WaterSense® Guide to Selecting Water Treatment Systems

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EPA WaterSense

Introduction

It is not unusual for water to contain some contaminants or impurities. Your water system treats water to remove contaminants, and under the Safe Drinking Water Act (SDWA), the U.S. Environmental Protection Agency (EPA) sets legal limits on more than 90 contaminants in drinking water. These legal limits are intended to protect human health by establishing the maximum amount of each contaminant that can be present in drinking water. U.S. water utilities provide treated drinking water that meets these standards and are otherwise required to communicate when unsafe levels of contaminants are present. However, if you are concerned with the taste, odor, color, or potentially unhealthy concentrations of contaminants in your drinking water at home or at work, water treatment units can be used to improve water quality. EPA's WaterSense program has developed this guide to help consumers understand treatment options for drinking water and how these systems can be maintained to ensure good performance and water efficiency.

Understanding Your Water Quality

Homes and businesses that get their water from a public water system should receive a consumer confidence report (CCR) from their utility each summer. The CCR contains state-certified lab results that compare the utility's water quality against National Primary Drinking Water regulations. As a water utility customer, you have the right to review the CCR; contact your local water supplier if you have not received one. Learn more about CCRs on EPA's website at www.epa.gov/ccr/ccr-information-consumers.

Homes that receive water from a well should have their water periodically tested by a state-certified lab to assure compliance with national drinking water standards. Individuals who receive water from a public utility but are concerned about their water quality can also get their water tested by a state-certified lab. EPA maintains a list of certified laboratories at www.epa.gov/dwlabcert/contact-information-certification-programs-and-certified-laboratories-drinking-water. EPA also has information about what to do to safeguard and test well water at www.epa.gov/privatewells/protect-your-homes-water.

Determining Your Treatment Goals

Using water quality test results, CCR information, and/or personal experiences with the water supply, you can determine whether your water quality poses any concerns that need to be addressed. If there are specific contaminants or concerns, you may wish to purchase a water treatment unit, but it's important to identify your treatment goals first. Table 1 on page 3 describes some example water treatment goals and potential sources of contamination. For additional information on a wide variety of water contaminants, visit EPA's National Primary Drinking Water Regulations web page: www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations.

TABLE 1: EXAMPLE WATER TREAMENT GOALS AND CONSIDERATIONS

Example Treatment Objective	Potential Sources of Contamination	Highest Susceptibility	Potential Health Effects
Improve taste and odor	Disinfectants and minerals in municipally-supplied water	Municipally-supplied water	Taste and smell are not necessarily a sign of poor water quality, since most harmful contaminants do not affect the taste or smell of water. Consider having water tested or consult the local water utility if there are noticeable changes in taste or smell.
Remove lead	Corrosion in lead service lines and lead-soldered plumbing parts	Homes and businesses with lead service lines	Lead in drinking water is especially harmful to children and pregnant women; it can cause damage to the brain and nervous system, impede development, and introduce learning, behavior, hearing, and speech issues in children.
Remove nitrate	Fertilizer, manure, septic systems, and sewage, as well as natural deposits	Well water	Nitrate can decrease blood's ability to carry oxygen to tissues, which can most severely affect pregnant women and bottle-fed babies.
Remove arsenic	Found naturally in some groundwater	Private wells and public water systems that use groundwater	Arsenic has been linked to several cancers and can cause other symptoms such as nausea, decreased production of red and white blood cells, and abnormal heart rhythm.
Remove per- and polyfluoroalkyl substances (PFAS)	Industrial sites (e.g., textile and plastic manufacturers), landfills, fire training and fire response sites	Water sourced near urban areas and potential PFAS sources	Studies have shown that PFAS could be linked to several cancers, liver damage, high cholesterol, and increased risk of asthma.

Why Does My Water Smell Like a Swimming Pool?

Sometimes you may smell chlorine in your tap water because your utility adds chlorine as part of the water treatment process. Chlorine is a disinfectant used to help to control pathogens in water. Many treatment devices can remove chlorine to improve water taste and odor. When selecting a treatment device, make sure to choose one that has been certified to NSF International (NSF)/American National Standards Institute (ANSI) 42 *Drinking Water Treatment Units—Aesthetic Effects*. The NSF/ANSI 42 standard addresses products that improve taste and odor. You can also reduce the chlorine taste and odor by simply pouring water into an open pitcher and placing it in the refrigerator for a day or two. The chlorine will naturally evaporate from the water over time, reducing taste and odor concerns.

Certain individuals may not be concerned with removing a particular contaminant but instead wish to protect vulnerable populations in their household (e.g., pregnant women, children, the elderly, immunocompromised) who may be more susceptible to waterborne pathogens. In these cases, ensuring removal of pathogens, such as *Cryptosporidium*, *Giardia*, and *E. coli*, may be of particular concern. However, conventional water treatment processes are highly successful at pathogen removal in drinking water.

Why Soften Water?

Water hardness increases with calcium and magnesium concentrations. Homes and businesses with significant water hardness may see mineral/scale formation on plumbing fixtures and appliances and find it difficult to get sufficient lather from soaps and detergents. While some water hardness is generally not a health hazard, water softeners can be used to remove excessive hardness.

Softening water with a water softener or neutralizing the scale-forming water properties using a water conditioner can improve taste and reduce impacts of water hardness on the plumbing system. When selecting a water softener or conditioner, make sure to choose one that has been certified to NSF/ANSI 44 *Requirements for Water Softeners* or International Association of Plumbing and Mechanical Officials (IAPMO)/ANSI Z601 *Standard for Scale Reduction Devices*.

Cation exchange water softeners can consume water during ion regeneration cycles and can therefore contribute to additional water use. NSF/ANSI 44 includes a voluntary efficiency rating that requires softeners to use 5.0 gallons of water or fewer per 1,000 grains of hardness removed. To minimize water and salt use when selecting a water softener, identify a model with demand-initiated regeneration that has a lower water consumption (i.e., gallons per 1,000 grains of hardness removed) and higher salt efficiency (i.e., grains of hardness exchanged per pound of salt).

Cation exchange water softeners can impact local water quality because they discharge salts as part of the treatment process. Therefore, some local jurisdictions have restrictions on the installation and use of these systems. Check local requirements prior to purchasing one of these systems.

Deciding What Is the Right System for Your Needs

Once you have identified water treatment goals for your situation and reviewed the options, you can select a system that fits your water use and lifestyle. Think about where treated water is needed most at home or in your business and the quantity of water that requires treatment each day. Avoid oversizing treatment systems, as larger systems tend to be more costly to purchase, operate, and maintain. Note, many water-consuming activities within a home or business (e.g., flushing toilets, washing clothes) do not require additional water treatment; stick to only treating water used for cooking and drinking.

Point-of-Use Systems

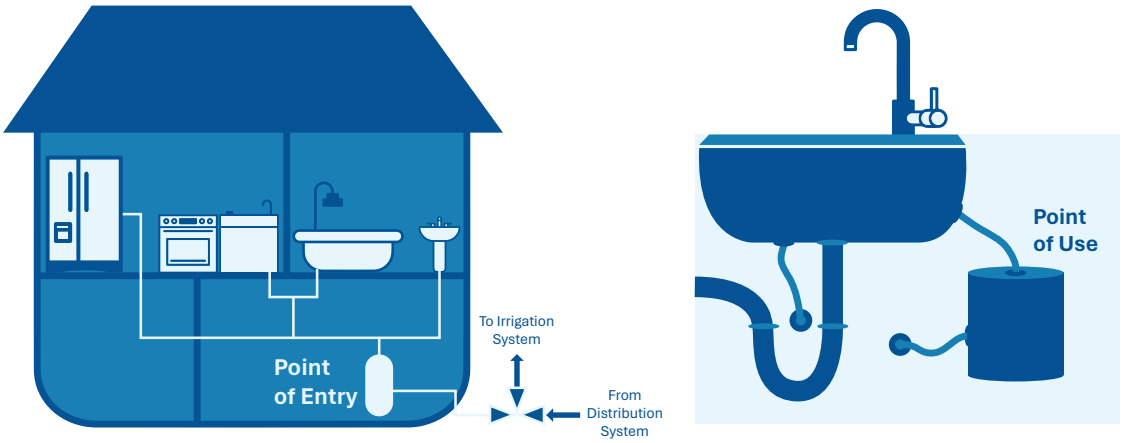
Treating water at the tap or where it is used is known as point-of-use treatment and can include a water pitcher with a filter; a filter that is installed on a dedicated faucet or spigot; or a device installed under the sink. Point-of-use devices are best suited for homes or businesses that wish to treat water used for drinking and cooking. Following are some point-of-use systems and how they are used:

- **Water pitcher filters** depend on the user to fill the pitcher with water manually.
- **Faucet-mounted filters** are attached to existing faucets and can be toggled on and off to produce filtered or unfiltered water from the tap.
- **Refrigerator filters** are a built-in feature of many modern refrigerators. Water and ice are supplied through a dedicated spigot or dispenser. Filters should be replaced based on the manufacturer's instructions.
- **Faucet-integrated filters** are faucets equipped with integrated filters. The filter housing is built into the faucet rather than a separate filter fitted to the tap.
- **Countertop or stand-alone systems** can be placed away from the kitchen sink and either draw water from the water supply line or require water to be filled manually within a self-contained unit.
- **Under-sink systems** are typically installed under the kitchen sink and are plumbed into a seperate faucet. Water from the supply line is treated within the system before it is directed to a dedicated faucet. Under-sink systems can treat larger quantities of water.

Point-of-Entry Systems

A point-of-entry—or whole-house—system is installed to treat water at the point the water enters the building to distribute treated water throughout it for all uses (e.g., toilet flushing, showering, clothes washing). Therefore, point-of-entry devices treat large quantities of water, and they are best suited for situations where the water source poses consistent and significant contamination challenges. Installation of these systems generally costs several thousand dollars and may require plumbing alterations and professional maintenance services.

Figure 1. Types of Water Treatment Systems



Water Treatment Technologies

Water treatment technologies vary by levels of contaminant removal and sophistication, so consider your treatment goals when reviewing options. Table 2 describes typical residential and commercial facility water treatment technologies and their testing standards, benefits, and limitations. Table 2 also shows whether a treatment technology consumes additional water during the treatment process. Several water treatment systems are available, and no single treatment system removes all contaminants, but many systems combine treatment technologies to address a wide range of water concerns.

TABLE 2: WATER TREATMENT TECHNOLOGIES COMPARISON

Treatment Technology	How It Works	Applicable Testing Standard	Benefits	Limitations	Does It Consume Water During Treatment?
Filtration	Filters often use physical barriers, such as fabric, fiber, ceramic screening, or other filtration methods to remove contaminants. Activated carbon or resins are commonly used in filters to trap contaminants and improve taste and odor.	• NSF/ANSI 42: *Drinking Water Treatment Units—Aesthetic Effects* • NSF/ANSI 53: *Drinking Water Treatment Units—Health Effects* • NSF/ANSI 401: *Emerging Compounds/ Incidental Contaminants*	• Relatively inexpensive to install and maintain • Improves taste and odor • Removes organic contaminants • Some can remove chlorination byproducts, cleaning solvents, and pesticides	• Does not remove nitrates, bacteria, or dissolved minerals	No
Reverse Osmosis (RO)	Using pressure, RO forces water through a membrane that limits the size of the particles that can pass through. The membrane traps and rejects contaminants, creating a stream of treated water that is able to pass through the membrane and a stream of reject water that is unable to pass through the membrane.	NSF/ANSI 58: *Reverse Osmosis Drinking Water Treatment Systems*	• Improves taste and odor • Removes sodium, dissolved inorganics, and organics • Some can reduce nitrates, pesticides, dioxins, chloroform, and petrochemicals	• Does not remove all inorganic and organic contaminants • Removes beneficial minerals such as calcium, along with contaminants • Can be costly to install and maintain	Potentially produces a large quantity of reject water during the treatment process; select a WaterSense labeled RO system to waste less water

Treatment Technology	How It Works	Applicable Testing Standard	Benefits	Limitations	Does It Consume Water During Treatment?
Distillation	Water is heated to the boiling point to kill microbes and generate water vapor. Most chemical contaminants remain in the liquid water. The water vapor is then collected into a separate container as it condenses.	NSF/ANSI 62: *Drinking Water Distillation Systems*	• Removes nitrates, bacteria, viruses, pathogens, sodium, hardness, dissolved solids, most organic compounds, heavy metals, and radionuclides • Can be used during boil water advisories	• Does not remove some volatile organic compounds, some pesticides, or volatile solvents • Bacteria may grow on cooling coils during inactive periods • Can be costly, and treatment is typically energy-intensive	Minimal water consumption for cleaning and maintenance between uses
Ultraviolet (UV)	Water is passed through a chamber equipped with a UV lamp that is used to kill pathogens.	NSF/ANSI 55: *UV Water Treatment Systems*	Inactivate biological contaminants such as bacteria, viruses, and protozoa	• Not effective against chemicals (e.g., heavy metals, organics)	No

Water Treatment Technology Certification

Certification of water treatment products helps ensure that the manufacturers' claims are independently verified and accurate. When choosing treatment technologies, it is important to ensure that they are certified to the applicable NSF/ANSI standards to treat for targeted contaminants. Certifications focus on different contaminants and performance indicators, and the specific contaminants that each treatment system can treat for can vary widely. Some systems combine different technologies to treat a variety of contaminants and are therefore certified to multiple standards. For example, an RO system might include filters or UV treatment in addition to the RO membrane, and therefore could be certified to NSF/ANSI 42, NSF/ANSI 53, or NSF/ANSI 55, in addition to NSF/ANSI 58.

Third-party certification is offered by different organizations. Look for certification logos or language that suggests the product or system is certified to the applicable NSF/ANSI standards. These markings are often on product packaging, supporting documentation, or other point-of-purchase materials. In addition, review the system's performance data sheet to confirm it is certified to treat for the targeted contaminant(s), or check for contaminant reduction claims on third-party certification organizations' websites.

Look for the WaterSense Label

Reverse osmosis systems generate water waste during the treatment process and therefore, will increase home or building water use once installed. EPA estimates that a typical point-of-use RO system generates at least five gallons of water waste for every gallon of treated water it produces, while some inefficient models can consume up to 10 gallons of water waste for every gallon of treated water produced.

All RO systems will generate some water waste. If purchasing an RO system, be sure to select a WaterSense labeled RO system for a more water-efficient option. WaterSense labeled models generate 2.3 gallons of water waste or less for every gallon of treated water produced. For more information, visit www.epa.gov/watersense/point-use-reverse-osmosis-systems.

Pricing and Water Efficiency

Prices of water treatment systems and installation vary depending on the type of technology used, where the unit is installed, and what contaminants it removes. Basic water pitchers and tap filters typically cost less than $100 and require no installation, whereas distillation and RO systems tend to cost a few hundred dollars and may require professional installation. Point-of-entry systems can cost thousands of dollars and generally require professional installation. Maintenance costs for all types of systems typically include periodic filter and/or membrane replacements to ensure the treatment is occurring.

A system's efficiency can also affect the long-term cost of a water treatment option. For example, RO systems increase overall household or building water use, because they generate water waste for every gallon of treated water produced. Distillation, meanwhile, is an energy-intensive process that can increase your energy bill.

Maintenance

All water treatment systems require some level of ongoing maintenance to ensure they remain effective and efficient, and unmaintained systems may make water quality worse. Maintenance may involve changing filters, disinfecting treatment units, removing mineral build-up, and backwashing. Filters should be replaced according to the manufacturer's instructions and recommended schedule. Some systems, such as RO systems, also have a membrane and other parts that may need to be replaced over time. Periodic water testing using a home test kit can help ensure that systems are functioning properly. Some purchasers may opt to have their system professionally maintained. Several companies offer maintenance services that send a water treatment professional to your home regularly to replace filters, clean your system, and address any specific concerns.

References and Additional Resources

CDC. About Choosing Home Water Filters. https://www.cdc.gov/drinking-water/prevention/about-choosing-home-water-filters.html.

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EPA WaterSense. Point-of-Use Reverse Osmosis Systems. www.epa.gov/watersense/point-use-reverse-osmosis-systems.

Minnesota Department of Health, 2022. *Home Water Treatment Fact Sheet*. www.health.state.mn.us/communities/environment/water/factsheet/hometreatment.html.