CAROLYN BATES / FROST INC.

*A subcontractor installs a water-softening system to treat all incoming water.*

# Taking the Worry Out of Drinking Water

*by Don Best*

Whether it's an outbreak of dangerous protozoa in a municipal water system, news of a private well contaminated with nitrates, or fresh warnings about the dangers of lead in our drinking water, rarely a day goes by without a worrisome new headline about water quality.

Polls show that seven out of ten Americans are concerned about the quality of the water they drink, and that millions of homeowners have already resorted to bottled water or installed some type of water filtration equipment in their home.

If you're a builder or plumbing contractor, it's important to the health of your clients — *and* your business — to understand the water quality issues that affect your area. Armed with the facts, you can answer your customers' questions and make confident recommendations. If some type of water treatment is called for, you're in a good position to either install and service the equipment yourself or to work through a subcontractor.

**How's the Water?**

About 85% of all homes in the U.S. are serviced by municipal water systems, which are governed by both the Safe Water Drinking Act, a federal law administered by the U.S. Environmental Protection Agency (EPA), and state health laws.

Enforcement of these laws, however, is far from perfect. In a highly publicized case last summer, 370,000 people in Milwaukee became ill with flulike symptoms from drinking public water contaminated with a parasite. While this incident was unique in the number of people affected, smaller outbreaks of illness from contaminated drinking water occur every year, according to Dr. Thomas Navin, epidemiologist at the Centers for Disease Control in Atlanta. The problem, says Navin, is that "with increasing population pressure, there is increased risk in raw water [sources] that must be addressed by municipal systems."

In a controversial report called "Think Before You Drink," released in September, 1993 the Natural Resources Defense Council (NRDC), an environmental group based in Washington, D.C., charged that many contaminants "are not adequately controlled under EPA rules because of inadequate … standards and weak or nonexistent enforcement." Particularly at risk are the elderly, infants, and people with weakened immune systems, says the report.

While EPA officials feel the NRDC report exaggerates the health risks and maintain that most tap water in the U.S. is safe, EPA's deputy director of drinking water standards, Stephen Clark, admits that a number of the smaller, poorer water districts cannot afford to meet current standards for monitoring.

Given this uncertainty, more municipal water customers are turning to in-home water treatment as a safeguard against possible *health* risks. Most purchasers of in-home systems, however, want their water treated primarily for *aesthetic* concerns, such as taste, smell, hardness, or color.

***To guarantee clear water for your clients, choose the right equipment and make sure it's serviced regularly***

# *Choosing the Right Filter*

| | Equipment Options | | | | | |
|---|---|---|---|---|---|---|
| | | | Filtration | | | |
| **Problem/Pollutant** | Reverse Osmosis | Distillation | Carbon | Mechanical | Activated Alumina | Water Softening (Cation Exchange) |
| Aluminum | • | • | | | | |
| Arsenic | • | • | | | • | |
| Asbestos | • | | | • | | |
| Barium | • | • | | | | • |
| Cadmium | • | • | | | | • |
| Chloride | • | • | | | | |
| Chlorine | • | | • | | | |
| Chromium | • | • | | | | |
| Color | • | | • | • | | |
| Copper | • | • | | | | • |
| Endrin | | | • | | | |
| Fluoride | • | • | | | • | |
| *Giardia* Cysts | • | • | | • | | |
| Hardness | • | • | | | | • |
| Iron ($Fe^{2}$) | • | • | | • | | • |
| Iron ($Fe^{3}$) | • | • | | | | |
| Lead | • | • | • | | • | |
| Lindane | | | • | | | |
| Manganese | • | • | | | | • |
| Mercury | • | • | | | | |
| Methoxychlor | | | • | | | |
| Nitrate | • | • | | | | |
| Particulates | • | • | | • | | |
| Pesticides, Herbicides, PCBs | | | • | | | |
| Radium | • | • | | | | • |
| Radon | | | • | | | |
| Selenium | • | • | | | • | |
| Silver | • | • | | | | |
| Sulfate | • | • | | | | |
| Tannic Acids | | • | • | | | |
| Taste & Odor | | | • | | | |
| Total Dissolved Solids | • | • | | | | |
| Total Trihalomethanes | | | • | | | |
| Toxaphene | | | • | | | |
| Turbidity | • | • | • | • | | |
| VOCs | | | • | | | |
| Zinc | • | • | | | | |
| 2,4-D | | | • | | | |
| 2,4,5-TP Silvex | | | • | | | |

**Note:** *Adapted from NSF International. Performance for a given unit may vary from the chart. For example, not all carbon units are effective for lead reduction. Always ask for proof of performance according to NSF standards.*

## *Major Contaminants Found in Drinking Water*

| Contaminant | Type | Main sources | Health effects | Main risk group |
|---|---|---|---|---|
| ***Health Hazards:*** *The following contaminants are widely found in water; their threats to health are well established.* | | | | |
| **Lead** | Inorganic chemical; heavy metal | Soft or acidic water in lead pipes, copper pipes connected by lead solder, or brass faucets | Developmental and learning disabilities, low birth weight | Children, fetuses |
| **Radon** | Radioactive gas | Groundwater | Lung cancer | Anyone |
| **Nitrate** | Inorganic chemical | Wells in agricultural areas | Methemoglobinemia, a blood disorder | Infants under 6 mo. |
| *The following contaminants are found in water less often than those listed above, or the seriousness of the hazard from low levels of contamination is unclear.* | | | | |
| **Pesticides** | Organic chemicals | Runoff and seepage in agricultural areas | In high doses, liver, kidney, or nervous-system damage; possibly cancer | Anyone |
| **Trichloroethylene** | Organic chemical | Industrial effluents or hazardous-waste sites | In high doses, nervous-system damage; possibly cancer | Anyone |
| **Trihalomethanes** | Organic chemicals | Chlorination of surface water | Possibly cancer | Anyone |
| **Bacteria, viruses, *Giardia*** | Microorganisms | Insufficiently disinfected or filtered water | Intestinal and other diseases | Anyone |
| ***Taste Killers:*** *The following contaminants, in sufficient quantity, may degrade the taste, odor, or appearance of water but are not known to be hazardous to health.* | | | | |
| **Ferrous iron, manganese** | Minerals | Groundwater | — | — |
| **Hardness minerals (calcium, magnesium)** | Minerals | Many water sources, especially groundwater | — | — |
| **Chlorine** | Water-treatment chemical | Excessive residue of chlorination | — | — |

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For example, many people dislike the taste given to water by chlorine, a disinfectant widely used in municipal water systems. As shown in the chart "Choosing the Right Filter", a carbon filter can effectively remove chlorine from the water and address some color and odor problems as well.

Another frequent source of complaints is "hard" water, which leaves scaly deposits on toilets and tubs, makes it difficult to rinse the soap out of clothes, and can give drinking water a cloudy appearance. A water softener can remove most of the dissolved calcium and magnesium that cause these problems.

Some water quality problems are evident to the eye, nose, or tongue, but many others are not (see "Major Contaminants," above). To find out what the water quality issues are in your area, start by asking the local water utility for an analytical breakdown. Since the quality of the water leaving the treatment plant is constantly monitored, it is easy for them to provide a printout for you. If there's no one at the water utility willing to help you interpret the information, get some help from your local or state health officials. You can also get some answers by calling the EPA's drinking water hotline at 800/426-4791.

Even if the water leaving the treatment plant is clean, contaminants can get into municipal drinking water *after* it leaves the plant, from either the utility's distribution pipes or household plumbing. Lead, which can cause serious neurological problems, especially in children, is the most common example. This dangerous contaminant, which is tasteless, colorless, and odorless in the water, leaches out of lead pipes, soldered joints, and brass faucets, creating a potential health hazard to some 40 million Americans, according to EPA estimates.

Since lead pipes and lead-based solder were banned nationwide in 1986,

# Water Treatment Technologies

The four main types of in-home water treatment devices are described below. Capabilities vary from model to model, so look for proof of performance. There are also special filters available for specific problems, such as lead, that may solve the problem at less expense.

## Reverse Osmosis

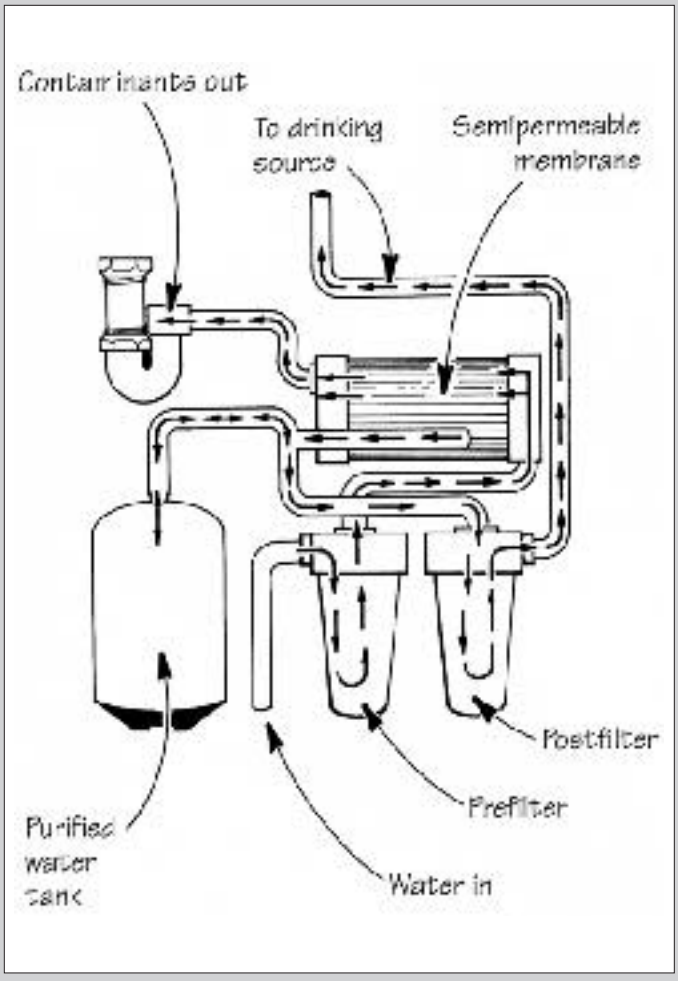
With RO systems, line pressure forces molecules of pure water through a thin semipermeable membrane. The purified water is slowly collected in a one- to three-gallon storage tank while dissolved contaminants, unable to pass through the membrane, are drained away. Most undersink units take from two to three hours to process one gallon of water.

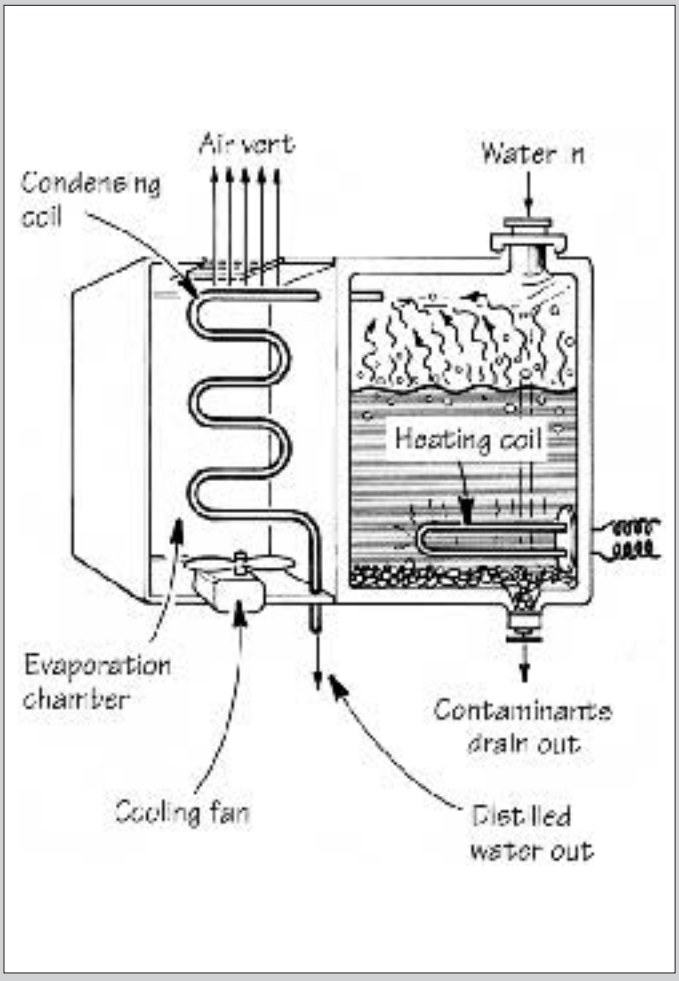
Reverse osmosis can remove 90% to 99% of the impurities in water, including lead and other toxic metals, arsenic, nitrates, and organic contaminants. It is not effective against high levels of minerals. Most models come with a sediment or carbon prefilter and/or a carbon postfilter. Depending on the model, RO units waste three to five gallons of water for every gallon used. The membranes need to be replaced every one to two years. Installed retail prices for point-of-use models run from $450 to $1,500. Replacement membranes cost $150 to $300.

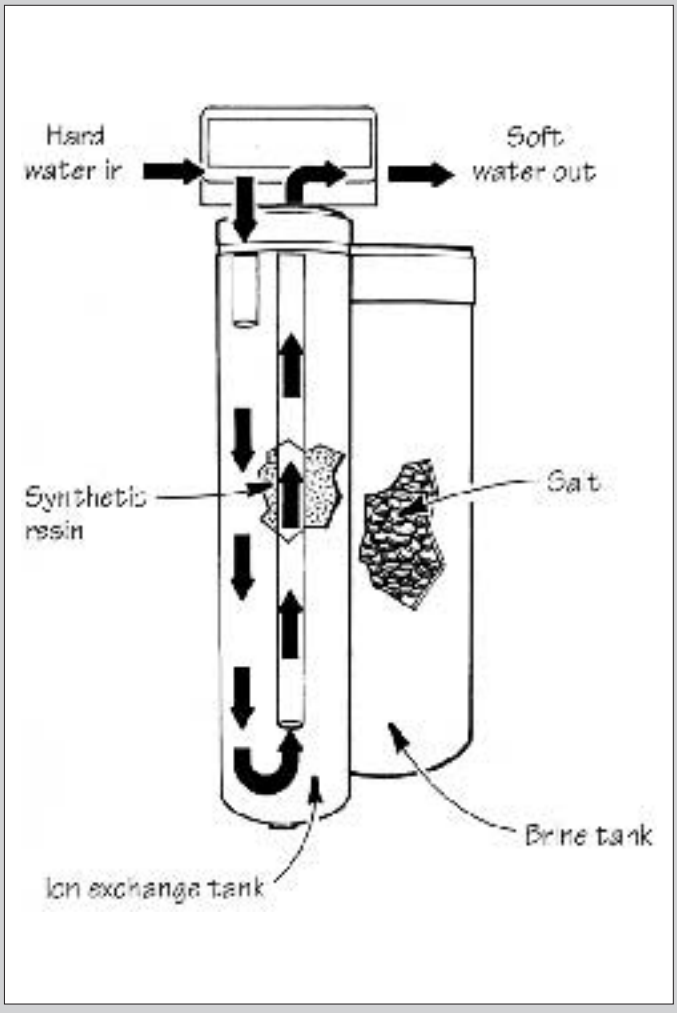
## Distillation

Water is electrically heated inside a vessel to make steam, which is then condensed in a coil to produce distilled water. This removes most dissolved solids, including salts and heavy metals such as lead, but is not effective against volatile organic compounds. Some models work with line pressure alone; others have a built-in pump.

This is a slower process than RO, requiring up to two hours to produce one quart of distilled water. The process requires about three kilowatt hours (kwh) of electricity to make one gallon of distilled water, making operating costs high where electric rates are high. Distillation units also release appreciable amounts of heat to the room, a plus in winter, a negative in summer. Some units are prone to scaling on the inside surfaces, so frequent cleaning may be required. Installed retail prices for distillation units range from about $250 to $1,000.



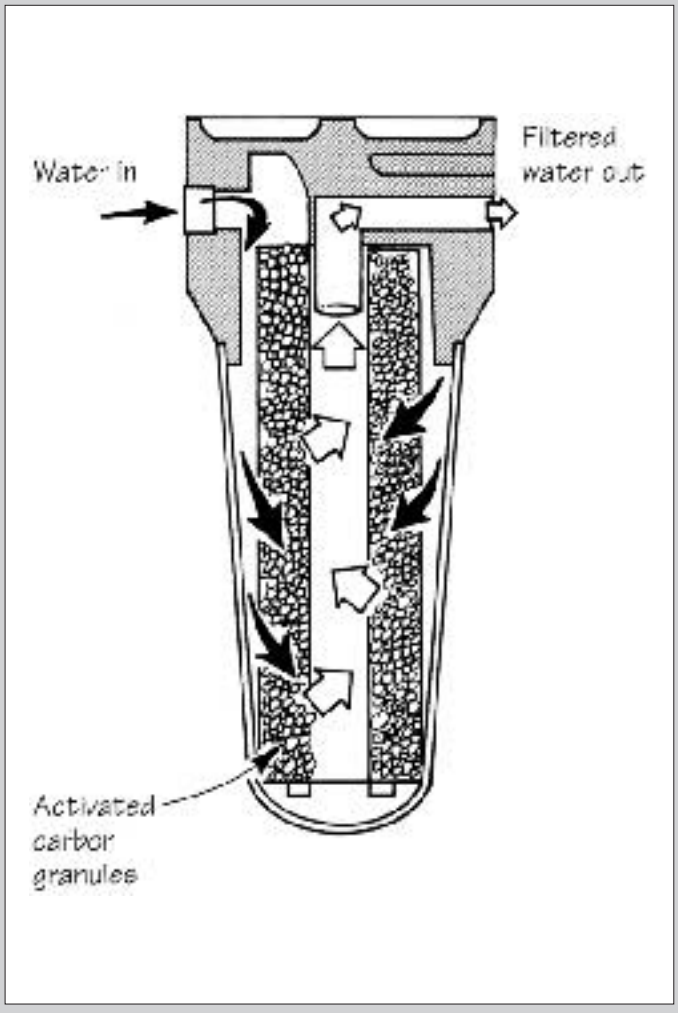






## Water Softeners

Line pressure pushes hard water through a canister filled with a synthetic resin. Through a process called ion exchange, the hard calcium and magnesium ions dissolved in the water are exchanged for soft sodium ions affixed to the resin. (Because the sodium-based process leaves the water relatively salty, water softened with sodium may not be suitable for people on low-sodium diets. Potassium-based softeners are an alternative.)

When the resin is saturated with calcium and magnesium, the system automatically regenerates itself by flushing the resin with salt water from a companion tank filled with brine. Most models require electrical hookup to power the regeneration cycle and use either a timer or a flow monitor to regulate the process. Softeners typically treat about 2,000 gallons between regeneration cycles, depending on the size of the unit and the hardness of the water. The brine tank must be periodically reloaded with salt. Installed retail prices range from about $750 to $2,200.




## Activated Carbon

With this system, line pressure forces water through one or more canisters packed with activated carbon granules, which trap and hold contaminants. Carbon filters are best at removing bad odors and tastes, chlorine, organic chemicals, and pesticides. Many are also effective against lead. Carbon filters work most effectively when equipped with a prefilter to remove sediment, which can clog the carbon prematurely.

High-volume models typically deliver one-third gallon to three gallons per minute — suitable for families with high water usage. These use large canisters about 10 inches high by 3 inches in diameter and will last approximately six months or process about 1,000 gallons of water before the carbon needs to be replaced. If filters are not replaced when needed, they can actually breed bacteria.

Small faucet-mounted filters are only effective against odors and tastes and need frequent filter changes. Installed retail prices for under-the-sink and countertop models range from $50 to $450. Replacement filter elements for high-volume filters range in cost from $15 to $75. — *D.B.*

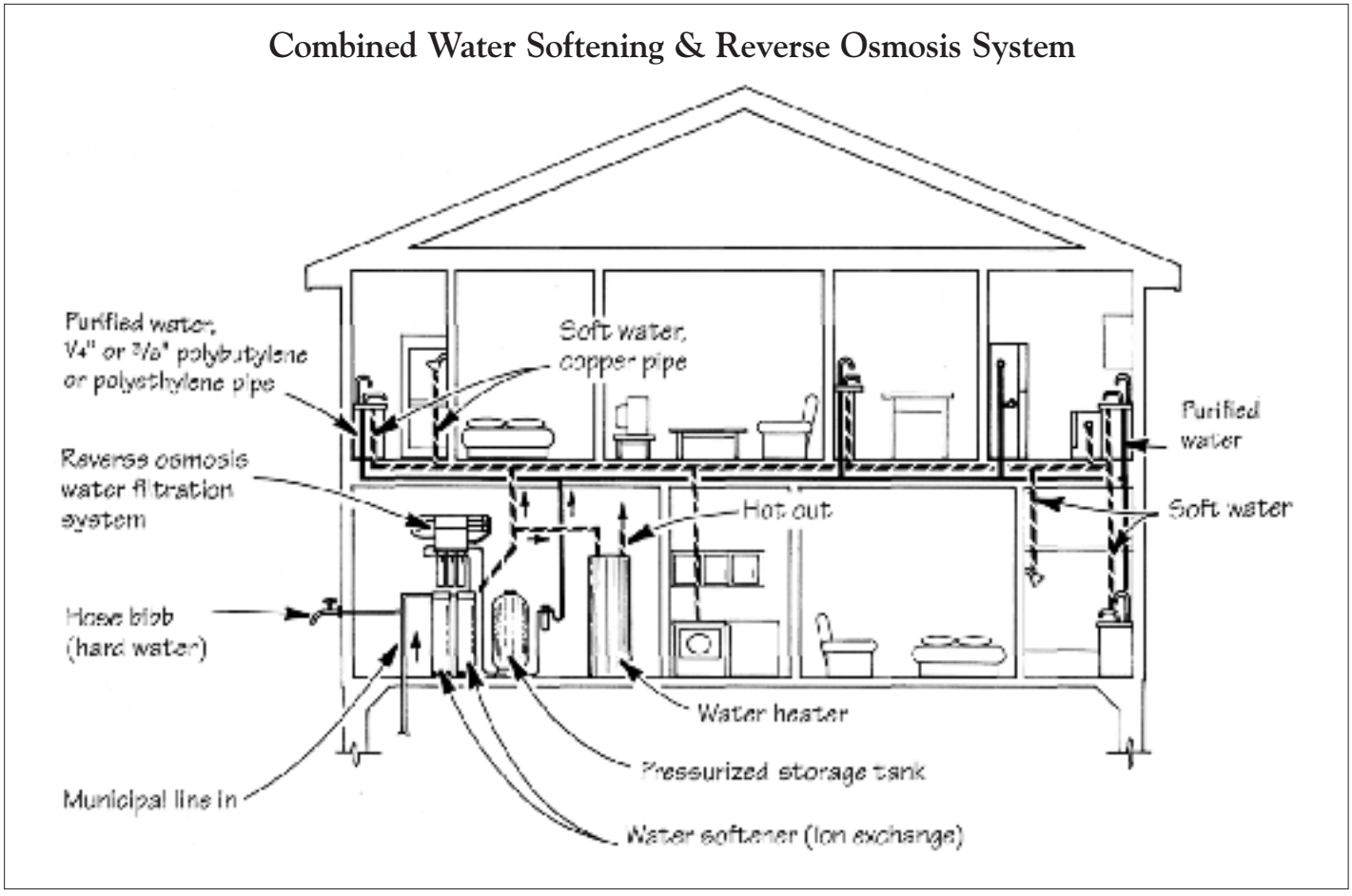



**Figure 1.** *This high-end, point-of-entry system has both water softener and filtering equipment clustered near the water main. Filtered water is routed through separate plastic piping to dedicated drinking-water taps throughout the house, and to a connector for the refrigerator's ice-maker.*

newer homes don't present a risk. But if you work on older houses, especially those built between 1910 and 1940, when the use of lead service pipes was common, it would be smart to have the homeowner test his water through a reputable lab. (See information box at end of article.)

If you work in an area with private wells, your local and state health officials can give you an overview of the groundwater quality. Using historical test records, they should be able to alert you to potential well water problems, including high levels of radon, arsenic, nitrates, pesticides, and other contaminants.

Local well drilling contractors are another good source of expertise on groundwater quality. In recent years, many of them have begun to sell and service water softening and filtration equipment as a natural extension of their drilling business.

Of course, neither historical nor anecdotal information can take the place of a site-specific water well test, which will precisely identify any substances that need to be removed to meet your customer's goals. All private wells should be periodically tested by a certified testing laboratory that's recommended by your state health department.

## Should You Subcontract?

Once you've done your homework, you'll know whether or not there's a genuine need for in-home water treatment in your area. If there is, you must decide whether you want to become a dealer yourself or to work with an established dealer who will install and service the equipment on a subcontract basis.

Most home builders choose the latter course, since there's usually not enough volume and profit in the work to justify the relatively large investment of time and effort it takes to become a dealer. (Plumbers, K&B remodelers, and well drillers, on the other hand, may find it worthwhile to start their own dealership.)

Since there are a lot of hucksters loose in the field — as well as some questionable equipment — it pays to choose a sub with care. Look for an established business with a good reputation, permanent location, and a stable relationship with one or more reputable manufacturers. It is also worth checking with the Better Business Bureau and Federal Trade Commission for a clean record.

The water filtration equipment should be certified by the NSF International or a reliable lab that tests to NSF standards. NSF is an independent, nonprofit group that tests products to see if they remove the specific contaminants that their manufacturers claim.

Some water contractors take the time to become Certified Water Specialists, which means they've completed at least a basic training course with the Water Quality Association (WQA). About 500 dealers nationwide have gone on to become level-five specialists, having completed advanced course work with the WQA.

**Figure 2.** *Point-of-use filtration is more common and less costly than central systems. This undersink reverse osmosis system from Culligan can deliver 1/2 gallon per hour and costs from $500 to $800 installed.*

### Service and Maintenance

Since all water treatment equipment requires ongoing maintenance to remain effective (e.g., periodically replacing the activated charcoal in a carbon filter or the membrane in a reverse-osmosis system), you must be able to count on your subcontractor to reliably service the system for years to come.

"One of the first things I looked for was a company that had the horsepower to stand behind their equipment and deliver good service," says custom builder Mark Falcone, president of Falcone Builders in Laguna Beach, Calif. "I didn't want any callbacks or problems down the road to end up on *my* desk."

Falcone says that he doesn't make a profit on the $4,000 water softening and reverse-osmosis systems that his subcontractor, Water Factory Systems, of Irvine, Calif., installs.

"The water treatment system goes into my homes just like the refrigerator and the other appliances," he explains. "I have them put in as a service to my clients, without any markup."

But most builders mark up the systems. For example, Maracay Homes, which develops subdivisions in the Phoenix area, adds $1,850 to $1,950 to the price of a new home for including a built-in water softener, reverse-osmosis filtration system, and related piping. Maracay pays its subcontractor, All About Water-Eco Water, in Gilbert, Ariz., about $1,000 for the equipment and installation.

"Builders can make a nice margin on these systems with little or no effort," says Joyce Crissman, co-owner of All About Water-Eco Water. "While the home is being framed, our crew goes in and plumbs in the softener loop and the polybutylene lines for the filtered drinking water. Once the home is finished, we install the equipment. After the new owner moves in, we do all the service and maintenance. All the builder has to do is offer the option to potential buyers."

### Point-of-Entry Systems

The upscale systems that Falcone Builders and Maracay Homes use are called "point-of-entry" water treatment systems. The equipment is typically clustered in a basement, garage, or utility room near the point where the water line enters the house.

With the exception of the outside hose bibs, all household water — hot and cold — is typically routed through the softener. Using water line pressure, some of the softened water is diverted through the reverse-osmosis unit into a storage tank. As demand calls, the filtered drinking water is distributed through separate piping to various service points throughout the house (Figure 1).

For customers concerned about the salt content of softened water (for example, those on low-sodium diets), you may want to bypass the water softener for their drinking water loop. The harder the water, the saltier it will be after softening, so this is mainly a concern with very hard water. However, hard water will more quickly scale up filter and distillation equipment or wear out the membranes on reverse-osmosis units. Another option for those on low-salt diets is to use a potassium-based softener rather than one using sodium.

The piping used to deliver the filtered drinking water is usually 1/4-inch or 3/8-inch polybutylene or polyethylene tubing. Not only is plastic tubing less expensive than copper, it also holds up better in contact with filtered water, which is very aggressive.

### Point-of-Use Systems

A more common and less expensive option is to install some type of "point-of-use" filtration (Figure 2). This approach places the water-treatment unit under the sink or on the countertop close to where the water is going to be used for drinking or cooking. (Water softeners are *always* placed at the point of entry, in order to treat all household water, since it would be impractical to put a softener on each plumbing fixture.)

The installed retail price for a point-of-use filtration unit varies dramatically from under $100 to over $1,000, depending on the technology used and the unit's capacity and features. See "Water Treatment Technologies" page 48.

Bear in mind that the lifetime operation and maintenance costs on these filtration systems can be several times their original purchase price, especially when the cost of wasted water (reverse osmosis) and electricity (distillation) is factored in. ■

*Don Best is a freelance writer in Surry, N.H., specializing in construction topics.*

## For More Information

**To find out whether a specific brand of water filtration equipment performs as the manufacturer claims, contact:**
NSF International
(formerly National Sanitation Foundation)
3475 Plymouth Rd.
P.O. Box 130140
Ann Arbor, MI 48113
313/769-8010

**For information on drinking-water quality standards, contact:**
U.S. Environmental Protection Agency
Office of Drinking Water
(WH5500)
401 M. St., SW
Washington, DC 20460
800/426-4791

**For a list of Certified Water Specialists in your area, contact:**
Water Quality Association
4151 Naperville Rd.
Lisle, IL 60532
708/505-0160