CLEMSON EXTENSION

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WATER QUALITY

Health Effects of Drinking Water Contaminants and How to Treat Them

Chemical contaminants occur in drinking water supplies throughout the United States, ranging from barely detectable amounts to levels that could possibly threaten human health. Determining the health effects of these contaminants is difficult, especially since researchers are still learning how chemicals react in the body to damage cells and cause illness.

POSSIBLE CHRONIC HEALTH EFFECTS

Toxic doses of chemicals cause either acute or chronic health effects. An acute effect usually follows a large dose of a chemical and occurs almost immediately. Examples of acute health effects are nausea, lung irritation, skin rash, vomiting, dizziness and even death.

The levels of chemicals in drinking water, however, are seldom high enough to cause acute health effects. They are most likely to cause chronic health effects - effects that occur after long exposure to small amounts of a chemical. Examples of chronic health effects include cancer, birth defects, organ damage, disorders of the nervous system, and damage to the immune system.

Evidence relating chronic health effects to specific drinking water contaminants is limited. In the absence of exact scientific information, scientists predict the likely adverse effects of chemicals in drinking water using laboratory animal studies and, when available, human data from clinical reports and epidemiological studies.

SETTING STANDARDS

The United States Environmental Protection Agency (EPA) sets standards for drinking water contaminants. These standards are based on estimates of the concentration of a contaminant that a person can drink safely over a lifetime. If you suspect that your drinking water may be contaminated, you need to have a water sample taken and tested by a reputable laboratory. (See WQL 1, Testing Drinking Water).

POSSIBLE CONTAMINANTS

Fluoride

Fluoride is found naturally in water supplies in varying amounts. The dental benefits from the use of optimally fluoridated water have been well documented. At concentrations greater than 1.0 milligrams per liter, fluoride will reduce the incidence of tooth decay, but at concentrations over 1.5 milligrams per liter mottling of teeth, called fluorosis, may occur. The Environmental Protection Agency has set limits for the amount of fluoride that may be found in public water supplies, either naturally or through water treatment.

Bacteria and Othe Infectious Disease Agents

Although most microorganisms in water are harmless, some can cause problems. Bacteria from human or livestock waste can cause serious health problems such as dysentery, hepatitis and typhoid fever. Bacteriological tests are based on the detection of coliform bacteria. Most coliform organisms may not themselves cause disease, but may be accompanied by various organisms which do. Chlorination and

filtration effectively control the level of bacteria in water supplies. Chlorination is closely regulated by the EPA.

In the past few years, Giardia iamblia, a tiny one-celled parasite not readily killed by chlorination, has entered water supplies. Bacterial contamination can cause a change in water color, taste or odor, but water contaminated with Giardia may look, smell and taste good. It is common in rural and mountain communities without adequate filtration systems. This is primarily a problem in surface water, not groundwater.

Giardiasis is a gastrointestinal illness affecting people and animals of all ages who have ingested Giardia cysts. The symptoms of Giardiasis include diarrhea, abdominal cramps, gas, dehydration, weakness and loss of appetite. Infected individuals can be treated with prescription medication. Some infections disappear spontaneously without any treatment. Proper hygiene, proper waste disposal and well construction are important factors in preventing infections.

Nitrate

Nitrate contamination of water supplies can come from many sources-chemical fertilizers, animal wastes, septic systems. Nitrate-contaminated water is a serious problem because in the digestive systems of human infants and in some livestock nitrate is converted to nitrite, a very toxic substance,

Infants are extremely susceptible to acute nitrate poisoning because of certain bacteria present in their digestive systems at birth. These bacteria change nitrate into toxic nitrite. The nitrite reacts with hemoglobin in the bloodstream to form methemoglobin. Hemoglobin carries oxygen methemoglobin does not. As the circulating oxygen level decreases, the infant suffers from methemoglobinemia, or blue-baby disease, which is characterized by a bluish skin color, particularly around the eyes and mouth. This is a sign of suffocation and the infant should be taken to the doctor immediately for treatment. Treatment results in methemoglobin converting back to hemoglobin.

Starting at about three months of age, an increase in the amount of hydrochloric acid in the infant's stomach kills most of the bacteria that convert nitrate to nitrite, and enzyme systems affecting nitrite formations mature. By the time the baby is six months old its digestive system is fully developed and none of the nitrate-converting bacteria appear to remain in the intestine. In older children and adults nitrate is generally absorbed and excreted.

If your drinking water contains more than 10 parts per million of nitrate-nitrogen, it is advisable to use an alternate source of water for infant formula and food.

Sulfate

Sulfates that occur naturally in groundwater include calcium, magnesium and sodium salts. Normally, small amounts of sulfate salts have little public health significance. Sodium sulfate (Glaubers salt) and magnesium sulfate (Epsom salt) are both laxatives. The laxative effect is noted most often by persons not accustomed to drinking water with quantities of these chemicals. Those who consume such water on a constant basis become used to it. The EPA recommends that water containing more than 250 parts per million of sulfate, not be used if other less mineralized supplies are available, primarily because of how this water tastes.

If the water smells like rotten eggs, it has a hydrogen sulfide problem.

Lead

Lead has no known useful function in the body. It is a well-know toxic heavy metal. Lead can cause damage to the nervous system, the blood-forming processes, the gastrointestinal systems and the kidneys. Children who accumulate high levels of lead in the blood - by drinking contaminated water, inhaling car exhaust or eating old paint chips containing lead pigment - often have learning difficulties and stunted growth. Even low levels of lead exposure can contribute to hypertension in adult males. Young children and fetuses are most at risk for damage by exposure to lead.

Lead rarely occurs naturally in drinking water sources. The major source of lead in drinking water is the corrosive action of water on the materials used in water distribution and plumbing systems. Old homes may still have lead pipes, lead alloy pipes or lead solder used with copper plumbing. Lead con-

tamination is more serious in areas with soft corrosive water. To minimize exposure to lead, run the tap for a few minutes each morning to flush out standing water and use only cold water for drinking and preparing foods. Once heated by the water heater, water becomes more corrosive and tends to increase leaching of lead from plumbing.

TREATING CONTAMINANTS

If after having your water supply tested, results indicate contaminants above levels recommended by EPA you need to consider appropriate water treatment to reduce or eliminate contaminants. The following chart provides a listing of common contaminants and recommended treatment. Formore information on water treatment, see WQ L5, Home Water Treatment Systems.

CONTAMINANT	TREATMENT
Arsenic	Activated alumina, distillation, reverse osmosis
Bacteria	Chlorination, distillation, microfiltration, ultraviolet radiation, improve well construction
Calcium/Magnesium (Hardness)	Ion exchange (water softener)
Fluoride	Activated alumina, distillation, reverse osmosis
Hydrogen Sulfide	Aeration, chlorination, microfiltration, oxidizing catalyst filter
Iron/Manganese	Polyphosphate feeder, chlorination, microfiltration, oxidizing catalyst filter
Lead	Distillation, reverse osmosis
Nitrate	Distillation, reverse osmosis
pH - Acidity	Neutralizing filter
Radon In Water	Aeration
Sediment	Microfiltration, improved well construction
Sodium Chloride	Distillation, reverse osmosis
Pesticides & Organics	Activated carbon, distillation

TERMS RELATED TO DRINKING WATER AND HEALTH

ADI - acceptable daily intake; replaced by reference dose.

Bacterial Analysis - a test to detect the presence or absence of coliform bacteria. It requires a sterile container, available from the testing laboratory.

Contaminant - any physical, chemical, biological or radiological substance or matter in the water.

Corrosivity - a characteristic of water related to alkalinity, pH, dissolved oxygen, total dissolved solids and hardness. Any combination of these features under localized conditions can cause water to be corrosive, gradually weakening or destroying the distribution system pipes and other materials. This affects the quality of water at the tap.

Health Advisory Level - information that describes nonregulatory concentrations of drinking water contaminants. Health advisories are determined for contaminants when no adverse health effects are expected to occur after specific exposures. Health advisories are developed for one-day, ten-day, longer term and lifetime exposures for a 10 kg child drinking one liter of water per day and a 70 kg adult drinking two liters of water per day.

MCL - maximum contaminant level; the highest amount of a specific contaminant legally allowed in water delivered by a public water system.

Mg/l - milligrams per liter; metric unit used to denote concentrations of chemicals or other substances in water. Mg/l and ppm are equivalent expressions of concentrations.

Mineral Analysis - a test which determines the dissolved mineral constituents in water.

Ppm - parts per million; a metric unit used to denote concentration of chemicals or other substances in water. Equivalent to mg/l. The unit implies a part of something in one millionparts of water. The following com parisons help in putting this concentration in perspective: one inch in 16 miles; one cent in $10,000; or one drop in 60 quarts.

Potable water - water safe for drinking.

Reference Dose (RFD) - Acceptable daily intake; the amount that may be taken into the body daily with a practical certainty that injury will not result, even after a lifetime of exposure. and materials produced by the Cooperative Extension System.