MassDEP Information Sheet

Manganese Monitoring for Public Water Systems

Required Sampling and Monitoring for Manganese in Drinking Water

Public Water Systems (PWS) have a long, proven record of providing abundant, clean drinking water to their customers by using innovative and proactive approaches for risk reduction. PWS now have an additional opportunity to contribute to public health protection by determining the levels of manganese in their drinking water. The Massachusetts Department of Environmental Protection (MassDEP) is requiring all water systems to analyze their drinking water for the presence of manganese so that MassDEP can characterize the occurrence, possible sources, and possible health risks associated with manganese in those water systems.

What is manganese and where does it come from?

Manganese is a common naturally-occurring mineral found in rocks, soil, groundwater, and surface water. It is also an essential trace mineral necessary for proper metabolism, immune system function, digestion, bone strength, and as a cofactor in many enzymes.

How are people exposed to manganese?

Manganese is a natural component of most foods, including infant formula. The majority of manganese exposure in the general population comes from the diet. The overall dietary contribution from drinking water is smaller than food, but in situations where manganese levels in drinking water are elevated, the contribution can increase the overall intake of manganese. The U.S. Department of Agriculture's (USDA) recommended dietary allowance is 1.8 - 2.3 milligrams per day (mg/day) for adults. Grains and beans particularly provide manganese in our diets. For example, a cup of cooked enriched white rice contains 0.75 milligrams (mg) of manganese. In a residential setting, inhalation is an unlikely route of concern for exposure, in contrast to certain occupational settings where workers may be exposed to manganese particles in the air (*e.g.*, steel welding). Manganese is poorly absorbed through the skin, thus, skin contact with food or liquid containing manganese is an unlikely exposure route of concern.

What health effects are associated with exposure to manganese?

At higher levels of exposure, manganese can produce neurological effects. While low amounts of manganese in the diet are important for health, several recent limited studies of children exposed to elevated levels of manganese in drinking water suggest associations with behavioral and neurological effects. In addition, infants may have more difficulty processing manganese than older children and adults due to incompletely developed gastrointestinal (GI) tracts and other important metabolic organ systems. Therefore, as a precaution, it is prudent to limit exposure to high levels of manganese in water so that sensitive populations (i.e., infants/young children) are best protected.

What levels of manganese in water are health concerns?

The United States Environmental Protection Agency (USEPA) and MassDEP currently list manganese as a secondary contaminant with aesthetic concerns including unacceptable taste, staining of fixtures and dark, cloudy water at levels greater than 50 micrograms per liter (µg /L).

Drinking water may naturally have manganese and, when concentrations are greater than 50 µg/L, the water may be discolored and taste bad. Over a lifetime, the USEPA recommends that people drink water with manganese levels less than 300 µg/L and over the short term, the USEPA recommends that people limit their consumption of water with levels over 1000 µg /L, primarily due to concerns about possible neurological effects. Children up to 1 year of age should not be given water containing manganese over 300 µg /L. This includes making formula for infants with levels exceeding 300 µg /L for longer than 10 days. Formula fed infants or children could consume more manganese than the rest of the family if the manganese fortified formula is prepared with water that also contains manganese. In addition, young children appear to absorb more but excrete less manganese than older children. See **EPA Drinking Water Health Advisory for Manganese** at:
https://www.epa.gov/sites/production/files/2014-09/documents/support_cc1_magnese_dwreport_0.pdf

When should testing begin?
If you do not currently test for manganese, MassDEP recommends that you voluntarily collect manganese baseline samples now in order to respond to possible inquiries from the public. One sample should be taken at the entrance point to the distribution system for each of your sources. **MassDEP will be adding baseline sampling for manganese to PWS sampling schedules for the 2014 – 2016 sampling period.** The analytical cost of testing for manganese in drinking water is relatively low, generally between $15 and$30 per sample. If your system is currently testing or required by MassDEP to test for manganese, you must continue to sample, report, and take all other actions required by MassDEP. **MassDEP continues to strongly encourage all PWSs to annually test for all secondary contaminants. Please be reminded: PWS are required to report the results of all analytical monitoring to MassDEP.**

What happens when MassDEP receives the results of your manganese monitoring?
Depending on the results of your monitoring, MassDEP will provide you with a written response regarding any further actions you should take. Follow-up actions may include appropriate steps to inform and educate your customers on how they can reduce elevated manganese levels for sensitive populations, additional monitoring or other actions to assist you and your customers to reduce any elevated manganese concentrations. At a minimum you should be aware of the following:

1. Be prepared to inform your local elected and health officials and your customers of confirmed manganese levels over the USEPA and MassDEP Health Advisory of 300 µg /L so that they can take action to provide information to consumers including any sensitive individuals.
2. Be prepared to undertake any additional confirmatory sampling and monitoring that may be required:
    a. Systems with sample results that are over the Health Advisory level of 300 µg /L are required to take confirmation samples within 2 weeks, following standard inorganic monitoring contaminant confirmation procedures. You may also be required by your regional office to collect additional samples within your distribution system within the next 30 days if your system's configuration and historical information indicate that the level reaching consumers may actually be lower than at the entrance point to your system.
    b. Systems with sample results that are above the SMCL of 50 ug/L but less than the Health Advisory level of 300 ug/L are required to undertake quarterly sampling for one year in order to determine if the levels are reliably and consistently below the

Health Advisory level. After the initial year of quarterly sampling, the systems are eligible for a reduction to annual sampling, unless otherwise specified by your regional office (due to site-specific circumstances). Annual samples are scheduled during the quarter that had the highest manganese level.

c. Systems with sample results that are below the SMCL of 50 ug/L are eligible for a reduction in sampling frequency to once every nine (9) years, unless otherwise specified by your regional office (due to site-specific circumstances). Nine (9) years is the longest waiver period under the standard monitoring framework.

3. Be prepared to provide interim and long-term corrective action plans indicating how the system plans to reduce manganese levels to below the Health Advisory level at each entry point. It is generally recommended to routinely monitor both iron and manganese at the same time and gather enough information to assess fluctuations, including pumping rates, blending patterns, periodic/seasonal use, and variations in seasonal water quality. Iron is commonly found with manganese and can interfere with manganese removal. Recording the background concentrations for both iron and manganese may be necessary to consider appropriate corrective actions for water quality management.
4. If your system has sources that are currently being treated for iron and/or manganese removal you should routinely assess treatment efficiency and changes in groundwater quality by collecting a set of raw and finished water samples. If breakthrough is indicated above the Secondary Maximum Contaminant Levels (SMCLs), review and optimize treatment as necessary to maintain levels below SMCLs.
5. If your system is currently providing treatment that is sequestering manganese, your system may have to conduct additional monitoring in the distribution system for manganese and other compounds that may be associated with the presence of manganese (e.g. iron).
6. If your system is a community public water system and detects manganese greater than the SMCL of 50 µg /L as part of required monitoring, you must report these results in your Consumer Confidence Report (CCR). For details on how to report manganese in your CCR, refer to Manganese – CCR Reporting document available at: http://www.mass.gov/eea/agencies/massdep/water/drinking/water-systems-ops.html#7
7. MassDEP is also strongly encouraging you to post your manganese results widely, as we anticipate that many of your customers will be requesting your manganese monitoring results. MassDEP has developed a fact sheet on manganese that you may find helpful when discussing manganese results with your customers and you may also want to provide the fact sheet directly to your consumers. The fact sheet is available at: http://www.mass.gov/eea/agencies/massdep/water/drinking/manganese-in-drinking-water.html

How to collect and report sampling if you are not currently sampling?

1. Sample each source at the entry point(s) to your distribution system. When sampling at a manifold entry point, ensure that samples are representative of each source under normal operating conditions and not only the source that was on-line during sample collection.
2. Use the same sampling containers to collect the samples for manganese analysis that you normally use for other inorganic (*e.g.*., metals) analyses.
3. MassDEP does not certify laboratories for the analysis of manganese in drinking water, so the analysis should be performed by a laboratory that is MassDEP-certified for the analysis of other drinking water metals using the same method it intends to use for the analysis of manganese.

4. Samples must be analyzed using one of the USEPA-recommended methods for Secondary Drinking Water Contaminants listed at https://www.epa.gov/dwanalyticalmethods. The current list includes the following methods for manganese: USEPA Methods 200.5, 200.7, and 200.8 and Standard Methods 3111B, 3113B, and 3120B.
5. Report all results on the MassDEP Secondary Contaminant Report Form (SEC) or electronically through eDEP. A copy of the form is available at http://www.mass.gov/eea/agencies/massdep/water/approvals/laboratory-analytical.html

If the results of sampling exceed 300 µg /L a minimum of one additional sample shall be collected at the same sampling point as soon as possible after the initial sample (not to exceed two weeks). PWS must follow confirmation requirements in 310 CMR 22.06 (10). On a case by case basis distribution system samples may also be necessary. For more information on manganese sample collection, analysis and reporting see http://www.mass.gov/eea/agencies/massdep/water/drinking/lead-and-other-contaminants-in-drinking-water.html#9.

Who can you contact for more information?

There are several available sources of useful information. In an effort to promote a holistic approach to public health protection, MassDEP's Drinking Water Program has provided information to various groups of environmental and medical specialists, including doctors, nurses, and local boards of health. Please contact the following MassDEP staff if you have additional questions on this information:

Region	Name	Phone	Email
WERO	Cathy Wanat	413-755-2216	Catherine.Wanat@state.ma.us
CERO	Paula Caron	508-767-2719	Paula.Caron@state.ma.us
NERO	Bill Zahoruiko	978-694-3232	William.Zahoruiko@state.ma.us
SERO	Allison Rescigno	508-946-2763	Allison.Rescigno@state.ma.us
Boston	Margaret Finn	617-292-5746	Margaret.Finn@state.ma.us

For more information on manganese in drinking water please visit our webpage at http://www.mass.gov/eea/agencies/massdep/water/drinking/manganese-in-drinking-water.html

You may also contact the MassDEP's Drinking Water Program at program.director-dwp@state.ma.us .

For questions related to manganese exposure and health you may contact the Massachusetts Department of Public Health's Bureau of Environmental Health (BEH) at 617-624-5757 or MassDEP's Office of Research and Standards (C.Mark.Smith@state.ma.us). You may also contact your Local Board of Health.