ADVANCES IN DRINKING WATER TREATMENT IN THE UNITED STATES

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ABSTRACT

The United States drinking water public health protection goal is to provide water that meets all health-based standards to ninety-five percent of the population served by public drinking water supplies by 2005. In 2002, the level of compliance with some eighty-five health-based standards was ninety-four percent. This significant accomplishment has been achieved through strong regulation and technical support to drinking water supply systems. The engineering and risk management research program that supports drinking water regulation has developed the Drinking Water Contaminant Management Framework to organize research related to control of a contaminant or group of contaminants in drinking water. The recent lowering of the arsenic drinking water standard serves as a case study for application of the Framework. Emerging research areas include the use of DNA based analytical techniques to advance our understanding of microbial contaminants in drinking water and water security. Real-time monitoring techniques will require significant advancement before they can be relied upon to insure drinking water protection.

INTRODUCTION

The United States remains strongly committed to providing safe drinking water for all of its citizens. This policy is codified in the Federal Safe Drinking Water Act. The United States Environmental Protection Agency (EPA) is responsible for insuring compliance with this law. The national goal for drinking water is to provide water that meets all health-based standards to ninety-five percent of the population served by public drinking water supplies by 2005 (U.S. EPA, 1999). Public water supply systems are, by definition for community settings, those that serve fifteen connections or twenty-five people at least sixty days out of the year. At the present time, there are some eighty-five health based microbial, radionuclide and chemical drinking water standards in effect. In 2002, the level of compliance with these health-based
standards was ninety-four percent (U.S. EPA, 2003). This significant accomplishment has been achieved through strong regulation and technical support, over the last twenty-nine years, to the 170,000 drinking water supply systems that serve more than 260 million consumers.

This paper will discuss the research approach to control contaminants in drinking water that includes source water protection, add-on treatment, distribution system effects and residuals management; apply the research approach to the newly promulgated standard for arsenic in drinking water; discuss recent advancements in distribution system biofilm characterization and outline priority research regarding water system security.

**DRINKING WATER CONTAMINANT MANAGEMENT FRAMEWORK**

A key element to the success of the drinking water protection program has been a sustained research effort to provide control methods and engineering technology to help water systems comply with the regulations. The Water Supply and Water Resources Division of EPA’s Office of Research and Development, National Risk Management Research Laboratory based in Cincinnati, Ohio has provided this critical research support.

Recently, the Division has established a conceptual model to identify research gaps for any contaminant or group of contaminants that need to be controlled in drinking water. This approach is termed the Drinking Water Contaminant Management Framework (Schmelling and Gutierrez 2002). The Framework identifies four points that must be considered in the development of a control strategy: (1) source water protection, (2) add-on treatment, (3) distribution system effects, and (4) residuals management. Results from studies and evaluations of the four control points then feed into cost-effectiveness determinations to develop sets of acceptable control options. It is important to note that not every control point will be relevant to each contaminant or group of contaminants.

The Framework analysis process begins with defining studies that may be needed to determine the effectiveness of controls associated with source water protection. Source water protection methods include identification of approaches that may be cost-effective and reliable in controlling a contaminant without the need for add-on treatment. The premise being that “no” treatment is the preferred approach to control any contaminant or group of contaminants in drinking water. This “no” treatment approach is the one that should yield the most public health benefit at the lowest overall cost. Control approaches that require add-on treatment will be less certain in assuring public health protection due to possibilities for human and mechanical failure, and will be more costly in the short and long-term. Source Management can be accomplished in a variety of ways for either surface or ground waters. These measures could include remediation of contaminated