Alkalinity Test

What is alkalinity?

- It is a measure of the ability of your water to resist changes in pH.
- The guideline for alkalinity is a **minimum**, not a **maximum** like most other tests.
- If the alkalinity is too low, the ability of your water to resist pH changes decreases. Therefore, water with low alkalinity can be corrosive and result in copper and lead leaching out of household plumbing, and it can irritate the eyes. Water with high alkalinity tastes like baking soda, can dry out skin, and it can cause scaling on fixtures and throughout the water distribution system - scaling decreases the efficiency of plumbing systems, increasing power consumption and costs.

You Will Need:

- The alkalinity analysis bag with its materials (1 - 50 mL tube containing 50 mL of alkalinity low limit sample, 5 - 15 mL tubes with approximately 12.5 mL of sulphuric acid in each, 1 - 1.5 mL tube of methyl purple indicator, 1 small plastic pipette)
- 5 plastic cups
- A 50 mL graduated cylinder (or some way of measuring 50 mL of water)
- Paper towels or scrap paper
- Rubber gloves

Steps to Test for Alkalinity (Note: You can find the link and the QR code for the Alkalinity PowerPoint and Video on the next page.):

1. Cover the area that you are working on with paper and use gloves as the methyl purple indicator might stain (however, it is not dangerous and it washes off with soap and water).

2. Put 50 mL of the water to be tested in a cup.

3. Add 7 drops of Methyl Purple Indicator to the cup by using the small plastic pipette. Swirl the water gently until it is a uniform green colour.

4. Get a tube of sulphuric acid, find the exact amount in the tube and write it down. While swirling the water in the cup, add the sulphuric acid **EXTREMELY SLOWLY!!!** until the water turns purple and stays purple (if you are right on the brink, it might turn purple and then turn green again). (The alkalinity lower limit sample should take 2.5 mL to turn purple, if the water sample you are testing takes more than 2.5 mL to turn purple it passes the test, if it takes less than 2.5 mL to turn purple it fails the test.)

5. Write the amount of sulphuric acid that is left in the tube after the water has turned purple. Subtract the amount left from the amount in the tube at the beginning to get the amount it took

to change colour. You can multiply the number of millilitres it took to change colour by 20 to get the parts per million (ppm).

PowerPoint - https://www.safewater.org/s/EnglishHSAlkalinityPowerPoint.pptx

Video - https://www.youtube.com/watch?v=srgyf2HTioE

Ammonia Test

What is ammonia?

- It is a reduced form of nitrogen combined with the non-ionized form of nitrogen.
- Ammonia ions need to be removed before breakpoint chlorination can be achieved.
- Breakpoint chlorination must be reached to comply with Canada's primary disinfection requirements.
- Ammonia comes from the breakdown of plants and animals, agricultural processes (especially fertilizer), and industrial processes.

You Will Need:

- The ammonia analysis bag with its materials (1 tube with 4 mL of 0.5 mg/L Ammonia European Union Limit - AEUL, 5 test strips in a tube, and 1 colour chart for determining ammonia concentration)
- 4 disposable beakers

Steps to Test for Ammonia (Note: You can find the link and the QR code for the Ammonia PowerPoint and Video on the next page.):

1. Fill the disposable beaker with the water sample you want to test.

2. Dip an ammonia test strip into the water sample for five seconds, remove with pad face up and hold level for 60 seconds. **Do not shake off excess water!**

3. Compare the colour pads on the test strips to the colours on the colour chart after the 60 seconds have elapsed to determine the ammonia concentration. If the ammonia results are greater than 0.5 mg/L then the water sample DOES NOT meet the guidelines.

4. Record the results.

PowerPoint - https://www.safewater.org/s/EnglishHSAmmonium-7mwf.pptx

Video - https://www.youtube.com/watch?v=CGbk9wUkGtU

Arsenic Test

What is arsenic?

- Arsenic occurs naturally, often together with other chemicals in soils and minerals.
- Arsenic and all of its compounds are poisonous, but the toxicity varies.
- Usually, groundwater has a higher concentration of arsenic than does surface water.

You Will Need:

- The arsenic analysis bag with its materials (2 plastic bottles - one containing 5 ppb arsenic sample, 4 caps - 2 screw cap and 2 flip top, 5 packets with arsenic reagent 1, 5 packets with arsenic reagent 2, 5 packets with arsenic reagent 3, 5 packets with indicator strips, and 1 colour chart)

Steps to Test for Arsenic (Note: You can find the link and the QR code for the Arsenic PowerPoint and Video on the next page.):

1. Put 100 mL of water sample into the plastic bottle with screw cap lid (water should be room temperature - 20 to 25 degrees Celsius).

2. Add one reagent #1 packet to the bottle, cap securely and shake vigorously with bottle upright for 15 seconds.

3. Uncap the reaction bottle, add one reagent #2 packet to the bottle, cap securely and shake vigorously with bottle upright for 15 seconds.

4. Allow the reaction bottles to stand undisturbed for 2 minutes. While waiting, prepare the reagent strip by inserting it into a flip top cap (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, then 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).

5. Uncap the reaction bottle and add one reagent #3 packet to the reaction bottle, cap securely with the screw cap and shake vigorously with the bottle upright for 15 seconds.

6. Uncap and then recap securely with the flip top cap with the strip in it. Ensure that the test strip is hanging straight down from the cap.

7. After 10 minutes, carefully remove the indicator strip from the cap and compare its colour to that of the colour chart. If the colour is lighter than 10 micrograms per litre, the water is within the guidelines. Record your results.

8. Before testing a different water sample, rinse the bottle twice with deionized water and twice with the new sample of water.

PowerPoint - https://www.safewater.org/s/EnglishHSArsenic-lzk7.pptx

Video - https://www.youtube.com/watch?v=KeY16-WmFOg

Colour Test

What does it mean if your water has colour?

- When water has a visible tint to it, it is usually due to the presence of decaying organic material or inorganic contaminants such as iron, copper, or manganese.
- The colour of the water indicates what is in the water:

Colour	Likely Cause	Problems
red or brown	iron or manganese	stains sinks and discolours laundry
yellow	suspended organic particles	when chlorinated, organic material can combine with the chlorine to form compounds called trihalomethanes (THMs)
blue or green	copper	staining of fixtures and laundry, high concentration of copper can cause vomiting, diarrhea, and general gastrointestinal symptoms
cloudy, white, or foamy	turbidity (finely divided particles in water, either organic or inorganic)	abrasions to pipes and staining of fixtures, turbidity can "shield" viruses, bacteria, etc. from chlorine so there is a risk of getting sick

You Will Need:

- The colour analysis bag with its contents (1 50 mL tube containing Canadian Guideline Limit Sample for Colour and 6 large plastic test tubes)
- A piece of white paper

Steps to Test for Colour (Note: You can find the link and the QR code for the Colour PowerPoint and Video on the next page.):

1. Pour 50 mL of the water sample into a test tube, pour the 50 mL of the Canadian Guideline Limit Sample into another test tube, and pour 50 mL of deionized water into a third test tube. (Be sure to remember which is which! You can label them.)

2. Hold the water sample tube between the tube of the Canadian Guideline Limit Sample and the tube of deionized water over a white piece of paper.

3. View the tubes from above and determine whether the water sample is lighter or darker than the Canadian Guideline Limit Sample - if it is lighter, it passes the test. If it is darker, it is not within the Canadian Guidelines for colour.

PowerPoint - https://www.safewater.org/s/EnglishHSColourPowerPoint.pptx

Video - https://www.youtube.com/watch?v=geBWIRWDn3M

Copper Test

What is copper?

- It is a metal that is naturally present in the environment, but the levels of contamination can be increased around agricultural land (due to manure spreading), near smelting facilities, and phosphate fertilizer plants.
- Significant amounts of copper are released from wastewater treatment plants.
- The main source of copper is household plumbing, especially when the water is corrosive. The corrosiveness of water towards copper is usually highest when the water is acidic, the alkalinity is low, and the hardness is low.
- Copper is an essential nutrient, it is required by the body in very small amounts.
- Health effects can happen when people are exposed to too much copper. The most common health effects of the excessive consumption of copper would be nausea, vomiting, diarrhea, upset stomach, and dizziness.
- If extreme intake of copper happens, kidney and liver damage is possible.

You Will Need:

- The copper analysis bag with its materials (1 - 1 mg/L Canadian Guideline Limit Sample and 5 test strip packets - with colour charts printed on them).
- 5 disposable beakers

Steps to Test for Copper (Note: You can find the link and the QR code for the Copper PowerPoint and Video on the next page.):

1. Fill a disposable beaker with the water sample.

2. Dip one test strip into the sample beaker for 30 seconds with constant back and forth motion.

3. Remove and match colour after two minutes to determine the copper concentration in mg/L (or parts per million - ppm).

4. Record your results. If the colour is darker than that of 1 mg/L, the water Does Not meet Canadian Drinking Water Guidelines for copper.

PowerPoint - https://www.safewater.org/s/EnglishHSCopperPowerPoint.pptx

Video - https://www.youtube.com/watch?v=RsNztCO3yTA&feature=emb_imp_woyt

Iron Test

What is iron?

- It is the fourth most abundant element in the Earth's crust.
- It is a very common problem in drinking water, and it has a strong relationship with water hardness - typically with both hardness and iron increasing at the same time.
- It can cause staining of laundry and plumbing, unpleasant taste, colour, and promotion of growth by iron bacteria.
- Iron is an essential element for humans, with food providing the majority of the iron requirements.
- Water with excessive iron is not pleasant to drink (due to its smell and taste), cooking with the water can lead to a very unpleasant experience, as will using it to do laundry or to bathe.

You Will Need:

- The iron analysis bag with its materials (1 - 0.3 mg/L Canadian Guideline Limit Sample for iron and 5 aluminum pouches containing chemical reagents that react with iron)
- 5 disposable beakers
- Scissors

Steps to Test for Iron (Note: You can find the link and the QR code for the Iron PowerPoint and Video on the next page.):

1. Label the five beakers with their respective names: Canadian Guideline Limit Sample for Iron and your water samples.

2. Fill the beakers with their respective water samples.

3. With scissors, cut the top of each aluminum pouch, then squeeze the pouch to open it, and add the contents of one pouch into each beaker.

4. Wait for 3 minutes, then compare the colour (look at the beakers from the top) with the CGLS (giving CGLS a rating of 10) (the Canadian Guideline Limit Sample for iron is 0.3 mg/L), estimate what the other beakers contain, the lighter the colour, the lower your rating. Record your results. If the colour is darker than that of the CGLS, the water Does Not meet Canadian Drinking Water Guidelines for iron.

PowerPoint - https://www.safewater.org/s/EnglishHSIronPowerPoint.pptx

Video - https://www.youtube.com/watch?v=dzkGEiHxLAk&feature=emb_imp_woyt

Manganese Test

What is manganese?

- It is a grayish, hard, white metal that resembles iron.
- It can stain plumbing and laundry.
- It can give the water a taste and odour.
- Manganese-containing water can react with coffee, tea, and other beverages, producing a black sludge that affects both taste and appearance.
- Commonly occurring dissolved manganese can be oxidized by bacteria, encouraging microbial slime formation in both distribution and household pipes.
- Manganese in water is leached out of rocks and minerals as well as man-made materials, such as iron and steel pipes.
- Groundwater usually has 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.
- If the manganese concentration in the water is much too high (not only over the aesthetic objective, but also over the maximum acceptable concentration for total manganese in drinking water), health affects such as problems with memory, attention, and motor skills can occur, and infants can develop learning and behavioural problems.

You Will Need:

- The manganese analysis bag and its materials (1 - 0.02 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, and 4 - 10 mL clear plastic vials)

Steps to Test for Manganese (Note: You can find the link and the QR code for the Manganese PowerPoint and Video on the next page.):

1. Test the manganese CGLS in its vial, test each of the other water samples in a clear plastic vial.

2. Support the 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 for 20 seconds. Dispose of the strip.

3. Dip one manganese #2 strip into the sample and move it back and forth in a gentle motion for 20 seconds. Dispose of the strip.

4. 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.

5. To determine the manganese concentration in mg/L (parts per million - ppm), wait 90 seconds and then 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 the aperture is against a white background. Record the results. If the result is greater than 0.02 mg/L the water does not meet the aesthetic objective for manganese in the Canadian Drinking Water Guidelines, if the result is greater than 0.12 mg/L the water does not conform to the Canadian maximum acceptable concentration for total manganese in drinking water.

PowerPoint - https://www.safewater.org/s/EnglishHSManganesePowerPointAug2019.pptx

Video - https://www.youtube.com/watch?v=kYjixsBURhU&feature=emb_imp_woyt

Nitrate Test

What is nitrate?

- It is a compound of nitrogen and oxygen that is found in many everyday food items (for example, spinach and carrots).
- Usually, low levels of nitrates occur naturally in water.
- It comes from fertilizer and manure run-off, animal feedlots, wastewater and sludge, septic systems, and nitrogen fixation from the atmosphere by legumes, bacteria, and lightning.
- In water, it is colourless, tasteless, and odourless.
- It can cause methemoglobinemia (blue-baby syndrome) (occurs most often in infants under 6 months of age).
- It becomes toxic when it is reduced to nitrite, this process can happen in the saliva and in the stomach.
- Healthy adults can consume large amounts of nitrate without suffering adverse health effects, but prolonged ingestion of high levels of nitrate has been linked to stomach problems and might increase the risk of bladder cancer.

You Will Need:

- The nitrate analysis bag with its contents (1 50 mg/L Canadian Guideline Limit Sample for nitrate and 5 nitrate test strips)
- 4 disposable beakers

Steps to Test for Nitrate (Note: You can find the link and the QR code for the Nitrate PowerPoint and Video on the next page.):

1. Fill the plastic beaker with the water sample (use the vial it comes in to test the Canadian Guideline Limit Sample).

2. Dip one test strip in the water sample for 2 seconds with no motion.

3. Remove the test strip and allow colours to develop for 1 minute, by lying the strip across the top of the beaker or the vial.

4. Match the colour reading (pink number) and record. Note: The end pad of the test strip measures nitrate, while the other pad on the test strip measures nitrite (we are more concerned with the nitrate reading).

5. Record your results. The Canadian Guideline and those for the United States and the World Health Organization range between 45 mg/L and 50 mg/L nitrate. A darker colour means that the water does not meet the Canadian Drinking Water Guidelines for nitrate.

PowerPoint - https://www.safewater.org/s/EnglishHSNitratePowerPoint.pptx

Video - https://www.youtube.com/watch?v=1glPiFFQOtY&feature=emb_imp_woyt

pH Test

What is pH?

- It is an index of the concentration of hydrogen ions that are in a substance.
- The pH scale runs from 0-14, with 7.0 being neutral.
- Substances with a pH higher than 7.0 are considered alkaline or basic, those with a pH lower than 7.0 are considered acidic.
- The ideal pH range for water is between 7.2 and 7.6 - which would mean that the water would be slightly basic.
- Alkalinity prevents pH from changing a lot.
- When water has a pH that is too low, it will lead to corrosion and pitting of pipes in plumbing and distribution systems. This can lead to health problems if metal particles are leached into the water supply from the corroded pipes.
- When water has a pH that is too high, it will have a taste similar to baking soda and it will feel slippery. It will also begin to leave scale deposits on plumbing and fixtures - which will decrease the efficiency of the plumbing systems.

You Will Need:

- The pH analysis bag with its materials (1 10 mL vial containing 5 pH strips, 1 5 mL vial containing pH 7 buffer, and 1 pH scale card)
- 4 disposable beakers
- Orange juice or cola if you want to test something that is acidic and bleach if you want to test something that is basic.

Steps to Test for pH (Note: You can find the link and the QR code for the pH PowerPoint and Video on the next page.):

1. Fill the plastic beaker with what you wish to sample (the pH 7 buffer can be tested in its tube).

2. Place the pH strip into the beaker or tube and leave for 2 minutes.

3. Remove the pH strip and lay it across the beaker or tube, coloured side up. Wait 30 seconds.

4. Determine the pH of the strip by comparing it to the pH scale card. Record your results. If the pH of the sample is between 7.0 and 10.5 it meets the Canadian Drinking Water Guideline.

PowerPoint - https://www.safewater.org/s/EnglishHSpH-cgp8.pptx\

Video - https://www.youtube.com/watch?v=_4pdQoj8V10&feature=emb_imp_woyt

Sulphate Test

What is sulphate?

- It is sulphur combined with oxygen.
- Sulphate products are used in the manufacture of many chemicals, dyes, soaps, glass, paper, fungicides, insecticides, and several other things. They are also used in the mining, pulp, sewage treatment, and leather processing industries.
- Drinking water with excess sulphate concentrations often has a bitter taste and a strong "rotten-egg" odour.
- It can interfere with disinfection efficiency by scavenging residual chlorine in distribution systems.
- High sulphate levels have been shown to have a laxative effect on humans and can cause mild gastrointestinal irritation.

You Will Need:

- The sulphate analysis bag with its contents (1 2 mL Canadian Guideline Limit Sample for sulphate - 500 mg/L, 6 - 5 mL vials containing 2 mL of sulphate reagent 1, 6 - 5 mL vials containing 3 mL of sulphate reagent 2, and 5 - 2 mL plastic pipettes)
- 6 plastic cups
- A graduated cylinder or another way to measure 25 mL of water

Steps to Test for Sulphate (Note: You can find the link and the QR code for the Sulphate PowerPoint and Video on the next page.):

1. Label the 6 plastic cups with their appropriate number and name:
   - #1 - Control (Deionized Water)
   - #2 - Canadian Guideline Limit Sample (CGLS)
   - #3 - Urban treated water
   - #4 - Rural treated water
   - #5 - Untreated raw source water
   - #6 - Local community treated water
     (or replace any of the samples from #3-#6 with water samples of your choice)

2. Label the 5 pipettes as follows:
   - #1 - Control (Deionized Water)
   - #2 - Urban treated water
   - #3 - Rural treated water
   - #4 - Untreated raw source water
   - #5 - Local community treated water

3. Use a graduated cylinder (or another way) to measure 25 mL of deionized water and put that amount of deionized water in each of the 6 cups.

4. To cups #1 and #3-#6, add 2 mL of the water of the type you named the cup by using the pipette that has the same name. To the #2 cup, add the 2 mL tube of sulphate CGLS.

5. To each of the 6 cups, add the contents of one of the sulphate reagent 1 tubes.

6. To each of the 6 cups, while swirling, add the contents of one of the sulphate reagent 2 tubes. Continue swirling for one minute and then set the cup aside.

7. Determine the cloudiness of the cups relative to the CGLS and record the results (is the water less or more cloudy than the solution in the CGLS cup?). The CGLS should be cloudy. If the water sample is less cloudy than the CGLS cup, then it passes the Canadian Drinking Water Guideline for sulphate, which is 500 mg/L.

PowerPoint - https://www.safewater.org/s/EnglishHSSulphate-9lmg.pptx

Video - https://www.youtube.com/watch?v=QMIXC_pX1f0&feature=emb_imp_woyt

Total Chlorine Test

What is total chlorine?

- Chlorine is a chemical that is used to disinfect water prior to it being discharged into the distribution system. It is used to ensure water quality is maintained from the water source to the point of consumption. When chlorine is fed into the water, it reacts with any iron, manganese, or hydrogen sulphide that might be present. If any chlorine remains (residual chlorine), it will then react with organic materials, including bacteria. To make sure that water is sufficiently treated throughout the distribution system, an excess of chlorine is usually added. This amount is adjusted to make sure there is enough chlorine available to completely react with all organics present. The chlorine will decrease in concentration with distance from the source, until it reaches the point where the chlorine level can become ineffective as a disinfectant. Bacterial growth will occur in distribution systems when very low levels of chlorine are encountered.
- It can kill many pathogenic (disease-causing) micro-organisms such as *E. coli*, but others (such as *Cryptosporidium* and *Giardia*) are very resistant to chlorine and require other measures to properly remove them.
- Residual chlorine might have a taste and/or odour that some people find disagreeable, but most people would prefer that to drinking water that contains potentially harmful inorganic and organic materials.
- Some studies have shown that chlorine in water can react with otherwise innocent organic material in drinking water and form chemicals called trihalomethanes (THMs), such as chloroform. THMs have been shown to be potentially carcinogenic (cancer-causing) and are, therefore, carefully monitored in water systems that are routinely chlorinated. While recommendations only state minimum residual chlorine levels, it is important that a careful balance is maintained in drinking water. There needs to be enough chlorine to make sure everything is properly disinfected, but there should not be an extreme excess of chlorine.

You Will Need:

- The total chlorine analysis bag and its contents (5 test strip packets with colour chart printed on the packet)
- 5 plastic cups

Steps to Test for Total Chlorine (Note: You can find the link and the QR code for the Total Chlorine PowerPoint and Video on the next page.):

1. Put about 50 mL of sample in a cup (volume is really not critical).

2. Dip one test strip in the cup for 5 seconds with constant back and forth motion, so that water passes through the small aperture in the test strip.

3. Remove and shake the test strip once, briskly, to remove any excess water on the strip. Allow the test strip to dry for 30 seconds by lying it across the cup.

4. Match the test strip with the colour chart to determine the total chlorine concentration in mg/L or parts per million (ppm). Complete the colour matching within 15 seconds. Record your results. Compare your results to the United States Environmental Protection Agency's maximum residual disinfectant level goal for chlorine of 4 ppm. If the test strip shows a result that is greater than 4 ppm, the water sample Does Not meet the United States Environmental Protection Agency's maximum residual disinfectant level goal for chlorine.

PowerPoint - https://www.safewater.org/s/EnglishHSTotalChlorinePowerPoint.pptx

Video - https://www.youtube.com/watch?v=oDF4TSwMpDk&feature=emb_imp_woyt

Total Hardness Test

What is total hardness?

- It is mainly caused by the dissolved mineral compounds calcium and magnesium, although smaller contributions to hardness come from some other ions including iron and manganese. It is calculated from the equation Hardness = 2.497(Ca) + 4.118(Mg). Therefore, magnesium fluctuations affect hardness to a greater extent than do calcium fluctuations.
- Hard water causes scale to form in water pipes, plumbing fixtures, and kitchen appliances. Scale build-up in hot water tanks and boilers increases heating costs and can lead to premature failing of heating equipment. Scale deposited in clothing during washing will cause increased wear and tear on fabrics. Soap reacts with hard water to form a curd and can also cause skin flaking and irritation. When washing or doing laundry with hard water, more soap or detergent is needed.
- Calcium and magnesium benefit people (drinking water provides about 5% of people's required amounts of these minerals).
- The Saskatchewan Government has set an upper acceptable limit for hardness of 800 mg/L. Such high levels will impart a taste to the water and will cause problems with clothes washing, minerals being deposited on dishes, tubs and showers, and water heaters becoming less efficient.
- If the hardness is too low, the water can be quite corrosive and leach copper and lead out of plumbing pipes.

You Will Need:

- Total hardness analysis bag with its materials (800 mg/L total hardness SGLS and 5 total hardness test strip packets).
- 5 disposable beakers

Steps to Test for Total Hardness (Note: You can find the link and the QR code for the Total Hardness PowerPoint and Video on the next page.):

1. Fill the disposable beaker with the water sample.

2. Dip one test strip in the water sample for 3 seconds.

3. Remove and immediately match to the closest colour on the colour chart that is located on the test strip packets. Colour is only stable for 1 minute. Record your results. If the test strip shows a result of more than 800 mg/L total hardness, the water sample is not within the Saskatchewan Government's upper acceptable limit for hardness. Generally, hardness levels between 80 mg/L and 100 mg/L are considered acceptable, levels greater than 200 mg/L are considered poor but can be tolerated, levels over 500 mg/L are normally considered unacceptable.

PowerPoint - https://www.safewater.org/s/EnglishHSTotalHardnessPowerPoint.pptx

Video - https://www.youtube.com/watch?v=qqYK11O9YkM&feature=emb_imp_woyt