Fuji Electric

Innovating Energy Technology

How to improve the efficiency and extend the lifespan of your industrial boiler?

Industrial boiler steam drums

Keywords

- Industrial boiler
- Energy plants
- Combustion control
- Boiler output
- Boiler lifespa
- Boiler controller

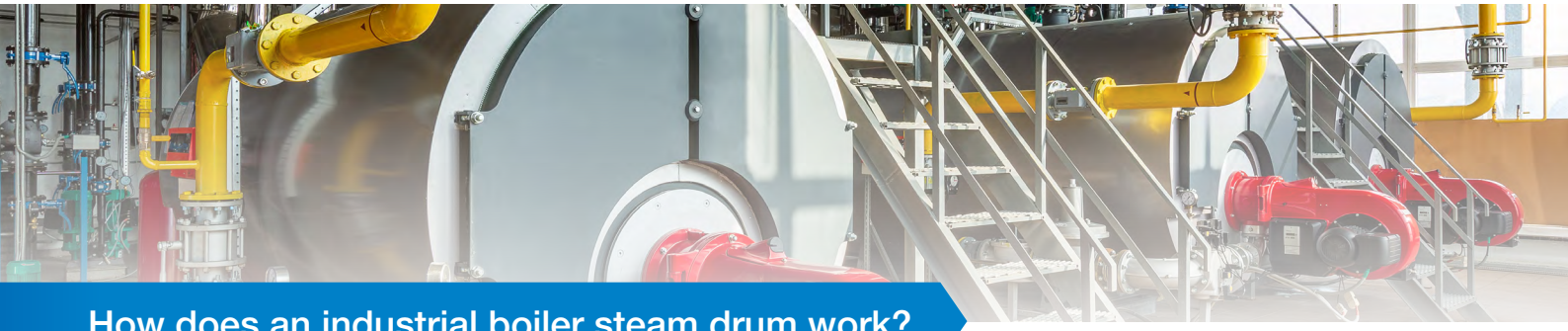
Importance of industrial boilers

Industrial steam boilers are essential for process heating or for the production of electrical energy.

The efficiency of steam heating systems must be optimised in order to reduce energy costs.

In addition, manufacturers and heating operators must ensure the continuous operation of these systems in order to keep plants running and meet their customers' requirements without interruption.

They need to ensure that the industrial boiler is working properly in order to achieve a long lifespan of their equipment.



How does an industrial boiler steam drum work?

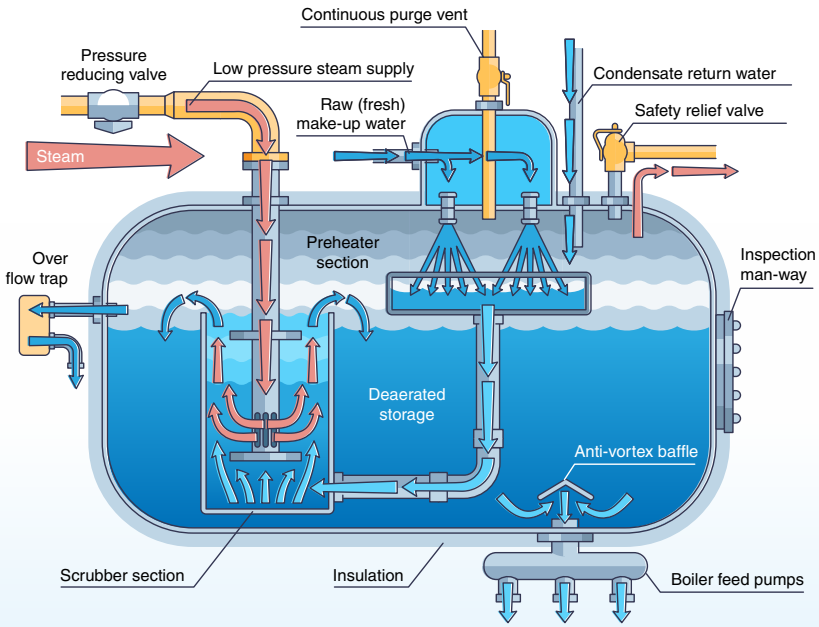
Industrial boiler drums are used to generate steam at high pressure.

They are usually installed in factories to produce energy for industrial heating processes, cleaning or hydration processes, or to generate electricity in power plants.

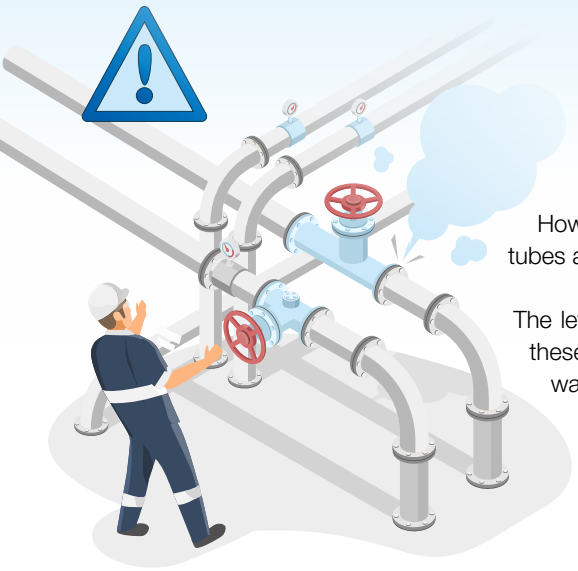
A drum is a large, cylindrical container that holds either boiling water or steam.

It's often placed on its side and located near the top of a boiler.

Its primary purpose is to either feed an industrial process or to provide power for a steam turbine so it can generate electricity.



Checking the level of the storage tank will optimise the efficiency of your boiler and extend its life



Keeping the water level precise in the drum is vital for both safe boiler operation and efficiency.

If the water level is too high, it causes flooding and gets in the way of separating moisture from steam in the drum.

However, if it's too low, then conversion efficiency suffers and even exposed or damaged boiler tubes are possible. Usually, this requires maintaining a narrow range for optimal results.

The level of the drum is affected by two elements: steam flow and feedwater flow. By adding these to the element of drum level, we are able to maintain a much steadier and controlled water level in the boiler. This particular control strategy is known as 'three-element control'.

The control of the drum level is also called «feedwater control», as its purpose in a drum boiler is to maintain a constant water level in the drum.

The Fuji Electric solution

Multi-function process controllers for an effective drum level control

Fuji Electric's multi-function process controllers provide a reliable and cost-effective solution for controlling the level of industrial boiler steam drums and achieving stable and accurate drum level control.

The primary goal of drum level control is to change the feedwater flow in reaction to water level feedback so that the height remains consistent. Water flow is usually adjusted by speeding up or slowing down a feedwater pump, or by opening/closing a valve.

The feedback control method is suitable if the boiler load (steam demand) is steady. However, a large and sudden change in load causes an issue called «reverse response of the drum level» which makes it unstable. The steam output flow is measured before any level change, and this information is used to manipulate the feedwater.

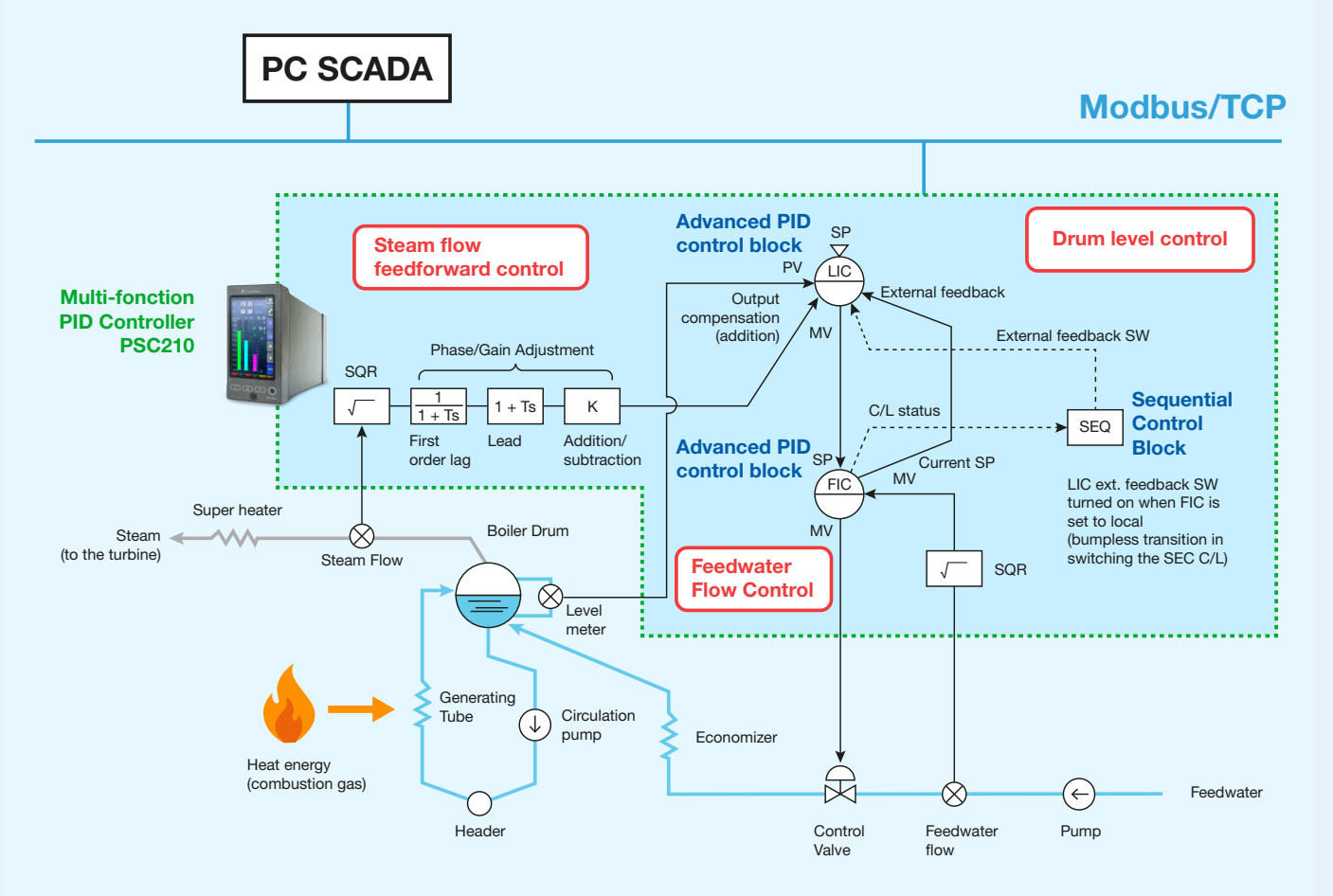
This action is known as «two-element control» and helps ensure close control during stable and transient conditions. Additionally, the feedwater flow control loop added in cascade from the drum level control loop improves controllability and eliminates the effects of feedwater pressure variation.

The addition of these three elements - (1) drum level, (2) steam flow and (3) feedwater flow - enables the controller to foresee how much water needs to be added to the drum, despite any disturbances, thus maintaining an even drum level.

Figure 1 shows an example of the PSC210 function block combinations for the three-element boiler drum control.

The PID control block output (MV) of the drum level control loop (LIC) is provided as the setpoint (SP) of the second PID control block for the feedwater flow control loop (FIC) in cascade. The LIC output (MV) is added to the steam flow to compensate for its variations (feedforward control).

Figure 1:
Example of a control loop configuration with three-element drum level control.



The PSC210 multi-function process controllers

The PSC210 controller model is particularly suitable for use in a critical control loop, such as for boilers, due to its backup and manual control functions.

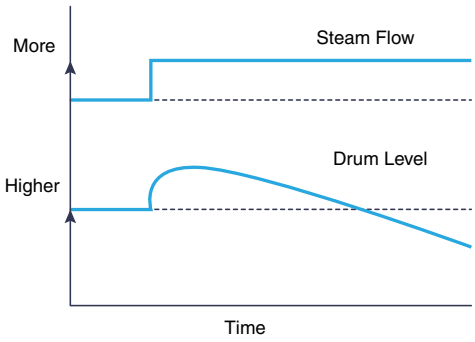
It also has Modbus/TCP communication capability for remote monitoring and control of boilers from a SCADA system.

The SC100/200 series controllers can provide extended software function blocks of addition/subtraction and offset/shift calculation in addition to PID control, to realise sophisticated control such as three-element drum level control.

With the three-element boiler drum level control available on the SC100/200 Series multi-function PID controllers, manufacturers and operators have an effective way to optimise their steam boiler efficiency and increase the lifespan of their equipment.

Operating costs are reduced and your investment is protected.

Reverse response of the level balloon



A sudden increase in load (steam output flow) causes a decrease in pressure in the drum. This, in turn, makes the bubbles in the generating tubes expand and move the water towards the drum-giving a false indication of trends regarding true water level changes happening within the said drum. The effect reverses as soon as the load decreases again. Similarly, adding feedwater causes the water level to temporarily decrease due to the contraction of cooled bubbles. This is known as the «reverse response of the drum level.» To compensate for this effect, controllers will increase the amount of feedwater when load increases. The controller temporarily increases the feedwater to compensate for this effect when the load increases.

Figure 2: Example of drum level fluctuation (reverse response).

Your advantages

- **Improved boiler efficiency**
- **Extended tube lifespan**
- **Ensured safety of the drum**
- **Increased profits**

Three-element level control of the boiler steam drum using the multifunctional PID controllers

PSC100/200 series

Multifunction PID controller
with manual function, Modbus/NestBus extension

- **Performance optimisation of your boiler**
  Programmable PID controllers with advanced calculation functions
- **Ideal for upgrading existing instruments**
  Compact size, compatible with existing systems
- **Easy to use and operate**
  Large colour graphic display and PC configuration
- **High reliability for demanding applications**
  Independent control, display and I/O functions
- **Collect, analyse and optimise**
  Modbus communication and measurement data storage

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