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Reverse Osmosis

'RO' filtration systems are helping reverse water quality issues today.

By John Vastyan

Thirsty? How about a glass of chromium? Or perhaps arsenic is more to your liking. It may not sound appetizing, but a recent study by the watchdog Environmental Working Group shows that dangerous chemicals are found in water coming out of many taps nationwide, and well water is certainly no exception.

Consumer demand for water purification and filtration has become the driving force for a relatively new and fast-paced industry. Concerned homeowners are responding to the broadly reported knowledge that more contaminants are being found in our water every day.

Last year, the Water Quality Association conducted an independent survey that verifies the breadth and scope of homeowners' concerns. The results showed that among Americans:

- 86% were concerned about their drinking water.
- 70% were knowledgeable about contaminants in their water.
- 43% said filtered water tastes better.
- 42% said filtered water is safer.
- 41% already used a water treatment device.
- 33% believed household drinking water isn't as safe as it should be.
- 10% said they plan to purchase a household water treatment system within the next year.

With the growing demand for higher quality drinking water, it's no surprise that more homeowners and businesses are buying and installing the same state-of-the-art technology used to purify water for Coca Cola's Dasani and Pepsi's Aquafina. The filtering process used by these bottling giants is nothing more than simple reverse osmosis (or "RO") filtration.

If you haven't yet installed RO technology for your customers — at a cost of just $200 to $400 for all of the equipment and materials required to do a first-rate job — this might be a good time to consider it.

Effective at absorbing chlorine and certain other contaminants, carbon filtration systems are generally the simplest and least expensive to install and operate. But RO systems are widely considered to be the best solution for problematic water. In fact, this technology has become the fastest growing form of in-home water treatment in the United States.

The key function of RO takes place within a tight, semi-permeable membrane that allows only pure water to pass through it. Contaminants such as arsenic, copper, iron, lead, chromium, fluoride, radium, nitrates, and bacteria are rejected. In addition, RO vastly improves water purity, color, and taste.

Unlike charcoal or carbon filters that become less efficient with each glass of water drawn through them and that remove only some contaminants, odors, and tastes, an RO system's membrane is self-cleaning.

Derek Sajdak, president of Aqua Science in Phoenix, Arizona, completes a storage tank connection for a manifold reverse osmosis unit.

As the source water flows through the RO module, it is divided into two streams. One stream is the high quality drinking water that has passed through the membrane. The second stream is the rinsed water that carries the rejected contaminants down the drain.

There are very few water sources in the United States that challenge the capabilities of an RO system. To operate at a peak performance, the incoming tap water supply should meet the following criteria:

- Water temperature: 40°F to 100°F max
- TDS: 2000 ppm max
- Iron tolerance: 0.5 ppm max
- Hydrogen sulfide: must be removed
- Silica tolerance: less than 125 ppm
- Hardness: more than 15 gpg should be softened
- pH range: 3 to 11
- Recommended operating pressure: 40 to 85 psi.

The key components of an RO system include three elements. The *sediment filter* reduces suspended dust, dirt, sand, rust particles, and other sediments. The *carbon filter* reduces chlorine and some volatile organic compounds such as benzene, MTBE, and pesticides. It is also the main cleanser of water odor and taste. The *reverse osmosis filter*, which is the heart of the system, is responsible for rejecting up to 98% of the total dissolved solids in the water. It's here where purification takes place.

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How a Reverse Osmosis System Works

RO systems use household water pressure to push water through a selective semi-permeable (RO) membrane to filter out pollutants. But because different water treatment technologies are effective on different types of contaminants, most RO systems consist of a semi-permeable membrane and other types of filters.

For example, water in a typical four-stage point-of-use system will first flow through a sediment fil-

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A zero waste reverse osmosis unit is prepared for installation.

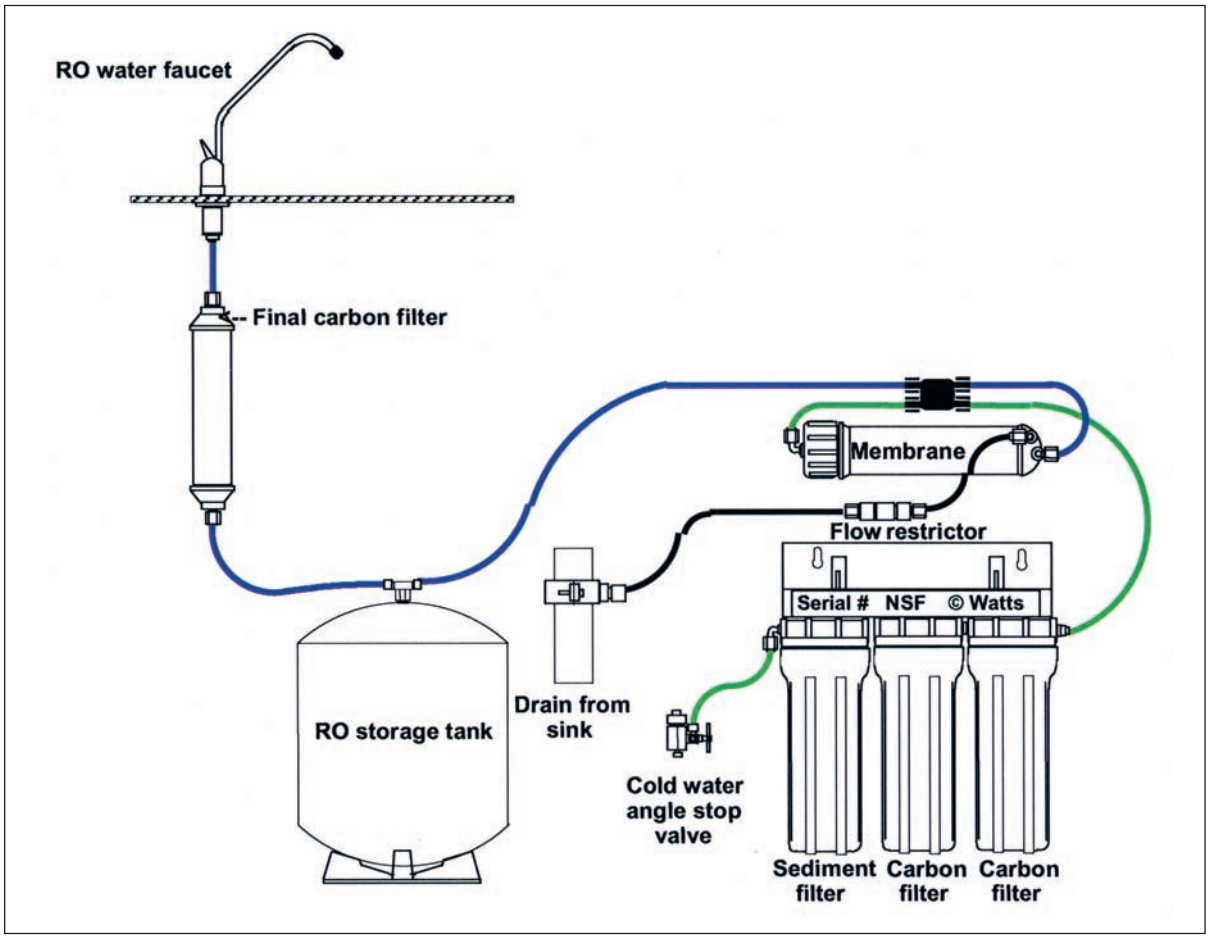

Figure 1. Five-stage reverse osmosis system.

reverse osmosis/ *from page 22*

ter to trap suspended dust, dirt, sand, rust particles, and other sediments. Water then passes through an activated carbon filter.

During the RO process, pressure is applied to one side of the RO membrane, forcing pure water through the membrane as contaminants are trapped on the other side. This pressure differential plays a key role in the production of high quality RO water. Two lines of water exit the RO membrane. One stream is the high quality drinking water. The second stream is the rinse water that carries away rejected contaminants.

Reverse osmosis is a gradual process, requiring up to five hours to produce three gallons of purified water, so the purified water flows from the RO module into a small storage tank (Figure 1). When water is called for at the RO tap, it passes from the water storage tank through a final polishing carbon filter.

Another facet to the water quality equation today is water conservation. Even the best residential RO systems use four to five gallons of water for every one gallon produced. Many systems waste as much as 20 gallons just to produce one gallon of product water. New "zero waste" technology on the market today eliminates this problem by returning the concentrate water from the RO system back to the home's plumbing, resulting in 100% efficiency.

Zero Waste Technology

In most RO systems, the rinse water containing the contaminants simply flows down the drain. But new technology routes this "waste" water back into the home's plumbing for non-drinking water uses such as bathing, dishwashing, and laundry — a cost-effective solution for areas with severe restrictions for water use and very high water costs.

For example, in a system manufactured by Watts Pure Water and Flowmatic Systems, water passes first through the sediment and carbon pre-filters, then moves through a solenoid valve and pump before going to the membrane inlet. The pump provides the pressure to drive water across the membrane and also forces the rinse water into the hot water line.

Conventional RO systems employ an automatic shutoff valve to stop the inlet water flow to the RO filtration system when the water storage tank is full. When water is used from the storage tank, this shut-off valve activates the additional production of RO water. This improves the production efficiency of the filtration system. A zero waste unit also shuts off the incoming water supply when the tank is full, done with a solenoid valve set in place prior to the system pump. A pressure switch activates the pump.

The zero waste function hits its stride as concentrate (rinse) water is moved to the hot water side (Figure 2) through the stop valve under the kitchen sink.

IAPMO (International Association of Plumbing and Mechanical Officials) requires the water from the outlet of the flow restrictor to be routed through two check valves before flowing to the hot water supply line. These check valves ensure the hot water will never reach the RO membrane if there is a surge or back pressure in the hot water system.

Here's How It Works

The difference between the industry standard point-of-use RO system and zero waste technology is shown in Figures 1 and 2. The typical point-of-use RO system, as shown in Figure 1, is a five-stage unit with three stages of pretreatment.

A zero waste system, as shown in Figure 2, takes the water outlet of the sediment and carbon filters and routes it through a solenoid valve and pump before going to the membrane inlet. This provides filtered water to the solenoid and pump, which will keep foreign material from damaging them. In some systems the filter configuration allows for water to be routed through the solenoid valve and pump from the water outlet of the sediment filter and then to the water inlet of the carbon filters.

A pressure switch is used to stop the system by opening the circuit to the solenoid valve and pump. When the RO storage tank is full, a pressure switch stops the system from producing more water.

The concentrate water is routed through a flow restrictor as before, except the flow restrictor size is

larger to allow for the back pressure of the hot water line. The larger flow restrictor allows the pump to circulate water at approximately a 4-to-1 ratio of concentrate to permeate. The actual flow ratio is the same as a standard RO system.

All of the concentrate water from the RO system is routed to the hot water supply through a fitting on the angle stop valve under the sink, reintroducing the water into the hot water side of the home's plumbing system for dishwasher, shower, and hand-washing uses.

In an area where there can be severe restrictions for water use and very high cost for water, zero waste technology offers advantages. As consumer awareness sharpens to the realities of higher water costs and shortages, this new technology merits a close look.

Tailored to Your Customer's Needs

One of the best things about new RO technology is its great flexibility. There's no need to settle on a "one size fits all" solution to water purification. After all, it's risky to assume that a system that purifies well water for one given month, or year, will capably purify water at some later point.

Well water users are subject to seasonal changes in their well water supply or the later insurgence of contaminants. And since most wells aren't monitored, wouldn't it make sense to add another level of filtration, or at least have the capability of accommodating it at some later point?

Some RO systems on the market offer added microbiological filtration that reduces 99.99% of bacteria, 99.99% of viruses, and 99.95% of cysts. The reduction of these microbiological contaminants is especially important to well water users since comparatively few disinfect their water with chlorine or a UV One can also incorporate a VOC filter into an RO system. The VOC filters are designed to remove compounds such as MTBE, DDT, and benzene. While some VOCs — most prevalent in current and former industrial areas — will break down over time, many of them will persist in the soil or water table for a long period of time and are recognized by the EPA as health hazards.

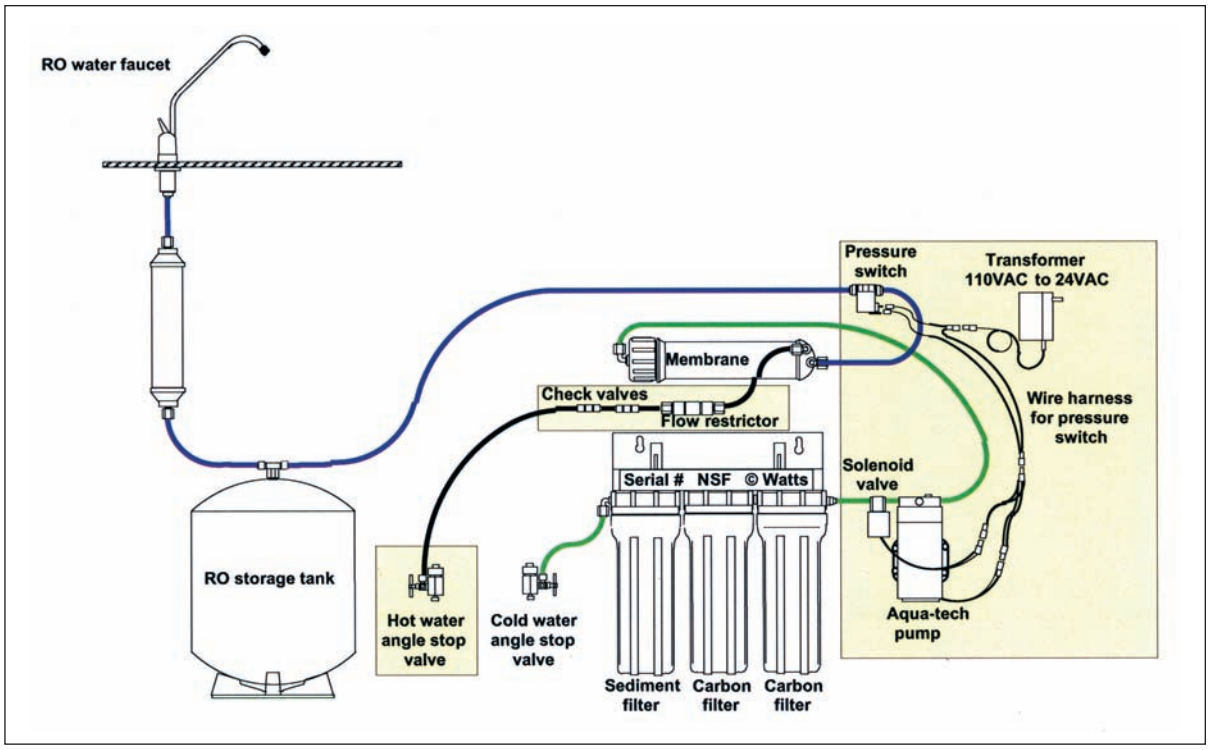

Figure 2. Five-stage zero waste system.

Any way you slice it or put it together, RO technology is amazingly versatile, effective, and inexpensive. It's an extremely simple, sensible solution to an ever more complex water quality problem.

Cheers. Here's to your health. *WWJ*