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ROLE OF ANALYTICAL CHEMISTRY IN WATER QUALITY ASSURANCE AND MANAGEMENT

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Abstract

Water is essential for life. Safe, abundant water is vital to our ability to prosper and to fulfill our potential. Without it, we face a continual decline in our well-being, poverty and hunger, and increasing levels of conflict. Water quality is impacted both by natural processes, such as seasonal trends, underlying geology and hydrology, weather and climate, and by human activities, including domestic, agriculture, industry and environmental engineering. Water contaminated by microbiological pollutants spread diseases such as dysentery, cholera, typhoid and other related disorders. Chemical contaminants, including those naturally found in the underlying bed rock, can also cause disease and developmental problems, and can adversely affect agricultural yields and industrial processes. A detailed knowledge of water quality is essential so that drinking water can be adequately treated and the contamination of its sources can be prevented.

Water quality is defined by its chemical, physical, and biological characteristics and needs to be considered in the context of whether it is fit for the required purpose. This will depend on its intended use. Key processes that impact on water quality include:

- Eutrophication, i.e. elevated nutrient concentrations leading to excessive algal growth and deoxygenation due to diffuse run-off from agricultural land and point source discharges from wastewater treatment plants;
- Diffuse and point source discharges/drainage from mining activities;
- Localised discharges of organic micropollutants and metals from specific industries and domestic wastewater;
- Saline intrusion into groundwater in coastal areas;
- Erosion and sedimentation from, for example, deforestation, rainfall events (which are temporally and spatially highly variable) and engineering projects.

Wet chemical analysis once provided essentially all the data needed for environmental decision making. While many wet chemical methods still provide useful information, the field of environmental analytical chemistry has developed, mainly through advances in analytical instrumentation, to meet the challenges of analyzing environmental samples. It is now an important tier in environmental protection, providing scientific information for informed decision making. In the area of environmental analysis, improvements in analytical instrument technology have reduced the scale of many previously insurmountable problems in environmental analysis, such as the analysis of small concentrations of contaminants in water. Yet, many challenges remain. These are largely tied to the properties of the analyte that make it difficult to study, or to the presence of substances within the sample that interfere with the study of the target analyte specifically. Sometimes these problems are comfounded by the need to determine a contaminant at trace levels or to accurately determine small changes in contaminant concentration.

The analytical methods involve a wide range of analytical instrumentation including inductively coupled plasma (ICP)/ atomic emission spectroscopy (AES), ICP/mass spectroscopy (MS), atomic absorption (AA) spectroscopy, ion chromatography (IC), and high performance liquid chromatography (HPLC). Application of these techniques to a diverse group of sample types is a somewhat unique feature. Sample types include waters ranging from drinking water to marine water as well as industrial and municipal wastewater, groundwater and landfill leachate. The safety parameters and their implications for different waters are discussed in this presentation.

Keywords: Water quality, Analytical chemistry, Analytical standards, Preservation of water samples.