

A
CITIZENS GUIDE
TO
HOME TREATMENT WATER UNITS
USEPA REGION 4

A CITIZENS GUIDE TO
HOME TREATMENT WATER UNITS

Many people feel the water coming out of their faucet at home is not safe. This has caused a large increase in the amount of home water treatment units being purchased in this country. There are many different types of units on the market with a large variety of prices. Citizens have become confused on whether they should purchase one at all. The Environmental Protection Agency neither approves nor recommends any home treatment unit for general usage. However, EPA does have jurisdiction for three general categories of home treatment units. They are as follows:

1. Water filters are generally comprised of activated carbon, make no claims for pesticidal (antimicrobial) activity, and are intended to remove rust, sediment, color, odor, chlorine, taste, and certain other selective contaminants. They do not, however, remove or destroy bacteria.

2. Bacteriostatic water filters are also generally comprised of activated carbon and remove the same undesirable contaminants as the water filters but, additionally are impregnated with a chemical agent such as silver ions to hinder the growth of bacteria that may become trapped within the filter.

3. Water purifiers are designed to treat raw water of unknown quality and render it suitable for human consumption. A purifier, by definition, must kill or remove essentially all bacteria present. These products are further subdivided as (a) pesticidal devices where purification is brought about purely by physical or mechanical means such as filtration, heating, etc., where no antimicrobial chemical agent is involved and (b) pesticides where purification is achieved through the use of antimicrobial agents incorporated within the product.

Within the breakdown of units as described above, bacteriostatic water filters and pesticides are required to be registered with EPA before being legally held or offered for sale. In addition Facilities producing Bacteriostatic Water filters and pesticidal devices, and pesticides are required to show an EPA establishment registration number. This establishment registration number indicates that the facility producing the unit deals with pesticides and that it is subject to EPA routine investigations with respect to recordkeeping, production, storage, shipping procedures, etc. Registration as such does not imply EPA approval or endorsement.

The majority of water filters being purchased are of the activated carbon type. Activated carbon is a form of carbon that is modified by a carefully controlled oxidation process to develop a porous carbon structure with a large surface area. Some of the raw materials are coal, wood, nut shells, peat, lignite and residue from petroleum processes. The large surface and high porosity give activated carbon unique adsorptive properties. Adsorption is the process whereby a material (adsorbate) moves from the solution phase to the surface of an adsorbent (carbon) and held by attractive forces. Activated carbon has a preference for most organic compounds and therefore is effective in removing compounds which may cause taste and odor problems in water supplies. Many engineering and other technical factors are involved in the actual adsorptive capacity which determine how much and what chemicals can be removed by carbon treatment. A problem exists in that certain chemicals can be removed by carbon, but different percentages of removal can be achieved depending on influent concentration, flow rate, contact time, amount of carbon, and particle size of the carbon. A smaller particle size generally allows better removal because more surface area is utilized. Longer contact time and slower flow rates also allow higher percentage of removal.

The carbon filter units come in basically five types:

- 1) Pour - Through - You run water thru a filter into a collecting vessel.
- 2) Faucet - Attached to the end of your faucet.
- 3) Stationary - These attach to the cold water pipe under the sink.
- 4) Line - Bypass - These attach to the cold water pipe under the sink. But they have a separate faucet for just drinking water.
- 5) Household - Installed where water enters your home.

A carbon filter unit will not make contaminated water safe. They will not remove bacteria. A carbon filter will improve the taste and odor if that is your concern and possibly some organic chemicals. A filter unit should only be used in a source of water that is known to be bacteria free. These units work well on public water supplies in which people do not like the taste of chlorine. Carbon units remove chlorine very effectively. The Environmental Protection Agency tested over thirty units for their effectiveness in removing various organic contaminants. A summary of the results is enclosed (TABLE 1). Also a summary of a study done by consumer reports is included (TABLE 2). Carbon filters will not remove bacteria, calcium and magnesium (hard water), fluorides, nitrates, chlorides. They remove a very small percentage of inorganic chemicals.

Since the units come in all different types and prices, the most common question is, what unit should I purchase? This is going to depend upon your personal needs. A cheap pour through unit might be able to produce water with no chlorine taste, but is time consuming and perhaps inconvenient.

The more expensive by-pass units have proven most effective in taking out organic contaminants. If you have the initiative, a plan is enclosed for building your own carbon filter.

If you do use an activated carbon filter, there are several suggestions you should follow:

- Watch for any signs of sediment in the water.
- If the water pressure becomes noticeably reduced, its time to change the filter.
- A change in taste could mean breakthrough of the filter has occurred. Breakthrough is when the carbon is no longer removing a contaminant, and it is time to change the filter.
- Flush out the filter before the first use of the day. The faucet should be opened fully for 30 seconds.
- Always filter cold water.
- Filter at slowest possible rate.
- Always follow the manufacturers recommended times for changing the filter cartridges.

OTHER TYPES OF HOME
TREATMENT UNITS

REVERSE OSMOSIS

Osmosis is the transport of a solvent from a dilute solution to a concentrated solution across a semipermeable membrane. For reverse osmosis to work the pressure is increased on the solution side of the membrane. The home reverse osmosis units will require a certain line pressure specified by each manufacturer.

A membrane can be defined as a phase which acts as a barrier to the flow of molecular or ionic species between other phases that it separates. The most widely used membrane is the modified cellulose acetate film. These membranes reject a variety of materials.

The following substances are removed very effectively with home reverse osmosis units:

Calcium ———— Hardness
Magnesium /
Sodium
Iron
Manganese
Aluminum
Chromium
Ammonia
Fluoride

High molecular weight Organics > 200 (although some lower molecular weight organics are removed there is no simple way to predict which ones). Reverse Osmosis alone does not reduce trihalomethanes* significantly.

*See Appendix

The trihalomethanes group includes the following compounds:

<u>Compound</u>	<u>Molecular Weight</u>
Chloroform	119
Bromodichloromethane	163
Dibromochloromethane	208
Bromoform	252

ION EXCHANGE

Ion exchange units are used primarily at the home for softening water. Calcium and magnesium are the prime constituents of hardness. In the cation-exchange softening process calcium and magnesium are removed and replaced by sodium. For individuals on a sodium restricted diets, this obviously would not be the process of choice.

Ion exchange is a process in which ions are exchanged for ions of a similar charge in a solution in which the solid is immersed.

Some substances dissolved in water are capable of conducting electricity. The substances are called electrolytes. When an electrolyte dissolves in water its molecules disassociate immediately into oppositely charged fragments or ions. Positive ions are cations and negative ions are anions. An example is Salt (NaCl), which when dissolved disassociates into Na (Cation) and Cl (Anion).

Distillation

Distillation is the process of driving gas or vapors from water by heating and condensing the water to a new liquid product. Basically the impurities should be left behind and uncontaminated water condenses to form a clean end product.

A problem does exist, in that certain contaminants have a lower boiling point than water. These chemicals could vaporize with the water and end up in the final liquid product.

Fortunately most of the distillers for home use utilize the process called fractional distillation. In this process the components of water are separated from one another by taking advantage of the differences in their volatilities. Obviously this is the type of distiller most people would be interested in purchasing.

They do take a lot of water to utilize, energy to heat the water, and the initial price can be expensive.

Boiling

If your major drinking water concern is trihalomethanes or any of the volatile organics such as vinyl chloride or trichloroethylene, boiling might be an alternative.

Although boiling is both time consuming and energy consuming it will drive off most trihalomethanes after 5 minutes and most volatile organics after 10 minutes. It should be noted that inorganic chemicals will be concentrated during the boiling process. Simply warming the water will do no good and may actually increase the amount of trihalomethanes.

In 1974 the Safe Drinking Water Act was passed by Congress. From this Act, regulations governing levels of many chemicals, including: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Nitrate, Selenium, Silver, Fluoride, Pesticides, Radioactivity, Bacteria, Trihalomethanes,* and Sodium have come into being. These parameters are now required to be analyzed for every community water system. If you have any doubts about any of these contaminants, contact your local water system. They will have analyzes records for each chemical. The only exception is small water systems serving less than 10,000 people are not required to analyze the water for trihalomethanes.

TABLE I

Information on Units Tested				Average Reductions	
Name	Test Life (gal)	Est. Ave. Contact Time (min)	Weight of Carbon (g)	THM (%)	NPTOC (%)
<u>Faucet-Bypass</u>					
1. Aquaguard, Model AGT-31, Cartridge T-3XL	500	3.4	51	43	12
2. Concept Bacteriostatic Home Water Filter	40	1.6	N/A ¹	16	18
3. Filter Fresh Model FF-1	1200	4.8	59	6	6
4. Hurley Town and Country	4000	36.5	895	69	31
5. Water Washer, Countertop Model 1000	1000	10.9	70	41	11
<u>Pour-Through</u>					
6. Filbrook Pour-Thru Activated Carbon	1000	43.8	97	40	14
7. Puritan Bacteriostatic Drinking Water Treatment Unit	1000	14.1	30	21	6
<u>Stationary</u>					
8. AMF-Cuno Housing 1M Cartridge AP-117	3000	3.9	395	34	7

Information on Units Tested				Average Reductions	
Name	Test Life (gal)	Est. Ave. Contact Time (sec)	Weight of Carbon (gms)	THM (%)	NPTOC (%)
9. Filtrate, Model 1 PC Cartridge 1C-9	3000	1.2	N/A	18	8
10. Fulfo Water Filter Model WC-10	3000	2.6	208	15	11
11. Keystone Model 3121 Housing with Model 310 Cartridge	3000	2.3	N/A	21	9
<u>Line-Bypass</u>					
12. Aquacell Bacteriostatic Water Treatment Unit	2000	12.4	417	86	23
13. Aqualux Water Processor, Model CB-2	2000	35.2	1150	98	23
14. Argenion Bacteriostatic Water Treatment Unit, Model 1	2000	8.1	146	23	N/A
15. Continental Water Filter Model 350	720	185	3402	99	87
16. Culligan Super Guard Model SG-2	4000	39	1708	89	28
17. Everpure, Model QC4-THM	1000	43	765	99	55

Information on Units Tested				Average Reductions	
Name	Test Life (gal)	Est. Ave. Contact Time (sec)	Weight of Carbon (gms)	THM (%)	NPTOC (%)
18. Mariner Renaturalizer Water Units	3000	31.4	560	47	21
19. Polarisdynamic Water Unit	2500	26.6	527	61	18
20. Purogen Water Detoxifier	2500	11.6	859	38	6
21. Seagull IV	1600	14.8	300	70	30
22. Ultrapure Bacteriostatic	3000	28.0	1103	40	20
23. Waterco, Model AS-5	3000	5.0	495	25	N/A
<u>Other</u>					
24. Wunderbar, Portable Water Cleaner-Filter	200	0.9	N/A	4	N/A
<u>PHASE I - Commercial</u>					
<u>Faucet-Bypass</u>					
25. Instapure Model F1-C	200	1.6	27	24	11
<u>Faucet-No Bypass</u>					
26. Mini Aqua Filter	200	0.9	16	6	2

Information on Units Tested				Average Reductions	
Name	Test Life (gal)	Est. Ave. Contact Time (sec)	Weight of Carbon (gms)	THM (%)	NPTOC (%)
<u>Pour-Through</u>					
27. H ₂ O _K Portable Drinking Water Treatment Unit	2000	15	94	19	10
<u>Stationary</u>					
28. Sears Taste and Odor Filter	3420	4.5	398	46	12
<u>Line-Bypass</u>					
29. Aqualux Water Processor, Model HB	2000	23	575	45	28
30. System 1 Water Processor, Model SY1-34	2500	46	1120	43	20
<u>PHASE II Experimental-Unique Resin</u>					
31. Rohm and Haas Ambersorb XE-340	3500	50.6	2353	93	6
1 N/A - Not Applicable					

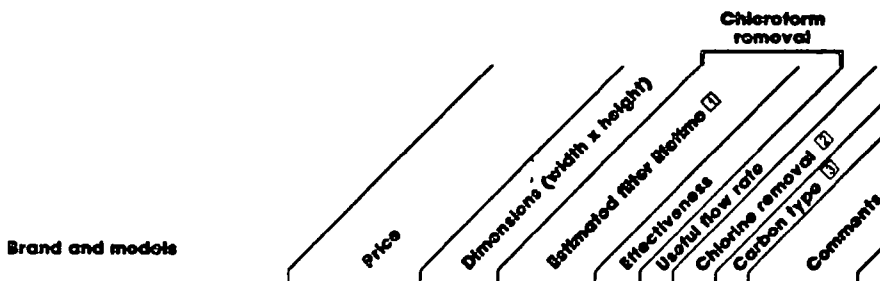
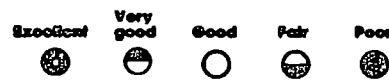
Ratings

Water filters

Listed by types; within types, listed in order of estimated number of gallons of water effectively filtered to reduce chloroform. Bracketed models are judged similar in ability to remove chloroform and are listed in order of increasing price. Estimated filter lifetime is for guidance; actual lifetime may

vary greatly according to local water quality. All come with installation instructions and mounting hardware. Under-sink models may require installation by licensed plumber. Except as noted, sink-mounted models fit on faucet end. Prices are suggested retail and do not include cost of installation;

prices in parentheses are for replacement filter cartridges; * indicates that price is approximate; + indicates that shipping is extra. Discounts may be available.



Under-sink models

Brand and models	Price	Dimensions (width x height)	Estimated filter lifetime	Effectiveness	Useful flow rate	Chlorine removal	Carbon type	Comments
CULLIGAN SUPER GARD 80-2	\$175* (\$23*)	5x16 in.	3000 gal.	⊕	⊕	⊕	G	A,B,O
SEARS 3464, A BEST BUY	23* (7.50)	5x12	1200	⊕	⊕	⊕	G	D,P,S
AMF-CUNO AP50T	67(12)	4½x14½	1200	⊕	⊕	⊕	G	H
SEAGULL IV X-1F	290(40)	5x6½	1200	⊕	○	⊕	Pb	A,B,C,E,F,K
FULFLO WC-12	51(8.85)	5x13	300	○	⊕	⊕	G	D,H,J,R
☒ The following 3 models were judged much less effective than those preceding. In addition, they "unloaded," or returned, some chloroform to tap water when used for more than 300 gal. All may be satisfactory for removing some tastes and odors, however.								
AQUA GUARD A07209	37+ (6.25+)	4½x12½	150	⊕	⊕	⊕	P	H,R,T
KEYSTONE 3121	44(6.75)	5x13	150	⊕	⊕	⊕	P	H,R
FILTERITE 1PC	55(9)	5½x12½	150	⊕	⊕	⊕	P	H,J

Sink-mounted models

HURLEY TOWN & COUNTRY	190(47+)	6½x10½	3000	⊕	⊕	⊕	G	A,I,M,N,O
ECOLOGIZER WATER TREATMENT SYSTEM 5508	35+ (10+)	4x6	250	○	⊕	⊕	G	A,H,I,L,U
POLLENEX PURE WATER "99"	35(4.95)	5½x5	150	⊕	○	⊕	G	A
AQUA GUARD A07-300	30+ (3.50+)	4x4½	100	⊕	○	○	G	H,T
☒ The following 2 models were judged much less effective than those preceding because they never achieved chloroform-removal level of 50 percent in CU's tests.								
INSTAPURE BY WATER PIX P-1C	34(4)	5x3½	—	⊕	○	⊕	G	—
PEERLESS RP8506	20(4)	3½x3	—	⊕	⊕	⊕	P	F,G,K,Q

☐ Lifetime, as determined by CU, is number of gallons during which removal of chloroform is expected to be greater than 50 percent. Lifetimes of 1000 gal. or more are combination of CU and EPA test results.

☒ Chlorine removal judged with unused cartridge for first few gal. only.

☑ G, granular; Pb, powder in block; P, powder in pad.

KEY TO COMMENTS

- A - Water flow restricted by filter's design.
- B - Requires ½-in. tubing (supplied).
- C - Supplied with outlet faucet fixture.
- D - Supplied with wrench to open housing.
- E - Registered as "purifier" with EPA.
- F - Manufacturer claims that unit can filter out particles less than 1 micron dia. CU believes unit may clog prematurely in turbid water.
- G - Silver incorporated into filter; bacteriostatic properties claimed, but not verified by CU (see story).
- H - Transparent plastic housing; cartridge visible in use, an advantage.
- I - Design incorporates cartridge change-date reminder, an advantage.
- J - Locks pressure relief button on top of filter housing, a disadvantage.
- K - Would rate higher if used with water supplies that have no sediment problem.
- L - Filter unit sits on counter and is connected by hose to diverter valve on faucet.
- M - Backwashing to clean filter recommended by manufacturer at 145°F, an advantage if you have water that hot; backwashing can extend lifetime of filter.
- N - No replaceable cartridge available; entire unit must be returned to manufacturer for refill (\$50).
- O - Filter contains much more carbon than others of this type. Estimated lifetime may exceed 3000 gal. listed.
- P - According to the company, filter housing tested has been replaced by a different model (not tested). Replaceable cartridge 34654, judged most effective of its type, is still available.
- Q - Chloroform-removal level never reached 25 percent in CU's test.
- R - Sears cartridge also fits this unit.
- S - Cartridges sold only in packs of 2 for \$15. Price given is for comparison purposes.
- T - Available from Universal Water Systems Inc., 705 E. State St., Geneva, Ill. 60134.
- U - Available from Rush Hampton Ind., P.O. Box 3000, Longwood, Fla. 32750.

Appendix 2

HOME TREATMENT UNIT FACT SHEET

This fact sheet is intended to explain what a home treatment unit is, what it will do and why it is registered with EPA. The fact sheet is intended for consumers who are considering purchasing a unit and for salespeople. Before considering any unit, a prospective salesperson or consumer should contact the associated water utility to obtain information about the quality of water to be treated.

WHAT IS A HOME TREATMENT UNIT

For the purposes of this fact sheet, a home treatment unit will be defined as a unit used at the consumers tap to treat water which already meets the EPA national drinking water standards. The benefits are usually non-health related. Home treatment units contain one or a combination of the following processes.

- 1) Granular Activated Carbon
- 2) Ion-Exchange Softening

SOFTENERS

Most commercial softeners are sodium exchange softeners. They remove hardness (mostly calcium, manganese, iron, and magnesium) from the water and replace it with sodium.

ADVANTAGES OF SODIUM EXCHANGE SOFTENING

- ° Will reduce iron and manganese concentrations. This is advantageous when the initial concentrations are high enough to be a nuisance (staining fixtures, clothes, etc.).
- ° Will provide cost savings on soap and detergents.
- ° Will reduce film on dishes, skin, etc., when washing.
- ° Might reduce calcium carbonate deposits in plumbing.

DISADVANTAGES OF SODIUM EXCHANGE SOFTENING

- Will make a corrosive water supply more corrosive, reducing the life of plumbing.
- People on a low sodium diet might not be able to drink the water.
- Units are generally expensive (\$1,000 - \$2,000).
- Unit must be maintained.
- Disposal of waste brine may be a problem.

QUESTIONS TO ASK ABOUT SOFTENERS

- How does one know when the unit needs recharging?
- How is the unit recharged and who does it?
- How much sodium will the unit put into the water? (i.e., what will be the concentration of sodium in the water flowing out of the unit?)
- How much are the maintenance costs?

ACTIVATED CARBON FILTERS

If given sufficient time for the water to remain in contact with the carbon, activated carbon will remove most organics to varying degrees and some inorganics (including chlorine). Removals will generally start off high and steadily decrease as the unit is used. Activated carbon works by a principle called adsorption where chemicals are trapped in the large surface area of the carbon. The chemicals should remain attached to the carbon, if it is properly maintained, until the carbon is reactivated.

ADVANTAGES OF ACTIVATED CARBON FILTERING

- Will remove bad tastes, odor, and color.
- Might reduce some organic chemicals that could cause a health risk if the chemicals are present in the drinking water.