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Matching Drinking Water Quality Problems to Treatment Methods

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As private well owner, you often notice changes in taste, odor, or color of your water which indicates potential problems. The following two tables discuss the common problems, symptoms, causes, and treatments to address water quality issues. Table 1 focuses on *observed* colors, smells, tastes, and other appearances. Table 2 focuses on results from laboratory tests. If you observe any of the problems noted in Table 1 of this publication, you should have your water tested by a certified laboratory to indicate and verify the problem (refer to Arizona Extension publication *Well Water Testing & Understanding the Results*, AZ 1486f). Your Arizona Cooperative Extension Office has additional publications on water testing and can be of assistance.

Table 1 is adapted with permission from the Arizona Cooperative Extension publication *Arizona Well Owner's Guide to Water Supply*, Appendix B: Water Problems: Symptoms, Tests, and Possible Sources, AZ1485. Treatment options are often designated as point-of-entry (POE) or point-of-use (POU). POE treatment options will treat the water entering the house; POU treatment options treat the water where the water is being used.

Table 1. *Observed* illnesses, colors, smells, or tastes in drinking water, their probable cause(s), and typical treatment methods.

	Symptom	Cause	Treatment
Illness	Gastrointestinal problems such as diarrhea and vomiting	Pathogens	· Remove source of contamination · Reduce pathogens through chlorination[1], UV radiation, or ozonation (POE)
Visual (Water appearance)	Cloudiness of water with a yellow, brown, or black cast that clears after standing 24 hours	· Turbidity (cloudiness) · Silt, clay, or suspended particles in water	· New well screen · Particle filter (sand trap) (POE) · Microfiltration (POE) · Flocculation and sedimentation
	Transparent yellow-brown tint to water that doesn't clear after standing 24 hours	High levels of natural organic matter (NOM), usually in surface water	· Activated carbon filter[2] (POE) · Chlorination[1] followed by activated carbon filter[2] (POE) NOTE: Water utilities use flocculation to remove natural organic matter (NOM)
	Blue-green tint to water	Acidity (pH below 6.8; reacts with brass and copper plumbing)	· Acid-neutralizing filters (calcite or calcite/magnesium oxide) (POE) · Soda ash (lime) chemical feed followed by particle filter (POE)
	Excessive salt deposits	Hardness and alkalinity (high pH and sodium)	· Reverse osmosis (POE) · Distillation (POE) NOTE: Consider acid neutralization of excessive alkalinity
	Detergent odor or foaming water	Septic tank leaking into groundwater supply	· Eliminate source and shock chlorinate well · Activated carbon filter will absorb a limited amount
	Milky colored (water cloudy when drawn)	Precipitated sludge that is created when water is heated	Flush water heater periodically
		High volume of air in water from poorly functioning pump or highly performing aerator	· Water will clear quickly after standing · Service pump
		Excessive coagulant-feed being carried through filter	· Reduce coagulant quantity being fed · Service filter(s)

	Symptom	Cause	Treatment
Visual (Water appearance) (continued)	Reddish slime or tint to water. Water turns reddish brown during cooking or heating	Presence of dissolved iron and iron bacteria	*Low amounts:* Reduce by · Particle filter (POE or POU) · Reverse osmosis (POE or POU) · Distillation (POE or POU) · In warmer climates, residential aerator and particle filter will substantially reduce iron (POU) *High amounts*: Remove by · Potassium permanganate-regenerated oxidizing filter (POE) · Particle filter (POE) *Very high amounts* (over 10 mg/L): Remove by · Chlorination[1] (in a retention tank that allows for oxidation) followed by particle filter and/or dechlorination (POE) NOTE: Consider well, distribution, and storage shock chlorination to kill iron bacteria.
		Precipitated iron (water is discolored when drawn)	· If pH is higher than 6.7, a manganese greensand filter will remove up to 10 mg/L iron (POE) · If pH is higher than 6.8 and oxygen is 15% of the total iron content, use a manganese-treated, nonhydrous aluminum silicate filter (POE) · Downflow water with good backwash will remove up to 1 mg/L iron (POE) · To remove more than 1 mg/L, use a calcite filter followed by a downflow water softener (POE)
		Iron dissolved from old pipe with pH below 6.8	Calcite filter to remove precipitated iron (POE)
	Brownish cast that does not precipitate from (drop out of) the water	Organic (bacterial) iron	· Shock chlorinate well, follow with chlorination[1] and filtration · Chemical feed of potassium followed by permanganate and then particle filter (POE)
	Reddish color in water sample after standing for 24 hours	Colloidal iron	Chlorination[1] followed by activated carbon filter[2] to remove chlorine
Visual other	Houseplants stunted or with burned leaf tips	Salinity	· Reverse osmosis (POU) · Distillation (POU)
Taste	Taste of chlorine, gasoline, or oil	Volatile organic chemicals (VOCs) including chlorine, disinfection by- products, pesticides, fuel (gasoline, diesel), or oil products	· Activated carbon filter[2] (POE) · Aeration (POE)
	Metallic taste	Very low pH (below 5.5)	· Acid-neutralizing filters (calcite or calcite/magnesium oxide) (POE) · Soda ash (lime) chemical feed followed by particle filter (POE)
	Salty or bitter taste	· High total dissolved solids, sodium, sulfates, or nitrates · High salinity	· Reverse osmosis (POU) · Distillation (POU) · Deionize drinking water only with disposable mixed-bed (anion/cation) resins (POU) NOTE: No economical home treatment when sodium levels exceed 1800 mg/L
	Soda taste	High total dissolved solids AND high alkalinity	Reverse osmosis (POU) NOTE: No economical home treatment if level of alkalinity is more than 3.08 mg/L

	Symptom	Cause	Treatment
Smell	Chlorine-like smell	Volatile organic chemicals (VOCs) including chlorine, disinfection by- products, pesticides	· Activated carbon filter[2] (POU) · Aeration (POU)
	Gasoline-like smell	Gasoline, diesel, oil products	NOTE: There is no practical treatment system available. It is essential to locate and remove underground source. Activated carbon filters[2] can provide some treatment.
	Phenol (chemical) odor	· Industrial waste seeping into groundwater · Leaching of applied pesticides into groundwater	Activated carbon filter[2] will help for a short time (POE)
	Detergent odor or foaming water	Septic tank leaking into groundwater supply	· Eliminate source and shock chlorinate well · Activated carbon filter[2] will absorb a limited amount of odor (POE or POU)
	Musty, earthy, or woody smell	Usually harmless organic matter	Activated carbon filter[2]
	Rotten egg smell	· Excessive acidity · Lack of oxygen in water source	Control excess acidity by: · Acid-neutralizing filters (calcite or calcite/ magnesium oxide) (POE) · Soda ash (lime) chemical feed followed by particle filter (POE)
		Dissolved hydrogen sulfide gas in water supply	· Manganese greensand filter (for levels over 6 mg/L when pH is no lower than 6.7) (POE) · Chlorination[1] followed by activated carbon filter[2] (POE)
		Presence of sulfate-reducing bacteria	Chlorination[1] followed by activated carbon filter[2] (POE)
		Action of magnesium rod in hot water heater in the presence of soft water	Remove magnesium rod from water heater
	Methane gas (extreme caution is required; gas is explosive and toxic) NOTE: Normally, you cannot smell methane gas; natural gas and methane gas for the home is treated so that people can smell it.	Naturally decaying organic matter found in: · Shallow water wells near swamps · Housing areas built above or near old landfills and dumps · Aquifers overlying oil fields	Residential/commercial aeration system and re-pump
Appliance/ Hardware Problems	Early appliance failure	Hardness	Water softener (POE or POU)
	· White or grayish stains on tile, faucet ends, in toilet bowls · White scaly deposits in pipes, water heater, or appliances · Soap curd and scum in sinks, bathtub	Hardness	· Water softener (POE or POU) · Reverse osmosis (POE or POU) · Distillation (POE or POU)
	Poor evaporative cooler performance	Build-up of scale on pads (high hardness and/or high salinity)	Use bleed-off mechanism to prevent build-up of salts and minerals (more information on Water Conservation website)
	Brown-orange or red-brown (rusty) stains on sinks, fixtures, laundry	Presence of dissolved iron and iron bacteria	*Low amounts:* Reduce by · Particle filter (POE or POU) · Reverse osmosis (POE or POU) · Distillation (POE or POU) · In warmer climates, residential aerator and particle filter will substantially reduce iron (POU) *High amounts:* Remove by · Potassium permanganate-regenerated oxidizing filter (POE) · Particle filter (POE) *Very high amounts* (over 10 mg/L): Remove by · Chlorination[1] (in a retention tank that allows for oxidation) followed by particle filtration and/or dechlorination (POE) NOTE: Consider well, distribution, and storage shock chlorination to kill iron bacteria.

	Symptom	Cause	Treatment
Appliance/ Hardware Problems (continued)		Precipitated iron (water is discolored when drawn)	· If pH is higher than 6.7, a manganese greensand filter will remove up to 10 mg/L iron (POE) · If pH is higher than 6.8 and oxygen is 15% of the total iron content, use a manganese-treated, nonhydrous aluminum silicate filter (POE) · Downflow water softener with good backwash will remove up to 1 mg/L iron (POE or POU) · To remove more than 1 mg/L, use a calcite filter followed by a downflow water softener (POE or POU)
		Iron dissolved from old pipe with pH below 6.8	Calcite filter to remove precipitated iron (POE or POU)
	Blackened or tarnished metal utensils and pipes	High chloride levels NOTE: High-temperature drying concentrates chloride, accelerating corrosion.	· Reverse osmosis (POU) · Distillation (POU)
		High water acidity AND high hydrogen sulfide	· Acid-neutralizing filters (calcite or calcite/ magnesium oxide) (POE) · Soda ash (lime) chemical feed followed by particle filter (POE)
	Black stains on fixtures and laundry	Interaction of carbon dioxide or organics and manganese in the soil (above 0.05 mg/L, manganese causes staining and is usually found with iron)	· Chlorination[1] followed by particle filter (POE) · Oxidizing filter (POE) · Oxidation with potassium permanganate (POE) · Ozonation (POE or POU) · Water softener (POE or POU)
	Green stains on fixtures	Acidity (pH below 6.8)	· Acid-neutralizing filters (calcite or calcite/ magnesium oxide) (POE) · Soda ash (lime) chemical feed followed by filtration (POE)
	Excessive staining in showers and aluminum cookware	Salinity	· Reverse osmosis (POU) · Distillation (POU)
Feel (How the water feels)	· Grittiness · Abrasive texture to water when washing or residues in sink	Very fine sand particles or silt in the water that is able to pass through the well screen	· Sand trap (POE or POU) · Ultrafiltration (POU)
	Slippery feel	High total dissolved solids AND high alkalinity	Reverse osmosis (POU) NOTE: No economical home treatment if level of alkalinity is more than 3.08 mg/L

Table 2. Test results indicating a problem, the symptom(s), causes, and typical treatment methods.

	Symptom	Cause	Treatment
Arsenic	EPA maximum is 0.01 mg/L, health risks increase above this level	· Natural groundwater contaminant in certain regions · Industrial waste · Pesticides	· Reverse osmosis (removes up to 90%) · Activated alumina · Anion exchange · Distillation
Barium	· Inhibits normal plant growth · Above 1 mg/L considered undesirable for human use	Naturally occurring in the southwest United States	· Selective anion-exchange resin · Reverse osmosis · Activated carbon filter[2] · Distillation
Cyanide	· No visible color or noticeable taste · Most people can detect cyanide by its faint, bitter, almond-like odor · Above 0.2 mg/L considered a health risk	Industrial waste pollution from electroplating, steel, and cooking facilities	· Continuous chlorination and activated-carbon filtration after pH adjustment · Anion exchange · Reverse osmosis
Fluoride	Yellowish or mottled teeth in children	Fluoride level is above 2.0 mg/L in drinking water	· Anion exchange · Reduce concentration to 0.2 mg/L with activated alumina · Reverse osmosis · Distillation
Heavy metals (lead, zinc, copper, cadmium)	EPA has established maximum contaminant levels (MCLs) for each metal	· Industrial waste pollution · Corrosion products from plumbing caused by low pH waters	· Reverse osmosis · pH adjustment to prevent corrosion of water distribution system · Water softener will remove cadmium, copper, and zinc · Distillation
Nitrate	Maximum level set by EPA is 10 mg/L to protect infant health	· Human or animal waste · Heavy use of commercial fertilizers · Naturally-occurring rock with nitrogen	· Find sources of nitrogen and take steps to protect wellhead · Anion exchange regenerated with sodium chloride (typical salt) for water with less than 3 mg/L · Reverse osmosis for cooking and drinking water will remove 65% of nitrate; try to limit original concentration to 25 mg/L as nitrogen · Distillation for cooking and drinking water
Radioactive contaminants	The public health authority will post notices. Radium-226 above 5 piC/L and Strontium-90 above 10 piC/L are considered health risks.	· Naturally occurring in deep wells from phosphate rock or radium bearing rock strata · Atmospheric fallout or other human related activities that produce nuclear waste	· Remove cationic radioactivity with cation-exchange water softener ·Treat with mixed-bed deionizer for removal of anionic and cationic nuclides · Reverse osmosis can remove 70% of nuclides
		Radon gas given off by decaying radium dissolved in water	· Aeration by faucet aerator to dissipate dissolved radon (the problem with this treatment is that it is released to the room) · Activated carbon filter[2] (preferred method)
Trichloroethylene	Notice from Public Health Department	Solvents from waste degreasing and dry cleaning entering surface or ground water supplies	· Series of activated-carbon filters[2] and constant monitoring between units for breakthrough · Aeration

[1] Chlorinating water with high levels of natural organic matter (NOM) may result in the formation of excessive disinfection by-products.

[2] Activated carbon filters should not be relied on to reduce levels of organic contaminants like gasoline, solvents, and pesticides which are known to be above MCLs in a water source used for drinking water, unless these filters have been sized and tested for efficacy by a professional.

For Additional Information

Arizona Cooperative Extension (ACE) bulletins contain a variety of information about water, water quality, safe drinking water, and private wells. They are available through your county Extension office or from CALSmart.

Distribution Center, located in Tucson, at 4101 N. Campbell Avenue; (877) 763-531; (520) 795-8508 FAX; or visit http://ag.arizona.edu/pubs/

Sources

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cals.arizona.edu/pubs/water/az1486l.pdf

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