maintained constant during a production rate change

Identical flow responses mean that the furnish ratio is maintained constant during demand changes

Process Optimization Surveys Recommendations

- **Loop Health Maintenance** (inexpensive)
 - Repair/Replace Valve due to backlash/stiction
 - Sensor calibration
- **Controller Tuning** (inexpensive)
 - Retune loop to optimize performance
 - Coordinate tuning (cascaded loops, interactive loops)
 - Implement tuning strategy to minimize variation in key processes
- **Control Strategy Design** (medium cost/effort)
 - Implement advanced strategy (cascade, ratio, feedforward)
 - Eliminate unnecessary controllers
- **Process Design** (higher cost/effort)
 - Repositioning of sensors
 - Resizing valves, pumps
 - Addition of pumps to decouple loops
 - Upgrade stock chest agitation

Summary

- The overall goal of optimization surveys is to reduce variability in the key process variables. This will result in improved product quality, an increase in operating and maintenance efficiency and a reduction in operating costs
- The control loop plays a crucial role in minimizing slow process variability. The majority of control loops do not perform to their potential due to poor process / loop design, flawed control strategies, control loop health problems such as valve backlash and stiction, and poor tuning. There is a high payback in improved control loop performance.
- The survey recommendations address loop health problems, controller retuning, control strategy modifications and process design changes.
- Implementing the recommendations is a crucial component of success
- **Thanks for your interest**
- **For more information call us at : 604 – 922- 9524**

**Or email us at : dougnelson@omniprocesssolutions.com
alexmardon@omniprocesssolutions.com**