HC900 Drum Level Control

Application Brief

Industry: All

Background

Until recent years, only the largest boilers could justify sophisticated boiler controls. Now high fuel costs and occasional limited fuel availability make it necessary to improve boiler efficiency and minimize costly steam losses and disturbances.

Government regulations force compliance with air pollution and safety standards. Drum level controls have also become more important because boiler loads are being varied to meet needs rather than operating at full capacity and wasting fuel and steam.

The effects of pressure surges and steam flow on drum level dictate more complex controls on this important parameter.

The HC900 Solution

Modern controls such as the HC900 Hybrid Controller can provide the most efficient boiler operation.

Drum Level Control. The steam drum is an integral part of a boiler. The vessel's primary function is to provide a surface area and volume near the top of the boiler where separation of steam from water can occur. It also provides a location for chemical water treatment, addition of feedwater, recirculation water, and blowdown.

Blowdown removes residue and maintains a specified impurity level to reduce scale formation. Because these functions involve the continual addition and loss of material, the water-steam interface level is critical.

Low level affects the recirculation of water to the boiler tubes and reduces the water treatment effectiveness.

High level reduces the surface area and can lead to water and dissolved solids entering the steam distribution system.

The objective of the drum level control system is to maintain the water-steam interface at the specified level and provide a continuous mass balance by replacing every pound of steam with a pound of feedwater.

The interface level is subject to many disturbances. Steam pressure is a major one. As steam pressure changes due to demand there is a transient level change due to the effect of pressure on entrained steam bubbles below the steam drum interface level. As pressure drops, a rise in level, called *swell* occurs because the trapped bubbles enlarge. As pressure rises, a drop in level occurs. This is called *shrink*.

Types of Drum Level Control. There are 3 basic types of drum level control systems: single element, two element and three element. Their application depends upon specific boiler size and load changes.

The **Single Element System** is the simplest approach. It measures level and regulates feedwater flow to maintain the level. This is only effective for smaller boilers supplying steady processes that have slow and moderate load changes.

This is because shrink and swell cause an incorrect initial control reaction. As steam demand increases, lowering the pressure, the drum level increases sending a false control signal to reduce feedwater flow when actually the feedwater flow should increase to maintain mass balance. More complex systems are required to handle significant shrink and swell effects.

The **Two Element System** uses two variables, drum level and steam flow to manipulate the feedwater flow.

Steam flow load changes are fed forward to the feedwater valve providing an initial correction for load changes. The steam flow range and feedwater flow range are matched so that a one pound change in steam flow results in a one pound change in feedwater flow.

The steam flow signal is combined with the output of the drum level controller which makes trim adjustments in feedwater flow to compensate for unmeasured blow down losses and steam flow measurement errors.

Types of Drum Level Control. (Continued)

This system is adequate for load changes of moderate speed and magnitude and can be applied to any size boiler.

It does have two drawbacks. It cannot adjust for pressure or load disturbances in the feedwater system and cannot adjust for phasing interaction in the process because only the relatively slow responding drum level is controlled.

The **Three Element System** adds a third variable, feedwater flow rate to manipulate the feedwater control valve. This system provides close control during transient conditions because the two controllers minimize phasing interaction present in the two element approach. The feedwater control assures an immediate correction for feedwater disturbances.

The drum level control compensates for the effects of smaller unmeasured flows such as blowdown and mismatch between the two flow elements. As in the two element system, nearly all the compensation for load changes is handled by the feedforward portion while the drum level control provides only trimming action.

This system can handle large and rapid load changes and feedwater disturbances regardless of boiler capacity. This approach is required on multiple boilers having a common feedwater supply. It is ideal for plants with both batch and continuous processes where sudden and unpredictable steam demand changes are common.

Honeywell's HC900 Hybrid Controller can be used for all the functional requirements of drum level control along with providing a familiar, easy to use, operator interface.

Benefit Summary

The Honeywell HC900 provides the following benefits when used in boiler control applications:

- Integrated loop and logic control minimizes equipment cost
- Integrated control and operator interface simplifies troubleshooting
- The ability to trend and log process data for regulatory agency reporting
- A common configuration tool for both control and OI minimizing engineering costs.
- Isolated, universal analog inputs allow mix of analog input types on same card, saving I/O cost

Implementation

The HC900 as shown in Figure 2 consists of a panel mounted controller, available in 3 rack sizes along with remote I/O racks, connected to a dedicated Operator Interface (OI).

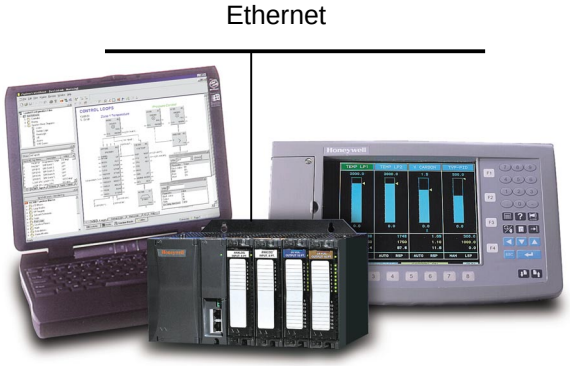

Figure 2: HC900 Hybrid Controller, Model 1042 OI and Hybrid Control Designer Software

All field signals terminate at the controller. The controller has universal analog inputs, analog outputs and a wide variety of digital input and output types. This controller will provide all the control functions required for the ***drum level control***, ***fuel-air ratio control*** and ***oxygen trim***.

Configuration. The Hybrid Control Designer tool provides advanced configuration techniques allow a variety of strategies to be easily implemented. The run-mode configuration monitoring and editing capability allows these strategies to be tested and refined as process knowledge is gained

Monitoring. The complete operation can be monitored and controlled from the easy to use, familiar displays of the Model 1042 OI.

Data Storage. The data storage feature of the OI can be used to log process information during the cycle to an integral floppy disk for a permanent record.

Open Connectivity Over Ethernet. Use popular HMI, data acquisition, OPC server, and HC900's HC Designer configuration software over an Ethernet LAN concurrently to access HC900 controllers.

Peer to Peer Communications. Any HC900 can support up to 8 peer controllers for exchange of analog or digital data over Ethernet.