Water Quality and Management

Overview

Hard water is the number one reason for costly maintenance, avoidable repairs, and even contamination in steam autoclaves.

Autoclaves that produce steam by heating water in the chamber, such as Priorclave's Electrically Heated (EH) models, require softened water and regular cleaning to function properly. The feed water must also be sufficiently conductive to be support the built-in sensors.

Steam Heated (SH) models are connected to an external steam source, and the feed water requirements depend on the boiler--requirements are specified by the facility, not the autoclave manufacturer.

How Water is Used in Autoclaving

Priorclave autoclaves use water in two ways: to produce steam within the chamber for sterilizing, and to feed ancillary equipment such as vacuum pumps and drain condensers.

In-Chamber Steam Production
There are heating elements in the bottom of the autoclave chamber that sit in a reservoir of water. When a cycle begins, the heaters boil the water to create the necessary steam. At the end of the cycle, the steam cools and condenses at the bottom of the chamber until the next cycle begins.

The heating elements remain submerged until the chamber is manually drained for cleaning or automatically drained during a drying cycle.

Ancillary Equipment
In general, tap water provides sufficient volume and pressure (a minimum of 2Bar) for ancillary autoclave equipment. The feed water for the condenser, vacuum, or other ancillary equipment need not be treated or softened.

Water Quality Issues

There are two main considerations for autoclave water quality: hardness and purity. Hard water causes harmful mineral scale to build up in the autoclave. Pure water is corrosive and lacks the necessary conductivity for autoclave sensors.

Hard Water

When hard water is heated, Ca^{2+} ions react with bicarbonate (HCO_3^-) ions to form insoluble calcium carbonate ($CaCO_3$). Calcium carbonate and other minerals, such as lime, can build up quickly in an autoclave. See page 3 for acceptable levels of $CaCO_3$.

Over a relatively short period of time, the mineral scale from hard water will coat the heating elements, initially reducing their effectiveness and ultimately causing them to fail. Mineral scale will also affect the operation of water level sensors and the efficient operation of valves.

Ultra Pure Water and Deionized (DI) Water

Ultra-pure and DI water are often available in research settings, but neither is suitable for use in a standard autoclave for two reasons:

- Extremely pure and DI are corrosive to the copper pipework and brass fittings inside an autoclave. If an application requires ultra pure or DI water, Priorclave can specially manufacture a unit for the purpose.
- Neither ultra-pure nor DI water are sufficiently conductive. There is a probe located at the bottom of the autoclave chamber that uses conduction to sense whether there is enough water in the reservoir to run a cycle.

Reverse Osmosis (RO) Water and Distilled Water

The conductivity of RO water varies between 0.05 µS/cm (DI water) and 200 µS/cm (drinking water). RO water can work well in an autoclave, as long as the purity of the water that comes through the membrane is within acceptable levels of conductivity (see page 3).

Likewise, the conductivity of distilled water varies by process. Distilled water can be used if it falls within acceptable levels of conductivity (see page 3).

Recommendations

Priorclave recommends testing your water quality prior to installing your new autoclave.

Recommended Levels for Hardness and Conductivity

- Total hardness in terms of CaCo3: **< 50mg/L (50ppm)**
- Conductivity**: > 15 microSiemens**

Water Softener

For facilities with hard water, Priorclave strongly recommends fitting a sodium ion exchange water softener to reduce the levels of calcium carbonate and other ionic contaminants to more acceptable levels. This type of softener will also maintain conductivity at a detectable level for the sensors and probes.

Electrical and magnetic softener alternatives are not recommended. They eventually produce a thick, white powder of denatured calcium carbonate in the bottom of the autoclave chamber.

Regular Maintenance

Autoclaves require care and cleaning as a matter of routine. Please consult the Priorclave Maintenance Manual provided for specific guidelines. At the same time, check the salt levels of the water softener (if fitted) in accordance with the owner's manual.

In autoclaves that generate their own steam in the chamber, the process of autoclaving naturally concentrates impurities from the water supply and successive loads in the reservoir at the bottom of the vessel.

Without regular maintenance, the concentrated charge water can lead to mineral scale and corrosive levels of salt and contaminants (even when a water softener is in use). It may become foamy and breach sealed containers during autoclaving--causing failure errors. Cycling concentrated charge water can damage the heating elements and valves over time, and it could even degrade the thick stainless steel of the Priorclave chamber.

For these reasons, the chamber should be drained, rinsed, and wiped down weekly--or sooner if a spill has occurred. Compliance with the water quality requirements and maintenance manual will ensure top performance of your Priorclave for years to come.