

# Traditional Treatment Methods

By Paul Ethier

One of the most pronounced shifts in the water treatment industry is the rapidly burgeoning need to improve water quality. The need for water treatment systems is growing quickly, and, unfortunately, North America is hardly immune to challenges.

I thought it might be helpful to develop a water treatment primer in two parts. This installment looks at current technology and its applications to traditional methods of water treatment and softening. The second installment, which will appear in *Water Quality Products* this fall, will examine new and emerging technologies.

## Ion Exchange Water Softeners

There are many ways that water can pose ongoing issues within a home's piping system, but in terms of overall cost, water hardness takes the prize. Water typically is considered hard when the amount of calcium and magnesium exceeds 3 grains per gal; 1 grain is equal to 17.1 ppm of calcium carbonate.

Although there are about as many types of water softeners as there are water treatment manufacturers, the method of ion exchange is basically the same. The units typically consist of three main components: a pressure vessel, where the ion exchange process takes place;

a separate tank, where the brine solution needed for regeneration (typically salt or potassium chloride) is stored; and a control valve that directs the flow of water during service and the regeneration cycle. In recent years, control valve manufacturers have been making great strides in optimizing salt efficiency.

**How it works.** Inside the pressure vessel are many thousands of tiny (0.5- to 1.2-mm) electrically charged polystyrene beads. These beads attract positively charged ions called cations. The resin beads are supercharged with sodium or potassium, both of which are cations, from the brine solution. Hard water containing cations such as calcium and magnesium will enter the inlet side of the valve and be directed to the ion exchange resin bed. The resin favors the more attractive hardness minerals. Calcium and magnesium hardness replace the sodium or potassium.

**The regeneration cycle.** Based on the valve's programming or time clock setting, and depending on the style of softener, once the hardness minerals have completely exhausted the resin bed during normal service, the valve will trigger a regeneration cycle, sending the collected impurities down the drain. First, the ion exchange media (where the softening process takes place) are super-charged with the brine solution through the control valve, and then the excess brine is washed down the drain during a rinse cycle.

To a homeowner with a newly installed water softener, the benefits of having softened water are immediately clear. It makes for a richer lather and therefore greater soap efficiency within the home.

## Reverse Osmosis Systems

Developed more than 40 years ago for large seawater desalination plants and other industrial uses, reverse osmosis (RO) technology has since been scaled down for point-of-use (POU) residential purposes to improve small quantities of water intended for drinking and cooking.

As its name suggests, RO is the reverse of the naturally occurring process of osmosis, which is how water is

transported into and out of living cells. By applying pressure on the incoming higher solids/salt content supply side, semipermeable thin-film RO membranes allow only pure water to pass through.

This process requires a rinse line to move the impurities away from the membrane. This water must be discharged to drain, or a pump may be installed to redirect it for another purpose—typically back into the water heater or into a rainwater collection system. These systems are known in the water treatment industry as “zero-waste RO systems.”

The efficiency of any RO system is dependent upon three variables:

1. Feedwater total dissolved solids (TDS): The natural osmotic pressure of feedwater is approximately 1 psi for every 100 ppm TDS.
2. Feedwater pressure: Raising the feedwater pressure produces more product water, while lowering the pressure produces less.
3. Feedwater temperature: RO is temperature dependent. The process occurs more slowly with cold water. All RO membranes are rated with a feedwater temperature of 77°F. Higher operating pressures can be used to compensate for colder water temperatures. For feedwater colder than 77°F, it will take approximately 1.5% more pressure, or the membrane will produce approximately 1.5% less water, for each degree Fahrenheit.

The RO feedwater must be pretreated in order to prevent membrane damage and/or premature fouling. There typically are two stages for residential RO pretreatment: a polypropylene sediment filter and a carbon filter for chlorine, taste and odor reduction.

## Ultraviolet Disinfection

In residential areas that are not supplied by a central, chlorinated municipal water source, other forms of disinfection, such as ultraviolet (UV), may be necessary. A UV system physically treats water by radiating the cells of microorganisms such as *Cryptosporidium*, *Bacillus*

A look at three tried-and-true methods for water softening & treatment

A technician from Phoenix-based Aqua Science installs a Watts Water Technologies water softener in a home.





An Aqua Science technician prepares for a residential water treatment installation.

and *E. coli*, to name but a few, causing a molecular rearrangement of their DNA that renders them unable to self-reproduce inside a home's water supply.

UV disinfection targets potentially harmful bacteria and viruses; it has no effect on the pH, taste, smell or appearance of the water.

Three important things to remember when sizing and installing UV systems are:

1. Size UV systems for peak flow within the home. UV radiation dosage is dependent on the time water spends inside the UV chamber.
2. Always install a UV system as the final treatment device, and make sure a 5- $\mu$  sediment filter is installed in front of it. The exception to this rule would be for any POU RO or ultrafiltration drinking water system.
3. When installing a UV system in a rural residential setting, it is a good practice to shock chlorinate the well and household piping system and check for dead spots, especially in older homes. If the drinking water has been tested and does not pass local drinking

water standards, disinfecting the well is necessary. For a standard 6-in. steel well casing, use 3 cups of household bleach for every 100 ft of water in the well. Turn on every tap one by one until chlorine can be smelled at each, being sure to check the tap furthest from the well. Let the chlorinated water sit inside the pipe for approximately 20 to 30 minutes, then flush it out until the chlorine smell can no longer be detected. To simply shock the piping system inside the home, add household bleach with water at a ratio of approximately 4 to 1 to the filter housing (making sure to remove the filter first) and go through the procedure above. For more information on shock chlorination, check online for local guidelines.

### Final Thoughts

For residential water treatment, nothing saves more time and aggravation than a water analysis. Knowing what is in the water is the first step toward knowing how to properly treat it.

Don't over- (or under-) do it—using the water quality report as a basis for suitable treatment, determine the size/capacity of the system by taking into consideration the incoming line size, fixture count and the number of people living in the house. The operative question is: What is needed? *wqp*

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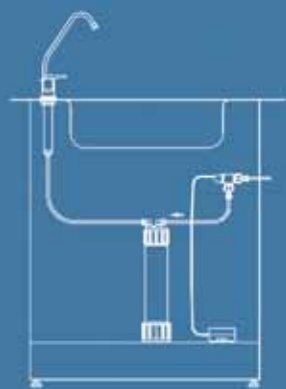
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