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Book review
SOIL AND ENVIRONMENTAL ANALYSIS

Keith A. Smith, Malcolm S. Cresser (Eds.)
Marcel Dekker, Inc., New York-Basel, ISBN: 0-8247-0991-8, 2004,
VIII+576 pags.

The third edition of this book provides an up to date evaluation of the major analytical methods utilized in modern laboratories, taking into account the new priorities in soil analysis.

Covering a wide range of scientific literature, this work is a helpful asset for scientists, teachers and postgraduate students working in soil science, environmental chemistry or ecological sciences. It provides a valuable support in the selection of effective analytical techniques and equipment, for the study of different environmental samples, with an emphasis on soil analysis.

The third edition is structured on twelve chapters. The firs chapter is concerned mainly with atomic absorption spectroscopy (AAS), but also covers flame emission spectroscopy (FES). While AAS is widely used for the determination of over 20 elements in various environmental samples, FES is addressed to a smaller number of elements. After an introduction on the basic principles of the methods, containing also the history of this technique, the author describes in great detail the instrumentation for AAS and FES, giving the essential information for the proper choice of the instrument configuration. The main 4 classes of interferences, which could impede the obtaining of accurate results, are presented together with solutions for their elimination. In the next part the factors that can be optimized in order to improve the detection limits are considered for both AAS and FES. The last section provide a concise guide to routine analysis for elements commonly regarded as being of environmental interest, giving readers a feel for what they need to know.

The second chapter deals with Inductively Coupled Plasma Spectrometry (ICPS), a method capable of providing fast multielement measurement of around 75 chemical elements in one sample solution, over concentration range varying from percent to ultratrace. The fundamentals of ICP-AES and ICP-MS and a detailed presentation of the instrumentation, with an accent on sample introduction systems, are discussed in the next two sections. In the last section of this chapter, several sampling techniques for air, water and soil analysis are described, together with many applications. The coverage of ion-selective electrodes is included in a separate chapter on electroanalytical methods.

The techniques are grouped according to the measured parameter in three classes: potentiometry, amperometry and conductivity. While in the first category several common types of ion-selective electrodes (including pH electrodes) are described, in the second the discussion is focused on polarography, anodic and cathodic stripping voltammetry and their applications to the detection of metals, sulfur and dissolved oxygen. Finally, a brief presentation of conductivity measurements closes this chapter.

In the chapter on Continuous-Flow, Flow-Injection and discrete analysis, the importance of automated methods for chemical analysis, especially for direct monitoring, where data are needed in real time, is stressed out. The theoretical principles and practical systems for each technique are presented, pointing the advantages of flow-injection and discrete analysis over segmented continuous-flow systems. In the final section, various examples illustrate the importance of these methods in soil analysis.

Chapter 5 deals with Ion Chromatography (IC), a very popular technique for accurate and precise determination of anions and cations in various environmental materials, including soils. The principle of IC methods and an evaluation of these instruments for soil, plant and water analysis were reviewed and applications are described. The potential that IC offers, particularly for the simultaneous analysis of several anions, justify the future use of this technique in environmental analysis.

The next chapter "Automated Instruments for the Determination of Total carbon, Hydrogen, Nitrogen, Sulfur and Oxygen", describes the principles on which automated dry combustion instruments and automated analyzers dedicated to the measurement of dissolved C and N in liquid samples. Also, different commercial systems are presented and commented, emphasizing the particular features available for each one. Various applications based on recent scientific literature, for the analysis of soils, plants, waters and other environmental materials provide an illustrative coverage of applications of automated CNS analyzers.

In Chapter 7, a very popular and well-established technique X-Ray Fluorescence Spectrometry is described. The new analytical capabilities of this technique, such as synchrotron x-ray microprobe, the use of polarized excitation geometries and portable instrumentation are particularly depicted in this chapter, with relevant applications in environmental analysis.

The chapter on the Measurement of Radioisotopes and Ionizing Radiation explains how to choose the adequate analytical tool, on the basis of the activity and/or mass concentration of the isotopes and also based on their chemical and radioactive decay properties. The principles of radiochemical separations, with a number of typical examples, and the problems associated with the quality control and method validation, are discussed in two separate sections.

Chapter 9, "Stable Isotope Analysis and Applications" begins with an overview of terminology and continues with a description of the current instrumentation and analytical techniques used for stable isotope analysis. Examples of isotope-ratio mass spectrometry to analyze the isotopic content of soil, plant and animal samples are given, followed by examples of tracer and fractionation applications.

Chapters 10 and 11, deal with the measurement of trace gases. The first part covers the principles of current instrumental techniques for the determination of trace gases: GC, nondispersive IR gas analysis and other methods (photoacoustic IR spectrometry, FTIR and Tunable Diode Laser Absorption Spectrometry, chemiluminescence analyzers and automated Denuder Systems). The next section deals with the experimental procedures employed to make flux measurements in the field on a small scale: 0.1 m^2 of land surface to 10-100 m^2. Examples of recent applications are included. Chapter 11 contains complementary information on micrometeorological methods for the determination of fluxes at larger scales. In addition to the well-known methods such as gradient, energy balance and eddy covariance, some novel micrometeorological methods such as mass balance and nocturnal budget methods are discussed. Finally, the authors pointed out that he advances in high-precision gas analysis employing FTIR and tunable diode laser (TDL) and the theoretical developments have further advanced the measurement capability.

The last chapter "Analysis of organic Pollutants in Environmental Samples" describes the main steps required in the analysis of key organic pollutants, concentrating on soil analysis, to provide illustrative examples. Sample preparation, cleanup techniques and methods of determination are the three topics discussed in an overview of organic analysis. Finally, several relevant case studies, including the determination of total petroleum hydrocarbons, chlorophenols, polychlorinated biphenyls and VOCs in soils are presented in the following section, followed by conclusions.

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