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Solving Water Quality Problems in the Home

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Everyone needs high quality water for drinking and other domestic uses. If your water supply is public, the water utility company must test the water regularly to make sure it meets standards set by the Environmental Protection Agency (EPA). The two types of standards are Primary Standards (having to do with pollutants that affect health, including pathogens, radioactive elements, and toxic chemicals) and Secondary Standards (having to do with properties such as taste, color, corrosivity, foaminess, and staining). The utility must treat the water, if necessary, to maintain its quality.

If your water supply comes from a private well, it is up to the well owner to test the water and make any treatments necessary. There are several reasons well water may be poor quality. Some water naturally contains elements or compounds for which it should be treated. In some cases, there may be a source of pollution that is affecting the well. Finally, the water may be reacting with the plumbing system to produce undesirable substances. Follow the step-by-step procedure described below to determine whether you have a water quality problem and find an appropriate solution.

Step 1. Inspect Your Water

First, you will need to inspect your water. Does it have an unusual taste, color, or odor? Does it contain sediment? Does it stain clothes, dishes, fixtures, or sidewalks? For example, water in some parts of Texas contains a high level of dissolved iron that causes reddish-brown stains on sinks, bathtubs, and toilets. Table 1 is a guide to common water problems and their causes. If you notice any of these problems, your water should be tested to confirm the cause.

Step 2. Get Expert Information

If your water comes from a public source, contact the water utility and request a copy of the Municipal Drinking Water Contaminant Analysis Report (commonly referred to as a consumer

Table 1. Common problems.

Problems and symptoms	Possible contaminants or confirmation tests
Stained fixtures and clothes:	
Red or brown	Iron
Black	Manganese
Green or blue	Copper
Reddish-brown slime	Iron bacteria
Off-color appearance:	
Cloudy	Turbidity
Black	Hydrogen sulfide, manganese
Brown or yellow	Iron, tannic acid
Unusual taste and odor:	
Rotten egg	Hydrogen sulfide
Metallic	pH, corrosive index, iron, zinc, copper, lead
Septic, musty, earthy	Total coliform bacteria, methane
Alkali	pH, total dissolved salts
Gasoline or oil	Hydrocarbon scan
Soapy	Surfactants
Corrosion of pipes or plumbing	pH, lead, iron, manganese, copper

confidence report) or check the utility website for a posted copy. The utility is required by law to send this report to its customers annually. Because public water utilities must test water regularly, your water may not need to be tested unless someone in your family becomes ill or the taste, odor, or color of your water changes. If you do have problems, the utility should help get the water tested.

If your water source is private, contact your groundwater conservation district (GCD), county Extension agent, or health department to find out what contaminants are typical of well water in your locale. The health department can test your water for bacterial contamination. The GCD, county Extension agent, and the health department can put you in touch with laboratories that test the quality of drinking water. Another source of laboratories is the National Environmental Laboratory Accreditation Program (NELAP), which is a national accreditation for potable water labs. A list of these labs is available at https://www.tceq.texas.gov/goto/certified_labs.

Step 3. Have Your Water Tested

Contact the testing laboratory and ask for complete instructions, and any necessary equipment, for taking a water sample. Read the instructions carefully and carry them out precisely. Proper sampling is the most important part of water testing. Use only the containers the lab sends or recommends. Note how much time the lab allows between the time the water is collected and the time it is analyzed. Make sure your samples arrive at the lab within the time limit.

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Some laboratories can test for all known contaminants, but this is expensive and usually unnecessary. Private well water should be tested annually for coliform bacteria, *E. coli,* and nitrates. Also test for lead if the house is old and contains iron or copper pipes, fittings, plumbing fixtures, or solder. Other contaminants need to be measured only if there is reason to believe they are present at levels that cause problems.

The laboratory report should state whether there are any contaminants that do not meet Primary or Secondary Standards. Within the Primary Standards, each contaminant is assigned a Maximum Contaminant Level (MCL) based on its toxicity and its effect on human health. Drinking water standards and related information can be found on the EPA Web site at www.epa.gov/dwstandardsregulations.

If you have questions about the report you receive, contact the lab and ask for an explanation. Your GCD, county Extension agent, or health department also can help you interpret laboratory results. Additional publications regarding specific water quality contaminants and best management practices for private water well management are available at http://twon.tamu.edu/fact-sheets/ and include titles such as *Drinking Water Problems: Arsenic, What to Do About Coliform Bacteria in Well Water,* and *Drinking Water Problems: Corrosion.*

The do-it-yourself water testing kits available in home product stores are not as accurate as laboratory analyses and usually do not detect low levels

of contaminants as readily. Most home testing kits are not useful for analyzing anything more than basic water characteristics such as hardness, pH, iron, chlorine, and sulfur. Also, they do not detect all kinds of contaminants. Organic pollutants, for example, must be analyzed in a laboratory with sophisticated equipment. Hydrogen sulfide (H_2S) also requires professional laboratory analysis. This is the contaminant that gives water a "rotten egg" smell. For more information on this substance, see L-5312, *Hydrogen Sulfide in Drinking Water,* available at http://twon.tamu.edu/fact-sheets/.

Step 4. Choose Treatment Equipment

If you have taken time to find out all you can about your water, you will be able to select the appropriate treatment method. If your water has no objectionable physical properties and contains no contaminants above acceptable limits, it does not need treatment. Table 2 lists major water problems and the treatment options you can use in your home. Point of Entry (POE) systems treat all of the water in the home, while Point of Use (POU) systems usually are attached to a faucet or installed near or under the sink so that only water used for drinking and cooking in the home is treated.

An individual who installs, repairs, or services water treatment equipment under contract must meet the qualifications of 30 Tex. Admin. Code §30.261. To find a licensed water treatment professional, search water treatment specialists licensed by the Texas Commission on Environmental Quality as shown through http://www2.tceq.texas.gov/lic_dpa/index.cfm.

When you select equipment, remember to consider not just the initial cost, but also the cost of maintaining the equipment (including back flushing, adding chemicals, and replacing filters). Without proper maintenance, your system will not operate effectively.

Another source of consumer information about water treatment equipment is NSF International, an independent, nonprofit organization that develops equipment standards and evaluates products against those standards. NSF International certifies plumbing products, drinking water additives, and drinking water treatment systems and devices. The NSF databases and reviews are searchable through http://www.nsf.org/certified-products-systems. The organization is accredited by the American National Standards Institute. The circled NSF approval stamp means that a product conforms to specified standards.

References

Center for Disease Control: http://www.cdc.gov/healthywater/pdf/drinking/Household_Water_Treatment.pdf. Accessed on 7/1/2016.

Water Testing, Publication AEX-314, Ohio Cooperative Extension Service.

Determining the Quality of Your Drinking Water: A Step by Step Guide, NSF International.

Groundwater: Household Water Treatment, Montana Cooperative Extension Service.

Home Water Treatment Systems, Publication L-2280, Texas Cooperative Extension.

Home Water Treatment Equipment: An Overview, Cooperative Extension, University of Nebraska Institute of Agriculture and Natural Resources.

Table 2. Drinking water treatment technologies for household use. Source: Center for Disease Control: http://www.cdc.gov/healthywater/pdf/drinking/Household_Water_Treatment.pdf. Accessed on 9/03/2018.

This document is designed as a guide for household water treatment, not a recommendation.****
Before installing a household water treatment system, contact your local health department's environmental health group for consultation.

Table key for pathogen removal

–	**not effective**
+	**low effectiveness**
++	**moderate effectiveness**
+++	**high effectiveness**
++++	**very high effectiveness**

POU/POE* Technologies that may remove some/all contaminants		**Household water contaminants*** **			
		Protozoa (e.g., *Cryptosporidium, Giardia*)	**Bacteria** (e.g., *Campylobacter, Salmonella, Shigella, E. coli*)	**Viruses** (e.g., Enteric, Hepatitis A, Norovirus, Rotavirus)	**Chemicals**
Filtration** (physical process that occurs when liquids, gases, dissolved, or suspended matter adhere to the surface of, or in the pores of, an adsorbent medium)	**Microfiltration**	++++	++	–	–
	Ultrafiltration	++++	++++	++	+
	Nanofiltration	++++	++++	++++	++
Reverse Osmosis Systems** (process that reverses the flow of water in a natural process of osmosis so that water passes from a more concentrated solution to a more dilute solution through a semi-permeable membrane. Pre- and post-filters are often incorporated along with the RO membrane itself)		++++	++++	++++	Will remove common chemical contaminants (metal ions, aqueous salts), including sodium, chloride, copper, chromium, and lead; may reduce arsenic, fluoride, radium, sulfate, calcium, magnesium, potassium, nitrate, fluoride, and phosphorous.
Distillation Systems (process of heating water to the boiling point and then collecting the water vapor as it condenses, leaving many of the contaminants behind)		++++	++++	++++	Will reduce most common chemical contaminants, including arsenic, barium, cadmium, chromium, lead, nitrate, sodium, sulfate, and many organic chemicals.
Ultraviolet Treatment Systems (with pre-filtration) (treatment process that uses ultraviolet light to disinfect water or reduce the amount of bacteria present)		++++	++++	+++	–
Water Softeners		Ion exchange technology for chemical or ion removal to reduce the amount of hardness (calcium, magnesium) in the water, can also be designed to remove iron and manganese, heavy metals, some radioactivity, nitrates, arsenic, chromium, selenium, and sulfate; does not protect against protozoa, bacteria, and viruses.			

***Point of Use (POU)—point of use water treatment systems typically treat water in batches and deliver water to a single tap, such as a kitchen sink faucet or an auxiliary faucet.**
***Point of Entry (POE)—point of entry water treatment systems typically treat most of the water entering a residence. Point-of-entry systems, or whole-house systems, are usually installed after the water meter.**

****Filtration:**
- A **microfiltration filter** has a pore size of approximately 0.1 micron (pore size ranges vary by filter—0.05 micron–5 micron).
- An **ultrafiltration filter** has a pore size of approximately 0.01 micron (pore size ranges vary by filter—0.001 micron–0.05 micron; Molecular Weight Cut Off (MWCO) of 13,000–200,000 Daltons); Ultrafiltration filters remove particles based on size, weight, and charge.
- A **nanofiltration filter** has a pore size of approximately 0.001 micron (power size ranges vary by filter—0.008 micron–0.01 micron; Molecular Weight Cut Off (MWCO) of 200–2,000 Daltons); Nanofiltration filters remove particles based on size, weight, and charge.
- A **reverse osmosis filter** has a pore size of approximately 0.0001 micron.

Filtration of contaminants depends highly on the amount of contaminant, size of the contaminant particle, and the charge of the contaminant particle. Depending on the household's water needs, pretreatment before filtration may include the addition of coagulants and powdered activated carbon, adjustments in pH or chlorine concentration levels, and other pretreatment processes in order to protect the filter's membrane surface.

***The treatment technologies described can be used in conjunction with each other for greater pathogen reduction. The addition of coagulants, carbon, alum, and iron salts to filtration systems may aid in chemical removal from water.

****In addition to providing safe drinking water to your household, you can also prevent illness by practicing good personal hygiene.
Wash hands before preparing and eating food, after going to the bathroom, after changing diapers, and before and after tending to someone who is sick.

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