

## Environmental Analysis Through Chemistry

Since the industrial revolution in the 19th century and the numerous technological breakthroughs that have occurred up to the present day, a large number of companies have emerged in Canada and in all parts of the world. Although these companies generally produce articles intended to improve the human condition, the wastes and gases escaping from factories have had, and continue to have, a harmful effect on the health of the environment. In this country, Environment Canada is the department that is largely responsible for sampling and analysing air and water pollution. To carry out this task, Environment Canada uses the services of chemists and chemical technologists in analytical chemistry to assess the rates of pollution and contamination in nature. Environment Canada is one of the departments with many government laboratories hiring chemistry specialists.

One of these specialists is Stephen Beauchamps, a chemist assessing air quality at the Environment Canada facilities in Dartmouth, N.S.. His work consists of identifying and measuring the various air pollutants. To perform his duties, he uses devices such as the "gas phase mercury detector" or the "brewer" spectrophotometer," both of which was designed and is manufactured exclusively in Canada. The latter instrument is used among other things to determine the ground-level ozone rate, (not to be confused with the ozone layer), a prime indicator of urban air quality. The combustion of hydrocarbons (oil, natural gas, petroleum, coal, etc.) discharges pollutant molecules ( $\text{NO}_2$ ,  $\text{NO}$ , volatile organic matter) into the air. These react with sunlight to produce ozone molecules, and thereby become a direct indicator of the level of pollution.

Other instruments such as gas analysers, designed by multidisciplinary teams that include chemists and chemical engineers, are used more specifically to identify pollutant gases and their concentration ( $\text{SO}_2$ ,  $\text{SO}_4$ ,  $\text{CO}_2$ , etc.). The analyser collects air samples that are then exposed to a special light. The gas molecules receive this light energy in the form of wavelengths that they first absorb. They subsequently re-transmit this energy in the form of another specific wavelength that is picked up by a light sensitive sensor.

Since each re-emitted wavelength is specific and characteristic of each pollutant molecule, the integrated computer can therefore deduce the nature of the pollutant as well as its atmospheric concentration.

Water quality analysis is equally as important as air quality analysis in determining the rate of regional pollution, especially in the Maritimes where acid rain is frequent. Water samples taken from lakes and waterways are analysed by chemists in laboratories through a battery of tests. The initial tests are used to assess the characteristics of the water such as pH, conductance and turbidity (detection of suspended particles). Another series of tests is conducted to determine the presence of fecal coliform (bacteria) and other micro-organisms. The samples are next analysed for contaminating pollutants. This category includes fertilizers, pesticides and herbicides from agricultural regions, heavy metals such as mercury, cadmium, zinc and copper, as well as acid rain fallout in the form of nitrogen oxides and sulphur dioxides. All these chemical products can be identified and measured using a range of tests and chemical reactions developed by researchers in laboratories.

The colorimetric analysis system for measuring nitrate concentration ( $\text{NO}_3$ ) is a good example. The procedure consists of pouring a part of the sample into a coiled glass rod containing cadmium. This catalyst transforms the nitrate into nitrite ( $\text{NO}_2$ ). This recovered product will next

react with a reactant known as sulphanilamide to form a diazotized compound. The latter will react with a certain quantity of N(1-naphthyl) ethylene diaminedihydrochloride to be transformed into a reddish, nitrogenated dye. The intensity of the colour is directly proportional to the initial quantity of nitrate and can be determined by a colorimeter.

Although Canada has new laws to control pollution, thousands of new chemical products are nevertheless developed each year. The manufacturing processes for these products, or the products themselves, pollute our air and water. From this perspective, the future of chemistry increasingly lies in developing non-toxic, non-polluting products, as well as in designing new pollution management techniques.