Process Control Optimization Surveys

Lost Efficiency / Product Variability

The aim of the process area optimization survey is to *reduce or even eliminate* process variability that is compromising operational efficiency and product quality. There are hundreds of reasons for process variability. These reasons are categorized and described below.

Process Design

A flaw in the process design is often the fundamental reason for high process variability. The following are some examples of common design defects:

- *Variability pathways* that move variability from relatively unimportant processes directly to key processes.
- *Inadequate process mixing or variability sinks* that allow high frequency process variability to pass through to the product.
- *Control loop design* that results in process dynamics that severely limit control capability. Excessive deadtime due to poor sensor positioning is very common. Control valve over-sizing increases process variability and limits control resolution.
- *Pump/pipeline design* that results in poor process control dynamics, excessive coupling between processes, energy and material losses. Pump over-sizing not only increases energy costs but usually degrades control performance.
- *Inadequate instrumentation* that increases the difficulty of diagnostics and optimization.

Control Strategy

The control strategy must be developed analytically in order to achieve the best design. Often the design simply defaults to the most commonly used strategy or the strategy that was used the last time. These approaches do not yield the best strategy, particularly where there are multiple, interactive control loops. The survey team addresses the following issues:

- Is the design fully consistent with the process objectives of the system?
- Does the strategy compensate adequately for the major process disturbances?
- Are the dynamics of the resulting control loops linear? Some alternatives appear attractive but carry built-in non-linearities, resulting in uneven control performance.
- Does the strategy minimize interaction between the control loops in the process system?
- Is the control strategy understandable to the operators?

Modifying the control strategy can reduce process / product variability *without* the need for more complex algorithms such as adaptive controllers and fuzzy logic.

Control Loop Health Problems

The process variability is often higher in auto mode than in manual mode. One reason for this is that some element of the control loop is not functioning properly. Common control loop health problems include:

- Excessive control valve deadband that compromises control capability or causes limit cycling.
- Malfunctioning sensors that results in the loop operating in manual mode
- Inadequate A/D resolution that results in a control induced limit cycle
- Unnecessarily high sensor filtering
- Poor sensor calibration
- Plugged impulse lines that result in a heavily damped process signal

Tuning

Controller tuning is often a guessing game. This approach rarely leads to optimized control and sometimes is responsible for process cycling – increasing the variability.

For the majority of process areas a tuning strategy needs to be developed. The tuning of the control loops must be coordinated so that variability in the key process is minimized. The Lambda tuning method is preferred since it lends itself to the implementation of a tuning strategy.

Optimization Survey - Objectives

The optimization survey reduces process variability by improving process performance through *increased operational efficiency, reduced raw material costs, and improved product quality*.

- *Operational efficiency* improvements will be achieved through reduction in process down-time, and off –quality product.
- *Raw material* cost will be reduced through improved feedrate control, improved energy efficiency and chemical addition control. This improved control will permit target shifting.
- *Product Quality* will be improved through reduced variability in the key process loops.

HOW CAN PRONAMICS HELP?

Our surveys begin with a review and analysis of the key product/process variables.

High speed data acquisition equipment is used to collect process data. Time series analysis tools are used to identifying variability sources. Coupling tests are conducted to quantify the impact of the source on variability. Open loop bump tests are conducted to define the loop process dynamics and provide insight into control valve non-linearity and loop design problems. Controllers are retuned where appropriate to improve process stability. Process simulation tools are used to assist in identifying process variability problems and to develop 'best practice' recommendations.

Some immediate gains are achieved during the site visit through controller tuning and operating changes. Further gains are achieved through improvements to control loop health. This is typically followed by control strategy modification to improve control capability. Process design modifications are also recommended.