

Manganese Analysis (High School)

October 8th, 2010

Purpose: To determine the manganese concentration in drinking water from 4 different sources, plus a Canadian Guideline Limit Sample for Manganese, this will be done for quality control purposes:

- Urban treated water
- Rural (Aboriginal and/or non-Aboriginal community) treated water
- Untreated raw source water
- Local community treated water
- Canadian Guideline Limit for Manganese sample

Determination will be done by using a test strip method. You will compare the different results, you will also see if the water meets the Canadian Drinking Water Guidelines.

Manganese occurs naturally in the environment, and even if humans can add to these levels most manganese is naturally occurring. Some foods contain manganese including grains, rice, nuts, eggs, soya beans, and green beans. Surface waters typically contain low levels of manganese while groundwater aquifers can contain levels that in some cases are more than ten times higher than the Canadian Drinking Water Quality Guidelines. Groundwater treatment plants are therefore more frequently monitoring for and trying to remove manganese.

Manganese is an essential element that our body requires to function properly. But, if the manganese concentration becomes too high in our body, it can have negative health effects.

Most countries, including Canada, have set an aesthetic rather than a health guideline for manganese. The reason for this is that levels above the guideline can stain porcelain and laundry, drinks such as coffee and tea can become cloudy and taste funny. High manganese levels can also cause diarrhea.

A 0.05 mg/L Canadian Guideline Limit Sample is included for quality control purposes; this is also the limit for manganese according to the Canadian Drinking Water Guidelines.

Operation Water Drop

Visit the Safe Drinking Water Foundation Website www.safewater.org

Materials:

- 1 – 0.05 mg/L Canadian Guideline Limit Sample for Manganese.
- 5 - #1 test strip packets
- 5 - #2 test strip packets
- 5 - #3 test strip packets
- 1 – Colour chart to determine manganese concentration.
- 4 – 10 ml clear plastic vials.

Method:

1. Label the four clear plastic vials with the names of the water samples to be tested.
2. Test the Manganese CGLS sample first.
3. Support the CGLS vial with one hand and with the other hand, dip one **Manganese #1 strip** into the sample and move it back and forth in a gentle motion. Do this for 20 seconds. Remove the strip and throw it away.
4. Dip one **Manganese #2 strip** into the sample and move it back and forth in a gentle motion. Do this for 20 seconds. Remove the strip and throw it away.
5. Dip one **Manganese #3 strip** into the sample and move it back and forth in a gentle motion for 30 seconds. Remove the strip from the sample and shake it once to remove any excess sample.
6. To determine the manganese concentration in mg/L (same as parts per million, ppm), wait **90 seconds** and match the colour of the test strip to the nearest colour on the chart. To best match the strip to the colour chart, fold the strip in half, so that the aperture is against a white background.
7. Record the results for the sample.
8. Fill up the 10 ml clear plastic vials with their respective samples. Repeat steps 3 to 7 with the four other water samples.

Results: Compare results to the Canadian Drinking Water Guidelines. The **CGLS** for manganese should give a result very close to the 0.05 mg/L guideline; a darker colour means that the water does not meet Canadian Drinking Water Guidelines.



Safe Handling of Materials

Caution must be taken at all times when handling any chemicals. Although this test is safe to use in any area, please be cautious with the materials supplied.

Visit the Safe Drinking Water Foundation website www.safewater.org to learn more about issues affecting safe drinking water.

Manganese:

What is manganese and why do we test our water for it?

Manganese is a grayish hard white metal resembling iron. Drinking water guidelines for manganese are set for aesthetic reasons as manganese can stain plumbing and laundry as well as imparting taste and odour to the water. Manganese-containing water can react with coffee, tea and even alcoholic beverages producing a black sludge affecting both taste and appearance. In addition, commonly occurring dissolved manganese (Mn^{2+}) can be oxidized (Mn^{4+}) by bacteria encouraging microbial slime formation in both distribution and household pipes.



Picture: Manganese containing microbial slime

Where does manganese in water come from?

Manganese is leached out of rocks and minerals as well as man-made materials, such as iron and steel pipes. Groundwater supplies having been in contact with rocks for long periods of time generally have much higher levels of manganese than surface water sources. Sometimes discharge of acidic industrial wastes or mine drainage can increase manganese problems in affected surface water sources. Manganese can also be found in many food items, including grains and cereals as well as being quite high in tea.

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What are the current drinking water quality guidelines for manganese?

The Guideline for Canadian Drinking Water Quality states that staining of plumbing and laundry occur above 0.15 mg/L manganese; for most individuals 0.05 mg/L of manganese is objectionable in terms of taste and this level, 0.05 mg/L, has been set as a manganese guideline both in Canada and the U.S. This level is identical to that set as a maximum acceptable concentration (MAC) in Europe, but in Europe a guideline level of 0.02 mg/L has also been adopted. Manganese can, however, at high levels, cause damage to the brain, liver, kidneys, and the developing fetus. Some drinking water supplies in North America contain 10-100 times the current guideline value.

What happens if manganese levels are too high?

Some of the most common water treatment processes for groundwater are designed to remove manganese to below guideline levels. In conventional treatment reduced manganese (Mn^{2+}), which is soluble, is oxidized to Mn^{4+} , which is insoluble, and the Mn^{4+} is then filtered out (Mn^{3+} may also be formed). The oxidation of Mn can take place with oxygen (pure or air), chlorine, ozone, potassium permanganate etc. It is also possible to oxidize the manganese with bacteria in biological filters. If the raw water contains a lot of organic material, ammonium and other interfering compounds, then the oxidation may be incomplete and manganese may still be present in high levels in the treated water. Under these conditions bacteria are encouraged to grow within distribution lines and household plumbing forming microbial slimes.

What do I do if the level of manganese in my water is too high?

We don't recommend that action is taken in individual homes as these are issues that should be dealt with in the water treatment plant.