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BOOK REVIEWS

Sources and Fates of Aquatic Pollutants, edited by RONALD A. HITES and S. J. EISENREICH, Advances in Chemistry Series 216, price: U.S. and Canada $99.95, export $119.95, clothbound, xiii + 558 pp., indexed, illustrated LC – 87-1290, ISBN 0-8412-0983-9, published by American Chemical Society, 1155 Sixteenth Street, N.W. Washington, D.C. 20036.

Studies on processes controlling the transport and fate of chemicals in the water environment (limnic and marine) have significantly advanced in the past 10 years.

This volume presents a holistic approach to the study of aquatic pollutant chemistry; the atmosphere, water, and sediment are treated as interdependent compartments of an ecosystem. For example, the water column of a lake receives inputs from the atmosphere and from surface and subsurface drainge and loses material to outflow, volatilization, and internal processes such as sedimentation and degradation. The rates of physical mixing within, and material transfer among, the atmospheric, hydrospheric, and sedimentary compartments and the rates of reactions occurring in each compartment determine the concentrations throughout the system. The dynamic phenomena occurring at interfaces drive the chemical fluxes, feed the degrading reaction, and control the element and compound residence times.

This book is divided into four sections: air–water processes, water column processes, water–sediment processes, and case studies. The emphasis of the first three sections is on the chemical and physical processes controlling solute behaviour and fate in air and water. The case studies serve to integrate information on these processes.

It is not easy to review in detail all the papers published in proceedings. Therefore I would like to give some information about these papers which attract my attention because they provide useful information for me. It does not mean that the papers which I do not mention here are less valuable.

The first section, *Air–Water Processes*, contains 5 papers. A brief review of the thermodynamic of hydrophobic compound solubility relationships is presented in the paper entitled *Methods for Estimating Solubilities of Hydrophobic Organic Compounds: Environmental Modelling Efforts.*

The review is followed by an examination of the UNIFAC activity coefficient prediction technique. The use of octanol–water partition coefficients, total molecular surface area, and molecular connectivity indexes to predict aqueous solubilities is then examined, and the resulting correlations are presented.

Some valuable information about the nature of vapor–particle interactions is presented in the second paper: *Vapor–Particle Partitioning of Semivolatile Organic Compounds.*

A mathematical model describing the variation in lake sediment concentration of a persistent organic chemicals with time and depth as a function of atmospheric concentrations is presented in the 3rd paper:

Lake Sediments as Historic Records of Atmospheric Contamination by Organic Chemicals. The model may be used to estimate historic atmospheric concentrations from analyses of sectioned sediments. The model includes wet and dry air particulate deposition, rain dissolution, volatilization and absorption, water column particulate deposition and resuspension, sediment–water diffusion, degradation reactions in water and sediment, and sediment burial. This section contains also papers entitled *Depositional Aspects of Pollutant Behavior in Fog and Intercepted Clouds* and *Air–Sea Transfer of Trace Elements.*

The second section entitled *Water Column Processes* contains 4 papers. In the paper *Mechanism Controlling the Distribution of Trace Elements in Oceans and Lakes* authors discuss the following processes: nutrientlike biological recycling, sediment fluxes oxidation–reduction cycling and scarenging by particles which govern distribution elements in oceans and lakes.

Changes in metals speciation (Ag, Al, Cd, Co, Cu, Hg, Mn, Ni, Pb, and Zn) in water, that may result from an increase in the acidity of natural waters over the pH range from 7 to 4, are reviewed in the paper: *Metal Speciation in Natural Waters: Influence of Environmental Acidification.* This section also contains the following papers: *Ion Budgets in a Seepage Lake* and *Mechanisms of Alkalinity Generation in Acid-Sensitive Soft Water Lakes.*

The 3rd section *Water–Sediment Processes* contains 3 papers. The purpose of the paper entitled *Hydrophobic Organic Compounds on Sediments: Equilibria and Kinetics of Sorption* is to examine in a tutorial manner the empirical, conceptual, and mechanistic knowledge concerning sorption of hydrophobic compounds onto sediments. Thermodynamic and kinetic models are examined in an attempt to understand the basis for current practical approaches and theoretical concepts. Estimation procedures and the development of generalized evaluative approaches are emphasized.

In the next paper, *The Role of Particulate Matter in the Movement of Contaminants in the Great Lakes*, the authors discuss particle–contaminant interactions and subsequent behavior of the particulate matter control, and the long-term concentration of many compounds in aquatic systems. Even in deep systems, such as the Great Lakes, particle settling times from the water column are less than 1 year. After reaching the bottom, contaminant-laden particles are redistributed by episodic cycles of resuspension and redeposition, resulting in focusing, which is the spatially inhomogeneous distribution of contaminants in sediments. Bioturbation, coupled with focusing, provides source material to the resuspendible pool. The combination of these processes mediated both the composition and long-term behavior of contaminants in these lakes.

Retrospective measurements of dated sediment cores can be used to determine the effect of regulations in controlling environmental inputs of hazardous chemicals. This problem is discussed in the papers: *Sediments as Archives of Environmental Pollution Trends.* Sediment cores have been used to reconstruct histories of environmental contamination by mercury, lead, polycyclic aromatic hydrocarbons (PAHs), dioxins, polychlorinated biphenyls (PCBs), DDT, octachlorostyrene, and carbon particles. These measurements have shown that most anthropogenic chemicals first appeared in sediments at the turn of the century at the time of the industrial revolution in most parts of North America. Industrial growth after World War II also resulted in inputs of pollutants such as PCBs and dioxins. Recent decreases in the levels of several contaminants may have occurred because of environmental awareness and the onset of environmental regulations. Inputs of banned pollutants continue, however, because of recycling of contaminants in the environment and long-range atmospheric transport.

The last section, entitled *Case Studied*, contains 4 papers: *The Chemical Limnology of Nonpolar Organic Contaminants: Polychlorinated Biphenyls in Lake Superior, Fate of Some Chlorobenzenes form the Niagara River in Lake Onzario, Cycles of Nutrient Elements, Hydrophobic Organic Compounds, and Metals in Crystal Lake — Role of Particle-Mediated Processes in Regulation* and *Element Cycling in Wetlands: Interactions with Physical Mass Transport.* These papers present a detailed chemical characteristics of selected aquatic systems.

While the emphasis of the first three sections is on the chemical and physical processes controlling solute behavior and fate in air and water, the "case studies" integrate information on these processes into a systemwide picture of the cycling of inorganic and organic chemicals.

This volume provides most recent chemical knowledge on sources and fates of pollutants in water systems. Everyone interested in the chemistry of water systems will benefit from this book.

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Mathematical Modelling of Environmental and Ecological Systems, edited by J. B. SHUKLA, T. G. HALLAM, and V. CAPASSO, Elsevier, Amsterdam–Oxford–New York–Tokyo 1987, xiv + 254 pages, price: D11. 140.00 (USA 68.25), ISBN 0-444-42807-0.

This volume contains selected papers presented at the International Symposium on *Mathematical Modelling of Ecological, Environmental and Biological Systems* held in Kanpur, India, in August 1985.

The book covers a very broad area, from modelling movements of pollutants in air and water to population changes, all on 254 pages. It is not a synthetic analysis of knowledge related to the above listed problems, but rather a presentation of the authors' own results of research. Therefore, it is difficult to evaluate a content of the book covering such a wide area of research. Looking through the book I asked myself, what can I find in the book which is of interest to me?

I am mostly involved in research related to the water environment, therefore I started with Part II, *Water Pollution*, which contains two papers:

Taking Advantage of Topography in the Siting of Discharges in Rivers by Ronald SMITH,

Analytical Solution of 3-D Unsteady State Diffusion Equation for a Pollutant from Point Source Discharge in Offshore Region by V. P. SHUKLA.

The first paper reviews recent work on choosing discharge sites, for continuous and for sudden releases of contaminants. It applies complicated mathematical apparatus to solve rather simple problem. Nevertheless, it is clearly written and therefore it may be useful for those who want to use mathematical methods to solve that problem.

The other papers describe the advantage of topography in the siting of discharges in rivers (R. SMITH) and analytical solution of 3-D unsteady state diffusion equation for a pollutant from a point source discharge in offshore region (V. P. SHULKA). Although the developed model is formulated for the particular application, it seems to me that the method gives a possibility for using it in describing the movement of pollutions in other water bodies. Therefore, the paper is of interest to all involved in modelling of pollutants' movement in water environment. Generally speaking Part II does not provide any very important information, nevertheless these papers are worth reading.

Much more valuable is Part I, *Air Pollution*, which contains the following papers:

Some Aspects of Mathematical Modelling of Atmospheric Transport and Chemistry by L. K. PETERS,

Attenuation of Air Pollution by Green Belt by R. K. KAPPOR and V. K. GUPTA,

Dispersion of a Reactive Air Pollutant in a Two Layered Environment by J. B. SHUKLA and R. S. CHAUHAN,

Dispersion from Time Dependent Point Source: Application to Methyl Isocynate Leakage in Bhopal, India by R. S. CHAUHAN, J. B. SHUKLA, and T. G. HALLAM.

In the first paper, the author gives an overview of regional-scale atmoshperic transport/chemistry modelling. The individual atmoshperic processes affecting species distributions are quite complex, so that

parametrizations are frequently necessary for an integrated, completed mathematical model analysis. The equations to be solved are summarized, some parametrizations are presented, and specific removal mechanisms are discussed. Simulation results from a three-dimensional, time-varying regional SO_2 and sulfate atmospheric model are discussed. Substantial spatial and temporal variations in the distributions of SO_2 and sulfate are predicted. It is well written paper.

In the second paper the authors discuss a mathematical model allowing us to evaluate the effect of a green belt in attenuation of air pollution. The model introduces the concept of pollution attenuation coefficient for estimating the removal of pollutant while passing through the green belt. The formulation for pollution attenuation coefficient makes use of widely measured parameters such as leaf area density of trees, deposition velocity of the pollutant on the leaf surface, and wind speed in the green belt. The mathematical expression for estimation of the pollution attenuation factor of the green belt, around a ground level population source, uses a combination of an exponential law for dry removal of pollution within the green belt and source depletion model for removal outside the green belt. The formulation for population attenuation coefficient is tested for particulate material using the experimental data available in the literature. The dependence of the pollution attenuation factor on various physical parameters of the green belt such as its height, width, distance from the pollution source and on atmospheric stability conditions is illustrated. The model has been found to be useful to optimize the design of the green belt, to obtain the desired degree of attenuation of the pollution around industrial plants.

In the third paper the authors discuss the effect of wind velocity and diffusion coefficient varying with height on the dispersion of air pollution from point and line source. They divided the inversion layer into two parts where wind velocity and diffusion coefficient are assumed to be constant in each layer, taking smaller values in the lower layer in comparison to the upper. The effect of chemical reaction and dry deposition on the ground has also been taken into account. The analysis has been applied to study the reduction of concentration of air pollutant due to the presence of a green belt in the wind direction.

In the fourth paper the authors discuss the dispersion, from time dependent point sources, of an airborne pollutant which undergoes a first order chemical reaction forming a secondary toxic substance. Various examples of time dependent flux at the source located near the ground are presented to assess the dispersion of the methyl isocynate release from the Union Carbide factory in Bhopal, India.

As I mentioned before, it is very difficult for me to evaluate the quality of the further parts of the book, i.e.:

Part III, *Polution Ecology*, containing the following papers:
Modelling Survival in Chemically Stressed Populations by T. G. HALLAM, *On the General Structure of Epidemic Models* by E. BERETTA and V. CAPPASSO, *Equilibria and Oscillations in Age-Structured Population Growth Models* by J. M. CUSHING.

Part IV, *Community Ecology*, containing the following two papers:
Young Predation and Time Delays by M. SALEEM, V. S. SIDDIQUI and V. GUPTA, *Uniform Persistence and Global Stability in Models Involving Mutualism. I. Predator–Prey Mutualistic Systems* by H. I. FREEDMAN and B. RAI.

Part V, *Resource Management*, containing the following three papers:
Dynamic Interactions Between Economic, Ecological and Demographic Variables by ALESSANDRO CIGNO, *Economic Growth Models: Effects of Logistic Population and Technology* by AJAI SHUKLA, *A Dynamic Predator–Prey Model for the Utilization of Fishery Resources: A Case of Trawling in Lake Kasumigaura* by Y. KITABAKE.

The book is of interest to readers having good experience in mathematical modelling of events taking place in the environment.

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