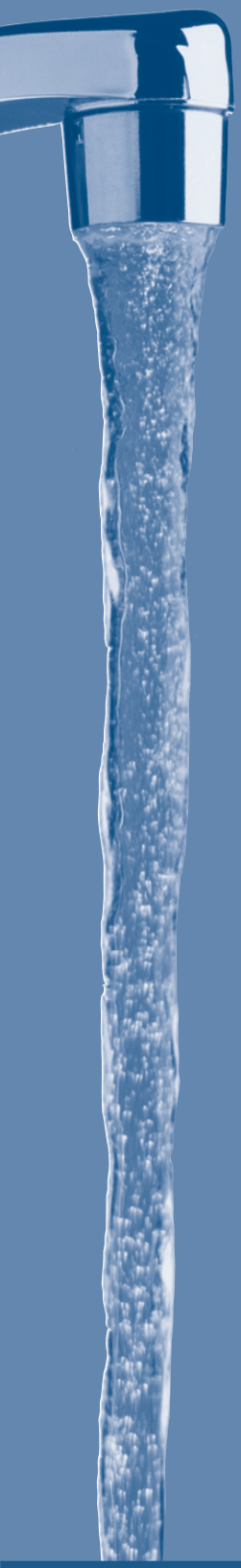
Rhode Island Department of HEALTH

UNIVERSITY OF Rhode Island

Healthy Drinking Waters for Rhode Islanders

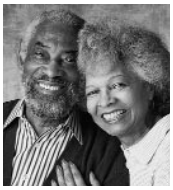
SAFE AND HEALTHY LIVES IN SAFE AND HEALTHY COMMUNITIES



Activated Carbon Treatment of Drinking Water Supplies

EFFECTIVE AGAINST: Unwanted tastes, odors, chlorine, detergents, radon, and some man-made, organic chemicals such as many pesticides, and volatile organic chemicals, such as paint thinners.

NOT EFFECTIVE AGAINST: Microbial contamination (e.g. coliform bacteria), and heavy metals (e.g.sodium, nitrate, fluoride, and lead).



How Activated Carbon Treatment Works

Activated carbon filters are used to remove unwanted tastes, odors, radon, and some man-made volatile organic contaminants from drinking water. The efficiency of the unit depends on the type of activated carbon installed, the filter bed depth, the type of contaminants in the water and their concentration, and the contact time between the water and the carbon filter. Activated carbon filters do not adsorb every type of contaminant equally well. Carbon filters are easy to install and maintain, and operating costs are usually limited to filter replacement. Depending on the type and concentration of the contaminant being removed, some carbon filters may require special hazardous waste handling and disposal, which can be costly. Other filter types are available including charcoal and ceramic materials that treat the water similarly, through the adsorption of the contaminant onto the filter.

The solid material used in an activated carbon filter is a specialized carbon manufactured for these purposes. Contaminants adhere to the surface of these carbon granules or become trapped in the small pores of the activated carbon. Generally, an activated carbon filter is used with a pre-treatment filter to remove sediment or iron particles that may be present and can clog the carbon filter.

Granular activated carbon, (GAC), treatment is most common for private water systems. Granular activated carbon is an effective filter for removing organic chemicals that may be in drinking water. Many other small devices use carbon that has been pressed into a solid block. Use of block carbon may result in a significant drop in home water pressure. These devices also clog easily if the water is cloudy or turbid.

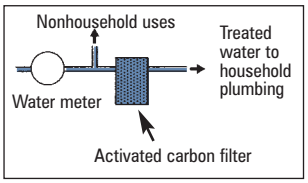
A synthetic resin may be a substitute for carbon. Although activated carbon is efficient in removing a variety of organic chemicals, a specially formulated synthetic resin may be a better absorber for a specific contaminant.

Types of Units

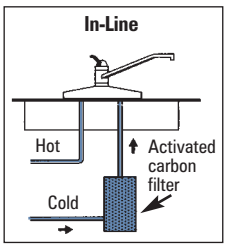
Activated carbon filters come in both point-of-entry (POE) units and point-of-use (POU) units. POE and POU devices refer to the location where the device is installed. POE units treat all the water coming into the house. POU units treat water at specific areas, i.e. installed below the kitchen sink to treat only tap water in the kitchen. POU units include pour through, faucet mount, in-line, and line bypass.

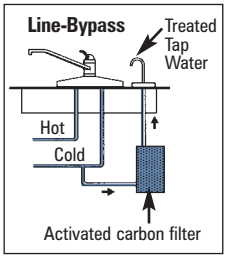
THE STATE OF RHODE ISLAND DEPARTMENT OF HEALTH AND THE UNIVERSITY OF RHODE ISLAND COOPERATIVE EXTENSION DEPARTMENT OF NATURAL RESOURCES SCIENCE

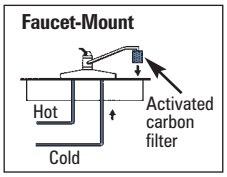
Point-of-Entry

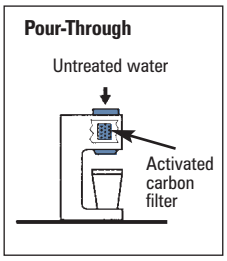


Point-of-Use









Adapted from Linda Wagenet and Ann Lemley, "Activated Carbon Treatment of Drinking Water," *Water Treatment Notes,* Fact Sheet 3, Cornell Cooperative Extension, December 1987.

All activated carbon units differ in level of treatment, installation, storage requirements, and cost. Also, some devices are better at treating certain contaminants than others. Discuss the options with the product distributer. In addition, confirm that the treatment unit has been tested to meet manufacturer's claims. See the **Product Certification** section at the end of this factsheet.

Pour-through units, similar in design to a drip coffee maker, is the simplest type of activated carbon filter. A quantity of untreated water is poured through the carbon, and the treated water is collected in a receptacle. These units are not connected to the water supply and usually sit on the counter. They are portable, require no installation and are convenient for camping or picnicking. Pour-through devices will treat only small quantities of water at a given time and are not generally as effective as larger, automatic units.

Faucet mount units are attached to the faucet (usually in the kitchen) or placed on the counter with connections to the faucet. There are two basic designs: the bypass option, which has a valve to filter water used for cooking and drinking (this prolongs the life of the carbon cartridge), and the non-bypass option, which filters all water passing through the faucet. Because the quantity of carbon contained in a faucet-mount unit is not large enough to provide extensive contact time with the water, these devices are not recommended for removal of organic chemicals.

The in-line device is installed beneath the kitchen sink in the cold water supply line to treat water for drinking or cooking. If both hot and cold water come from a single faucet, the treated (cold) water can mix with the untreated (hot) water. Treated water is assured only when using cold water for drinking and cooking.

The line-bypass unit is also attached to the cold water pipe, but a separate faucet installed at the sink provides treated water for cooking and drinking. The regular tap delivers untreated water. This design increases the life of the carbon by allowing a choice of treated or untreated water, depending on the intended use.

Whole-house treatment or point-of-entry, is recommended for treatment of volatile organic compounds (VOCs). Since VOCs easily vaporize from water into the air, POE treatment prevents inhalation of hazardous vapors from the shower, dishwasher, washing machine, or other times when large amounts of water are used like in washing the floor, or exposure through skin contact. This device should meet certain guidelines concerning the application rate of water to the carbon, contact time between the water and the carbon, the type of carbon used, and the concentration of contaminate(s) to be removed.

Unit Effectiveness

The effectiveness of an activated carbon unit depends on the extent of contact between the carbon and the untreated water. During regular operation of any device, channels form within the carbon filter, allowing some water to bypass the filtering material, short-circuiting treatment. Since treatment depends on the carbon granules adsorbing the chemical contaminants, these channels decrease the contact time and the effectiveness of the carbon filter unit. A disadvantage of block carbon is that if it is unevenly compressed when manufactured, irregular flow patterns may affect the effectiveness of contaminant removal.

There are two main procedures to determine how much a carbon filter can adsorb: the iodine test and the phenol test. The iodine number is defined as the amount of iodine (in milligrams) adsorbed by one gram of carbon under a certain set of conditions. The larger the number, the more the carbon filter can adsorb. Phenol is another measure of effectiveness. The lower the phenol number, the better the carbon is at removing organics. When comparing home carbon devices, pay attention to these values.

Please keep in mind that manufacturers tend to report the best removal rate for their product. The values are frequently the amount the unit will remove at the beginning of use for a single contaminant at moderate concentrations. Units having a larger bed volume of carbon usually remove a greater quantity of contaminants. Some types of activated carbon will remove specific

contaminants better than others. Buyers need to examine as many products as possible and know exactly what contaminant they want the unit to remove. You will also need to know how much water is used in the home on an average day to adequately size the treatment system. Additionally, have both the raw water (prior to treatment) and the treated water retested after a unit is installed to ensure it is functioning properly.

Maintenance

Regardless of the quality of the equipment purchased, it will not perform satisfactorily unless maintained in accordance with the manufacturer's recommendations for maintenance, cleaning, and part replacement. Keep a log book to record equipment maintenance and repairs.

Most activated carbon filter units need to have the carbon changed periodically. For small specialty units, the entire unit is normally replaced. Cartridge filters are the easiest to change. Before purchasing a unit, consider the ease of opening the filter housing and the amount of space required to change the filter.

Service periods vary greatly. Small units with heavy loads of contaminants may need replacement monthly or more often, while a six-month service interval is frequently advised for the cartridge filters. Since some filters treat up to a particular amount of water, a water meter installed on the filter can help judge when carbon replacement is necessary.

Depending on the type and concentration of the contaminant being removed, some carbon filters may require special hazardous waste handling and disposal, which can be costly. An example would be carbon filters used to remove radon in drinking water. It is important to establish beforehand how handling and disposal will work and whether alternative treatment methods or locating alternative water sources (such as installing a new well in a new location, tying into a public water supply if available, or using bottled water) would be more effective in the long run.

Other Considerations

Ensure the system you choose is installed and operated according to the manufacturer's instructions. After installation, retest both the raw water (prior to treatment) and the treated water at a state certified laboratory to ensure it is working properly and removing the contaminants. You should continue to test the quality of both the raw and treated water annually or more frequently (quarterly or semi-annually) if high levels of contaminants are present in the raw water. Frequent testing will also help you determine how well your treatment system is working and whether maintenance or replacement of components may be necessary.

Activated carbon is an excellent medium for growing bacteria. Bacterial growths will plug and coat the activated carbon and reduce the effectiveness of the filter and can introduce bacteria into your drinking water.

Silver is often added to the carbon media of some carbon filters with a claim that it controls bacteria growth. However, the U.S. Environmental Protection Agency, (EPA), sponsored tests have shown that silver is not effective in treating bacterial growth in activated carbon filters. Allowing the water to run through the filter for at least 30 seconds is a good practice to flush out bacteria that may have accumulated and grown in the filter. Backwashing and regular filter replacement also help reduce bacteria build-up.

Questions to Ask Before You Buy

Before purchasing a water treatment device, have your water tested at a state certified laboratory to determine the contaminants present and their concentration. This will help you determine if activated carbon is an effective treatment method for your situation. See the factsheet *Questions to Ask When Purchasing Water Treatment Equipment* for more information.

Consumers should inquire about the following before purchasing an activated carbon filter.

- What type of filter best meets your water supply needs?
- What contaminants will the filter remove?
- Can the homeowner replace the filter or is a service technician required? At what cost? Is special handling and disposal of hazardous waste required due to the type of contaminant being treated? What should the frequency of monitoring and filter replacement be?
- How do you determine when replacement is necessary?
- Where can you purchase filters and what is the cost?
- Are there any costs for disposing of used filters?
- Has the treatment system been tested and certified by a third party to ensure that it meets manufacturer's claims?
- Are there any special installation requirements that may add to the equipment cost, for instance changes to your household plumbing?

Product Certification

NSF, International is a non-profit organization that sets performance standards for water treatment devices. Because companies can make unsubstantiated statements regarding product effectiveness, the consumer must evaluate test results of the device to determine if claims are realistic. Products that

have been tested or evaluated by NSF and meet their minimum requirements are entitled to display the NSF listing mark on the products or in advertising literature for products. Manufacturers and models that meet NSF's standard are included in a listing published twice a year. For more information contact NSF at: 800-NSF-MARK or http://www.nsf.org/water.html

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For More Information:

This factsheet is one in a series on drinking water wells, testing, protection, common contaminants, and home water treatment methods. Contact the URI Home*A*Syst Program for more information.

University of Rhode Island Cooperative Extension Home*A*Syst Program
Offers assistance, information, and workshops on private well water protection. 401-874-5398 www.uri.edu/ce/wq

RI Department of Health, Office of Drinking Water Quality
Offers assistance, information on testing and state certified laboratories.
401- 222-6867 http://www.health.ri.gov/environment/dwq/Home.htm
For a listing of HEALTH's certified private laboratories in Rhode Island http://www.health.ri.gov/labs/instate.htm

US EPA New England website: http://www.epa.gov/ne/eco/drinkwater/

US Environmental Protection Agency. For a complete list of primary and secondary drinking water standards: http://www.epa.gov/safewater

RI Department of Environmental Management, Office of Water Resources
Maintains listing of registered well drillers, information on well location and construction.
401-222-4700 http://www.state.ri.us/dem/programs/benviron/water/permits/privwell/index.htm

NSF International
For information on water treatment systems, NSF International has tested and certified treatment systems since 1965.
800-NSF-MARK http://www.nsf.org/water.html

Water Quality Association
The Water Quality Association is a not-for-profit international trade association representing the household, commercial, industrial, and small community water treatment industry. For information on water quality contaminants and treatment systems. www.wqa.org

This project is a collaboration of the staff at the Rhode Island Department of Health: Richard Amirault, Gary Chobanian P.E., Dana McCants, and the University of Rhode Island Cooperative Extension Water Quality Program: Alyson McCann, Holly Burdett, Brianne Neptin.

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