Water Chemical Analysis

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Considering the current and recent use of a large number of compounds, it is of great importance to have appropriate methods for determining the levels of water pollution and, from the results, to assess the risks of exposure and to examine measures to mitigate the effects on the environment and life.

The demands of analysis of environmental samples are very broad in terms of environmental matrices, with emphasis on different types of water, effluents, soil, sediments, air, particulate matter, animals and plants, as well as in relation to the analytes of interest; among them, persistent organic pollutants, endocrine disruptors, pesticides, pharmaceuticals and personal care products (PPCPs), veterinary drugs, flame retardants, metals and organometallic compounds.

The proper qualification of analysts to work in this area is of fundamental importance in order to generate reliable results that allow a greater control of the occurrence of pollution. Several parameters of water chemical analysis are well established; however, there is a limited availability of personnel with broad knowledge of sample preparation techniques and wide-scope analyses, with the ability to establish and apply appropriate methods, as in the case of emerging pollutants, and to participate in decision-making in this area. The search for analyses in accredited laboratories is a growing trend and, therefore, the training of analysts in laboratories with implanted quality systems is of fundamental importance.

The determination of chemical elements in water is well established, including the speciation of the most important cases from the point of view of environmental and toxicological control. The major challenges are in the analysis of samples such as seawater and ultrapure water, as a function of interferences and low concentrations, respectively. However, the determination of organic compounds, due to the wide range of analytes of interest and their stability, has required a great effort in the establishment of adequate analytical methods.

The assessment of the extent of environmental impacts due to the presence of pollutants is generally hampered by the lack of reliable results, as well as of knowledge of the situation prior to the occurrence of the problem. In addition, it is important to highlight that food is produced in the environment and, in general, requires a large amount of water, the pollution of which can cause problems in the final product. Therefore, the risks to human health are much greater than is generally perceived.

It is imperative to make continuous investment in the qualification of laboratories in terms of infrastructure and training of analysts in the area. The search for an intensification of cooperation between research groups, as well as with government agencies and the private sector, will allow progress in the area of monitoring and control of water quality, since new pollutants, such as microplastics, are continually being identified.

The instrumentation available today has allowed faster and more comprehensive analyses, with detection limits much lower than those obtained in previous decades. Chromatography coupled to mass spectrometry has enabled multi-residue and multi-class analyses of organic compounds with great
efficiency, even in complex samples. The use of detectors with high resolution allows the analysis of target and non-target compounds with high reliability for a large number of analytes, allowing screening analyses that are of great importance, especially in situations when pollutants are unknown, as well for retrospective evaluations of the data.

The availability of reference materials for most analytes of interest, as well as a wide variety of isotopically-labeled compounds, provides for greater reliability on the results obtained. Proficiency tests, essential to increase the reliability of the analyses, are becoming more accessible and offer a wider range of analytical parameters, although for organic compounds problems of the stability of most analytes in environmental matrices persist. The determination of metabolites is also important, especially in cases where these are stable and relevant from the toxicological point of view; however, few studies have evaluated these compounds in water samples, due to the analytical difficulties and the limited availability of standards.

It is important to highlight that the methods must comply with the limits established by legislation, providing that those limits can be changed. It is also important to analyze properly at levels below the maximum limits allowed, to minimize the risks of possible problems in water, which is essential for terrestrial life.