Ammonium:

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

Ammonium is a reduced form of nitrogen (NH_4) and together with the non-ionized form (NH_3) they compose ammonia. Ammonia is frequently present in groundwater sources where there is no oxygen present. **Ammonia ions play a key part in water treatment because they need to be removed before breakpoint chlorination can be achieved. Breakpoint needs to be reached to comply with Canada's primary disinfection requirements.**

Where does ammonia in water come from?

Ammonia comes from the breakdown of plants and animals, agricultural (application of large quantities of ammonia fertilizer), and industrial processes. The use of ammonia-containing groundwater and chloramination can also contribute to the ammonia levels. Groundwater that is anaerobic (no oxygen) can contain large quantities of ammonia (>2 mg/L) while surface water sources generally contain levels ten times lower. During specific events in a lake, such as the death of an algal bloom, or spring and fall turnover (when bottom waters get mixed in with the surface water layer), the ammonia levels can increase although it is typically decreased quite rapidly. Also, intensive livestock operations can contribute large quantities of ammonia to surface water sources. High levels of ammonia in surface waters can therefore be an indicator of pollution by various sources.

What are the current drinking water quality guidelines for ammonium?

There is no guideline for ammonia in the U.S. or Canada, but the European Union recommends that ammonia levels should be lower than 5 mg/L. However, as discussed here, such high levels would basically exclude the use of chlorine as a primary disinfectant. Unfortunately, many communities don't realize this and are not adequately disinfecting their water.

What happens if ammonia levels are too high?

There are no health based guidelines for ammonia in drinking water, but its removal is recommended as ammonia can compromise disinfection, it can cause taste, odour and the formation of nitrite as well as interfering with the removal of manganese. Strong oxidizing reagents, such as ozone, chlorine dioxide, chloramines and potassium permanganate cannot remove ammonia ions while chlorine will remove the ammonia by forming less toxic compounds, the chloramines. However, for every mg of ammonia removed, the chlorine demand is 10-15 mg.

pH:

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

pH is an index of the amount of hydrogen ions (H^+) are in a substance. The pH scale runs from 0-14, with 7.0 being neutral. Substances with a pH higher than 7.0 (7.1-14.0) are considered alkaline or basic. Substances with a pH less than 7.0 (0 - 6.9) are considered acidic. We consume many different foods and beverages with a large range of pH. For example, citrus fruits like oranges, lemons and limes are quite acidic (pH = 2.0 - 4.0). On the other hand, egg whites are a little basic, with a pH of 8.0. The ideal pH range for water is between 7.2 and 7.6. This means that the water is slightly basic. By maintaining the proper alkalinity of water, the pH will stay around the ideal levels. However, if the alkalinity gets too low, the pH can start to deviate and can begin to cause water quality problems.

What happens if the pH of my water is too low or too high?

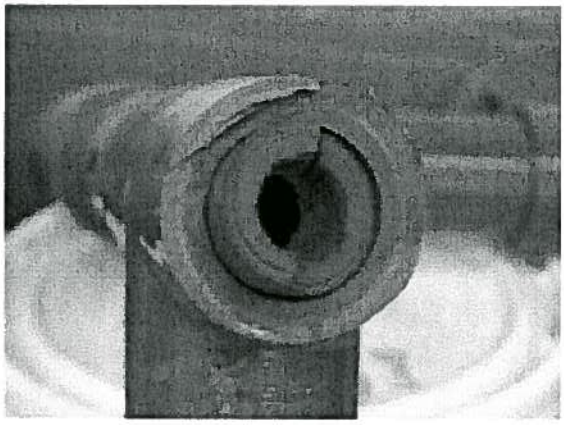
There are no health risks associated with consuming water that is slightly acidic or basic. After all, we can eat lemons, drink soft drinks, and eat eggs. However, when water has a pH that is too low, it will lead to corrosion and pitting of pipes in plumbing and distribution systems. This can lead to health problems if metal particles are leached into the water supply from the corroded pipes. The water also has a slightly bitter and metallic taste that some may find objectionable. If the pH of your water is too high, it will have a taste similar to baking soda and will have a slippery feel to it. It will also begin to leave scale deposits on plumbing and fixtures, which will decrease the efficiency of the plumbing systems.

Type of Substance	*pH Range*
Battery Acid	1.1-1.7
Lemon Juice	1.9-2.8
Vinegar	3.2-3.6
Orange Juice	3.7-4.2
Cola	4.0-4.5
Normal Rainwater	5.1-5.6
Distilled Water	7.0
Blood	7.4-8.1
Baking Soda	8.3-8.8
Milk of Magnesia	9.8-10.2
Ammonia	10.7-11.5
Bleach	12.4-13.0
Household Lye	13.6-14.0

Total hardness:

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

The Guidelines for hardness are based on aesthetic, rather than health concerns. Hard water causes scale to form in water pipes, plumbing fixtures and kitchen appliances (see photo). Scale build-up in hot water tanks and boilers increases heating costs and can lead to premature failure 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. In addition, when washing or doing laundry with hard water, more soap or detergent is needed.



Where does hardness in water come from?

Hardness is primarily caused by the dissolved mineral compounds calcium and magnesium although smaller contributions to hardness will also come from some other ions including iron and manganese. The amount of hardness is expressed in milligrams per litre (mg/L) or grains per gallon (gpg) as calcium carbonate.

Hardness is calculated from the equation $Hardness = 2.497*Ca + 4.118*Mg$. Therefore, fluctuations in the magnesium pool affect hardness stronger than do calcium fluctuations.

The main components of hardness, calcium and magnesium, are actually of benefit to people. There are no Canadian guidelines for calcium in water and when present in drinking water, calcium may be considered to be of nutritional benefit (if levels around 50 mg/L were consumed, drinking water would provide around 5 to 10% of the daily calcium requirements). The European Community has set

a guideline level of 100 mg/L with no maximum acceptable upper concentration. The European Union has also stated that water intended for human consumption should contain a minimum of 20 mg Ca/L.

Magnesium is an essential nutrient for humans, with adults requiring around 350 mg/L per day. Moderate levels of magnesium may provide a nutritional benefit to individuals consuming a magnesium deficient diet. There are no Canadian recommendations in regard to magnesium, but the European Community suggests a guideline of 30 mg/L, with a maximum acceptable level of 50 mg/L, which may be related to magnesium's strong effect on hardness and has no health significance.

What do guidelines say about hardness?

The *Guidelines for Canadian Drinking Water Quality* notes the following:

1) public acceptance of hardness varies considerably. Generally hardness levels between 80 and 100 mg/L as $CaCO_3$ are considered acceptable;
2) levels greater than 200 mg/L are considered poor but can be tolerated;
3) levels in excess of 500 mg/L are normally considered unacceptable;
4) where water is softened by sodium-ion exchange, it is recommended that a separate unsoftened supply be retained for culinary and drinking purposes.

The Saskatchewan Government has set an upper acceptable limit for hardness of 800 mg/L. Such high levels will, however, impart a taste to the water and will cause problems with clothes washing, minerals will be deposited on dishes, tubs and showers and water heaters will become less efficient.

Dissolved Oxygen

Eggs and fry need lots of dissolved oxygen, that's oxygen that's "mixed" in the water. Eggs use oxygen that they exchange from the water, through their egg shells. Fish don't breathe the water, they actually "net" the air out of the water with their gills. That's the white, feathery stuff inside the gill slits on the sides of their heads. Fish pull water in through their mouth and push it out through their gills and the gills "grab" the oxygen and carry it into the fish. The pwerhead moves the water around in the tank and puts oxygen in the water.