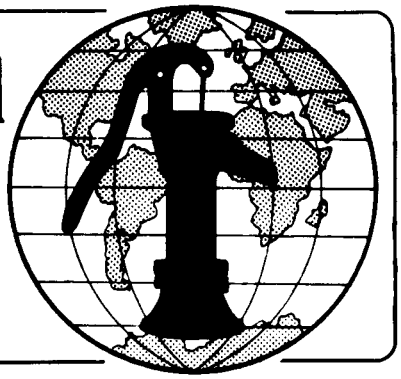
Water for the World



Determining the Need for Water Treatment

Technical Note No. RWS. 3.P.1

A potable water supply is essential for the prevention of waterborne diseases. Water that is contaminated by disease-causing organisms or that is unacceptable aesthetically will need some kind of treatment before being used.

All water from natural sources has some impurities in it. Not all of these impurities are harmful to human health. Some are easily detected by sight, taste or smell. Others can be found only by scientific analysis. To determine if a water supply is potable or will need treatment, the bacteriological, physical and chemical characteristics of the water must be studied.

There are three basic methods of studying water supplies to determine their acceptability. One method is simple observation of a locality, looking for obvious signs of water contamination. Simple observation precedes a second method, the sanitary survey, which is an extensive field evaluation of actual and potential conditions affecting the acceptability of all available water sources. A third method is laboratory or field analysis of a water sample. This analysis measures selected bacteriological and chemical characteristics of the water. Each of these methods of studying water quality collects different kinds of data on a water source. It is best to use all three methods to compile complete information on the quality of a water supply.

A water supply should be treated only when the source cannot be protected from contamination, when there is no other better source available, and when complete operation and maintenance of the treatment system is possible.

Useful Definitions

ALGAE - Tiny green plants usually found floating in surface water.

BACTERIA - One-celled microorganisms which multiply by simple division and can be seen only through a microscope.

COLIFORMS - Bacteria found in the large intestine; a coliform count is often used as an indicator of fecal contamination in water supplies.

CONTAMINATION - Bacteria and physical or chemical concentrations in water that are hazardous to human health.

POTABLE WATER - Water that is both safe and acceptable for drinking.

TURBID WATER - Water that is clouded with suspended particles.

WATER-RELATED DISEASES - Diseases caused by a lack of safe water and poor sanitation.

WATERSHED - The ground area over which rainfall flows into bodies of surface water.

WATER TREATMENT - A process in which impurities such as dirt and harmful materials are removed from water.

Water Quality Problems

The World Health Organization (WHO) has issued standards that define acceptable water quality. The basic requirements for drinking water are that it should:

- be free from disease-causing organisms,

- contain no compounds that harm human health,
- have little turbidity, color, taste or odor, and
- not corrode or encrust piped water supply systems or stain clothing washed in it.

The most important type of contamination to look for and treat is bacteriological contamination which causes many kinds of infectious diseases. Bacteriological contamination is usually caused by fecal organisms from human and animal wastes. Fecal organisms are members of the coliform bacteria group. Not all coliform bacteria cause diseases, but their presence in a water sample indicates that fecal contamination is present. Water that is free of coliform bacteria is free of disease-causing bacteria. A bacteriological water analysis will estimate the coliform level in a water supply. (See "Analyzing a Water Sample," RWS.3.P.3.) A higher standard of quality is expected of sophisticated water systems than of smaller, simpler ones but if coliform bacteria are detected in any kind of water system, a sanitary survey must be conducted to determine their source if it is not known. The source of contamination should be eliminated and the water should be treated to destroy the coliform bacteria already present.

Physical and chemical contaminants are not usually as serious a health hazard as bacteriological contamination. However, physical and chemical impurities often make a water supply so unacceptable aesthetically that people use a non-offensive, but contaminated, supply instead. Physical and chemical impurities can be removed but the treatment processes are usually inappropriate for rural areas because of their cost and complexity.

Improvement of rural water supplies must emphasize elimination of bacteriological contamination. Care must be taken to ensure that water and sanitation facilities and operational procedures do not introduce contaminants to a water supply that is free of disease-causing organisms and is aesthetically acceptable. Water supplies and systems that do not meet these standards should be improved or treated or another source should be developed.

The quality of a water source should be examined when a water supply system is first being developed and periodically after it has been put into use. The quality should be checked when any change occurs that might affect the watershed, such as construction work or use of new farming techniques; when an outbreak of disease occurs in the area of the water supply; when the physical characteristics of the water change; and during all seasonal variations. Records of all examinations should be carefully kept.

Simple Observation of Water Quality

Quality of an existing water source can often be judged by observing the source and local habits of water use. Unprotected water sources such as open wells and ditches, very turbid water, animals or people wading in a supply, people bathing or washing clothes in a supply, and direct waste disposal into a supply are strong signs of bacteriological contamination. Heavily populated areas are more likely to be subject to fecal contamination from these conditions than sparsely populated areas.

Physical characteristics of the water may indicate other contamination. High turbidity may be caused by decomposing organic matter. This may indicate the presence of acids and carbon dioxide which can both damage metal water pipes. Algae growing in a water supply may indicate the presence of sewage and cause bad tastes and odors. Algae may also indicate large amounts of nitrate which can cause blood problems in infants. Rust colored or black water indicates high iron and manganese content. This could leave deposits on pipes and cooking utensils.

If any of these conditions are obvious, a sanitary survey needs to be conducted to determine the source of the contamination. It should be followed by analysis of a water sample, if possible.

Sanitary Survey

A sanitary survey is an extensive field inspection and evaluation of local environmental and health conditions. It is an important method of examining a water supply's quality because it assesses current and potential hazards to the water supply or the existing water system, or both. Sanitary surveys are especially important when outbreaks of water-related diseases occur in the area and when changes such as repair work or construction affecting the water system take place. Conducting a sanitary survey requires technical knowledge and good judgment.

Sanitary surveys are equally important as backup inspection when interpreting the results of a laboratory or field analysis of a water sample. If analysis indicates contamination of the water supply, a sanitary survey should be conducted to identify the source of the contamination. A sanitary survey may also indicate that a supply used regularly without incidence of disease should not be condemned when analysis of a single sample shows contamination.

Sanitary surveys should be undertaken when new surface water sources are being developed. See "Conducting Sanitary Surveys to Determine Acceptable Surface Water Sources," RWS.1.P.2 and "Selecting a Well Site," RWS.2.P.3. In addition, sanitary surveys should be conducted to inspect existing water supply systems. "Simple observation" is the first part of all sanitary surveys. Closer inspection of existing water supply systems involves checking facilities and operational practices for signs of contamination. For example, water from a well should be considered contaminated if the well is uncovered or unprotected. Water drawn from a well should be considered contaminated when the collection vessel is not kept clean, or is in contact with possible ground contaminants. Water stored in uncovered tanks or other containers is subject to contamination from birds, animals and humans. Water stored in tanks with cracked walls or with poorly constructed, broken or loose covers is subject to contamination from leakage, especially during the rainy season. Leaky pipes may draw in sewage or other contamination from the soil. If pipes have been packed or repaired with jute, hemp, cotton or leather, they may provide a wet breeding material for bacteria that will contaminate the water supply.

If a sanitary survey reveals possible bacteriological contamination, the water should be treated until the system can be improved, repaired or replaced. When possible, an analysis of the water should be done to measure the level of contamination and determine the treatment needed.

Sanitary surveys of existing systems can reveal physical and chemical impurities. Water that is turbid may not be safe or aesthetically acceptable. If pipelines, pumps or other system components are corroded, the water supply may be chemically contaminated. Hard, scaly deposits on pipes or pumps indicate water with high mineral content which may be unsuitable for many domestic purposes. Minerals can encrust pipes and pots. If red stains appear on plumbing the water may be high in iron. If the community believes a water source is harmful even though contamination is not evident, the water should be tested for harmful toxic chemicals.

If a sanitary survey reveals possible physical or chemical contamination, a complete laboratory analysis should be done to verify conditions. If analysis reveals that the water system is seriously contaminated either physically or chemically, the problem should be solved immediately or another water source should be developed. Treatment of physical and chemical impurities is complex and often inappropriate for rural communities.

Analysis of Water Sample

An analysis is a laboratory or specific field examination of a sample of water. A sanitary survey identifies probable sources of contamination of a supply. An analysis determines the type and level of contamination present in a sample of the supply. A water analysis can verify a sanitary survey's conclusions and is an important aid in choosing a method of water treatment.

Water analysis is not a replacement for a sanitary survey. Contamination is often intermittent in a water supply and is not always revealed by analysis of a sample. A sample provides information only on conditions of the supply at the time of the sampling and cannot identify potential contamination like a sanitary survey can. For example, a bacteriological analysis of two sources may indicate that both are of the same quality at a given time. A sanitary survey considers potential environmental changes in both supplies which may indicate that one source is safer than another in the long run and is a better choice for a water supply. When an analysis is done it needs to be very carefully interpreted in conjunction with results of the sanitary survey so that a relatively good water source is not abandoned.

A bacteriological analysis examines a water sample for coliform bacteria indicating fecal contamination. Analysis of almost any rural water supply will show some amount of coliform bacteria. It is the level of bacteria that is important in determining the need for water treatment. See "Analyzing a Water Sample," RWS.3.P.3, for details on determining the need for water treatment from bacteriological analysis. Simple field kits for bacteriological analysis of a water sample are available at considerable cost.

A physical and chemical analysis of a water sample would include tests for turbidity, color, taste and odor, followed by tests for elements which may harm a water system, for hardness and for excess minerals. A chemical analysis of a water supply cannot be done with a simple field kit, although some complex field kits are available at a high price. Chemical analysis is best done in a well-equipped laboratory which is rarely available in rural areas. For information on analyzing a water sample for its physical and chemical content, consult an expert.

Water samples should be drawn and analyzed whenever a new source is being developed and periodically after a system has been put into use. See "Taking a Water Sample," RWS.3.P.2, for details on collecting samples for analysis. Water that is already treated should be analyzed routinely to make sure the treatment is effective. Refer to technical notes on the operation and maintenance of specific treatment methods for information on analyzing treated water.

Summary

To determine whether a water supply needs treatment to make it safe for drinking, the supply should be carefully studied. This is done by simple observation of water used in a community, by a sanitary survey of the area and by scientific analysis of a water sample. The WHO standards for drinking water summarized at the beginning of this technical note should be used as quality criteria in observation and sanitary surveys. Standards for levels of bacteriological contamination are explained in "Analyzing a Water Sample," RWS.3.P.3.

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.

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