Arsenic Analysis (High School) Revised May 14th, 2010

Purpose: To determine the arsenic concentration in drinking water from 4 different sources, plus a Proposed Canadian Guideline sample for quality control purposes:

- Urban treated water
- Rural (Aboriginal and/or non-Aboriginal community) treated water
- Untreated raw source water
- Local community treated water
- Possible Future Canadian Guideline for arsenic

Determination will be done by using a test strip method. You will compare the different results, you will also see if the water meets a future stringent guideline that may be implemented by Health Canada (5 micrograms arsenic/L). Arsenic in the form of arsenate is very similar to phosphate, an essential nutrient in the human body, and is incorporated into many compounds causing many different diseases including cancer. This is the reason why Health Canada's guideline ten years ago was, 50 micrograms/L, was decreased to 25 micrograms/L and then to 10 micrograms/L with a possible future decrease to 5 micrograms/L.

Materials

- 2 - Plastic bottles (1 will contain 5 ppb arsenic sample).
- 4 - Caps (2 screw caps and 2 with flip tops).
- 5 - Packets with arsenic reagent 1.
- 5 - Packets with arsenic reagent 2.
- 5 - Packets with arsenic reagent 3.
- 5 -Packets with indicator strips.
- 1 - Colour Chart

Method

1. One bottle contains 5 micrograms/L arsenic. Put 100 mL of water sample in second plastic bottle with lid (not the flip top type). Water should be room temperature (20-25 degrees C).
2. Add reagent #1 to both bottles, cap securely and shake vigorously with bottle upright for 15 seconds.

3. Uncap the reaction bottles, add reagent #2 to both bottles, cap securely and shake vigorously with bottle upright for 15 seconds.
4. Allow the reaction bottles to stand undisturbed for 2 minutes (this will ensure that there is no Hydrogen Sulfide interference).
5. While waiting, prepare reagent strips by inserting into flip top caps. (**Do not touch the small pads on the test strip).** Insert the strip into the turret pad end first, until the red line is even with the top of the turret, and now close (flip down) the turret, which will hold the test strip in place. Make sure that the test strip is positioned in the middle of the cap, so that it is hanging straight down from the cap do this by bending the test strip but be careful NOT to touch the test pad.
6. Uncap the reaction bottles and add reagent #3 to both reaction bottles, cap securely with the yellow cap and shake vigorously with bottle upright for 15 seconds.
7. Uncap; now recap securely using the flip top cap with the strip in it. Ensure that the test strip is hanging straight down from the cap.
8. After 10 minutes, carefully remove indicator strip from cap and compare colour to that of *colour chart.
9. Rinse bottles twice with Deionized Water, and twice with new sample water. Fill the bottles with 100 mL of the next water samples to be tested. Repeat steps 2-8 with the 2 remaining water samples.
10. Put indicator strips back in Ziploc bag and dispose of in garbage.

Results:

***PLEASE NOTE: The scale on the arsenic colour chart to match the test strips to, is measured in milligrams/L (mg/L). Therefore, the proposed CGLS is 5 micrograms/L (ug/L) which is equal to 0.005 miligrams/L (mg/L) on the colour chart. Therefore, the test strips should be close to the 0.005 mg/L colour in order to meet the proposed arsenic CGLS of 5 ug/L.**

The 5 microgram/L sample should compare to the concentration on the color chart, which is a potential future limit for the Canadian Drinking Water Guidelines. If the sample is darker in color than this, then the drinking water will **NOT** meet this potential future Canadian Drinking Water Guideline. Communities with levels higher than 5 micrograms/L need to carefully optimize their treatment plant processes or

look at alternate processes to achieve the new lower guideline level. The current arsenic limits for the European Union and the United States are set at 10 microgram/L with possible changes going to 5 or less microgram/L. SDWF's Simon Kapaj M.D. argued that arsenic levels above 5 are not sufficiently protective of human health (article published by Journal of Environmental Science and Health, October 2006).

Safe Handling of Materials

Caution must be taken at all times when handling any chemicals, please use an exhaust/fume hood when performing this test, or a very well ventilated area. Wear gloves, goggles and some type of apron when handling these materials, please dispose of test strips by putting them in a bag, and discarding in garbage. This test is only recommended for high school students.

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

Arsenic:

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

Arsenic occurs naturally often together with other chemicals in soils and minerals. Arsenic and all of its compounds are poisonous, but the toxicity varies. Inorganic arsenic is thought to be most toxic; it can occur as trivalent arsenite (As3+) or pentavalent arsenate (As5+). These are the types of arsenic present in drinking water. Organic arsenic is mainly found in seafood and is much less harmful to human health. The guideline for arsenic has decreased from 50 micrograms per L to 25 and this year it has decreased further to 10 micrograms/L. As we know more about the ill effects of arsenic it is expected that it will decrease further. The Safe Drinking Water Foundation recommends that efforts should be made to keep treated water levels below 5 micrograms/L.

Arsenical keratosis on the palm, Santiago del Estero

Where does arsenic in water come from?

In Canada arsenic concentrations in underground water sources (well water, aquifer water) are higher than surface water supplies, which is common to most locations around the world suffering from arsenic problems. If you live in an area that is known to have high arsenic levels then you should have the water tested.

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

For people on municipal water supplies the arsenic levels should normally be tested regularly and efforts are generally made to improve and optimize water treatment methods so that arsenic levels remain below Guideline levels. However, as the acceptable level of arsenic is decreasing, it is becoming increasingly difficult to remove arsenic to trace levels without the use of some form of advanced treatment systems. The introduction of Reverse Osmosis membranes can remove high levels of arsenic (>75 micrograms/L) to levels below 2 micrograms/L. If the arsenic is in the form of arsenite (As3+) it will not be effectively removed even by RO membranes. It is therefore necessary in high arsenic water sources to make sure that the arsenite is converted to arsenate before the water is treated by RO.

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