

BOOK REVIEWS

Environmental Instrumentation and Analysis Handbook

By R. D. Down and J. H. Lehr, Wiley, Hoboken, NJ. 2005, 1068 pp., \$198.50

The volume entitled *Environmental Instrumentation and Analysis Handbook*, by R. D. Down and J. H. Lehr (Editors) represents a long-awaited authoritative account of the current state of affairs in the field of environmental pollution measurement and control-relevant technologies/instrumentation. It emerges as a product of thoughtful editing efforts and meticulous interest in the historic evolution of the environmental instrumentation field by R. D. Down and J. H. Lehr, as well as a kaleidoscopic description of its current and future prospects, thematic breadth and technological versatility attested by a high-quality compilation of articles and commentary provided by the volume's contributors. A distinct characteristic of the volume under consideration is the successful establishment of a conceptual framework within which contemporary realities associated with regulatory regimes and developments in the environmental technology milieu are recognized and considered in a nuanced rather than a simplistic manner. It should be pointed out that this is not a trivial task and accomplishment, given the fact that important objectives such as cohesion, analytic clarity and perspective should also be met. Indeed, the authors deftly set the stage for all subsequent contributions/papers by discussing the synergistic subtleties between constantly evolving regulatory requirements and the dynamics of the development of environmental technology and instrumentation. In particular, a "feedback loop" is conceptually delineated that explicitly acknowledges the effect of increasingly stringent regulatory requirements on the introduction of new environmental technology and instrumentation, which in turn allows the further refinement and/or revision of regulatory policy structures, requirements and directives. Since the attempts for harmonization and fine balancing between the objectives of environmental and public health protection with cost-effectiveness through the introduction of the appropriate environmental pollution abatement technology underlies almost all environmental risk management and regulatory policies, the significance of environmental instrumentation should be accordingly underscored. Currently, major international regulatory frameworks (federal and state-sponsored ones in the US, and institutionally administered ones through specific directives issued by the European Commission in the EU zone) put the notion of Best Available Control Technology (or variants of it across the Atlantic) at the center of their policies and

compliance requirements, thus stimulating creative innovation in the appropriate sectors and incentivizing the development of environmental instrumentation through which the above key objectives can be met, and environmental protection, public health along with industrial competitiveness and job growth can be sustainably attained. In addition, promising advances in material science, solid state physics and the miniaturization of actuating, computing (data processing) and sensing devices, as well as wireless communication networks are deemed potentially critical for the advent of a new generation of environmental technology and instrumentation characterized by enhanced accuracy, precision, reliability, sensitivity and sensor response times. Rapid scientific and technological advancements in these fields are already unfolding and expected to confer first-mover advantages to companies and other ventures with the foresight to seize the emerging opportunities and introduce new products and technology in the global markets. In light of these developments in the environmental instrumentation sector, the Volume under consideration becomes an invaluable source of reference where technical knowledge is presented in an application-centered manner, as well as a precious guide for confidently selecting the appropriate instrumentation (out of a broad menu of available options) to address specific environmental problems by familiarizing the reader with its inherent merits, operational limitations and future prospects. In particular, the Volume is thematically structured in a way that ensures conceptual continuity and cohesion, while gradually progressing towards more complex needs and technically challenging cases of environmental pollution assessment, measurement and control. The first chapter encompasses and incisively analyzes all aspects related to instrumentation methodologies (contemporary ones as well as others with considerable potential for future applications) used in the field of environmental analysis and management, and not surprisingly occupies the largest part of the Volume. In particular, the first chapter provides a comprehensive and thorough account of environmental instrumentation methodologies that are particularly useful within the purview of EPA's continuous emission monitoring system requirements. Optical/spectroscopic methods such as infrared absorption spectroscopy and ultraviolet ones are described, forming a menu of complementary options for analytical measurements related to gas analysis, as well as NMR spectroscopy which offers the distinct advantage of monitoring and visualization of physicochemical interactions on the molecular level between various contaminants and environmental matrices. Modern uses of flame ionization detectors are also presented where reliable continuous monitoring of hydrocarbon concentrations in ambient air conditions (also ozone and volatile organic compound concentration estimates) represents the key objective. Furthermore, a variety of gas chromatography detectors is examined followed by a quite insightful discussion on mass spec-

troscopy as a method amenable to automation which also offers the possibility of real-time analysis of several organic compounds in a multitude of environmental matrices with enhanced sensitivity. It should be noted that recent technological advancements resulting in less expensive, smaller in size mass spectrometers could potentially allow expanded uses in emergency situations such as spills, fires, industrial accidents, detection of explosives and chemical weapons monitoring. When critical and timely decisions need to be made in the field, photo-ionization detectors and analyzers are recommended offering a rapid and simple way to screen organic pollutants in water and soil. Finally, the first Chapter offers a very useful comparative assessment between *in situ* and extractive measurement techniques, portable vs. stationary instrumentation, as well as ideas and technical suggestions for integration prospects with automated calibration and diagnostic systems, distributed control systems over wireless communication networks for enhanced accuracy, reliability, data collection, processing and display capabilities.

The second chapter represents the starting point for the presentation and critical assessment of more specialized in scope analytical measurement techniques and the corresponding instrumentation. This thematic arrangement is retained throughout the rest of the Volume as material is presented in ensuing chapters. Specifically, the second chapter encompasses a thorough and comprehensive discussion on the available technical means to monitor key water quality parameters such as opacity monitors for particulate matter, temperature monitoring devices, pH and conductivity analyzers, as well as turbidity monitoring systems for the presence of suspended particulate matter in water. It is also very important to note that this chapter includes also interesting ideas on the development of a systematic water quality monitoring program. The focus of the third chapter becomes sharper and is placed on ground water monitoring issues. The key problem of reliable level measurements in ground water wells is very well analyzed and presented, along with the problem of field sampling in ground water pollution assessment studies, in particular, the microbiological one. It should be pointed out that the third chapter contains also very interesting, both theoretically as well as practically, material on soil permeability and dispersion analysis. In a spirit similar to the one of the previous chapter, the fourth one frames the environmental pollution assessment and control problem within the class of wastewater systems. Wastewater level measurement techniques are discussed in satisfactory detail together with the potential and challenges of automation for reliable wastewater sampling. The reader is also rewarded with a nice discussion on the identification of an "optimal set" of wastewater sampling locations, which currently represents a significant challenge in environmental systems analysis.

An indispensable part of the volume is devoted to ambient air condition monitoring

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and pollution control systems with a focus on the versatility of their respective uses towards the attainment of ambient air quality standards on both the primary as well as the secondary level. The fifth chapter is thus comprised of a number of papers presenting and analyzing state-of-the-art technology options designed to monitor and reduce the concentration of an array of pollutants such as NO_x, SO₂, O₃, CO, particulate matter (PM₁₀, PM_{2.5}), volatile organic compounds, etc., typically emitted from industrial and utility plants, ultimately ensuring regulatory compliance. The reader is pleasantly surprised by a wealth of information and thoughtful analysis of all pertinent air pollution monitoring and control systems such as thermal oxidizers, wet-scrubbers and carbon adsorption systems (suitable for vapors of various solvents and other volatile organic compounds), as well

as filtration systems (suitable for particulate matter). The pursuit of an ambitious agenda would not be complete without the inclusion of a chapter that emphasizes the centrality of reliable flow monitoring systems in environmental system analysis and pollution assessment and control. In this direction, a high-quality final chapter is delivered analyzing and discussing the multi-faceted problem of developing reliable technologies for flow measurements across a wide spectrum of environmental conditions. Furthermore, the distinct need for the next generation of flow monitoring systems to be functionally integrated with automated calibration and diagnostic systems is persistently underscored. Finally, one feels genuinely compelled to commend the efforts made by the volume's editors and many contributors for not only successfully assembling and analyzing, in the most

comprehensive way, practically all available information related to environmental instrumentation and its future prospects, but also assiduously focusing on one of the most profound challenges of our times in the most scientifically responsible manner.

Literature Cited

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Handbook of Membrane Separations

By Anil K. Pabby, Syed S.H. Rizvi, Ana Maria Sastre, CRC Press, Taylor & Francis Group, Boca Raton, FL, 2009, 1184 pp., \$299.95.

Most individuals that work in the membrane field are familiar with the *Membrane Handbook* edited by W.S. Winston Ho and Kamallesh K. Sirkar. The *Handbook of Membrane Separations* has a similar title but emphasizes applications and provides the perspective of research groups from nearly every continent (except South America and Antarctica) on the rapidly evolving membrane industry.

This massive tome contains 1184 pages divided into three sections: (1) Membrane Applications in Chemical and Pharmaceutical Industries and in Conservation of Natural Resources, (2) Membrane Applications in Biotechnology, Food Processing, Life Sciences, and Energy Conversion, and (3) Membrane Applications in Industrial Waste Management (Including Nuclear), Environmental Engineering, and Future Trends in Membrane Science. Each section is

prefaced by an introduction written by one or more of the editors and contains 10–15 chapters describing related applications.

While the groupings used to organize the three sections are somewhat arbitrary, the number of applications described in the book is impressive. Virtually everyone, from the membrane novice to those with extensive experience, will find an intriguing application in the table of contents that will motivate a quick scan of a chapter. Moreover, each chapter begins with an overview of the underlying science and technology that enable the application.

Traditional membrane applications described in the book include gas separation, pervaporation, ultrafiltration, membrane contactors, and water treatment. The coverage of these areas is current and comprehensive. For example, the gas separation chapter includes a discussion of recent efforts to develop ion conducting (proton and oxygen), molecular sieving, and facilitated transport membranes.

Emerging application areas described in the book include membranes for nuclear waste

processing, membrane extraction for preconcentration, nanotube membranes, membrane electroporation, and membrane distillation in food processing. The juxtaposition of these diverse areas likely will lead readers to envision other novel processes.

Several chapters stood out as especially comprehensive. The bipolar membrane, radioactive waste processing, membrane chromatography, and liquid membrane chapters provide an excellent introduction to the application area and extensive references to past work.

The *Handbook of Membrane Separations* will be a welcome addition to the bookshelves of those interested in membrane separations. Its broad coverage of application areas and fundamentals of membrane science make it a valuable reference.

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