Effective monitoring of the quality of feedwater, boiler drum water and condensate and steam purity is necessary to control deposition and corrosion within the boiler and steam and condensate systems. The absence of continuous online monitoring and control can lead to increased costs, system component failure, unplanned operational shutdown and may cause a threat to safety, economy and reliability.

On the financial front, scales and deposits can aggravate the following costs/losses:

- Poor heat transfer efficiency leading to fuel wastage
- Losses because of improper blowdowns (Energy and DM Quality Water)
- Higher maintenance costs
- Downtime which can adversely affect the production line
- Poor quality of steam which can worsen the quality of the final product

We can provide data 24 X 7 and measurement of important parameters which needs to be controlled.

Critical Points that Control Water Chemistry in Process Boilers

**Feedwater Monitoring**

Problems due to corrosion and scale can be avoided by the proper pre-treatment of incoming cooling and boiler water and by the addition of certain water treatment chemicals to the recirculated cooling or boiler water. Feedwater needs to be checked for the following,

- Specific conductivity
- pH
- Dissolved oxygen
- Cation conductivity (optional)
**Boiler Blowdown**

As steam is generated in drum water, the TDS level of boiler water starts to increase. At levels above the manufacturer specified maximum TDS range, scale deposits begin to form on the boiler drum and tubes. The high TDS water begins to foam, which when carried over by steam, leads to corrosion and deposits on heat transfer surfaces. This affects the heat transfer efficiency resulting in higher steam demand, and increased fuel bills. In drum water the following need to be checked,

- Conductivity or TDS
- pH

**Condensate Monitoring System**

As the condenser is an important potential entry point for contaminants into the water steam cycle, it is essential to closely monitor the quality of the condensate downstream of the condenser. As acid conductivity measurement is not affected by alkalizing agents and is more sensitive to contaminating salts, cation conductivity is the best possible method to check condensate contamination. The following need to be checked,

- Specific Conductivity
- pH

Any other measurement based on condensate contamination (Degassed conductivity Monitoring, Oil in Water, Refinery, Petrochemical leak detection), TOC (Sugar leak detection, Edible oils and other organic leakages)

---

**Process Boiler Cycle**

![Diagram of Process Boiler Cycle](image-url)

- Condensate
- Condensate tank
- Raw water pretreatment
- Deaerator or Feedwater tank
- Heat Exchanger Process
- Feedwater Pump
- Blow Down
- pH
- Cond.
- DO₂
- pH
- Cond.
The schematic diagram here shows how the sample is being controlled.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Sample Isolation Valve</td>
</tr>
<tr>
<td>NV2</td>
<td>Needle Valve for Pressure Gauge</td>
</tr>
<tr>
<td>SC</td>
<td>Primary Sample Cooler</td>
</tr>
<tr>
<td>BDV1</td>
<td>Blow Down Valve (HT Globe Valve)</td>
</tr>
<tr>
<td>SG</td>
<td>Sight Glass Indicator</td>
</tr>
<tr>
<td>CV</td>
<td>Coolant Isolation Valve (Ball Valve)</td>
</tr>
<tr>
<td>SF</td>
<td>Sample Filter (40 Micron Fine Filter)</td>
</tr>
<tr>
<td>NV</td>
<td>Needle Valve for Pressure Regulation</td>
</tr>
<tr>
<td>SRV</td>
<td>Safety Relief Valve</td>
</tr>
<tr>
<td>TG</td>
<td>Temperature Gauge</td>
</tr>
<tr>
<td>PG</td>
<td>Pressure Gauge</td>
</tr>
<tr>
<td>TP</td>
<td>Thermal Shut Off Valve with Manual Reset</td>
</tr>
<tr>
<td>FICV</td>
<td>Rotameter with Built in Needle Valve</td>
</tr>
<tr>
<td>TUNDISH</td>
<td>Tundish</td>
</tr>
<tr>
<td>BPR</td>
<td>Back Pressure Regulator</td>
</tr>
<tr>
<td>BHU</td>
<td>Bulkhead Union</td>
</tr>
</tbody>
</table>

**Working**

It is a complete plate mounted system with flow, pressure and temperature of the sample being controlled. A single system comprises of 3 modules as mentioned below.

**Sample Cooling Module**

In this module the sample temperature is reduced by cooling water available at around 35 degree Celsius to the extent that the analyser sensor can withstand. The cooling process is carried out in Forbes Marshall sample coolers and this being an important process to monitor condensate quality we recommend a consultation with us before the selection of coolers.

**Sample Conditioning Module**

The cooled sample passes through a filter and then through a pressure reducer. Installation of a temperature protection valve ensures blocking of the sample flow in case of over temperature conditions. The sample is then distributed to various analysers for analysis with a tapping also being provided for grab sampling. A back pressure regulator is installed prior to the grab sample valve to avoid build-up of over pressure in the flow line and keep upstream pressure constant.

**Sample Analysis Module**

The conditioned sample is provided to the measuring sensors which transmit a feedback signal to the respective transmitters located in the sample analysis module.
Building Blocks for a Compact, Quick, and Easy to Install QSWAS™

Sample Cooling Module

Sample Conditioning Module

Sample Analysis Module

Safety Features

Inlet valves design suitable for supercritical pressure – steam services
Sample cooler coil – IBR approved with form IIIIC
Sample cooler with inbuilt safety relief valve and drain plug

Relisafe™- PR sample pressure reducing valve-SPRV
Relisafe™-TP high temperature safety shutoff valve with manual reset
Inline pressure relief valve
Option of temperature switch and 3 way solenoid valve over temperature shut off
Temperature gauge, pressure gauge for indication
Back pressure regulator and rotameter for precise flow control “as per ASME PTC 19.11-2008”

Prefabricated plate to mount analyzer includes QSWAS™ mounting arrangement for
Analyzer transmitter – Single/dual channel
Analyzer sensor – Single/dual probe
Flow indicating rotameter (FICV)
Flow through chamber – SS316
Interconnection tubing – SS316 “as per ASME PTC 19.11-2008”

Quality and Reliability

Sample cooler with correct coil material for longer and reliable life. Options – SS316 / Inconel 625

Components

Sample Cooler

The Forbes Marshall DHx Sample Cooler has been designed to meet sampling requirement of today’s highly efficient boiler. This Sample Cooler is used to cool the sample from a high temperature to the temperature acceptable to the analyzer sensor. These coolers are compact yet more effective in terms of heat extraction capacity.

Coil
Max. operating temperature: 580 Deg C.
Max. pressure: 250 kg/cm²
Material of construction coil: ASTM A213, TP-316 / MONEL (on request) / INCONEL (on request)
Flow: Max. 100 LPH
Inlet and outlet connection: 1/4” OD (default) or 3/8” on request

Shell
Material of construction coil: ASTM A312, TP-304
Inlet and outlet connection: 3/4” OD or 1” OD
Components

Sample Filters

The Forbes Marshall Sample Filter provides a clean sample, free from suspended matter. Any particles of size up to 40 microns are filtered in this unit. The hexagonal cap makes it easy to remove the filter element. It is possible to remove this element, clean it and replace it without the need to remove the complete filter assembly from the line. The forged body gives this filter a fresh new look.

MOC: SS316
Pressure: 250 kg/cm²
Temperature: 100 Deg C.
Inlet / outlet connection: 1/4" OD

Back Pressure Regulator

A Pressure Reducer (needle valve) and Back Pressure Regulator combination provides very stable pressure and flow conditions, thereby ensuring reliable, efficient and accurate analysis.

Material of construction: SS316
Set pressure: 0 - 6 kg/cm² (adjustable)
Temperature rating: 80 Deg. C.
Flow: 100 LPH
Inlet and outlet connection: 1/4" OD

Relisafe-TP

Temperature Safety Shutoff Valve with Manual Reset

Forbes Marshall's Relisafe-TP is a mechanical device which ensures protection against temperature overshoot.

We recommend the use of a temperature safety shutoff valve to block high temperature samples which otherwise could damage the analyzer sensors which are delicate and costly.

Design pressure: 300 kg/cm²
Design temperature: 121 Deg. C.
Set temperature: 45 Deg. C.
Material of construction: SS316
End connection type: 1/4" OD
Additional features: Manual reset

DO

At elevated temperature, dissolved oxygen causes corrosion which may cause puncturing and failure of piping and components respectively. Dissolved oxygen also promotes electrolytic action between dissimilar metals causing corrosion and leakage at joints and gaskets. Mechanical deaeration and chemical scavenger additives are used to remove the dissolved oxygen. An analytical check of process efficiency, therefore, is essential. Dissolved oxygen monitoring is imperative in power stations using neutral or combined operating conditions (pH 7.0-7.5 or 8.0-8.5). The typical points in a steam circuit where a dissolved oxygen monitoring is required are deaerator inlet and outlet.
Conductivity: Conductivity is an important parameter for detecting any contamination of steam in the boiler circuit. Conductivity of pure water is almost zero (1-2 μ Siemens). Ingress of any kind of dissolved impurity will raise conductivity instantly. Thus conductivity is an important parameter for the detection of leakages.

Typical points in the steam circuit where conductivity should be monitored are: superheated steam, drum water, high pressure heaters, low pressure heaters, condenser, plant effluent, DM plant, make-up water to DM plant.

pH: The steam which goes to the turbines has to be ultra pure. The pH value of the feed water gives direct indication of alkalinity or acidity of this water. Ultra pure water has a pH value of 7. In a steam circuit, it is a normal practice to keep the pH value of feed water at slightly alkaline levels. This helps in preventing the corrosion of the pipe work and other equipment.

Typically dedicated pH analyzers are recommended at following locations in a steam circuit: high pressure heaters, DM make-up water, condensate extraction pump discharge.

Conductivity Analyzer

pH Analyzer