



Livingston County Department of Public Health  
Environmental Health Division

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## **Arsenic in Drinking Water**

### **Testing and Treatment for Residential and Small Public Wells**

December 16, 2005

## **1.0 Introduction**

The purpose of this document is to provide information about the public health threat associated with arsenic in drinking water in Livingston County and to establish testing and treatment procedures for residential and small public water supplies (Type III and Type II Transient). Current regulations require larger public wells (Type I and Type II Non-Transient) to comply with the new arsenic standard through the Michigan Safe Drinking Water Act (Act 399, 1976, as amended).

The Michigan Department of Environmental Quality (MDEQ) requires the review of all drinking water wells in land divisions and subdivisions under one acre in size meet with the Safe Drinking Water Standards which includes Arsenic. Many new residential wells in these land developments are currently required to sample for Arsenic and provide for a safe supply if the Arsenic standards are exceeded.

New wells installed on property covered under the Livingston County Sanitary Code do not currently require the same review as those wells drilled under the MDEQ rules. The purpose of this document is to bring consistency for the review and approval of all drinking water wells where Arsenic standards are exceeded.

## **2.0 Background**

Earth materials such as bedrock, sand, and gravel may contain arsenic bearing minerals. Arsenic may be dissolved by, and absorbed into, the drinking water we withdraw from the ground. Groundwater is water that collects and flows within the earth. Arsenic has no smell or taste in water, so you cannot sense if arsenic is present. The only way to determine if your well is impacted is to have it tested through a certified drinking water laboratory.

Drinking water standards are regulations that Environmental Protection Agency (EPA) sets to control the level of contaminants in the nation's drinking water. These standards are included in the Safe Drinking Water Act to protect our drinking water. In most cases, EPA delegates responsibility for implementing drinking water standards to states and tribes.

Primary standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health and are known or anticipated to occur in water. They take the form of Maximum Contaminant Levels (MCLs).

The EPA recently reduced the MCL for arsenic in drinking water from 0.050 mg/L (milligrams per liter) to 0.010 mg/L. The Michigan Safe Drinking Water Act was also amended to reflect the MCL reduction for arsenic. Based upon available laboratory data for arsenic in Livingston County it is estimated that 1 out of 3 wells exceed the MCL for arsenic.

The way arsenic affects our bodies is not fully understood. Studies of exposed populations in the United States have not shown clear proof of health problems caused by drinking contaminated water at levels similar to those found in Livingston County.

Based on studies in other countries, long-term exposure to high arsenic levels (generally greater than 0.30 mg/L) in drinking water has caused the following effects:

- Thickening and discoloration of the skin. Sometimes these changes can lead to skin cancers. These cancers can be cured if discovered early.
- Stomach Pain, Nausea, Vomiting, and Diarrhea
- Numbness in the Hands and Feet

The MCL for arsenic is a long-term exposure standard protective against cancer and is based on consuming two liters of water per day for a 70 year period. Incidental consumption of water containing arsenic above 0.010 mg/L and under 0.30 mg/L is not a significant exposure.

### **3.0 Authority**

The Livingston County Department of Public Health Sanitary Code provides the following:

#### 401.02 State Laws and Regulations

Unless otherwise specified the requirements as set forth in Part 127 Act 368 of the Public Acts of 1978, as amended and Act 399 of the Public Acts of 1976, as amended and the rules and regulations adopted pursuant to said acts are hereby adopted as requirements of these regulations.

#### 401.04 Water Quality

The quality of water furnished to any lavatory, drinking fountain, dishwasher, bathtub, shower, or other fixture, device or equipment wherein or from which direct consumption or human body contact is possible, shall be safe for human consumption and potable as approved by the Health Officer.

Acceptability shall be based upon the minimum chemical and bacteriological standards of the Michigan Department of Public Health (Michigan Department of Environmental Quality).

#### 401.05 Treatment of Unsatisfactory Water Supplies

Water supplies which do not comply with the minimal chemical or bacteriological requirements of the Michigan Department of Public Health shall be treated by methods approved by said agency. If it is not possible to secure satisfactory compliance, said water supply shall be abandoned and, when applicable, the well shall be sealed to protect the water-bearing formation against further contamination.

#### 401.12 Permit Required

No person shall install or construct a new water supply system or make an extensive change to an existing water well system unless a valid permit has been issued by the Health Officer authorizing such installation or construction.

#### 401.21 Water Supply Inspection and Approval

The Health Officer may make such inspections or evaluations and collect samples that are necessary to determine that a water supply system complies with the provisions of the Livingston County Sanitary Code. Approval from the health officer shall be received prior to a new water well or extensively repaired water well being placed into service. The owner shall supply the Health Officer with adequate information regarding the construction of the water well system and water quality so as to determine if the system is in compliance with the permit requirements and the provisions of these regulations. Unless otherwise specified on the permit, the submittal of an acceptable well log, safe bacteriological sample analysis and nitrate analysis showing levels below public health concern will be sufficient to provide adequate information to the Health Officer.

The Public Health Code provides the following:

Part 127, Act 368 of 1978, as amended

#### **R 325.1612 Compliance with regulations and local codes**

A person who installs a well, pump, or pumping equipment shall comply with applicable laws, regulations, ordinances, and codes, including all of the following:

(g) Any local code of a municipality which regulates the installation of a well, pump, or pumping equipment and which is not less restrictive than these rules. If a local board of health, in the discharge of its duties to protect the public health, deems it necessary to establish requirements that are more stringent than these rules, it shall do so and file a record of the requirements with the director.

#### **4.0 Permitting Requirements**

The Livingston County Department of Public Health requires that a permit be issued for any residential or small public water supply well (Section 401.12 Sanitary Code). As part of the permit issuance process, several restrictions are placed upon the permit. Generally, all permits require sampling and analysis for Bacteriology and Nitrates. Due to the recent reduction in the arsenic MCL and the prevalence of naturally occurring arsenic in the groundwater of Livingston County, and because of the public health implications, the **LCDPH will be requiring that all new and replacement wells be sampled for Arsenic effective January 1, 2006.**

It shall be the property owner's, or authorized representative's (i.e. builder or well drilling contractor) responsibility to collect water samples from the newly constructed well and submit samples to a certified drinking water laboratory for analysis. Results shall be submitted to LCDPH for review.

Arsenic results that exceed the MCL of 0.010 mg/L shall not be approved. At this point the property owner has two options: (1) Construct a new well to a different aquifer where the arsenic concentration does not exceed the MCL, or (2) Install a treatment device on the water supply to remove arsenic concentrations below the MCL. The treatment device shall, at a minimum, treat the primary drinking water tap in the home (Point-of-Use Treatment).

If the property owner chooses treatment, the following information must be submitted to LCDPH for review: (1) Proposed treatment device specification sheet detailing the type of system and appropriate approvals for the removal of arsenic, and (2) Additional water sample analyzed for arsenic downstream from treatment device. Results shall not exceed the MCL for final approval.

(3) Signed affidavit that the owner acknowledges elevated arsenic in well and treatment necessary for safe drinking water and final approval.

Due to the limited arsenic data available for Livingston County and the variability of our subsurface geology, and aquifer systems, it is generally recommended to install treatment devices on water supplies that exceed the MCL for arsenic, versus constructing a new well to a different aquifer.

## 5.0 Treatment

There are many options available for water systems to remove arsenic from drinking water. Below is summary of arsenic removal technologies that are currently on the market. The list is not considered complete since new technologies are rapidly being developed. Any mention of a company or trade name does not imply MDEQ or LCDPH endorsement.

**Conventional Iron Removal Systems** – Existing iron removal systems that include oxidation, detention and filtration are effective in removing arsenic. When the iron to arsenic ratio in the raw water is 20:1 respectively, these types of systems work well. However, it is important that the arsenic be in the form of arsenate; As (V), which is insoluble and allows the As to be filtered out along with the iron in the filter.

Many groundwater sources have arsenic in the As (III) state. In some cases, simple aeration (air) will not be a strong enough oxidant to convert As (III) to As (V). In these cases, chlorine or permanganate may be used as to convert all arsenic to arsenate.

**Modified Iron Removal Systems** – These systems work similar to conventional iron removal systems, but either use a proprietary media or add Fe to maximize arsenic removal efficiencies. These types of systems would include potassium permanganate- manganese greensand systems, Layne-Ox media by Layne-Northern and Macrolite media by Kinetico.

**Adsorption Medias** – Adsorption is contaminant removal from water by attachment onto the surface of a porous solid. These types of medias will be a popular choice for As removal due to the ease of operation and their ability to remove both As (III) and As (V). However, these systems are much more efficient if the arsenic is in the (V) form. There are two common types of adsorption medias, iron based and alumina based which are described below in detail.

*Iron based adsorption media* – this includes granular ferric hydroxide (GFH), granular ferric oxide (GFO) and other proprietary products. Below is a chart listing current iron based products on the market, but there are others also available.

Product	Manufacturer	Material
GFH	GEH Wasserchemie (USFilter)	Fe(OH) <sub>3</sub> and FeOOH
GFO-Bayoxide E33	Bayer (Severn Trent, AdEdge)	Goethite (α-FeOOH)

Media G2	ADI	Ferric hydroxide coated diatomite
ARM 200	Engelhard	Iron Based (Hematite)

All of these products are ANSI/NSF Standard 61 certified. Care must be taken when comparing these medias since they all act a little different from each other. As an example, the ADI-G2 media can be regenerated with an acid wash while the others cannot. Also, some others require pretreatment (iron removal) if iron concentrations are above certain levels.

*Alumina based adsorptive media* - these medias perform similar to iron based medias by removing arsenic through adsorption. Many products are currently on the market and each one has its own pros and cons on how efficient it will remove arsenic. Alumina medias usually have a shorter media life than iron based medias, but cost is lower per pound. Please note that most of these products are ANSI/NSF standard 61 approved, but not all.

Product	Manufacturer	Material
AA-400G	Alcan Chemicals	Activated Alumina
AA-FS50		Activated Alumina with proprietary additives
ARM-100	Engelhard Inc.	Alumina with proprietary promoters
CPN-AA	Alcoa	Activated Alumina
Aqua-Bind EP	Apyron Technologies	Activated Alumina
Aqua-Bind MP	Apyron Technologies	Metal Oxide composite

**Anion Exchange** - is the physical process where ions on the solid phase (resin) are exchanged for an ion in the feed water. This process works well for arsenic removal if the arsenic is in the arsenate (V) form and the pH is in the 6.5 - 9.0 range. In general, ion exchange for arsenic removal is only applicable for low TDS, low sulfate waters. Chloride is also a competing ion during this process and chloride-form resins are often used in arsenic removal.