Life Sciences

INDUSTRY

- **Two and three element drum level control**
- **Enhanced three element drum level control**

Boiler Drum Level Control

Application Note

The purpose of the drum level controller is to bring the drum up to level at boiler start-up and maintain the level at constant steam load. A dramatic decrease in this level may uncover boiler tubes, allowing them to become overheated and damaged. An increase in this level may interfere with the process of separating moisture from steam within the drum, thus reducing boiler efficiency and carrying moisture into the process or turbine.

The functions of this control module can be broken down into the following:

- Operator adjustment of the setpoint for drum level
- Compensation for the *shrink & swell* effects
- Automatic control of drum level
- Manual control of the feedwater valve
- Bumpless transfer between auto and manual modes
- Indication of drum level and steam flow
- Indication of feedwater valve position and feedwater flow
- Absolute/deviation alarms for drum level

The three main options available for drum level control are:

Single-element drum level control

The simplest but least effective form of drum level control.

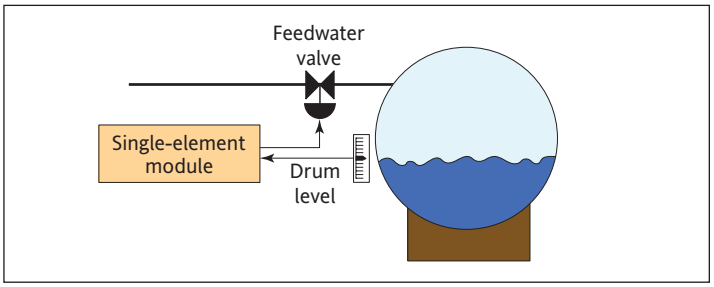

Figure 1 Single-element drum level control

This consists of a proportional signal or process variable (PV) coming from the drum level transmitter. This signal is compared to a setpoint and the difference is a deviation value.

This signal is acted upon by the controller which generates corrective action in the form of a proportional output. The output is then passed to the boiler feedwater valve, which then adjusts the level of feedwater flow into the boiler drum.

Notes:

- Only one analogue input and one analogue output required
- Can only be applied to single boiler / single feedpump configurations with relatively stable loads since there is no relationship between drum level and steam- or feedwater flow
- Possible inadequate control option because of the *swell* effect

Two-element drum level control

The two-element drum level controller can best be applied to a single drum boiler where the feedwater is at a constant pressure.

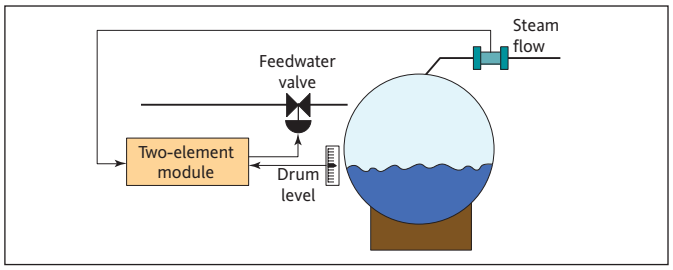

Figure 2 Two-element drum level control

The two elements are made up of the following:

Level Element: a proportional signal or process variable (PV) coming from the drum level transmitter. This signal is compared to a setpoint and the resultant is a deviation value. This signal is acted upon by the controller which generates corrective action in the form of a proportional value.

Steam Flow Element: a mass flow rate signal (corrected for density) is used to control the feedwater flow, giving immediate corrections to feedwater demand in response to load changes.

Any imbalance between steam mass flow out and feedwater mass flow into the drum is corrected by the level controller. This imbalance can arise from:

- Blowdown variations due to changes in dissolved solids
- Variations in feedwater supply pressure
- Leaks in the steam circuits

Notes:

- Tighter control of drum level than with only one element
- Steam flow acts as feed forward signal to allow faster level adjustments
- Can best be applied to single boiler / single feedpump configurations with a constant feedwater pressure

Three-element drum level control

The three-element drum level control is ideally suited where a boiler plant consists of multiple boilers and multiple feedwater pumps or where the feedwater has variations in pressure or flow.

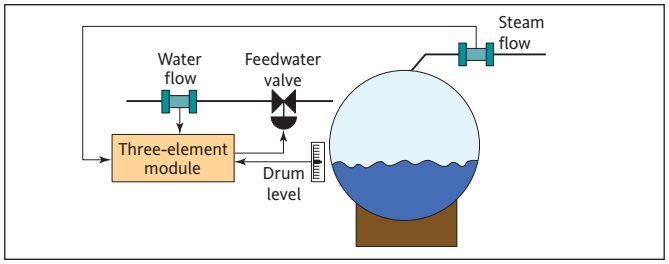

Figure 3 Three-element drum level control

The three-elements are made up of the following:

Level Element and Steam Flow Element: corrects for unmeasured disturbances within the system such as:

- Boiler blowdown
- Boiler and superheater tube leaks

Feedwater Flow Element: responds rapidly to variations in feedwater demand, either from the

- Steam flow rate feedforward signal
- Feedwater pressure or flow fluctuations

In order to achieve optimum control, both steam and feedwater flow values should be corrected for density.

Notes:

- The three-element system provides tighter control for drum level with fluctuating steam load. Ideal where a system suffers from fluctuating feedwater pressure or flow
- More sophisticated level of control required
- Additional input for feedwater flow required

Enhanced three element drum level control

The enhanced three-element drum level control module incorporates the standard three element level components with the following improvements:

- The three-element mode is used during high steam demand. The two-element mode is used if the steam flow measurement fails and the module falls back to single element level control if the feedwater flow measurement should fail or if there is a low steam demand.
- The drum level can be derived from up to three independent transmitters and is density compensated for pressure within the boiler drum.

Notes:

- Tighter control through a choice of control schemes. Drum level maintained on failure of steam or feedwater flow measurements
- This module introduces an additional level control loop Boiler drum level control

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