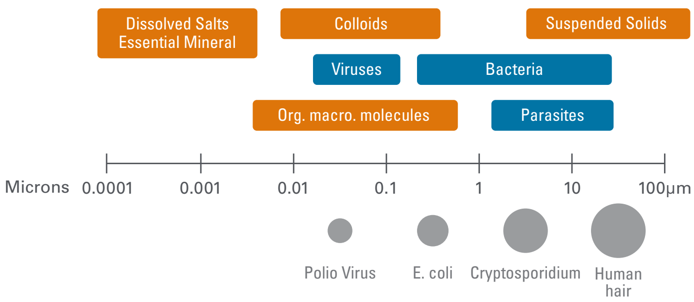
Home Water Treatment from A to Z

You received the results of your water quality test, and there are issues you need to solve. Surely, there must be a "one-size-fits-all" solution, right? In reality, that's unlikely. Water is the universal solvent. As it travels through the ground to our taps, it picks up different contaminants that can cause problems. As a result, water quality varies dramatically around the world, and each problem may require its own solution. Understanding water treatment basics can help you make an informed decision with your water treatment professional.

Adsorption: Involves the adhesion of contaminants to an adsorbent material. Often, the material is granular activated carbon (GAC). It's effective against some organic chemicals; hydrogen sulfide, which gives water a "rotten egg" smell; and residual chlorine. A common application is in pitcher-style kitchen filters. Unfortunately, GAC can make a great home for bacteria, so these filters should only be used for water that's been effectively treated for microbial contamination.

Distillation: One of oldest and simplest water purification methods, it depends on the principle that water as a liquid carries contaminants, but water as a gas carries none. By applying heat to convert water to steam, contaminants are left behind. Then the vapors are passed over cooling coils, condensing the water back to liquid form. The resulting fluid is nearly pure water. Distillation is highly effective but energy inefficient, and upfront costs can be prohibitive.

Filtration: Passes water through a porous material to remove suspended particles. The filter's pore size determines what gets rejected and what's allowed to pass through. Often, a sediment filter is used as the first stage of water treatment to remove the larger particles and may be followed by more refined filters. Pore size is typically measured in microns (μ).



Filter pore sizes in microns represented by marks on the line. Round shapes show the relative sizes of impurities. Graphic is not to scale, it gives an idea of size of filter pores and impurities.

Ion exchange: Is like the "swap meet" of water treatment. Water passes over a resin bed that holds certain ions, particles that hold a charge. But that resin would prefer to swap for ions found in water. The classic example is a water softener, which is a cation (positive charge) exchanger. The softener resin bed is saturated with sodium ions but prefers the calcium ions that make water "hard." Hardness ions are exchanged for sodium ions that stay in the solution. Because iron in water is also positively charged, a water softener can be used for iron removal when levels of iron contamination are low.

An anion exchanger can also remove negatively charged molecules like nitrates and tannins.

Oxidation: Transfers electrons from the unwanted molecule to the oxidizing agent. A common water treatment example is the oxidation of iron—changing ferrous iron (Fe^{2+}), which is soluble in water, to ferric iron (Fe^{3+}), which is not. The ferric ions then form compounds that precipitate and can be filtered out. Common oxidizing agents for water treatment are chlorine, ozone, hydrogen peroxide, and oxygen.

Inactivation: Uses a physical process, like exposure to ultraviolet (UV) light or a chemical (chlorine, ozone, or hydrogen peroxide), to break down the membranes of microbial contaminants, preventing them from reproducing or causing disease.

Reverse osmosis (RO): Forces water through a porous membrane (much finer than filtration), which traps larger molecules and dissolved ions. RO removes dissolved ions; metals like arsenic, lead, and nitrates; organic compounds like trihalomethanes (disinfection byproducts); and pesticides. However, the RO system's effectiveness depends on the membrane type and overall operating conditions. Additional filtration is typically needed for best results. Because RO produces a high proportion of reject water, it's more practical (but still wasteful) for point-of-use applications rather than whole-home treatment. RO typically produces 2 to 4 gallons of reject water for every gallon of treated water.

TABLE 1: COMPARING DIFFERENT APPROACHES FOR INACTIVATION

Inactivation technique	Pros	Cons
Ultraviolet (UV)	Inactivates microbial contaminants found in water* No change to the water's taste or odor† Low energy usage Limited maintenance	Requires prefiltration for best results Does not provide a residual
Chlorine	Can also oxidize (see oxidation) Can provide a residual	Adds an unpleasant taste and odor to the water Requires handling of chemicals Requires holding time and tank Does not address highly resistant protozoa, like *cryptosporidium* and *giardia*
Ozone / hydrogen peroxide	Can also oxidize (see oxidation)	Requires handling of chemicals Provides a limited residual

* Efficacy of VIQUA systems has been demonstrated in internal testing. Visit VIQUA.com for details.

† In rare circumstances, low levels of sulfur in source water may become detectable due to the UV system.

Putting it together

The chart outlines common well water contaminants and possible treatment options. Again, it's unlikely that your water will contain only one of these troubling substances. It's important to test your water to understand not just WHAT is in the water but HOW MUCH. Be sure to explore the pros and cons of each approach with your water treatment professional and always be mindful of the manufacturer's specifications.

TABLE 2: TREATMENT OPTIONS FOR COMMON WELL WATER CONTAMINANTS

Contaminant	Adsorption	Filtration	Ion exchange	Oxidation	Inactivation
Arsenic	Activated aluminum filter	Reverse osmosis	Anion exchange system		
Hardness minerals (Ca^{2+}, Mg^{2+})			Water softener		
Hydrogen sulfide	GAC filter			Chlorinator‡ Carbon / air filter	
Iron / manganese			Sanitizer (high levels) Water softener* (low levels)	Chlorinator‡ Birm / air filter	
Microbial contaminants					UV Chlorinator† Distiller
Nitrates		Reverse osmosis	Anion exchange system		
Pesticides	GAC filter	Reverse osmosis*			
Radon	GAC filter*				

*Check manufacturer's specifications

† *Giardia* and *cryptosporidium* can be highly resistant to chlorination

‡ Usually, chlorination must be followed by filtration

To find a water treatment professional or for more information about UV treatment and the efficacy of VIQUA UV systems, visit VIQUA.com.

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