Illinois State Water Survey

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Subject: Technical Letter No. 6
Nitrate in Water Supplies

In Illinois about 25 percent of all water samples from wells of 50 foot depth or less have been found to contain an excessive concentration of nitrate. Because this can be a serious problem in the use of such water, the following information has been prepared.

Limits

In view of the frequency of occurrence and the widespread geographic distribution of nitrate poisoning, the U. S. Public Health Service has recognized the hazards of nitrate by assigning a maximum limit of 45 milligrams per liter (mg/1) as nitrate (NO_3^-) as the standard for drinking water supplies (see Publication 1 in the list on page 3).

For further information on the hazards to humans of nitrate in drinking water, the State Department of Public Health, Springfield, should be consulted.

At this time, the level at which nitrate becomes injurious to farm animals has not been established with any degree of certainty. This is not surprising, because there are many factors that may influence the level at which nitrate may be injurious to animals.

It is important to know that although we commonly refer to "nitrate" poisoning, the nitrite ($NO2^-$) form of nitrogen is about ten times as toxic (Publications 2 and 3). Because of the chemical instability of the nitrite form, "nitrite" is either not present in water supplies or present in only small amounts. However, nitrite (a chemically reduced form of nitrate) could be formed from nitrate either before ingestion by farm animals or in the digestive tract of such animals (Publication 4). Therefore, any water supply containing nitrate is a potential source of the more toxic form, nitrite.

Sources

Barnyards, feedlots, manure piles, septic tank fields, silage juices, and decomposing plant and animal tissue are all common sources of nitrate through microbial action. Nitrate is also formed

in the soil by certain bacteria. These micro-organisms take nitrogen from the air and "fix" it in the soil as nitrate.

Fertilizers containing nitrogen may be additional sources of nitrate. Any of these sources may contribute nitrate to water supplies, although it has not been demonstrated that fertilizers have been responsible for high nitrate concentrations in water. High nitrate concentrations in water were observed before nitrogen fertilization became popular.

Nitrates are very soluble in water. When water comes in contact with material containing nitrate, some of the nitrate goes into solution and becomes a mineral constituent of the water. The level of nitrate in ground water may be also increased by the leaching of nitrate from the soil as the water percolates through.

Water from shallow wells is more likely to contain high nitrate than water from deeper drilled wells. In particular, shallow wells near barnyards, feedlots, manure piles, and other sources of contamination should be viewed with suspicion. Occasionally, deep drilled wells contain considerable nitrate, occurring naturally, or entering the well by surface leakage from above, through unsealed gravel pack in gravel pack wells, or possibly from nitrogen-rich deposits within lower soil zones. If there is any reason to suspect nitrate in a water supply, the water should be analyzed by a reliable laboratory.

Analyses

An important point to consider when interpreting an analysis from any laboratory is the method of expressing the results. Some laboratories report results as milligrams per liter (mg/1); others as parts per million (ppm); and still others as grains per gallon (gpg). For all practical purposes, values reported as mg/1 and ppm are equal. However, if the results are reported in gpg, the results must be multiplied by 17.1 to convert to mg/l. For instance, 2.64 gpg is equivalent to 45 mg/l.

Another point to consider is whether the nitrate is reported as nitrate (NO_3^-) or some equivalent of nitrate. In addition to reporting as nitrate, nitrate may be reported as nitrate-nitrogen (NO_3^--N), potassium nitrate (KNO_3), sodium nitrate ($NaNO_3$), or some other equivalent. These equivalents can be converted to nitrate (NO_3^-) by multiplying by factors as shown in the following table:

Reported as		Factor		
Nitrate-nitrogen	(NO_3^--N)	X 4.43	=	nitrate (NO_3^-)
Potassium nitrate	(KNO_3)	X 0.61	=	nitrate (NO_3^-)
Sodium nitrate	($NaNO_3$)	X 0.73	=	nitrate (NO_3^-)

Treatment

The treatment of water supplies containing nitrate poses a difficult problem. Boiling the water does not help; it merely serves to concentrate the nitrate. Nitrate, along with the other mineral constituents, can be removed by demineralization, but demineralization is usually not economically desirable for a private water supply. It may be desirable to abandon the supply of high nitrate water and obtain water from another source or a more distant location.

Information

The State Water Survey will perform an analysis of water from any well located in Illinois. Anyone interested should first write for information about how to submit the water sample. (Address: State Water Survey, Box 232, Urbana, Illinois 61801).

For further information on this subject, you are referred to the following publications.

1. "Public Health Service Drinking Water Standards-1962." U. S. Government Printing Office, Washington 25, D. C. (Price 30 cents).

2. "Nitrate Problems in Plants and Water Supplies in Missouri" by George E. Smith. Journal Series No. 2830, University of Missouri, Columbia.

3. "Where Do We Stand on Nitrates?" by G. S. Smith. The Illinois Veterinarian, Vol. 8, pp. 3-7, Spring 1965.

4. "The Nitrate Problem" by J. J. Hanway, J. B. Herrick, T. L. Willrich, P. C. Bennett, and J. T. McCall. Special Report No. 34, Iowa State University, Ames.

Very truly yours,

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