<<环境科学与工程原理>>

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前言

Following the format of the first edition, the second edition of Principles of Environmental Engineering and Science is designed for use in an introductory sophomore-level engineeringcourse. The book covers the basic, traditional subject matter that forms the foundation of more advanced courses. As such, it provides the fundamental science and engineering principles that instructors in more advanced courses may assume are common knowledge for an advanced undergraduate.In our offerings of this course, we have found that mature college students in allied fields—such as biology, chemistry, resource development, fisheries and wildlife, microbiology,and soils science—have no difficulty with the material.We have assumed the students using this text have had courses in chemistry, physics, and biology as well as sufficient mathematics to understand the concepts of differentiation and integration.Basic environmental chemistry and biology concepts are introduced at the beginning of the book. In the mathematical presentations, we have provided only a few derivations. In our experience, the more rigorous approach of derived mathematics may yield a result that is not more but less demonstrative—and even confusing—to the beginning engineering student.A major theme carried through the text is mass balance. Chapter 4 is an introduction to the concept of materials and energy balance as a tool for understanding environmental processesand solving environmental engineering problems. It is then applied in the hydrology, sustainability, water quality, water and wastewater treatment, air pollution, and solid and hazardous waste chapters.Each chapter concludes with a list of review items, the traditional end-of-chapter problems, and, perhaps less traditional, discussion questions. The review items have been written in the "objective" format of the Accreditation Board for Engineering and Technology (ABET). Instructors will find this particularly helpful for directing student review for exams, for assessing continuous quality improvement for ABET, and for preparing documentation for ABET curriculum review. We have found the discussion questions useful as a “ minute check ” or spot quiz item to see if the students understand concepts as well as number crunching.The second edition has been thoroughly revised and updated. With the addition of 73 new end-of-chapter problems, there are now a total of 395 problems. The following paragraphs summarizethe major changes in this edition.? Eleven case studies have been added to introduce material in appropriate chapters.? Adiscussion of the history of environmental engineering and environmental science is now included in the first chapter. The discussion of laws and regulations has been replaced by abrief discussion of the process by which laws and regulations are developed. Anew, stand-alone chapter on biology has been added (Chapter 3).All the example problems and end-of-chapter problems on risk assessment have been revised to incorporate new estimates of intake and slope factors.A quantitative introduction to well drawdown has been added to the hydrology chapter (Chapter 7).The chapter on resources (Chapter 8) has been completely revised and slimmed down. Its focus is on sustainability. A discussion of biofuels and hydrogen fuel for automobiles isincluded.The water quality management chapter (Chapter 9) has been revised with updated material on arsenic, nanoparticles, and endocrine disruptors.dav22351_fm.qxd 12/14/07 10:40 Page xi The water treatment chapter (Chapter 10) has been revised to include new material on membrane filtration and AOPs.Anew introduction, a new section on treatment standards, and a new section on membrane treatment have been added to the wastewater chapter (Chapter 11).The air pollution standards have been updated and new material on mercury, lead, and PM2.5 has been added to the air pollution chapter (Chapter 12). In addition, the sections on origin andfate, indoor air, acid rain, ozone depletion, global warming, and control of automobile emissions have been updated.The solid waste chapter discussion of collection methods has been updated to include collection of compostable material (Chapter 13).In the hazardous waste chapter, a new section and example problem, on pump and treat, has been added (Chapter 14).A revised introduction to the noise pollution chapter (Chapter 15) includes the impact of hearing loss on people, as well as the economic impact of noise pollution on civil engineeringprojects and businesses. A new discussion of the Ldn concept and a revision of the method of calculating airborne transmission of noise are included.The ionizing radiation chapter has three new example problems and an updated discussion of radioactive waste management (Chapter 16).Online ResourcesAn instructor ’ s manual and set of PowerPoint slides are available online davismasten for qualified instructors. Please

inquire with your McGraw-Hill representative for the necessary access password. The instructor ’ s manual includes sample course outlines, solved example exams, and detailed solutions to the end-of-chapter problems. In addition, there are suggestions for using the pedagogic aids in the next.As always, we appreciate any comments, suggestions, corrections, and contributions for future revisions.Mackenzie L. DavisSusan J. Masten

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内容概要

《环境科学与工程原理（第2版）》系统介绍了环境科学与工程的原理与方法。
书中内容包括：化学及生物学原理，物质与能量平衡，生态系统，风险认知、评估与管理，水文学，可持续能源、矿物资源及土壤资源，水质管理，水和废水处理，空气污染，固体废物工程，危险废物管理，噪声污染，电离辐射。
本书配有大量例题，每章后附有本章复习、习题、问题讨论、参考文献等。
《环境科学与工程原理（第2版）》具有以下特点：　　注重环境问题的综合性，强调科学原理、伦理及安全，而不是具体的工程设计。
涉及内容广泛，如风险管理、各种环境污染问题及相关法规和实践等。
综合考虑物质与能量平衡，并将其作为分析和解决环境工程问题的工具。
《环境科学与工程原理（第2版）》可作为高等院校环境类专业及生物学、化学等专业的教材，并可供从事环境保护的科技工作者参考。

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章节摘录

1-1 WHAT IS ENVIRONMENTAL SCIENCE?Natural ScienceIn the broadest sense, science is systematized knowledge derived from and tested by recognition and formulation of a problem, collection of data through observation, and experimentation. We differentiate between social science and natural science in that the former deals with the study ofpeople and how they live together as families, tribes, communities, races, and nations, and the latter deals with the study of nature and the physical world. Natural science includes such diverse disciplines as biology, chemistry, geology, physics, and environmental science.Environmental ScienceWhereas the disciplines of biology, chemistry, and physics (and their subdisciplines of microbiology, organic chemistry, nuclear physics, etc.) are focused on a particular aspect of natural science, environmental science in its broadest sense encompasses all the fields of natural science. The historical focus of study for environmental scientists has been, of course, the natural environment.By this, we mean the atmosphere, the land, the water and their inhabitants as differentiated from the built environment. Modern environmental science has also found applications tothe built environment or, perhaps more correctly, to the effusions from the built environment.Quantitative Environmental ScienceScience or, perhaps more correctly, the scientific method, deals with data, that is, with recorded observations. The data are, of course, a sample of the universe of possibilities. They may be representative or they may be skewed. Even if they are representative they will contain some random variation that cannot be explained with current knowledge. Care and impartiality in gathering and recording data, as well as independent verification, are the cornerstones of science.When the collection and organization of data reveal certain regularities, it may be possible to formulate a generalization or hypothesis. This is merely a statement that under certain circumstances certain phenomena can generally be observed. Many generalizations are statistical in that they apply accurately to large assemblages but are no more than probabilities when applied to smaller sets or individuals.In a scientific approach, the hypothesis is tested, revised, and tested again until it is proven acceptable.If we can use certain assumptions to tie together a set of generalizations, we formulate a theory.For example, theories that have gained acceptance over a long time are known as laws. Some examples are the laws of motion, which describe the behavior of moving bodies, and the gaslaws, which describe the behavior of gases. The development of a theory is an important accomplishment because it yields a tremendous consolidation of knowledge. Furthermore, a theorygives us a powerful new tool in the acquisition of knowledge for it shows us where to look for new generalizations. “ Thus, the accumulation of data becomes less of a magpie collection offacts and more of a systematized hunt for needed information. It is the existence of classification and generalization, and above all theory that makes science an organized body of knowledge ” (Wright, 1964).Logic is a part of all theories. The two types of logic are qualitative and quantitative logic.Qualitative logic is descriptive. For example we can qualitatively state that when the amount of wastewater entering a certain river is too high, the fish die. With qualitative logic we cannot identify what “ too high ” means we need quantitative logic to do that.When the data and generalizations are quantitative, we need mathematics to provide a theory that shows the quantitative relationships. For example, a quantitative statement about theriver might state that “ When the mass of organic matter entering a certain river equals x kilograms per day, the amount of oxygen in the stream is y. ” Perhaps more importantly, quantitative logic enables us to explore ‘ What if? ’ questions about relationships. For example, “ If we reduce the amount of organic matter entering the stream,dav22351_ch01.qxd 12/14/07 9:53 AM Page 2 how much will the amount of oxygen in the stream increase? ” Furthermore, theories, and in particular,mathematical theories, often enable us to bridge the gap between experimentally controlled observations and observations made in the field. For example, if we control the amount ofoxygen in a fish tank in the laboratory, we can determine the minimum amount required for the fish to be healthy. We can then use this number to determine the acceptable mass of organic matter placed in the stream.Given that environmental science is an organized body of knowledge about environmental relationships, then quantitative environmental science is an organized collection of mathematical theories that may be used to describe and explore environmental relationships.In this book, we provide an introduction to some mathematical theories that may be used to describe and explore relationships in environmental science.1 – 2 WHAT IS

ENVIRONMENTAL ENGINEERING? 什么是环境工程?Engineering 工程Engineering is a profession that applies science and mathematics to make the properties of matter and sources of energy useful in structures, machines, products, systems, and processes.Environmental Engineering 环境工程The Environmental Engineering Division of the American Society of Civil Engineers (ASCE) has published the following statement of purpose that may be used to show the relationship betweenenvironmental science and environmental engineering:Environmental engineering is manifest by sound engineering thought and practice in the solution of problems of environmental sanitation, notably in the provision of safe, palatable, and ample public water supplies; the proper disposal of or recycle of wastewater and solid wastes; the adequate drainage of urban and rural areas for proper sanitation; and the control of water, soil, and atmospheric pollution, and the social and environmental impact of these solutions. Furthermore it is concerned with engineering problems in the field of public health, such as control of arthropod-borne diseases, the elimination of industrial health hazards, and the provision of adequate sanitation in urban, rural, and recreational areas, and the effect of technological advances on the environment (ASCE, 1977).Neither environmental science nor environmental engineering should be confused with heating, ventilating, or air conditioning (HVAC), nor with landscape architecture. Neither should they be confused with the architectural and structural engineering functions associated with built environments, such as homes, offices, and other workplaces.1-3 HISTORICAL PERSPECTIVE 历史的观点Overview 概要Recognizing that environmental science has its roots in the natural sciences and that the most rudimentary forms of generalization about natural processes are as old as civilizations, then environmental science is indeed very old. Certainly, the Inca cultivation of crops and the mathematicsof the Maya and Sumerians qualify as early applications of natural science. Likewise the Egyptian prediction and regulation of the annual floods of the Nile demonstrate that environmental engineering works are as old as civilization. On the other hand if you asked Archimedes or Newton or Pasteur what field of environmental engineering and science they worked in, they would have given you a puzzled look indeed! For that matter, even as late as 1687 the word science was not in vogue; Mr. Newton ’ s treatise alludes only to Philosophiae Naturalis Principa Mathematics (Natural Philosophy and Mathematical Principles).1-3 Historical Perspective 3 dav22351_ch01.qxd 12/14/07 9:53 AM Page 3.4 Chapter 1 IntroductionEngineering and the sciences as we recognize them today began to blossom in the 18th century. The foundation of environmental engineering as a discipline may be considered to coincidewith the formation of the various societies of civil engineering in the mid-1800s (e.g., the American Society of Civil Engineers in 1852). In the first instances and well into the 20th century, environmental engineering was known as sanitary engineering because of its roots in waterpurification. The name changed in the late 1960s and early 1970s to reflect the broadening scope that included not only efforts to purify water but also air pollution, solid waste management and the many other aspects of environmental protection that are included in the environmental engineer ’ scurrent job description.Although we might be inclined to date the beginnings of environmental science to the 18th century, the reality is that at any time before the 1960s there was virtually no reference to environmental science in the literature.Although the concepts of ecology had been firmly established by the 1940s and certainly more than one individual played a role, perhaps the harbinger of environmental science as weknow it today was Rachel Carson and, in particular, her book Silent Spring (Carson, 1962). By the mid-1970s environmental science was firmly established in academia, and by the 1980s recognized subdisciplines (environmental chemistry, environmental biology, etc.) that characterize the older disciplines of natural sciences had emerged.Hydrology Citations for the following section originally appeared in Chow ’ s Handbook of Applied Hydrology (1964). The modern science of hydrology may be considered to have begun in the 17th century with measurements. Measurements of rainfall, evaporation, and capillarity in the Seine were taken by Perrault (1678). Mariotte (1686) computed the flow in the Seine after measuring the cross section of the channel and the velocity of the flow.The 18th century was a period of experimentation. The predecessors for some of our current tools for measurement were invented in this period. These include Bernoulli ’ s piezometer, the Pitot tube, Woltman ’ s current meter, and the Borda tube. Ch é zy proposed his equation to describe uniform flow in open channels in 1769.The grand era of experimental hydrology was the 19th century. The knowledge of geology was applied to hydrologic problems. Hagen (1839) and Poiseulle (1840) developed the equationto

describe capillary flow, Darcy published his law of groundwater flow (1856), and Dupuit developed a formula for predicting flow from a well (1863).During the 20th century, hydrologists moved from empiricism to theoretically based explanations of hydrologic phenomena. For example, Hazen (1930) implemented the use of statisticsin hydrologic analysis, Horton (1933) developed the method for determining rainfall excess based on infiltration theory, and Theis (1935) introduced the nonequilibrium theory of hydraulicsof wells. The advent of high-speed computers at the end of the 20th century led to the use of finite element analysis for predicting the migration of contaminants in soil.

编辑推荐

《环境科学与工程原理(第2版)》可作为高等院校环境类专业及生物学、化学等专业的教材，并可供从事环境保护的科技工作者参考。

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