Book review


Interest in groundwater and soil contamination has steadily increased since the 1970s as public concern led to a vast range of new and stringent environmental regulations. Owing to the increasing numbers of contaminated site remediations in recent decades, this field of study is often spoken of as the ‘remediation industry’. Groundwater and soil contamination management from site assessment to remediation takes a lot of time and expense. Site restoration usually proceeds through several phases and requires a concerted, multidisciplinary effort. Thus, remediation professionals come from a variety of technical and educational backgrounds, including geology, hydrology, chemistry, microbiology, toxicology and epidemiology, as well as chemical, mechanical, electrical, industrial, civil and environmental engineering. Because of differences in the formal education and training of these professionals, their ability to perform or review remediation design calculations varies considerably. Groundwater and soil remediation is more complicated than conventional water and wastewater treatment because the characteristics of soil and surface geology and hydrogeology greatly affect the implementability and effectiveness of a given technology. The absence of uniformly trained specialists is exacerbated by the continuously evolving remediation technologies, but up-to-date design information is only sporadically published in the literature. Such studies are focused predominantly on theoretical aspects, whereas illustrative applications are rarely given. Most of the books dealing with site remediation provide only descriptive information on remedial technologies and none provide helpful guidance on illustrations of practical calculations.

This latest edition of Kuo’s book covers important aspects of major design calculations as well as providing practical and relevant working information for groundwater and soil remediation. Realistic examples are used liberally to illustrate the applications of the design calculations, with more than 200 equations in both SI and US customary units, as well as unit conversions.

The book is divided into seven chapters. The first gives information on the background and objectives of the book, organization of the book and recommendations on how to use it.

Chapter 2, ‘Assessment and remedial investigation’, illustrates engineering calculations needed for site assessment of contamination and remedial investigation. First, the vertical and areal extents of surface soil, vadose zone, soil gas and the size of the plume in the aquifer are determined, including the necessary calculations of compounds of concern (COCs) in different phases such as soil, soil gas and free product. The next section deals with soil borings and groundwater monitoring wells, and soil and groundwater sampling including the necessary calculations for borings and sampling. The last section focuses on the mass of COCs in different phases, including such topics as the vapour concentrations resulting from the presence of free product in pores and the relationship between COC concentrations in liquid and that in the air and on soil grains.

Chapter 3, ‘Plume migration in aquifer and soil’, is dedicated to the estimation of the speed of groundwater movement, plume migration and COC transport in the vadose zone. In addition, groundwater pumping and aquifer tests to estimate the hydraulic conductivity and transmissivity of the aquifer in steady radial and unsteady flow are mentioned. Calculations with practical examples are presented exhaustively for infinite aquifers.

Chapter 4, ‘Mass-balance concept and reactor design’, introduces the mass-balance concept, followed by the reaction kinetics, types, configuration and sizing of reactors. The determination of reaction rate constants, removal efficiency, optimal arrangement of reactors, residence time and reactor size for specific applications are described in more detail.

Chapter 5, ‘Vadose zone soil remediation’, deals with soil remediation at sites where the COC concentrations exceed acceptable levels. This chapter provides important design calculations for commonly used in situ and ex situ soil remediation technologies, such as soil vapour extraction (venting), soil washing, bioremediation, in situ chemical oxidation, low-temperature thermal desorption and thermal destruction. Regarding venting, the chapter describes the design calculation for such topics as gasoline, industrial solvents, radius of influence, well spacing, air flow rate, extracted COC concentrations and clean-up time.

Chapter 6, ‘Groundwater remediation’, is focused on groundwater extraction, starting with design calculations of the capture zone, optimal spacing of both single and multiple well systems, and extraction rate. The rest of the chapter is dedicated to design calculations for commonly used in situ and ex situ groundwater remediation technologies such as activated carbon adsorption, air stripping, in situ and ex situ bioremediation, air sparging, biosparging, chemical precipitation, in situ chemical oxidation and advanced oxidation processes.

Chapter 7, ‘VOC-laden air treatment’, introduces the transfer of volatile organic compounds of concern from soil and groundwater into the air. Development and implementation of an air emission control strategy is an integral part of the overall remediation programme. This chapter illustrates design calculations for commonly used off-gas treatment technologies, including activated carbon adsorption, direct incineration, catalytic incineration, internal combustion engines and biofiltration.

This book provides a comprehensive methodological and practical manual, suitable for specialists trained in a variety of technical and educational backgrounds, for the solution of very complicated groundwater and soil remediation requiring a multidisciplinary approach. The text provides practical information that addresses the current needs of practising engineers, scientists and legal experts who are employed by industry, consulting companies, law firms and regulatory agencies in the field of soil and groundwater remediation. The book can also serve as a textbook or reference book for undergraduate and graduate students who are pursuing a career in site remediation.

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