Pretreatment of feedwater for bottled water applications

Proper identification of contaminants is critical to operating a successful bottling operation.

By John Swancara

The identification of specific contaminants and their treatment before water reaches the bottling stage is critical to the operations of a successful water bottling plant.

Failure to treat these contaminants effectively may lead to contaminated product water, costly product recalls and, potentially, loss of customer trust.

Water sources

Spring water

- **Definition:** water derived from an underground formation from which water flows naturally to the earth's surface.
- **Contaminants:** include turbidity; nitrates; Total Dissolved Solids (TDS); bacteria; and iron or manganese.
- **Pretreatment methods**: options include: multimedia filtration down to 10 microns; depth filtration down to 5 microns; ultraviolet units; and depth filtration down to 1 micron absolute.

If ozonation follows, other pretreatment may be needed to remove iron or manganese from the feedwater. In some cases of heavy bacterial contamination that occurs on a steady basis, chlorination of water and then chlorine removal by carbon filtration is necessary.

Well water (or bore hole water)

- **Definition:** water derived from a hole bored or drilled, which taps the water of an aquifer.
- **Contaminants:** include nitrates; TDS; iron or manganese; bacteria; bromides; and pH balance problems.
- **Pretreatment methods:** multimedia filtration; aeration; depth filtration down to 1 micron; and ultraviolet application.

As with spring water, if ozonation is to follow, other pretreatment may be required to remove iron or manganese from the feedwater. In some cases of reoccurring heavy bacterial contamination, chlorination of the well and carbon filtration may be required.

If bromide levels are high - generally over 0.02 ppm - ozonation of the water may not be possible. Therefore, ultraviolet units followed by 1-micron absolute filtration will be required.

Correction of pH levels may be needed for very low pH values from wells. Many low pH conditions result from carbon dioxide gas in the water. Aeration will drive this out of the water.

In some cases, sacrificial calcium carbonate filters will raise pH values as well.

Reverse osmosis-processed water

- **Definition:** purified water produced by the RO process and meeting the definition of purified water in the United States Pharmacopoeia.
- **Contaminants:** bacteria, silica, hardness, turbidity, iron and manganese, chlorine in municipal supplies and aluminum.
- **Pretreatment methods:** Bacterial contamination of feedwater should be reduced, if possible, by ultraviolet units before feedwater enters the RO system to help prevent biofouling of RO membranes.

Sodium bisulfite can be injected in the feedwater as well.

Turbidity can be reduced by multimedia filtration, followed by 5-micron filtration.

Hardness is typically reduced by softening incoming feedwater. A twin alternating automatic regenerating system is preferred to prevent any hardness bypass to the RO unit. Anti-scalant chemicals can also be used to keep hardness minerals and not scale membranes

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Testing requirements

Among the tests required by the FDA and the bottled water industry that impact feedwater characteristics are:

- A complete water analysis when the plant starts up (and once a year after that);
- Monthly tests for bacteria;
- Ozone at start-up of every product run and twice per product per day; and
- Check of pH levels every hour if processing and daily if not processing.

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in suspension.

Silica can be a problem if it is over 20 ppm in feedwater. If levels are high, the recovery rate of RO systems can be changed or the incoming feedwater pH lowered by acid injection.

The current preferred method is to inject an anti-scalant solution into the feedwater to keep the silica in solution until it goes out of the system in the reject drain water stream. In this case, a good product flush system should be installed on an RO system as well.

Iron and manganese need to be removed from feedwater by pretreatment methods such as aeration, chlorination, softening, or can be kept in solution with the use of anti-scalants.

Prior to the RO system chlorine must be removed with poly amide type membranes and carbon filtration or sodium bisulfite injection. Chlorine will attack the membranes causing loss of product quality.

Water source	Potential problems	Treatments
Spring water	Turbidity Nitrites Total Dissolved Solids Bacteria Iron or manganese	• Multimedia filtration • Ulraviolet systems • Filtration down to 1 micron absolute
Well water (bore hole)	Nitrates Total Dissolved Solids Iron or manganese Bacteria Bromide pH problems	• Multimedia filtration • Aeration • Filtration down to 1 micron • Ultraviolet systems
Reverse osmosis-processed water	Bacteria Silica Hardness Turbidity Iron and manganese Chlorine Aluminum	• Ultraviolet system • Inject sodium bisulfate, or carbon filtration • Multimedia filtration • 5-micron filtration • Acid injection • Anti-solvent injections • Softening
Distilled water	Chlorine High TDS Hardness Silica High chloride levels	• Carbon filtration • Reverse osmosis prior to distillation • Softening

Distillation-processed water

● **Definition:** water that has been vaporized, condensed and meets the definition of purified water in the US Pharmacopoeia.

● **Contaminants:** include: chlorine, high total dissolved solids, hardness, silica and high chloride levels.

● **Pretreatment methods:** Chlorine should be removed with carbon filtration before it enters the distillation equipment, otherwise, the chlorine will attack internal parts made of stainless steel.

Very high levels of TDS will dictate the need for an RO unit before distillation or the use of a special seawater-type distillation system.

A twin alternating automatic regenerating softener is recommended to remove hardness before feedwater enters the distiller since the hardness may cause scaling problems.

Silica levels need to be tested for large-size distillers. High silica levels may result in silicate formations inside the distiller. □

John Swancara is an engineer at Norland Int'l. Inc., Lincoln, NE.