SENTRY

Steam Sampling 101

Protect your power generation equipment with these key operational insights.

What is Steam Sampling?

Steam is essential in any process plant, including refineries, petrochemicals, and specialty chemical plants. Without it, molecules don't get cracked, reactors don't get heated, and high-yielding chemical processes don't materialize.

Steam sampling is the process of collecting and analyzing steam to ensure it's free from impurities. Contaminants in steam like silica and sodium, as well as deviations from target pH values, can wreak havoc on a plant's operations – leading to corrosion, scaling, or even failure of boilers, turbines, and other process equipment.

Why it Matters

Regular sampling ensures that impurities are caught before they cause serious problems. It's a critical step in maximizing process efficiency and reliability.

Steam sampling ensures you collect accurate, representative data to prevent issues before they escalate – ultimately protecting equipment, reducing unplanned downtime, and improving efficiency.

How Steam Sampling Works

1. **Collect.** Capture a representative sample of steam from a plant process.
2. **Cool.** Reduce the temperature of the steam to condense it into water to ensure it's in a stable condition for analysis.
3. **Control.** Carefully regulate the sample's pressure, temperature, and flow to get accurate readings.
4. **Analyze.** Test the collected sample for purity and chemical properties.



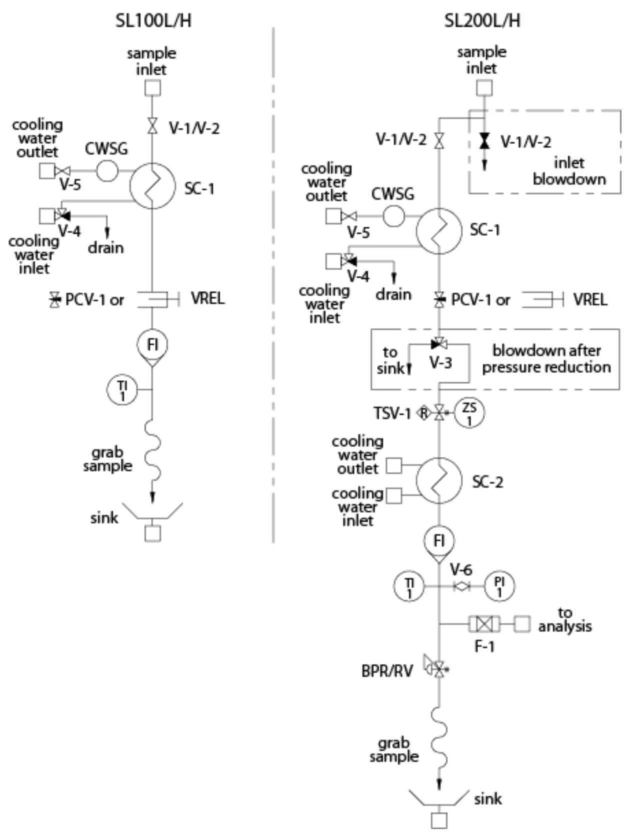

Common Measurement Properties

PARAMETER	PARAMETER IMPORTANCE
pH	ISpecifies a range that protects equipment from acidic impurities and brings equipment metallurgy to a range with a minimal corrosion rate.
Cation Conductivity	Detects excessive levels of harmful impurities such as chlorides and sulfates.
Impurity Level **(usually Chloride, Sulfate, Silica, and Sodium)**	Specifies the range when the impurity concentration is tolerable and does not affect equipment integrity. Impurity concentrations above control limits can result in equipment damage due to scaling or corrosion.

Steam Sampling System Requirements

A well-designed sample conditioning system consists of the following components:

- **Inlet isolation valve**– to control steam entry and isolate a line for maintenance or repairs
- **Blowdown valve (high and/or low pressure)**– to purge any contaminants from the line to keep sample lines clear
- **Primary sample cooler** - to cool the steam so it's safe for analysis
- **Pressure-reducing valve** - to control sample pressure and flow
- **Thermal shutoff valve**- to shut down sample flow quickly when cooling water is lost, or sample flow is too high
- **Secondary cooler** - to further cool and control the sample to 77°F (25°C) for the best analytical results per EPRI, ASME, and ASTM guidelines
- **Pressure and temperature gauges**– to monitor conditions throughout the process
- **Total line and individual analyzer flow indicators**– to monitor the overall flow of the sample through the sampling line and to individual analyzers
- **Back pressure regulating relief valve**– to ensure constant sample flow and relieve pressure in the sample line



Common Challenges in Steam Sampling

Corrosive Contaminants. Steam in process plants may be contaminated with ionic impurities such as sodium, silica, or other corrosive elements.

Cooling & Pressure Problems. Improper cooling or pressure control in the sampling system or significant deviation from recommended levels can lead to inaccurate readings or even system failure.

Cross Contamination. This occurs when impurities from other parts of the plant end up in the steam, which can cause process disruptions, product defects, and equipment damage.

Sample Flow Rates. Slow sample flow rates can cause delayed or inaccurate readings, making responding quickly to steam quality changes difficult.

Line Plugging. Debris or impurities can clog the sample line, disrupting the flow and leading to inaccurate or incomplete sample collection.

Addressing Common Challenges

Cation Conductivity

Cation conductivity is one of the best ways to monitor for contaminants within a steam or water sample. It measures the presence of ionic species which can signal contamination from corrosive compounds like chlorides or sulfates using cation resin columns.

Cation resin columns can be helpful in several applications, including:

- Detecting minerals and mineral salts/acid contaminants
- Detecting sodium, typically from cooling system leaks, which can damage equipment quickly
- Identifying leaks that can introduce contaminants to the process
- Detecting compounds carried over in the steam from the boiler

Trisodium Phosphate (TSP)

Trisodium phosphate (Na3PO4, or TSP) is a chemical additive often used as a boiler scale inhibitor.

TSP reacts with water-soluble calcium salt and magnesium salt—two culprits of scaling in boiler systems—to form insoluble calcium phosphate, magnesium phosphate, and other sediments that stay suspended in water and won't adhere to the boiler to form scale.

At the same time, the excess TSP will soften any existing scale, causing it to fall off and resuspend into the water. This can then be easily removed from the boiler via routine blow-down of the system.

If proper drum level control isn't maintained, it is possible to carryover TSP into the saturated steam and downstream to critical process components such as turbines.

TSP treatment is recommended when:

- Your plant isn't able to frequently monitor piping of the water system
- Your plant experiences infrequent shutdowns or cleanouts
- High-quality feedwater isn't available
- Water treatment costs need to stay low

ASME suggests that feed water be kept at a pH of 8.310.5.

Secondary Cooling

Proper design and maintenance of your sample system are essential to mitigating the risks of impurities in steam. This includes adding appropriate coolers for your process.

Primary sample cooling typically uses plant cooling water at the nearest location to "rough cool" the sample. However, this process often leaves the analyzers with excessively high sample temperatures (over 100°F).

That's why you need secondary coolers. These are fed by chilled water from a temperature control unit (TCU or chiller system) to consistently provide a constant 77°F final sample temperature.

To achieve accurate analysis, EPRI, ASTM, and ASME recommend cooling water samples to 77°F (25°C) to ensure consistent, precise analysis.

Design Tips for Steam Sampling Systems

A well-designed sample conditioning system helps capture a safe and representative sample that allows operators to measure steam quality and detect impurities before they cause problems.

To build a reliable steam sampling system, keep these guidelines in mind.

Easy Access. A well-designed system must be laid out in the most ergonomic way possible to ensure all equipment is easily accessible without disturbing adjacent equipment.

Good Lighting. To facilitate a safe and operable working environment, sufficient lighting must be provided at the location of the sample conditioning system.

Indoor Location. Panels should be indoors or inside a temperature-controlled shelter. If they must be outside, shield them from direct sunlight and extreme temperatures.

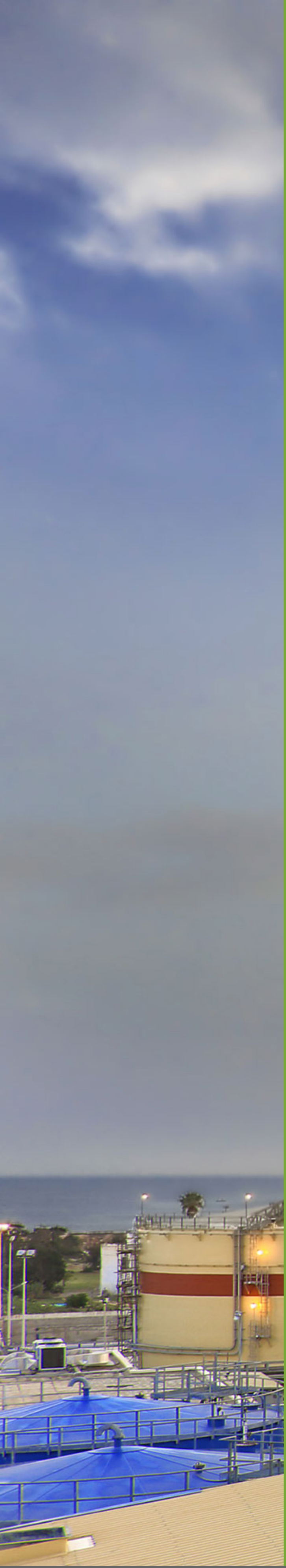
Stay Close. The closer the sample system is to the steam source, the more accurate your readings.

Plan for Maintenance. Ensure there's enough space around the system for maintenance and repairs.

Learn more in our eBook:

9 Mistakes to Avoid in Your SWAS Specs

Download eBook



With proven sampling expertise since 1925, Sentry products and services provide business operations with the critical insights to optimize process control and product quality. Standing behind our commitments, we are determined to tackle any application, anywhere.

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