

Drum level control using a ControlMaster PID controller

Three-element drum level control system



Precision control of drum level from a preconfigured control strategy

Measurement made easy

Maintaining accurate water levels in boiler drums

Introduction

Drum level control systems are used extensively throughout process industries and utilities to control the level of water in a boiler drum and compensate for varying steam demands.

Maintaining the correct water level in the drum is critical for many reasons. A water level that is too high causes flooding of the steam purification equipment; resulting in the carry-over of water and impurities into the steam system. A water level that is too low results in a reduction in efficiency of the treatment and recirculation function.

It can even result in tube failure due to overheating from lack of cooling water on the boiling surfaces. Normally drum level is expected to be held within 2 to 5 cm (0.79 to 1.96 in.) of the set-point with some tolerance for temporary load changes.

Providing tight water level control in a drum is accomplished by utilizing one of three types of drum level control: single-element, two-element, or three-element. All three types of control strategies can be achieved in a single ControlMaster controller.

The process

The table below details three types of drum level control strategies with typical applications for each. While single-element drum level control is acceptable for steady boiler load conditions; as load changes become more frequent, unpredictable, or severe; this type of level control cannot respond quickly enough to compensate. More information must be included and processed to determine the amount of water to be added to the drum to compensate for load changes. The addition of steam and feed-water flow measurements enables the controller to predict the amount of water required to maintain drum level set-point.

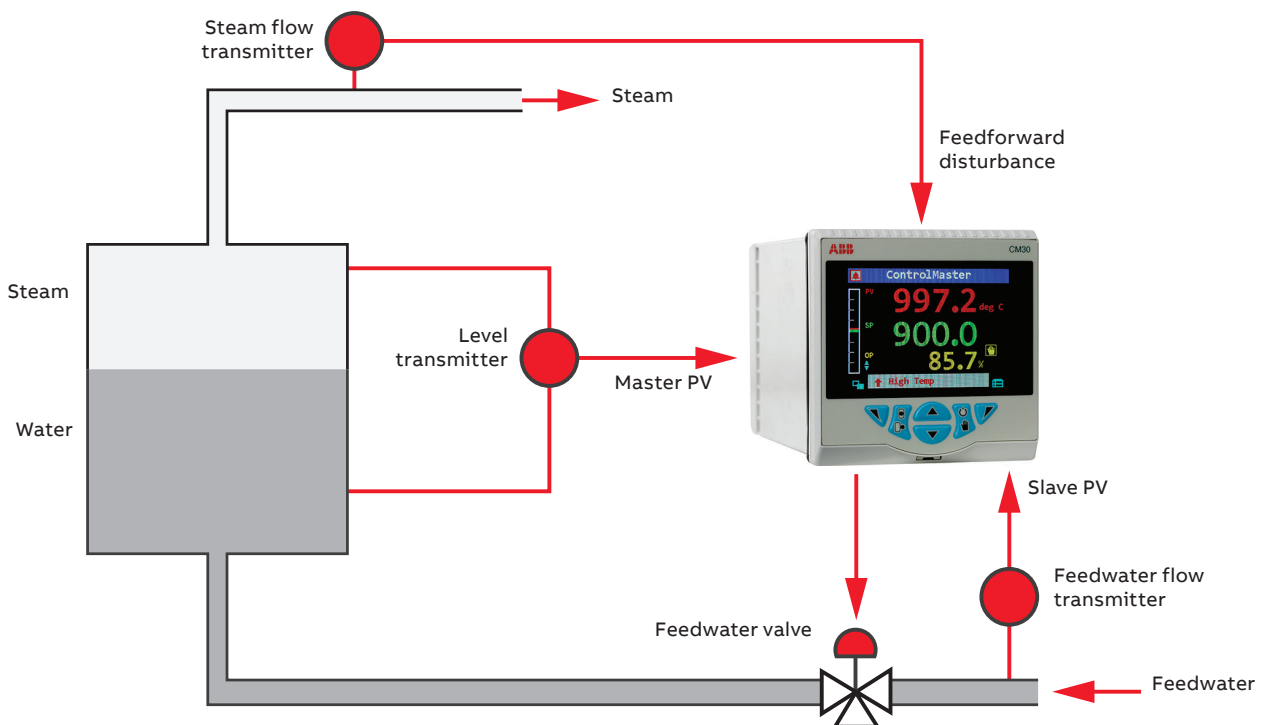
System classification	Load change capabilities		Typical applications
	Magnitude	Rate	
Single-element	Moderate	Slow	Institutional and industrial heating plants Steady process conditions
Two-element	Moderate	Moderate	Industrial plants with essentially continuous type processes and good feedwater pressure regulation
Three-element	Wide	Fast	Combination of batch and continuous type operations such that plant steam load characteristics varies continuously and usually unpredictably. Most industrial power applications fall into this category.

Application chart for drum level control system

In most drum level control applications, the two-element drum level control will maintain the required water / steam interface level – even under moderate load changes. However, if an unstable feedwater system exists exhibiting a variable feed header-to-drum pressure differential, or if large unpredictable steam demands are frequent, a three-element drum level control scheme should be considered.

The performance of the three-element control system during transient conditions makes it very useful for general industrial and utility boiler applications. It handles loads exhibiting wide and rapid rates of change. Plants which exhibit load characteristics of this type are those with mixed, continuous, and batch processing demands. It is also recommended where normal load characteristics are fairly steady; but upsets can be sudden, unpredictable and / or a significant portion of the load.

The figure below shows the control scheme for three-element drum level control. The effect of steam demand change on the level within the boiler drum is predicted and accounted for via the feed-forward disturbance signal. The feed water supply is then controlled accurately using a ‘slave’ flow loop that accounts for any variations in water supply.



Three-element drum level control system

What ABB products are suitable?

ControlMaster CM30 controller

Three element drum level control can be implemented using a single CM30. This multi-loop controller has the I/O, HMI and features packed in a single unit, making it an inexpensive solution compared to a PLC.

Cascade with feed-forward feature in CM30 is used for the three-element drum level control. To minimize commissioning time, the CM30 features preconfigured control strategy templates. By selecting the appropriate preconfigured template, CM30 configures its internal function blocks and display automatically.

Other ControlMaster features include:

- A choice of communications options including Ethernet and MODBUS
 - Ethernet communications can provide automatic notification of critical process events via email or remote monitoring of the controller and process via ControlMaster's integrated webserver by simply addressing it in a standard web browser
 - MODBUS (RTU or TCP) enables easy integration with larger control or supervisory systems, and allows both read and read / write access to real-time process value data as well as most other variables.
- NEMA4X (IP66) rating as standard offers the highest protection against particles and a high level of protection against water.

In addition to CM30, other ControlMaster controllers that can perform three element drum level control are:

- ControlMaster CM50 (3x6 DIN)
- ControlMaster CMF310 (field mountable)



ControlMaster CM30 and CMF310

Acknowledgments

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