

Arsenic in Drinking Water

Part 1. The development of drinking water regulations

John T. O'Connor, EngD, PE and Thomas L. O'Connor
© 2001 H₂O'C Engineering, LLC

Arsenic is widespread in almost all types of soil, particularly in association with iron and sulfur compounds. Accordingly, much has been made of the natural origins of dissolved arsenic in U.S. ground waters. However, the broad spectrum toxicity of arsenic compounds has made them favorites for many agricultural and industrial uses. Because of this, arsenic deposits are mined and tailings created that may leach arsenic into U.S. surface waters.

Arsenic compounds have long been used for their lethal properties in wood preservatives, weed-killers, sheep dip, fungicides, insecticides, rodenticides and, notoriously, in the Middle Ages, for homicides. As early as 1935, it was known that organic arsenic compounds accumulated in shrimp and shellfish.

Although found in human tissue, arsenic is not generally considered to be an essential element for human physiology. In England (circa 1900), 7,000 clinical cases of subacute poisoning and 70 deaths were attributed to the consumption of arsenic in beer. Autopsies on winegrowers (1957) showed that arsenic poisoning progresses even after no more arsenic can be found in the body. By 1969, it was known that chronic arsenic poisoning could lead to loss of appetite and weight; diarrhea and, alternately, constipation; neuritis; conjunctivitis; hyperkeratosis and melanosis of the skin; and skin cancer. More recent medical findings on adverse human health effects has made arsenic appear even more formidable.

As shown on the attached table (Time Line), in 1942, the U.S. Public Health Service (USPHS) first issued a Drinking Water Standard for arsenic. The maximum tolerance limit was set at 50 parts per billion (ppb) or micrograms per litre ($\mu\text{g}/\text{l}$). The water utilities of the U.S. were not markedly affected by these USPHS standards, since they only applied solely to the limited number providing water for interstate commerce.

By 1962, USPHS had revised its Drinking Water Standards and, again, called for a Maximum Permissible Concentration (MPC) of 50 $\mu\text{g}/\text{l}$ of arsenic. The MPC implied grounds for rejection of the supply. This time, the USPHS also issued a Recommended Maximum Limit (RML) of 10 $\mu\text{g}/\text{l}$ for arsenic. This implied that water sources with more than 10 $\mu\text{g}/\text{l}$ arsenic should not be used when more suitable supplies could be made available. Though of no practical consequence, this establishment of this RML was considered noteworthy because it was appreciably (five times) lower than the MPC. The impact of the 1962 USPHS arsenic standard on water utilities nationwide was essentially nil. It was not until after the formation

of USEPA in 1970, that drinking water standards that were applicable to water suppliers, nationwide, were promulgated,. Even then, little effort was made to monitor water sources or remove arsenic from drinking water.

As indicated in the Time Line, USEPA began a laconic review of the arsenic standard in 1975. While several interim deadlines were missed, the issue became more urgent with a 1999 National Research Council health effects panel recommendation calling for a stricter arsenic standard “as soon as possible.” A USEPA proposal (2000) to set the drinking water maximum contaminant level (MCL) for arsenic at 5 µg/l met with strong opposition from mining, wood-preserving and water industry groups. Seemingly, a compromise was reached with a revised USEPA proposal for a 10 µg/l MCL for arsenic.

The chaotic aftermath of the 2000 presidential election brought unparalleled attention to the otherwise routine confusion involved in the establishment of a drinking water standard. Three days prior to going into effect, the 10 µg/l arsenic standard, approved in the waning days of the Clinton administration, was withdrawn by the newly-appointed USEPA Administrator. A new National Research Council was impaneled to reassess the health effects of arsenic in drinking water. In addition, USEPA reorganized its National Drinking Water Advisory Committee and asked it to urgently review the arsenic MCL compliance cost assumptions and methodologies.

For all the political rhetoric, additional review and public anxiety, little real latitude appears to exist for the establishment of the final MCL for arsenic. USEPA proposes to issue a new arsenic standard, in range of 3 to 20 µg/l, by Feb. 22, 2002.

Part 2 of this series will deal with human exposure and advances in knowledge concerning human health effects of exposure to arsenic.

Time Line - Establishment of Arsenic Standards, Maximum Contaminant Levels

- 1914 - US Treasury Department sets a bacteriological (*B. coli*) standard for drinking water
- no chemical standards were set because agreement could not be reached on health effects,
 - the bacteriological standard applied only to public drinking water supplies carried by common carriers engaged in interstate commerce.
- 1925 - US Public Health Service (USPHS) sets first drinking water standards for chemicals
- tolerance limits were set for lead (100 µg/l), copper (200 µg/l) and zinc (5000 µg/l).
- 1942 - USPHS sets first arsenic standard (tolerance limit) at 50 µg/l
- little arsenic data available.
- 1946 - USPHS revises Drinking Water Standards; retains arsenic, adds chromium and selenium
- 1962 - USPHS retains arsenic tolerance limit at 50 µg/l; sets recommended maximum limit at 10 µg/l
- recommended limit reflects increasing concern over human health effects (cardiovascular system),
 - link to cancer not yet established,
 - standard had no effect on most municipal water utilities; not regulated under USPHS,
 - Noting that the standards were intended to apply *“only to water used on common carriers,”* the American Water Works Association resolved that the *“Standards of the USPHS be accepted as minimum standards for all public water supplies.”*
- 1970 - US Environmental Protection Agency (USEPA) established; William Ruckelshaus, Administrator
- 1974 - USEPA promulgates minimum drinking water standards, including 50 µg/l arsenic MCL
- for the first time, drinking water standards applies to all public water suppliers,
 - AWWA strongly opposes establishment of all mandatory drinking water standards.
- 1975 - USEPA initiates review of 50 µg/l arsenic MCL
- 1989 - USEPA fails to meet deadline to set revised arsenic maximum contaminant level (MCL)
- 1996 - Safe Drinking Water Act requires review of arsenic standard
- Congress sets January 1, 2001 deadline for arsenic MCL,
 - USEPA asks National Research Council to study existing standard for arsenic.
- 1999 - National Research Council determines 50 µg/l too high
- panel of 16 scientists and physician recommends USEPA develop a stricter standard for allowable levels of arsenic in the nation’s drinking water *“as soon as possible”*,
 - panel estimates current standard could lead to 1 in 1,000 chance of bladder cancer among males.
- 2000 - Congress extends deadline to June 22, 2001 (present legal deadline for USEPA)

2000 - USEPA considers 3 to 20 µg/l arsenic and proposes 5 µg/l MCL

- mining, wood preserving and drinking water industry groups voice opposition on economic grounds
- western states strongly object, citing compliance costs for small communities.

2001 (January) - Clinton administration approves 10 µg/l arsenic regulation beginning March, 2001

- same standard used by European Union,
- World Health Organization (International Drinking Water Standards, 1971) provisionally recommended 10 µg/l "because of the lack of suitable testing methods,
- Based on health concerns alone, WHO arsenic standard "would be lower still",
- Congressional opposition voices outrage over hastily drawn, "midnight" regulation,
- mining and wood-preserving industries initiate lawsuit attacking USEPA's "science,"
- Albuquerque, NM; El Paso, TX plus smaller utilities join industries suit,
- Senator Pete Domenici (R-NM) introduces bill to void the arsenic standard.

2001 (March) - New USEPA Administrator withdraws 10 µg/l arsenic standard citing concern over costs

- President Bush calls for decision based on "sound science,"
- Christine Todd Whitman initiates 'independent review' by a new, select NRC panel,
- New NRC panel assessment of the health risk of arsenic in drinking water due in August, 2002,

2001 (April) - USEPA proposes to issue new arsenic standard, in range of 3 to 20 µg/l, by Feb. 22, 2002,

- USEPA reorganizes National Drinking Water Advisory Committee and asks panel to review compliance cost assumptions and methodologies (conduct a cost-benefit analysis),
- Compliance date for the revised arsenic standard will remain January 22, 2006,

- Consumer Confidence Reports (CCR) for 2001, due in July 2002, will require water systems that detect arsenic between 25 µg/l and 50 µg/l to provide additional information about arsenic,

- Senate bill introduced to amend Safe Drinking Water Act to require water systems to notify customers if their water contains arsenic and at what level.

Political and Public Reactions to USEPA Decision to Delay and Withdraw the Arsenic Rule

- March 22, 2001 - Addressing the Western Governor's Association, USEPA Administrator Whitman announced she would withdraw the arsenic rule pending further review and public comment; the arsenic rule's compliance date would remain January 2006,
- March 23 2001 - Federal Register announces USEPA will extend the arsenic rule's effective date to May 22, the first step in withdrawing the rule,
- Senator Joseph Lieberman (D-Conn.) seeks an investigation of USEPA's decision by the Government Affairs Committee,
- Senator Christopher Dodd (D-Conn.) and Representative Bernie Sanders (I-Vt.) introduce bills to reinstate the 10 µg/l standard and make it subject to revision only by Congress,
- Senator Harry Reid (D-Nev.) introduces a bill to authorize \$750 million in grants to assist small systems in removing arsenic and other contaminants,
- April 23, 2001 - Federal Register announces USEPA plans to extend the effective date of the January 22 final arsenic rule to February 22, 2002; invites public comment on extension,
- USEPA receives 14,000 comments, mostly unfavorable,
- AWWA calls extension 'prudent;' asks USEPA to grant full five-year compliance schedule to avoid undue hardship on utilities,
- May 22, 2001 - Federal Register announces USEPA decision to finalize delay to January 22, 2002; seek appraisal of the benefits of the 10 µg/l arsenic standard by the Science Advisory Board's Environmental Economics Advisory Committee,
- June 28,2001 - The Natural Resources Defense Council (NRDC) announces it will file lawsuit against the USEPA and its administrator, Christie Whitman, for ignoring the June 22 congressional deadline for having a new plan to reduce arsenic levels,
- Sen. Barbara Boxer, D-Calif., announces she and several colleagues on the Senate Environment and Public Works Committee would file papers in support of the NRDC's lawsuit; Senators Hillary Rodham Clinton and Charles Schumer of New York, Jon Corzine of New Jersey, Paul Wellstone of Minnesota and Harry Reid of Nevada join in support NRDC's lawsuit.
- July 27, 2001 - Nineteen Republicans join Democrats in 218-189 House vote to restore 10 µg/l arsenic limit by prohibiting USEPA from using funds to lower standard. Administrator Whitman warns that amendment "will not put a standard in place any sooner than planned under EPA's science-based approach."