Print CLOSE WINDOW

The ChronicleHerald.ca

Published: 2011-05-04

Chemistry: our life, our future

By JEAN BURNELL and MARY ANNE WHITE

UNESCO has designated 2011 as International Year of Chemistry. The theme is "Chemistry: Our life, our future" and a range of educational activities for all ages will take place across the globe.

Although the term "chemical" is most often used as to describe something bad, we would like to highlight a few of the very many chemicals that are indispensible to our lives.

Some are obvious, such as water, oxygen, carbohydrates and chlorophyll. Indeed, nothing is "chemical free." All matter around us, even in the outer reaches of our solar system, is composed of chemicals, all formed from the same 100 or so elements (atom types).

We will focus on a few chemicals that are synthesized (human-made), to give a flavour of the breadth and importance to society of chemical sciences.

A simple but important chemical is ammonia. It stinks, but ammonia is required for the manufacture of fertilizers. The chemical production of ammonia demonstrates the close link between chemistry and food production. It was only 100 years ago that the process was devised to make ammonia from the nitrogen in air. It is doubtful that the Earth's population could have been sustained without large-scale production of fertilizer from ammonia.

Cleanliness and health go hand in hand, but soap must be cheap and widely available. Soap-making requires sodium hydroxide, commonly called lye. Without the electrochemical process that makes sodium hydroxide from brine, soap would be prohibitively expensive. We would be dirtier, smellier, and certainly less healthy without sodium hydroxide.

Most people have never heard of tetrafluoroethane, but it's the most commonly used refrigerant. We depend on it for the transport and storage of meat and of fresh fruits and vegetables. Canadians enjoy healthy and varied diets because chemists devised tetrafluoroethane, but this chemical can serve to highlight that chemical development is ongoing.

A few decades ago, CFCs (chlorofluorocarbons) were used in refrigerators, but then it was discovered that CFCs released into the air reacted with ozone, reducing the ozone layer that is necessary to prevent too much ultraviolet light from the sun from reaching Earth.This finding led to the replacement of CFCs with the much safer chemical tetrafluoroethane. It is likely that even tetrafluoroethane will soon be replaced for household refrigerators by even less reactive refrigerants; it has already been replaced for airconditioning units in new cars.

Have you ever noticed the octane rating on the pumps at the gas station? This rating refers to iso-octane, a chemical used to prevent knocking in combustion engines. Iso-octane and all the petroleum products that we put in our gas tanks are produced through chemical processes. And, of course, the energy that moves your vehicle comes from a chemical

reaction — combustion (burning) of the fuel under highly controlled conditions.

Many chemicals exist as small groups of atoms called molecules, but one family of chemicals is composed of molecules that link together to form huge assemblies containing millions of atoms, called polymers. Many polymers are large commodity items. Polystyrene foam is used for insulation, and acrylics are in paints. Nearly 100 million tonnes of polyethylene are produced annually worldwide.

Another material, that you might not realize is a polymer, has even bigger production rates: Cement is an inorganic polymer composed primarily of oxides of calcium, aluminum and silicon, and when added to aggregate, it makes concrete — with an annual worldwide production of 10 billion tonnes, the most abundant manufactured material!

Of course, chemistry also has produced many life-saving drugs. Medicines are all chemicals, and almost all medicines are the direct result of chemical research.

At some time, almost everyone has taken amoxicillin. This is the most prescribed antibiotic, and it combats a broad range of pathological organisms. Thank a chemist for clearing up that ear ache or strep throat.

Although silicon is a simple element, when chemically refined to very high purity, it is the principal component of most semi-conductor devices in all modern electronics. We would not have Twitter without silicon!

These are a few samples of the millions of chemicals in our lives. In the past hundred years, the progress of humanity has advanced through chemistry, and our future lives will surely depend on new chemical developments. We hope you will join in celebrating International Year of Chemistry by appreciating the role of chemistry in our lives.

Jean Burnell and Mary Anne White are professors in the department of chemistry at Dalhousie University.