Platte County Health Department
ENVIRONMENTAL HEALTH DIVISON

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FACTS ABOUT THE CHEMICAL QUALITY OF YOUR DRINKING WATER

The State Public Health Laboratory in Jefferson City tests water from private water supplies to determine certain physical and chemical characteristics. Some of these characteristics may affect the taste or odor of the water; some may determine its usefulness for processing or manufacturing; and others may affect its suitability for human consumption.

Private citizens may request bacteriological tests or the chemical tests of nitrate and fluoride. The laboratory will charge ten dollars for each sample collected. Additional tests may be requested if the samples are collected by an Environmental Public Health Specialist employed by the Platte County Health Department.

For a chemical test, approximately one quart of water can be collected in an appropriate container provided by the Health Department. A form will be provided with the container requesting your name, complete address and phone number and specific information about your water supply. Tests for special problems require special handling of the water sample; for example, if your water is suspected of being contaminated with an insecticide or a herbicide, a specific type of container must be requested from the laboratory. Contact the Health Department for assistance.

The following information will help individuals determine what chemical tests might be appropriate for samples from their private water supplies and will aid in interpreting the results of laboratory tests.

PHYSICAL CHARACTERISTICS

The water as used should be free from all impurities that are offensive to the senses of sight, taste, or smell. The physical characteristics of the water include color, conductivity, foamability, taste & odor, temperature, and turbidity.

Color. Dissolved organic material from decaying vegetation and from certain inorganic matter causes color in water. Occasionally, excessive blooms of algae or the growth of aquatic micro-organisms may also impart color. While color itself is not usually objectionable from the standpoint of health, its presence is esthetically objectionable and suggests that the water needs appropriate treatment.

Conductivity. The ability of a water sample to carry an electrical current can be referred to as its conductivity. The conductivity of drinking water supplies normally ranges from 50 to 1500 micromhos/cm. Tests for conductivity become important in cases where drinking water supplies are suspected of being contaminated from sanitary or hazardous waste

Foamability. Since 1965, detergent formulations were changed to eliminate alkyl benzene sulfonate (ABS), which was very slowly degraded by nature. The more rapidly biodegradable linear alkylate sulfonate (LAS) has been substituted in most detergents. Even LAS is not degraded very rapidly in the absence of oxygen-a condition that exists in some septic tank and soil absorption fields.

Foam in water is usually caused by concentrations of detergents greater than 1 milligram per liter (mg/l). Milligrams per liter is the same as parts per million (ppm). One mg/l is about 0.00003 ounces per quart. While foam itself is not hazardous, the user should understand that if enough detergent is reaching a water supply to cause a noticeable froth on a glass of water, other possibly hazardous materials of sewage origin are also likely to be present. The maximum level for foaming agents in water is 0.5 mg/l.

Taste and Odor. Taste and odor in water can be caused by foreign matter such as organic compounds, inorganic salts, or dissolved gasses. These materials may come from domestic, agricultural, or natural sources. Acceptable water should be free from any objectionable taste or odor at point of use. Knowledge concerning the chemical quality of a water supply source is important in order to determine what treatment, if any, is required to make the water acceptable for domestic use.

Tastes and odors caused by dissolved gasses are most easily detected in freshly drawn water and are difficult to test for in the lab, because many tend to dissipate during shipment. A description of what the water tastes or smells like should always accompany the water sample when it is sent to the lab. An example of such an odor is the characteristic “rotten egg” odor caused by hydrogen sulfide. The odor tends to be quite noticeable when the water is first exposed to the air, as when first drawn from the tap, but upon standing, however, the water loses the dissolved gas and the odor no longer is present. Other tastes and odors may result from the decomposition of organic materials, and here again the best way to determine their source is to give a complete description of the location and the construction of the water source, as well as a description of the particular taste or odor. Certain inorganic salts can impart tastes to water. For example, chloride causes a salty taste, copper a metallic taste, and zinc gives an astringent taste. When a taste problem appears to be associated with inorganic salts, the lab usually tests for chloride, copper, manganese, sulfate, total dissolved solids, and zinc. Some tastes and odors can be controlled by aeration of the water or by oxidation with chlorine. Other methods of taste and odor removal may be available commercially for use in treating private water supplies.

Temperature. The most desirable drinking waters are consistently cool and do not have temperature fluctuations of more than a few degrees. Ground water and surface water from mountainous areas generally meet these criteria. Most individuals find that water having a temperature between 50° and 60° F is most palatable.

Turbidity. The effect of suspended material such as clay, silt, finely divided organic material, plankton, and other inorganic material in water is known as turbidity; it is noticeable as a cloudiness in the water. Turbidities in excess of 5 units are easily detectable in a glass of water, and are usually objectionable for esthetic reasons. Turbidity should average 1 unit or less over a period of one month.

Clay or other inert suspended particles in drinking water may not adversely affect health, but such particles may harbor bacteria and may require treatment and disinfection to make the water suitable for its intended use. Following a rainfall, variations in the ground water turbidity may be considered an indication of surface contamination or other introduced pollution.

CHEMICAL CHARACTERISTICS

The nature of the soil and rocks that form the earth's crust affects not only the quantity of water that may be recovered but also its characteristics. As surface water seeps downward to the water table, it dissolves portions of the minerals in the soil and rocks. Ground water (from wells), therefore, usually contains more dissolved minerals than surface water (from streams). Surface waters, on the other hand, are more likely to contain substances that wash into them from surrounding areas.

The chemical characteristics of water in a particular locality can sometimes be predicted from tests of adjacent water sources. These data are often available in published reports of the U.S. Geological Survey or from federal and state health, geological, and water agencies. In the event that the information is not available, a chemical test of the water source should be made. The types of information that can be obtained from a chemical test are:

1. The possible presence of harmful or disagreeable substances.
2. The potential for the water to corrode parts of the water system.
3. The tendency for the water to stain fixtures and clothing.

In the following discussions the maximum recommended levels, when indicated, are taken from the Missouri Department of Natural Resources Public Drinking Water Regulations.

Alkalinity. Alkalinity is a chemical term that refers to the buffering capacity of water, or its ability to resist changes in pH. Alkaline water is generally the opposite of acidic water. Alkalinity is imparted to water by bicarbonate, carbonate, and hydroxide components and the total alkalinity is a measure of these components. Knowledge of alkalinity is useful in the treatment of water. The optimum level of total alkalinity will vary from one water supply to the next, and could be anywhere from 30-250 mg/l. When both alkalinity and pH are sufficiently high, lime (calcium oxide) will tend to deposit on the inside of pipes. And on the other hand when both are too low, pipes can corrode which will in turn cause iron and copper to be released into the water.

Calcium. Calcium is one of the major components causing hardness in water. It can range from zero up to several hundreds of mg/l. Calcium in water is not harmful; it is an important element in nutrition in the formation of bone.

Chloride. Chloride is a component of table salt. Most waters contain some chloride in solution. The amount present can be caused by the leaching of marine sedimentary deposits, or by pollution from sea water, brine, or industrial and domestic wastes. Chloride concentrations in excess of about 250 mg/l usually produce a noticeable salty taste in drinking water. In areas where the chloride content is higher than 250 mg/l, and all other characteristics of the water are acceptable, it may be necessary to use a water source that exceeds this limit. Higher concentrations apparently have no health significance, and water sources with concentrations as high as 1800 ppm have been used as public water supplies in Missouri. However, at these high concentrations the water is not suitable for infants, and other sources of drinking water should be sought for them. Corrosion is an additional problem caused by chlorides, and this can lead to iron or "red water" problems in piping systems.

Chlorides are abundant in human wastes, and their presence in a water supply in amounts exceeding the level that is normal for the particular geographic area is an indication of pollution. Soluble chlorides cannot be economically removed from water, so it is important that wells be properly constructed to prevent infiltration of shallow groundwater which might contain excessive chloride.

Copper. Copper is found in some natural waters, particularly in areas where copper bearing ore deposits have been mined. Excessive amounts of copper can occur in corrosive water that passes through copper pipes. Copper in small amounts is not considered detrimental to health, but will impart an undesirable metallic-like taste to the drinking water. It may also stain plumbing fixtures green. For these reasons, the recommended limit for copper is 1.0 mg/l.

Filterable residue or total dissolved solids. Filterable residue is that portion of the water that does not precipitate out or cannot be filtered out. Waters with high residues are generally inferior with respect to taste and odor. These waters can also cause unfavorable physiological reactions, like diarrhea, to those unaccustomed to drinking the water. High residues can also reduce the life of water heaters, and can cause precipitation in cooking vessels. Filterable residue is made up primarily of alkalinity, chloride, and sulfate. The recommended limit for filterable residue is 500 mg/l.

Fluoride. Naturally ocurring fluorides are found in water supplies throughout the country. When present in optimum amounts, they are an important factor in the reduction of dental caries. Excessive fluorides may produce a brownish discoloration or mottling of the teeth.

The optimum range for fluorides in Missouri has been established as between 0.8 to 1.4 mg/l with the optimum level being 1.0. The fluoride content of many public water supplies is adjusted to the optimum level by the addition of fluoride compounds. A fluoride level above 2.0 mg/l is considered excessive, although there is evidence that supplies naturally containing more than this amount have been used with no apparent ill effects.

Hardness. Hardness is a chemical term that refers to the amount of soap that is required to make a suds or a lather with the water; soft water requires a small amount of soap, whereas hard water requires a larger amount. Hardness is generally derived from the natural accumulation of salts that are found in the soil and geological formations, principally limestone, dolomite and gypsum. Waters with a total hardness of less than 75 mg/l are considered to be soft, those between 75-150 are moderately hard, those between 150-300 are hard, and those greater than 300 are considered very hard. Generally a softener is recommended to treat waters that have a hardness above 80-100 mg/l. Commercial water softeners are available that will economically remove the elements that cause hardness, which are primarily calcium and magnesium. In the removal process, however, sodium is added to the water in proportion to the amount of hardness removed, which is undesirable for persons on low sodium diets. Hard waters are satisfactory for human consumption; some individuals even prefer them over soft waters.

In addition to requiring more soap for laundering, hard waters cause the formation of scale on pipes, water heaters, boilers, and on cooking utensils. Ice cubes made from hard waters often leave a white precipitate when they melt, like in a glass of ice water. The white precipitate that often forms in water after boiling is usually due to hardness.

Hardness is often expressed as grains per gallon, so to convert from mg/l to grains per gallon, multiply mg/l by 0.05841. And to convert from grains per gallon to mg/l multiply grains per gallon by 17.12.

Iron. Small amounts of iron are frequently present in water because of the large amount of iron present in the soil and because corrosive water will pick up iron from pipes. The presence of iron in water is considered objectionable because it stains plumbing fixtures; it imparts a brownish color to laundered goods; and it affects the taste of beverages such as tea and coffee. Recent studies indicate that eggs spoil faster when washed in water containing iron in excess of 10 mg/l.

“Red water” is generally caused by iron compounds present in the water. Certain organisms called iron bacteria use the iron compounds for their metabolism. These organisms cause the red water, and in severe cases they can even cause clogging of water lines. These bacteria are normally controlled by chlorination.

The removal of naturally occurring iron may be accomplished by oxidation, settling and filtration. Groundwater containing iron may at first be clear if there is an absence of oxygen, but when exposed to air a reddish-brown gelatinous precipitate will form and settle out upon standing. The presence of iron is common in groundwater, and while objectionable from an esthetic standpoint, will not affect the health of the user. Water containing iron in excess of 0.3 mg/l is considered objectionable for domestic use. Water softeners can remove some iron, but there are questions about how effective they are.

Iron concentrations greater than 1 mg/l tend to coat the exchange resin in the softener which eventually renders it ineffective. The recommended limit for iron in drinking water is 0.3 mg/l.

Magnesium. Magnesium is one of the major components causing hardness in water. It can range from zero up to about 100 mg/l. Magnesium is generally not harmful as it is one of the nutritional elements.

Manganese. Small concentrations of manganese are found in some water supplies and manganese concentrations can even exceed 1 mg/l in streams that receive acid drainage from mines. Manganese like iron is objectionable, because it stains laundry and sinks a brownish color. It also forms a reddish to black precipitate in water and can impart a taste to beverages such as coffee and tea. The recommended limit for manganese is 0.05 mg/l.

Nitrate. The reduced form of nitrate, which is nitrite, causes methemoglobinemia (infant cyanosis or "blue baby disease") in infants who have been given water or fed formulas prepared with water having high nitrates. The digestive system of infants contains a bacteria that changes the nitrate to nitrite. Nitrite combines with the red blood cells which prevents them from transporting oxygen. There is little danger to an adult, however, from consuming water having high nitrates. The amount of nitrate occurring naturally in water is usually insignificant from a health standpoint; however, the wells in some areas of Missouri are exceptions. The presence of nitrate in excess of 10 mg/l (expressed as nitrogen) is considered grounds for rejection of a water supply.

High nitrate concentration in well water is generally an indication that the well is improperly constructed and that surface water containing excessive nitrates is entering the well. Because privies, cesspools, fertilizers, and barnyards are sources of organic nitrogen, a large amount of nitrate in well water may indicate pollution from these sources. When high nitrates are present in a well supply, the well should be checked for defects in construction and a bacteriological examination of the water should be made.

pH. pH is a chemical term that indicates the degree to which a water is either acidic or alkaline. Waters with pH less than 7 are acidic and tend to be corrosive when the pH goes below 6.5. Waters with pH greater than 7 are alkaline. When the pH goes above 8.5, lime deposits tend to form, a bitter taste is noted, and the germicidal activity of chlorine is lowered. The pH of water in its natural state often varies from 5.5 to 9.0. The recommended limits are between 6.5 and 8.5.

Potassium. Potassium ranks seventh among the elements in order of abundance. Drinking water seldom reaches more than 20 milligrams of potassium per liter; however, some brines can contain in excess of 100 mg/l.

Sodium. When it is necessary to know the precise amount of sodium present in a water supply, a laboratory test should be made. When home water softeners utilizing the ion exchange method are used, the amount of sodium will be increased. For this reason, water that has been softened should be analyzed for sodium when a precise record of individual sodium intake is recommended.

For healthy persons, the sodium content of water is unimportant because the intake from table salt is so much greater. But for persons placed on a low-sodium diet because of heart, kidney, or circulatory ailments or complications of pregnancy, sodium in water must be considered. The usual low-sodium diets allow for 20 mg/l sodium in the drinking water. When this limit is exceeded, such persons should seek a physician's advice on diet and sodium intake. Sodium in water can range from zero to hundreds of mg/l.

Sulfate. Sulfates enter water sources by the leaching of natural deposits of magnesium sulfate and sodium sulfate; calcium and magnesium sulfates cause hardness in water. The recommended level of sulfate in water is 250 mg/l. Levels higher than this can cause diarrhea in humans, and can impart a bitter or gyp taste to the water.

Zinc. Zinc is found in some natural waters, particularly in areas where zinc bearing ore deposits have been mined. Zinc is not considered detrimental to health, but it will impart an undesirable taste to drinking water. For this reason, the recommended limit for zinc is 5.0 mg/l.

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