ALABAMA A&M AND AUBURN UNIVERSITIES

Drinking Water Standards

How Are They Set?

ANR-790-2.1.2

When you fill a glass with water from your tap, you expect to drink water that is safe and pure. However, gases, minerals, bacteria, metals, or chemicals suspended or dissolved in water can influence its quality and affect your health.

Drinking water supplied by public water systems is monitored for many contaminants. As authorized by the 1974 Safe Drinking Water Act and its amendments, the Environmental Protection Agency (EPA) has established limits on the concentration of certain drinking water contaminants allowed in public water supplies. These limits, or standards, are set to protect human health and to ensure that public drinking water is of good quality. In addition, many state environmental or health agencies (ADEM in Alabama) have issued other limits for specific drinking water contaminants.

Contaminants are regulated when (1) they occur in drinking water supplies, (2) they are expected to threaten public health, and (3) they can be detected in drinking water by current laboratory methods. The EPA standards for drinking water fall into two categories: primary standards and secondary standards.

Primary standards are based on health considerations and are enforced by the EPA. They protect you, the U.S. citizen, from three classes of toxic pollutants: pathogens, radioactive elements, and toxic chemicals.

Secondary standards regulate contaminants that cause offensive taste, odor, color, corrosion, foaming, and staining. Secondary standards are not enforced by EPA, although some are enforced at the state level, as is the case with ADEM in Alabama. Secondary standards are useful guidelines for water treatment plant operators and state governments attempting to provide communities with the best quality water possible.

What Are The Health Concerns?

Contaminants in drinking water are always cause for concern. However, it is important to distinguish between acute and chronic effects of harmful substances.

Acute effects are usually seen within a short time after exposure to a toxic substance. An example is a farmer who accidentally spills a pesticide and shortly thereafter suffers from nausea, dizziness, and vomiting.

Nationally, and in Alabama, the most commonly detected drinking water problem is bacterial contamination from human or animal sources. Bacterial contamination is a common cause of acute toxicity, causing symptoms as mild as stomach upsets to diseases as serious as dysentery, typhoid fever, and hepatitis.

Chronic effects result from exposure to a substance over a period of weeks or years. An example is a coal miner who breathes in traces of coal dust for many years and later develops serious respiratory problems. With contaminants such as pesticides and volatile organic chemicals (VOCs) in drinking water, health officials are almost always concerned about chronic effects such as cancer or damage to the central nervous system.

How Standards Are Set

In setting standards for drinking water contaminants, regulatory officials estimate the concentration of contaminant that a person can drink safely over a lifetime. These calculations are based on all available toxicological information and allow a generous safety margin.

The EPA standard for drinking water, the Maximum Contaminant Level (MCL), is the highest amount of a contaminant allowed in drinking water supplied by public water systems. The MCL is set as close as possible to the Maximum Contaminant Level Goal (MCLG), which is a preliminary standard set but not enforced by the EPA. MCLGs are health goals based entirely on health effects; MCLs take into consideration the feasibility and the cost of analysis and treatment of the regulated contaminant. Although often less stringent than the corresponding MCLG, the MCL is set to protect health.

Because the levels of contaminants found in drinking water are seldom high enough to cause acute health effects, health officials are most concerned about chronic health effects such as cancer, birth defects, miscarriages, nervous system disorders, and organ damage. These health effects may occur after prolonged exposure to small amounts of a substance. In addition, when regulatory officials set drinking water standards, they treat substances that cause cancer (carcinogens) differently from contaminants that cause other health effects.

Setting Standards

If A Chemical Does Not Cause Cancer: Officials set standards using a figure calculated from animal studies called the Acceptable Daily Intake (ADI) for chemicals that cause adverse health effects other than cancer. The ADI is the daily dose of a substance that a person can ingest over a lifetime without suffering any adverse health effects, and it includes a conservative safety margin.

If A Chemical Causes Cancer: In setting primary standards for chemicals believed to cause cancer, regulatory officials assume that no concentration is safe. Consequently, the MCLG is set at zero. A zero level is not practical nor even possible to achieve in many cases, so officials estimate toxicity by calculating a figure called a risk estimate.

In theory, any concentration of a carcinogen in drinking water may possibly cause cancer. In practice, however, at very low concentrations, the risk of cancer becomes so small that it is considered negligible. Therefore, regulatory officials must decide what level of risk is acceptable. It may be one excess cancer in 10,000 persons or one excess cancer in 1,000,000 persons exposed over a lifetime (70 years). The concentration of chemical estimated to cause the "acceptable level" of risk is the risk estimate.

The important difference between a risk estimate and the ADI method is that the ADI method assumes that there is a threshold, or "safe" dose, below which there will be no adverse health effects. The risk estimate assumes that at any dose, no matter how small, some adverse health effect is theoretically possible. Drinking water standards or health advisories based on the risk estimate approach are set at a level at which the risk, while present, is judged to be acceptable (that is, extremely low). Alabama, for example, uses risk levels ranging from one additional case of cancer in 100,000 people to one in 1,000,000.

Confidence In The Standards

How much confidence should we place in numerical standards and guidelines for drinking water? Unfortunately, there is no simple answer.

One area of uncertainty stems from the difficulty of applying the results from tests on genetically similar laboratory animals in a controlled environment to a diverse human population living in a complex environment. A second area of uncertainty stems from incomplete toxicity data on some chemicals. A third area of uncertainty exists because objective scientific analysis involves numerous assumptions and judgments.

To compensate for some of these uncertainties, scientists typically make a series of "safe" or conservative decisions when assessing health risks. For example, if there is doubt about whether to use a safety factor of 10 or 100, the larger number is used. Similarly, the acceptable daily intakes are usually calculated to protect a small child, which results in a greater degree of protection for larger adults.

Many of these uncertainties will continue to exist unless people are willing to volunteer as laboratory test animals. This is not likely. Therefore, we must rely on the best possible information available to us.

Do The Standards Guarantee Safety?

All human activities, even those considered perfectly safe, involve some degree of risk. Ultimately most people are probably less interested in guarantees of absolute safety than in reasonable assurances. Drinking water standards provide a reasonable assurance that water from the tap will not cause any health problems now or in the future.

Like other laws designed to protect public health, drinking water standards cannot always guarantee that there is absolutely zero risk from water containing a contaminant. Drinking water standards do, however, guarantee that scientists and public officials have looked at all available information on the health effects of a substance and have made a careful, con-

servative judgment of the level of contamination that will not endanger public health.

References

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This publication, supported in part by a grant from the Alabama Department of Environmental Management and the Tennessee Valley Authority, was prepared by James E. Hairston, *Extension Water Quality Scientist,* assisted by Leigh Stribling, *Technical Writer.*

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UPS, **New June 1995,** Water Quality 2.1.2

ALABAMA COOPERATIVE Extension SYSTEM

ANR-790-2.1.2