VOLATILE ORGANIC CHEMICALS IN THE DRINKING WATER

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When addressing water treatment needs, the average person usually wants to remedy their water of items that cause laundry stains, unpleasant "egg-like" or musty odors and buildup on pipes and fixtures. While the contaminants that cause these problems certainly present legitimate reasons for treatment, it is the "silent" contaminants in our drinking water that cause the most problems with everyday health.

While there are great efforts currently exercised on a daily basis to clean our environment, past carelessness and naivete have created environmental chaos in some areas of the country. In order to determine the areas of most concern regarding hazardous waste, the EPA has developed a scoring system known as the Hazard Ranking System. Under this scoring system, sites are judged on the likelihood of a substance leaching from the area, the toxicity and amount of the substance and the population in the surrounding area that could potentially be affected. If a site ranks a high enough score, the site is then placed on the National Priorities List (NPL) making it eligible for cleanup with the use of federal funds. According to data from the EPA, as of March, 2000 there are 1,485 sites on the NPL throughout the country. New Jersey has the most sites with 130 and Nevada has the least with only 1. Although these sites are of the most serious long term concern, there are also 41,442 sites listed in the Superfund inventory as non-NPL sites and also sites that have no further remedial action planned, NFRAP sites. Non-NPL sites still may pose environmental and health risks, however, it is believed that they may be addressed with shorter-term cleanups.

A majority of the compounds that are a result of contaminated sites and leaking underground storage tanks are chemicals that are considered volatile organic chemicals. Chemicals are called volatile because they rapidly vaporize when they come into contact with air. Many of these items, although they are not highly soluble, may still be transported from a site by water with little effort if they are not stored properly and come into contact with the ground water. These chemicals are typically generated from petroleum and gasoline products, plastics, paints, solvents, degreasers and other types of industrial chemicals.

Volatile chemicals may also come from the components of a home's distribution system when conditions are aggressive. Sources may include leaching of the plastic piping used in plumbing or from adhesives used in the original construction of the system. Another source of volatile compounds that we will not discuss in detail is from the municipal systems. In the disinfection process utilized by the municipalities, compounds called trihalomethanes are generated when chlorination agents come into contact with naturally occurring organic materials in the source water. The chemicals that are formed are those such as Bromoform, Chloroform and Dibromochloromethane to name a few.

A volatile compound that has recently been highly publicized and is of growing concern in the environment is methyl-tertiary-butyl-ether (MtBE). The recent publicity, although the chemical is not new, is due to the result of various amounts of the chemical discovered in wells and municipal water sources throughout the country. The chemical is so readily dissolved in water, that it takes less than a teaspoonful of MtBE to contaminate an olympic-sized swimming pool. MtBE is used as an oxygenate in gasoline to reduce air pollution. Until either another acceptable

oxygenate is put into use or until requirements of the clean air act are changed or amended, MtBE will continue to be a problem.

Testing

Some volatiles, because of their nature, will make themselves known by an unpleasant odor at *high* concentrations in the water. Unfortunately, they do not necessarily have to be present at a high concentration to be considered a health concern. Many volatiles are considered possible carcinogens, therefore, it is important to determine their existence in the water (even if only in minute quantities) in order verify the appropriate treatment.

The EPA has established many different methods of analysis for volatiles in drinking water and wastewater. The methods primarily used for the analysis of drinking water and those that will be discussed are known as EPA Method 502.2 (502.2) and EPA Method 524.2 (524.2). Generally speaking, 502.2 is performed by the use of Gas Chromatography and 524.2 is performed by the use of Gas Chromatography in combination with Mass Spectrometry. 524.2 is the more advanced and preferred method because of it's ability to determine a greater scope of compounds that may be identified. 502.2 does not allow for the differentiation between the ions in the compound. Until recently, many states allowed for the use of either method in the analysis of volatile organic compounds, however, many now require that they be run according to 524.2.

The EPA has established Maximum Contaminant Levels or safety levels for approximately 25 different volatile organic compounds and requires that other unregulated volatile organic compounds also be tested for by municipalities on a regular basis. All compounds that are required can be detected using the 524.2 method. Another advantage to this method is the ability to identify "unidentified compounds" that are detected in the scan. In the process of the test, different "peaks" are generated based on the unique mass spectra of each analyte. The location of where the peak is produced can help determine what the compound is with an assuredness that is simply not available by other techniques.

With this superior technology available through certified and accredited laboratories throughout the country, it simply behooves an individual in a known contamination zone to have their household water tested.

Health Effects

Contaminants in drinking water can cause either acute or chronic health effects. Acute affects usually occur immediately after ingestion of a large dose. Common acute affects include nausea, lung irritation, skin rash, vomiting, dizziness and in extreme cases death. Normally the levels of contaminants in water are not high enough to cause acute health effects. Typically the amount of contaminants in water are more likely to cause chronic health effects. Chronic effects occur after exposure to small amounts over long periods of time. Chronic health effects can include cancer, birth defects, organ damage, nervous system disorders and immune system deficiencies.

The effects of some toxic substances on human life have been understood for some time. For example in Japan in the 1950's the effects of mercury became apparent when thousands of people eating mercury-tainted fish became crippled and some even died. There have been a significant number of studies conducted determining that even small amounts of lead can result in adverse health problems. However, the effects of volatile and synthetic organic chemicals are less understood.

In efforts to improve the quality of life, chemical manufacturers are developing new chemicals to protect and preserve food supplies. There have also been a variety of sprays created for personal hygiene, pet, automobile and home use. Over a thousand new chemicals are designed each year to meet the growing demands in the marketplace. Tragically, chemicals are introduced into the environment faster than the risks and benefits of each individual chemical can be estimated. There are currently in excess of 70,000 chemicals in commercial use. According to the National Academy of Sciences, only 10% of these chemicals have been tested for toxicity. Those chemicals that are tested for toxicity are tested using laboratory animals, which may not accurately predict how that chemical will affect humans. Periodically human data from clinical reports and epidemiological studies are available. The information generated is difficult to use in predicting the health effects related to ingesting small amounts of a chemical over a long period of time. One must also consider that volatile organic chemicals can affect your health through skin absorption and inhalation of water vapor. It is important to remember when treating water containing volatile organic compounds; to address the water utilized by the entire home.

Establishing Guidelines

The USEPA is responsible for establishing Maximum Contaminant Levels (MCL) for potential contaminants in drinking water. The MCL is the maximum allowable level for a contaminant in drinking water. Public Water Supplies are required to monitor their water quality to ensure they are meeting these safety guidelines. Standards are divided into two categories, primary and secondary. Primary contaminants are known to cause adverse health effects, while secondary contaminants cause aesthetic effects such as odor, taste and staining. There are a variety of factors considered when developing primary standards. The contaminant must be known to cause adverse health effects and known to occur in drinking water. Other important factors include the availability of instruments, technological ability to detect the contaminant in the water at an acceptable level and the cost of treatment.

Carcinogens

The USEPA has established Agency Guidelines for Carcinogen Risk Assessment. There are five classes of carcinogenicity. The first is referred to as Group A, which is considered a human carcinogen, based on sufficient evidence from epidemiological studies. Group B is labeled as a probable carcinogen and is divided into Group B1 and B2. Group B1 is based on limited evidence of carcinogenicity in humans while Group B2 is based on a combination of sufficient evidence on animals and inadequate data for humans. Group C is listed as a possible human carcinogen with limited data in animal studies and no human data available. Group D is not classifiable based on a lack of animal and human studies. Finally, Group E is designated for evidence of non-carcinogenicity for humans. No evidence of carcinogenicity in at least two adequate animal tests in different species or a combination of both epidemiological and animal studies determines non-carcinogenicity.

Treatment

When choosing a water treatment system for volatile organic chemical removal, it's important to select a system that has been certified to reduce volatile organic chemicals. It is recommended to install a "point-of-entry" treatment system to ensure all water used for drinking, cooking, cleaning and bathing is free of volatile contamination. Systems that are certified to remove volatile organic chemicals are put through a strict set of testing protocols to determine that the unit actually removes volatiles and to

what capacity it is capable of removal. Typically, the testing is done according to a protocol specified in the ANSI/NSF Standard 53. The National Sanitation Foundation (NSF) or any other independent certified laboratory can perform the testing. For volatile organic chemical reduction claims, the manufacturer is able to make claims for removing an extensive list of volatiles by testing using chloroform as a surrogate. Chloroform is used because it is representative of how typical volatile organic chemicals are removed. The testing involves continually spiking the influent water with a known amount of chloroform and then checking the effluent to ensure the filter is effectively removing chloroform. The manufacturers are required to test their units to 200% of the capacity they will be claiming to ensure adequate protection for end-users. Some manufacturers have developed units with performance indicator devices, which will indicate to the users that the unit is not functioning properly. Devices may include a termination of discharge water, a sounding alarm, or a flashing light. If such a device is included in the unit, the manufacturer is only required to test to 120% of the claimed capacity provided the performance indication device works properly. Unfortunately, there are hundreds of systems being sold, but only a few are tested for the efficiency of VOC removal by an independent laboratory. Without some type of independent testing, consumers have no way of knowing whether or not the unit is capable of removing volatile compounds and to what capacity.

It is important to maintain a regular maintenance and monitoring schedule for systems that remove volatile organic chemicals. Regular maintenance will usually include changing a carbon cartridge based on how many gallons are being treated. This is extremely important because once carbon is exhausted it can start to add the volatiles it was removing. It is also important to periodically test the water before and after the filter to ensure the filter is functioning properly.

Useful resources regarding this topic may include the following:

EPA website:	**www.epa.gov**
EPA Drinking Water Hotline:	**1-800-426-4791**
Environmental Working Group:	**www.ewg.org**
NSF Website:	**www.nsf.org**