
Organics in Drinking Water,

TYPES OF ORGANIC CONTAMINANTS

The term "organics" in this document means compounds that have the element carbon as a principal constituent. Organic compounds can be of many types and can have many origins. Some organics in drinking water can be caused by the decay of naturally occurring vegetation. These decay compounds are called lignins or tannins. The presence of these compounds, dissolved in water, would be part of the natural environment of that water resource.

A much larger group of organic contaminants are the thousands of manmade organic chemicals that have been created in the last 50 years. The US EPA regulates some of these contaminants as health risks in the Safe Drinking Water Act (SDWA). The upper acceptable concentration of regulated contaminants, in drinking water, is called the maximum contaminant level (MCL). The MCL concentrations for the organics regulated by the SDWA are shown on pages 4 through 6.

These manmade organic contaminants can be grouped into subcategories that are often more recognized (and more easily pronounced) than the more formal chemical name. These subcategories are given below along with a few illustrations of specific contaminants in each subcategory.

1. Industrial solvents, such as trichloroethylene, carbon tetrachloride;
2. Hydrocarbons, such as benzene, xylene, toluene;
3. Pesticides, such as aldicarb and chlordane; and
4. Herbicides, such as alachor and silvex.

Trihalomethanes are the byproducts of the chemical reaction between chlorine and the natural occurring organics in drinking water. These naturally occurring carbon compounds are not hazardous by themselves, but combined with chlorine they produce byproduct reactants which have a health concern. Examples of compounds in the trihalomethanes subcategory include chloroform and bromoform.

All of these contaminant subcategories, with the exception of trihalomethanes, are of man-made origin and the result of land use or other human activity such as: agriculture, manufacturing or improper waste disposal.

ABATEMENT OF CONTAMINATION

Before beginning evaluations as to what treatment techniques will remove the contaminant(s) of concern, an effort should be first made to identify and abate the origin of the contamination. This can minimize the size of the treatment device and will shorten the period during which treatment will be necessary. Determining the origin of manmade contaminants, particularly in bedrock wells, is typically difficult. We suggest contacting the Groundwater Protection Bureau at 271-3503 for their suggestions and assistance.

TREATMENT OPTIONS

There are generally three treatment methods that have been shown to be effective in removing organics from drinking water. They are: aeration, adsorption using activated carbon, and oxidation. Please refer to pages 4 and 5 of this document to determine which method(s) is predicted to give superior performance for the type of contaminant(s) present in your water.

If the concentration of the contaminants is high, two treatment units (using different methods) are typically installed. The first unit is used to remove the "heavy" contaminant load while the second provides a "polishing step" to assure full removal of the contaminant(s) and to address "breakthrough". This sequential treatment configuration is called a series configuration. If appropriate for your contaminant, aeration is often the first method used while activated carbon is often used as the polishing step.

A treatment method(s) should not be purchased until sufficient water quality testing has been done to identify all of the following:

1. The short-term variability of the contaminants.
2. Whether each contaminant concentration is rising or falling over the long term.
3. What other contaminants are in the recharge area of your well and how many are predicted to impact your well in the future.
4. Whether the contaminant is present in a dissolved or pure product form.

If contaminants are present in a pure product state, a recovery method is also necessary to reduce the size of the treatment system. Please check with the Groundwater Protection Program at 271-3503 to ensure that the DES is aware of the contamination.

Activated Carbon Treatment: Advantages and Disadvantages

Activated carbon has an enormous surface area for the volume it displaces. One pound has the surface area of more than a football field. Activated carbon is a material that attracts many types of organic contaminants onto its surface. Once the carbon's removal capacity is used up, the carbon may be returned to the manufacturer for rejuvenation (for very large users) or can be disposed of appropriately.

If activated carbon is used, the radon and mineral radioactivity concentrations of the water should also be determined. Activated carbon concentrates radioactivity, potentially creating a low level radionuclide waste and possible source of increased radiation within your home. Also activated carbon can foster the growth of bacteria by concentrating the food the bacteria need to live. A final concern with activated carbon is the possible release of contaminants already adsorbed. This possibility is known as "dumping". This could occur when the carbon is nearly saturated with contaminants and a contaminant of high preference displaces another with lower preference.

To address exhaustion and dumping, the overall amount of carbon should be divided into two treatment tanks and the two tanks installed in "series" such that breakthrough in the first unit can be adsorbed by the newer carbon in the second unit. The advantage of activated carbon is that the water does not need to be repressurized and there is less likelihood of bacterial from contamination by dust and other airborne contaminants.

Aeration: Advantages and Disadvantages

Aeration treatment consists of passing large amounts of air through the contaminated water. The efficiency of the device is improved by breaking up the water flow into many small droplets. The goal is to allow the contaminants to volatilize into the air stream. Aerator configurations include packed tower and low profile shallow tray styles. Where aeration is used, two operational problems are possible:

- Where there are elevated levels of iron or manganese, rusty precipitate staining of water use fixtures and clothing is possible.
- Bacterial slime may grow in aerators requiring continuous or periodic chlorination.

The advantage of aeration is that there is no disposal or regeneration of the treatment system necessary.

Oxidation: Advantages and Disadvantages

Certain organic contaminants will chemically react with oxygen and oxygen-like compounds. After this treatment, the resultant compounds may be either fully neutralized or will have a lower level of hazard. Further treatment may still be necessary. Oxidizing chemicals could include: potassium permanganate, hydrogen peroxide and hypochlorite. Oxidant treatments have limited applications.

MONITORING PROGRAM AFTER INSTALLATION OF A TREATMENT SYSTEM

Periodic laboratory testing should be done on both the raw and finished water to determine treatment effectiveness. The frequency of this monitoring would be determined based on level of health risk posed by the contaminants, variability and duration of the past sampling record and other site-specific conditions. Where activated carbon is used, the carbon will lose removal capacity and will need to be replaced at some point. A monitoring program will be needed to predict the expected longevity of each new recharge of carbon.

TESTING YOUR WATER

EAI Analytical Labs will provide you with your free water testing kit containing: sample bottles, detailed sampling instructions and a tracking form. Bacteria samples bottles are distributed pre-sterilized and all sample bottles contain their necessary preservatives. Kits are available for pickup or they can be mailed to you. If you are interested or have any questions regarding the analysis of your water, please give us a call.

TREATMENT OPTIONS

Volatile Organic Chemicals	Maximum Contaminant Level	Granular Activated Carbon	Packed Tower Aeration	Oxidation, Chlorination or Ozonation
Benzene	0.005 mg/L	c	a	
Carbon tetrachloride	0.005	c	a	
1,2 Dichloroethane	0.005	c	a	
Trichloroethylene	0.005	c	a	
Para-dichlorobenzene	0.075	c	a	
1,1 Dichloroethylene	0.007	c	a	
1,1,1 Trichloroethane	0.200	c	a	
Vinyl Chloride	0.002		a	
cis-1,2 dichloroethylene	0.07	c	a	
1,2 Dichloropropane	0.005	c	a	
Ethylbenzene	0.7	c	a	
Monochlorobenzene	0.1	c	a	
o-Dichlorobenzene	0.6	c	a	
Styrene	0.1	c	a	
Tetrachloroethylene	0.005	c	a	
Toluene	1.0	c		
trans-1,2 Dichloroethylene	0.1	c	a	
Xylene (Total)	10.0	c	a	
Dichloromethane	0.005		a	
1,2,4 Trichlorobenzene	0.07	c	a	
1,1,2 Trichloroethane	0.005	c	a	

TREATMENT OPTIONS

Synthetic Organic Chemicals	Maximum Contaminant Level	Granular Activated Carbon	Packed Tower Aeration	Oxidation, Chlorination or Ozonation
Alachlor	0.002	c		
Aldicarb	0.003	c		
Aldicarb sulfoxide	0.004	c		
Aldicarb sulfone	0.002	c		
Atrazine	0.003	c		
Carbofliran	0.04	c		
Chlordane	0.002	c		
Dibromochloropropane (DBCP)	0.0002	c	a	
Ethylene Dibromide (EDB)	0.00005	c	a	
Heptaehlor	0.0004	c		
Heptachlor epoxide	0.0002	c		
Lindane	0.0002	c		
Methoxchlor	0.04	c		
Polychlorinated Biphenyls (PCB)	0.00005	c		
Pentachlorophenol	0.001	c		
Toxaphene	0.003	c	a	
2,4,5-TP (silvex)	0.05	c		
2,4-D	0.0002	c		
Dalapon	0.2	c		
Di(ethylhexyl)adipate	0.4	c	a	
Di(ethylhexyl)phthalate	0.006	c		
Dinoseb	0.007	c		
Diquat	0.02	c		
Endothall	0.1	c		
Endin	0.002	c		

Glyphosate	0.7			o
Hexachlorobenzene	0.901	c		
Hexachlorocyclopentadiene	0.05	c	a	
Oxaml (Vydate)	0.2	c		
PAH's				
Benzo(a)pyrene	0.005	c		
Benz(a)anthracene	-			
Benzo(b)fluoranthene	-			
Benzo(k)fluoranthene	-			
Chrysene	-			
Dibenz(a,h)anthracene	-			
Indenopyrene	-			
Picloram	0.5	c		
Simazine	0.004	c		
2,3,7,8 TCDD Dioxin	0.0000003	c		