ARIZONA COOPERATIVE EXTENSION
THE UNIVERSITY OF ARIZONA
College of Agriculture and Life Sciences

AZ1498

September, 2009

Water Facts: Home Water Treatment Options[1]

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Today, homeowners have access to several water treatment systems to help control minerals and contaminants and to disinfect their water. Nearly half of the homes in the U.S. have some type of water treatment device. Mistrust of public water utilities, uncertainty over water quality standards, concerns about general health issues and limited understanding about home water treatment systems have all played a role in this increasing demand for home water treatment systems. Private well owners also need to provide safe drinking water for their families and have to make decisions as to how to treat their own water sources to meet this need. However, choosing a water treatment system is no easy task. Depending of the volume of water and degree of contamination, the homeowner should consider professional assistance in selecting and installing water treatment systems. The process of selection is often confounded by incomplete or misleading information about water quality, treatment options, and costs. The following paragraphs outline the major water treatment options. Further details on types, uses (point of use versus point-of-entry) and costs of these home water treatment systems are provided in the *Arizona Know Your Water* booklet. Additional information about Arizona's water sources that can help private well owners make decisions about home water treatment options, can be found in *Arizona Well Owner's Guide to Water Supply* booklet and Arizona Cooperative Extension Fact Sheets (see references section).

Each of the following water treatment options should be carefully evaluated when considering water treatment alternatives to reduce the levels of mineral (inorganic) and carbon-based (organic) contaminants, and disinfect water. These methods are well proven and widely accepted by experts and regulatory agencies as being efficient for the reduction of contaminants in water. Use the Filter Application Guide to help determine which system is right.

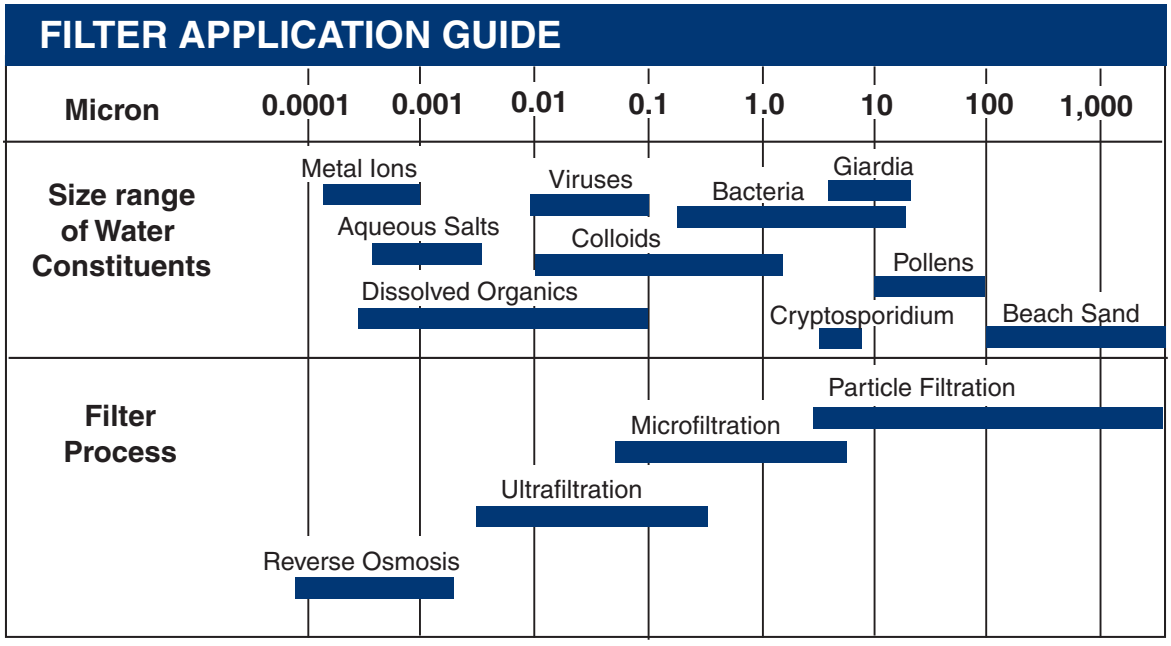

Figure 1. Water Filtration Guide. Adapted from: Water Quality Improvement Center.

[1] This material has been adapted from *Arizona Know your Water (2006)* and *Arizona Well Owner's Guide to Water Supply (2009).*

Particle and Microfiltration

Particle filtration is a process that removes small amounts of suspended particles, ranging in size from sand to clay, from water. It can be used alone or prior to other water treatment devices installed in homes. Home filters are not intended to filter large amounts of particles. However, larger filtration systems (usually located near the well head or at the home point of entry) are available to remove well sediments and particulates, depending on the well water quality. Microfiltration may also be used to remove some bacteria and large pathogens, like cysts (*Giardia* and *Cryptosporidium*). Note that microfiltration should not be relied on to disinfect water with high concentrations of bacteria and viruses; instead, chemical disinfection should be used. Other forms of filtration include ultrafiltration and reverse osmosis.

Activated Carbon Filter

Activated carbon filtration, a form of ultrafiltration, often used as a point of use treatment, may be selected to reduce unwanted taste, odor, and low concentrations of organic chemicals (such as pesticides and solvents) from drinking water. Activated carbon will also reduce radon gas and residual chlorine. Larger filters are available to treat high volumes of water but these usually require professional installation and maintenance. Carbon filters will not remove or reduce major inorganic ions (e.g., sodium, calcium, chloride, nitrate, and fluoride or metals). However, some carbon filters can reduce lead, copper, and mercury. Activated carbon filters will not soften the water or disinfect it. If the source water is cloudy, a particle filter should be used before the activated carbon filter in order to remove particles that may plug or reduce its efficiency.

Figure 2. Faucet-mounted carbon filter (insert: activated carbon grains).

Reverse Osmosis

Reverse osmosis (RO) is becoming a common home treatment method to reduce total dissolved solids (TDS) in drinking water. RO, probably best known for its use in water desalinization projects, can also reduce chemicals associated with unwanted color and taste. It also may reduce pollutants like arsenic, lead, and many types of organic chemicals.

RO treatment is not effective for the removal of dissolved gases such as radon, or for some pesticides and volatile organic chemicals such as solvents. Consumers should check with the manufacturer to determine which contaminants are targeted and what percent of the contaminant is removed.

RO is not recommended for sediment (particle) and pathogens. Pretreatments such as particle filtration (to remove sediments), carbon filtration (to remove volatile organic chemicals), chlorination (to disinfect and prevent microbial growth), pH adjustment or even water softening (to prevent excessive fouling produced by water with excessive hardness) may be necessary for optimum RO functioning.

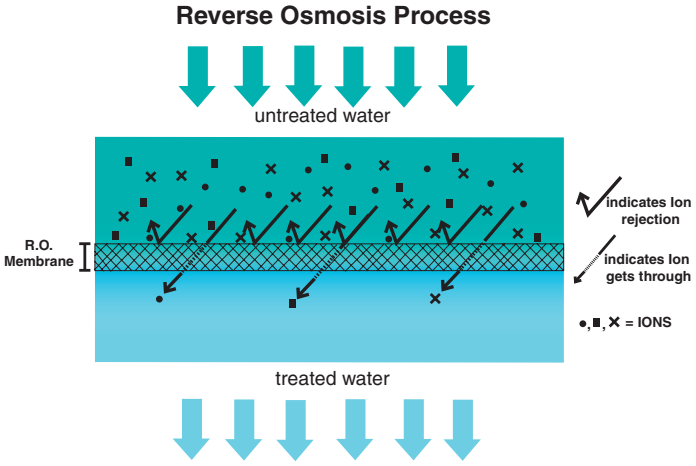

Figure 3. Reverse Osmosis Process.

Distillation

Distillation effectively removes inorganic contaminants (suspended matter including minerals and metals) from water. Since distilled water has no minerals, some people claim distilled water tastes flat or slightly sweet. Distillation kills or removes microorganisms, including most pathogens. Distillation can also remove organic contaminants, but its efficacy depends on the chemical characteristics of the contaminant. Volatile organic chemicals (VOCs) like benzene and trichloroethylene (TCE) that boil at a temperature lower than water vaporize along with the water and re-contaminate the distilled water if not removed prior to distillation. Some distillation units may initially purge some steam and volatile chemicals. These units should be properly vented to prevent indoor air contamination (venting into the home may not be a good choice). Some home distillation units have activated carbon filters to remove VOCs during distillation.

Ion Exchange—Water Softening

Ion exchange units that replace calcium and magnesium ions from water are known as water softeners. They may also remove varying amounts of other inorganic pollutants such as metals, but they will not remove organic chemicals, pathogens, particles, or radon gas. Water softener units work most efficiently with particulate-free water. Note that soft water, in particular with elevated sodium levels, should not be used to water houseplants, garden vegetables or yard plants with low salinity tolerance. Soft water may not be suitable for drinking due to its salty taste and elevated levels of sodium or potassium.

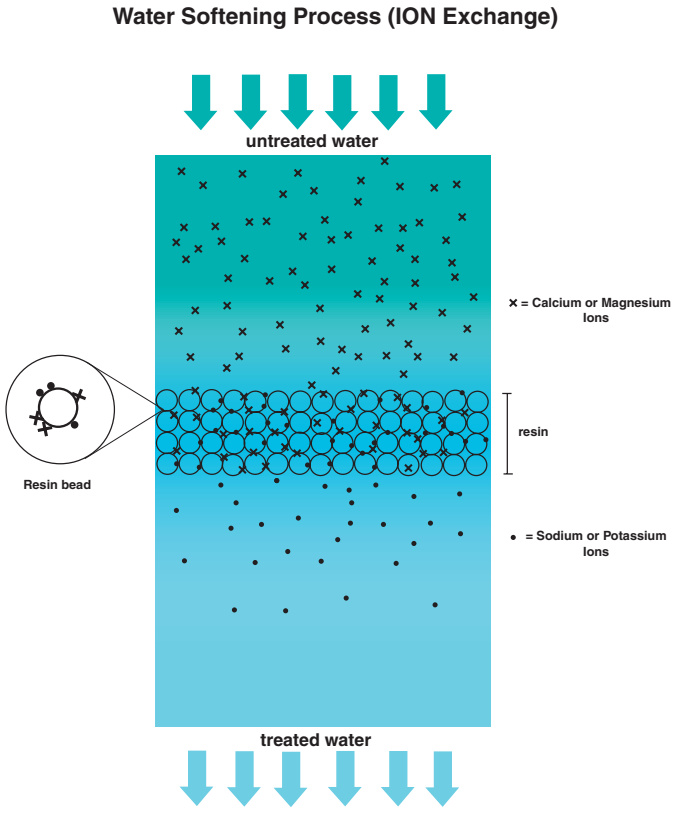

Figure 4. Water Softening (Ion Exchange) Process.

Disinfection

Waterborne contaminants must be either filtered out of the water or killed (inactivated) to make the water safe to drink. The methods discussed above are not suitable (except for distillation) for this purpose. As a rule, water must be disinfected using chemicals (oxidizing agents such sodium or calcium hypochlorite, chloramines, chlorine and ozone), boiling, or ultraviolet (UV) radiation. Water disinfection will not remove inorganic contaminants from water but it may change the chemical species of some of them and can form disinfection byproducts that may be of concern. See the *Arizona Know Your Water* booklet for a more detailed discussion on water chemical and UV-radiation disinfection methods.

Boiling

Two minutes of vigorous boiling ensures biological safety[2]. Boiling kills most organisms in water (whereas chlorination reduces them to safe levels). However, boiling is costly and practical only as an emergency measure. Remember that once boiled, cooled water must be protected from re-contamination.

Emergency Disinfection

The use of household chemicals (such as bleach or iodine) to disinfect water without the appropriate equipment or technical supervision should only be considered under emergencies. For a list of these chemicals and their safe use, see the EPA website: www.epa.gov/OGWDW/faq/emerg.html.

References and Additional Sources of Information

Arizona Know Your Water. 2006. A consumer guide to water sources, quality, regulations, and home water treatment options. The University of Arizona College of Agriculture and Life Sciences. Tucson, AZ. 85721. http://cals.arizona.edu/pubs/

Arizona Well Owner's Guide to Water Supply. 2009. The University of Arizona Cooperative Extension Bulletin No. AZ1485. College of Agriculture and Life Sciences. Tucson, AZ 85721 http://cals.arizona.edu/pubs/

Commonly Available Home Water Treatment Systems. 2009. Arizona Cooperative Extension fact sheet AZ1486m. http://cals.arizona.edu/pubs/

Matching Drinking Water Quality Problems to Treatment Methods. 2009. Arizona Cooperative Extension fact sheet AZ 1486l. http://cals.arizona.edu/pubs/

US EPA Well Water & Drinking Water (http://www.epa.gov/ogwdw/faq/faq.html)

This website contains a wealth of information including frequently asked questions on water quality, standards, water treatment units, home water testing, health-related questions and how to obtain information on local drinking water sources. This website also provides links and telephone numbers to:

[2] Cysts may not be completed destroyed with heat; these must be removed using particle filtration methods prior to heat treatment and/or chemical disinfection.

NSF International (http://www.nsf.org/consumer/) and the Underwriters Laboratories (UL) (http://www.ul.com/global/eng/pages/). These organizations certify and provide information about home water treatment devices and brands.

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This information has been reviewed by University faculty.
cals.arizona.edu/pubs/water/az1498.pdf