

Information for Public and Private Drinking Water Systems
Michigan Department of Environmental Quality
Environmental Resource Management Division

Nitrate and Health

Large amounts of nitrate in drinking water can cause serious illness in infants under six months of age. This pamphlet answers questions you may have about this possible problem.

What is nitrate?

Nitrate (NO_3) is a form of nitrogen combined with oxygen. It can be converted in the body to nitrite (NO_2). The major adult intake of nitrate is from food rather than water; but sometimes excessive amounts of nitrate get into drinking water.

How does nitrate get into drinking water?

It can get into water if a well is improperly constructed or located where it is subject to contamination sources. Typical sources of nitrate include; sewage disposal systems, run-off from barnyards or fertilized fields, industrial wastes, or nitrates that are naturally occurring in the soil, as found in some parts of Michigan.

What illnesses can nitrate cause?

Large amounts of nitrate in drinking water are a cause of a disease called methemoglobinemia, a blood disorder primarily affecting infants under six months of age. Also, because nitrate contamination can be related to human, animal, or industrial waste practices, excessive levels of nitrate in drinking water may indicate potential for the presence of other types of contaminants which may cause health problems.

What is Methemoglobinemia?

Methemoglobinemia is a condition in which the ability of the red blood cells to carry oxygen is reduced. The acutely poisoned person will have a blue discoloration of the skin due to the reduction of oxygen in the blood system and must be attended by a physician immediately.

Why are infants more susceptible than adults to nitrate-induced methemoglobinemia?

There are four reasons. One: Infants have a lower stomach acidity which allows growth of bacteria capable of converting nitrate to nitrite. Nitrite can change hemoglobin to methemoglobin which cannot carry oxygen. Two: Young infants still have considerable amounts of fetal hemoglobin which is more easily converted to methemoglobin than the adult hemoglobin. Three: Infants are deficient in certain enzymes that are able to convert methemoglobin back to normal hemoglobin. Four: In relation to body weight, an infant consumes a much larger volume of water than an adult.

What is "excessive" nitrate?

The United States Environmental Protection Agency (EPA) has established a Maximum Contaminant Level (MCL) value for nitrate (as nitrogen) at 10 milligrams per liter (mg/l) and nitrite at 1.0 mg/l for public water system. The Michigan Department of

Environmental Quality has adopted these standards. Public water supplies with nitrate levels above 10 mg/l or nitrite above 1 mg/l are required to notify the health department and take corrective action. Private water supply owners with excessive nitrate or nitrite should contact their local health department or family physician for assistance.

Is there a treatment for the removal of nitrate from drinking water?

The technology for removal of nitrate from drinking water does exist. Reverse Osmosis, ion exchange and distillation are three possible methods. This equipment requires frequent, careful maintenance and sampling to achieve and confirm effective operation. Improperly installed, operated, or maintained, equipment can result in nitrate passing through the treatment process and in some cases concentrating the nitrate above the incoming levels. Bacteriological problems can also develop in improperly installed and poorly maintained systems. Therefore, it is the position of the Michigan Department of Environmental Quality that an alternate source of drinking water that meets the nitrate standard be developed where possible. The local health department should be consulted for information on deepening wells or changing aquifers to reduce nitrate levels. If a nitrate removal system is to be used, one with National Sanitation Foundation (NSF) or equivalent certification should be selected. Public water systems must obtain health department approval prior to installing this type of treatment equipment. Boiling water will not remove nitrate and may concentrate it.

How often should samples be collected?

All community and noncommunity public water supplies using groundwater are required by law to sample at least once every year for nitrate and once every three years for nitrite. If results exceed 5 mg/l for nitrate or .5 mg/l for nitrite, quarterly sampling (one sample every three months) is required. Private water systems are not generally required to sample for nitrate on a routine basis. However, if nitrate contamination is known to the area, or a sample indicates nitrate or nitrite levels approaching the drinking water standards, periodic sampling is recommended.

Can a water supply be properly evaluated on the basis of one laboratory analysis for nitrate?

No. for example, a sample may be collected during dry weather from a poorly located and improperly constructed well near a barnyard, and found to contain little, if any, nitrate. The same well sampled following a rain could contain a nitrate concentration of 100 mg/l, N or more. Therefore, a sanitary survey is necessary to fully evaluate the supply and determine what may be done to eliminate or reduce the nitrate contamination. Such a survey includes information of the well depth, construction, location from potential sources of contamination, area geology, and groundwater quality. Periodic sanitary surveys are required for community and noncommunity public water systems.

What kind of container should I use for collecting a sample for nitrate determination?

Any laboratory certified for nitrate analysis of drinking water can provide you with the proper container. The regular partial chemical sample container furnished by the Michigan Department of Environmental Quality is used by that lab for nitrate analysis.

Local health departments have a supply of these bottles or they can be ordered directly from the laboratory. Ask for Unit 32 when ordering and indicate test code R when submitting a sample to the DEQ lab.

When a water sample is analyzed for nitrate, how are the results reported?

The state laboratory reports results to the person submitting the sample. Community and noncommunity public water supplies must always include their **water supply serial number** (WSSN) when submitting samples for analysis to insure proper identification. Nitrate results are reported to the Michigan Department of Environmental Quality as milligrams of nitrogen (N) per liter of water (mg/l, N). Other labs may report milligrams of nitrate (NO₃) per liter of water (mg/l, (NO₃)). Nitrite is reported as NO₂. It is essential to know which units are used for reporting because they differ by a factor of 4.4. In other words, 10 mg/l, N can also be reported as 44 mg/l, NO₃. Most laboratory reports will indicate which unit is used.

REFERENCES

Drinking Water and Health, Safe Drinking Water Committee, Advisory Center on toxicology, Assembly of Life Sciences, National Research Council, National Academy of Sciences, Washington, D.C., 1977, Library of Congress Catalogue Card Number: 77-089284, pp. 441-425.

Winton, E.E., Tardiff, R.G., and McCabe L.J., Nitrate in Drinking Water, Jour. AWWA, 63:95 (January 1971)

For more information contact the Michigan Department of Environmental Quality, P.O. Box 30630, Lansing, Michigan 48909-8130, your local health department or your physician.

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