环境工程概论——专业英语教程

OVERVIEW TO ENVIRONMENTAL ENGINEERING

高等学校“十二五”规划教材　市政与环境工程系列丛书

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哈爾濱工業大學出版社

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Overview to Environmental Engineering

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内 容 提 要

本书以介绍环境工程专业知识、培养良好外语能力为出发点，从环境与可持续发展的角度，介绍了给水与废水处理、大气污染与控制、固体废物管理、危险废物管理、噪声污染与控制、辐射污染与控制、环境世界观与可持续性等内容，重点介绍环境工程的基本概念和基本原理。全书以英文编写，每一章节均由课文、工程实例与复习题组成，内容参考多种国外原版教材，为便于使用，书后附有常用环境术语表。

本书图文并茂，内容清晰，适用于我国高等院校给水排水、环境工程专业本科双语和专业英语教学，也可供环境保护爱好者、相关环境研究人员学习参考。

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前　言

近20年来，全球的环境工程技术发展迅速，随着环境意识的深入，人们对环境问题越来越重视，环境工程与技术的高等教育达到一个新的平台。在这一背景下编写适应环境工程专业本科生的英语教材很有必要。本书重点介绍环境工程的基本概念和基本原理，共分7章。第1章主要概念环境工程的背景知识、技术和相关政策发展；第2章主要介绍给水处理系统、废水处理方法以及污泥的处理与处置；第3章主要介绍空气污染物及其控制处理技术；第4章主要概述固体废物和危险废物的综合管理、处理与处置方法；第5章主要概述噪声的特性与影响、评估系统和控制方法；第6章主要介绍辐射的特性与暴露、防护方法；第7章阐述环境世界观的类型与相应的社会可持续发展方向。本书注重材料的新颖与实用性统一，尽可能考虑实际教学中的课时安排与教学要求、学生需求等诸方面情况，力图在宏观上介绍当环境工程领域的发展趋势以及该课程的基本内容。为兼顾教学和学生自学需要，每章后面留有习题。课文内容包括环境工程专业英语词汇和相当数量的常用科技词汇，词汇复现率较高，有助于提高学生正确、快速地阅读英语科技文献能力。

本书由哈尔滨工程大学官涤、丁学忠、米海蓉，吉林建筑工程学院陆海，哈尔滨供水工程有限责任公司王志军等合作编写。书中第1章由米海蓉编写，第2、4、7章由官涤编写，第3章由陆海编写，第5章由丁学忠编写，第6章由王志军编写。全书由官涤担任主编并统稿，丁学忠、陆海、王志军担任副主编。参加本书编写的还有哈尔滨供排水集团有限责任公司王志滨、黑龙江省环境保护科学研究院任伊滨、牡丹江师范学院李继光、牡丹江大学孙慧等，在此一并致谢。

本书选材于原版英文教科书及相关专业著作，书中的引文，编者尽力与原文作者取得联系，但仍有部分联系不上，在此深表歉意。由于本教材涉及面广泛，限于编者水平，书中难免有疏漏不妥之处，敬请有关专家和读者批评批正。

编　者

2011年5月

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Chapter 1 Introduction

1.1 Introduction to Environmental Engineering

Engineering is a profession that applies mathematics and science to utilize the properties of matter and sources of energy to create useful structures, machines, products, systems, and processes. Environmental engineering is a relatively new profession with a long and honorable history. The roots of this profession reach into several major disciplines including civil engineering, public health, ecology, chemistry, and meteorology. From each foundation, the environmental engineering profession draws knowledge, skill, and professionalism.

The Environmental engineering division of the American Society of Civil Engineers (ASCE) has published the following statement of purpose:

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).

Thus, we may consider what environmental engineering is not. It is not concerned primarily with heating, ventilating, or air conditioning(HVAC), nor is it concerned primarily with landscape architecture. Neither should it be confused with the architectural and structural engineering functions associated with built environments, such as homes, offices, and other workplaces.

The general mission of colleges and universities is to allow students to mature intellectually and socially and to prepare for careers that are rewarding. The chosen vocation is ideally an avocation as well. It should be a job that is enjoyable and one approached with enthusiasm even after experiencing many of the ever-present bumps in the road. Designing a water treatment facility to provide clean drinking water to a community can serve society and become a personally satisfying undertaking to the environmental engineer. Environmental engineers now are employed in virtually all heavy industries and utility companies in the world, in any aspect of public works construction and management, by the Environmental Protection Agency(EPA) and other national agencies, and by the consulting firms used by these agencies. In addition, every state and most local governments

have agencies dealing with air quality, water quality and water resource management, soil quality, forest and natural resource management, and agricultural management that employ environmental engineers. Pollution control engineering has also become an exceedingly profitable venture.

Environmental engineering has a proud history and a bright future. It is a career that may be challenging, enjoyable, personally satisfying, and monetarily rewarding. Environmental engineers are committed to high standards of interpersonal and environmental ethics. They try to be part of the solution while recognizing that all people including themselves are part of the problem.

1.2 Overview of Environmental Technology

Before beginning a study of the many different topics that make up environmental terminology and technology, it would be helpful to have an understanding of the overall goals, problems, and alternative solutions available to practitioners in this field.

To present an overview of such a broad subject, we can consider an engineering project involving the subdivision and development of a tract of land into a new community, which will include residential, commercial, and industrial centers, whether the project owner is a governmental agency or a private developer, a wide spectrum of environmental problems will have to be considered and solved before construction of the new community can begin. Usually, the project owner retains the services of an independent environmental consulting firm to address these problems.

1.2.1 Water Supply

One of the first problems project developers and consultants must consider is the provision of a potable water supply, one that is clean wholesome, safe to drink, and available in adequate quantities to meet the anticipated demand in the new community. Some of the questions that must be answered are as follows:

(1) Is there an existing public water system nearby with the capacity to connect with and serve the new development? If not,

(2) Is it best to build a new centralized treatment and distribution system for the whole community, or would it be better to use individual well supplies? If a centralized treatment facility is selected,

(3) What types of water treatment processes will be required to meet federal and state drinking water standards? (Water from a river or a lake usually requires more extensive treatment than groundwater does, to remove suspended particles and bacteria.) Once the source and treatment processes are selected,

(4) What would be the optimum hydraulic design of the storage, pumping, and distribution network to ensure that sufficient quantities of water can be delivered to consumers at adequate pressures?

1.2.2 Sewage Disposal and Water Pollution Control

When running water is delivered into individual homes and businesses, there is an obvious need to provide for the disposal of the used water, or sewage. Sewage contains human wastes, wash water, and dishwater, as well as a variety of chemicals if it comes from an industrial or commercial area. It also carries microorganisms that may cause disease and organic material that can damage lakes and streams as it decomposes.

It will be necessary to provide the new community with a mean for safety disposing of the sewage, to prevent water pollution and to protect public and environmental health. Some of the technical questions that will have to be addressed include the following:

(1) Is there a nearby municipal sewage system with the capacity to handle the additional flow from the new community? If not,

(2) Are the local geological conditions suitable for on-site subsurface disposal of the wastewater (usually septic systems), or it is necessary to provide a centralized sewage treatment plant for new community and to discharge the treated sewage to nearby stream? If treatment and surface discharge are required,

(3) What is the require degree or level of wastewater treatment to prevent water pollution? With a secondary treatment level, which removes at least 85 percent of biodegradable pollutants, be adequate? Or will some forms of advanced treatment be required to meet federal and state discharge standards and stream quality criteria? (Some advanced treatment facilities can remove more than 99 percent of the pollutants.)

(4) Is the flow of industrial wastewater an important factor?

(5) Is it possible to use some type of land disposal of the treated sewage, such as spray irrigation, instead of discharging the flow into a stream?

(6) What methods will be used to treat and dispose of the sludge, or biosolids, that is removed from the wastewater?

(7) What is the optimum layout and hydraulic design of a sewage collection system that will convey the wastewater to the central treatment facility with a minimum need for pumping?

1.2.3 Air Pollution Control

Major sources of air pollution include fuel combustion for power generation, certain industrial and manufacturing processes, and automotive traffic. Project developers can exercise the most control over traffic. Private industry will have to apply appropriate air pollution control technology at individual facilities to meet federal and state standards.

The volume of traffic in the area will obviously increase leading to an increase in exhaust fumes from cars and other vehicles. Proper layout of roads and traffic-flow patterns, however, can minimize the amount of stop-and-go traffic, thus reducing the amount of air pollution in the development.

Usually, the developer's consultant will have to prepare an environmental impact statement (EIS), which will describe the traffic plan and estimate the expected levels of air pollutants. It will have to be shown that air quality standards will not be violated, for the project to gain approval from regulatory agencies. (In addition to air pollution, the completed EIS will address all other environmental effect related to the proposed project.)

1.2.4 Solid and Hazardous Waste Management

The development of a new community (or growth of an exciting community) will certainly lead to the generation of more municipal refuse and industrial waste materials. Ordinarily, the collection and disposal of solid waste is a responsibility of the local municipality. However, some of the waste from industrial sources may be particularly dangerous, requiring special handling and disposal methods.

There is a definite relationship between public and environmental health and the proper handling and disposal of solid wastes. Improper garbage disposal practices can lead to the spread of diseases such as typhus and plague due to the breeding of rats and flies.

If municipal refuse is improperly disposed of on land in a "garbage dump," it is also very likely that surface and groundwater resources will be polluted with leachate (leachate is a contaminated liquid that seeps through the pile of refuse into nearby streams as well as into the ground). On the other hand, incineration of the refuse may cause significant air pollution problems if proper controls are not applied or are ineffective.

Hazardous wastes such as poisonous or ignitable chemicals from industrial processes, must receive special attention with respect to storage, collection, transport, treatment, and final disposal. This is particularly necessary to protect the quality of groundwater, which is the source of water supply for about half the population in the United States. In recent years, an increasing number of water supply wells have been found to be contaminated with synthetic organic chemicals, many of which are thought to cause cancer and other illnesses in humans. Improper disposal of these hazardous materials, usually by illegal burial in the ground, is the cause of the contamination.

Some of the general questions related to the disposal of solid and hazardous wastes from the new community include the following:

(1) Is there a materials recycling facility (MRF, or "murf") serving the area? What will be the waste storage, collection, and recycling requirements (for example, will source separation of household refuse be necessary)?

(2) Will a waste processing facility (such as one that provides for shredding, pulverizing, baling, composting, or incineration) be needed to reduce the waste volume and improve its handling characteristics?

(3) Is there a suitable sanitary landfill serving the area, and will it have sufficient capacity to handle the increased amounts of solid waste for a reasonable period of time? (Despite the best efforts to recycle solid waste or reduce its volume, some material will require final disposal in the ground in

an environmentally sound manner) If not,

(4) Is there a suitable site for construction and operation of a new landfill to serve the area? (A modern sanitary landfill site must meet strict requirements with respect to topography, geology, hydrology, and other environmental conditions.)

(5) Will commercial or industrial establishments be generating hazardous waste, and, if so, what provisions must be made to collect, transport, and process that material? Is there a secure landfill for final disposal available, or must a new one be constructed to serve the area?

1.2.5 Noise and Radiation Pollution Control

Noise can be considered to be a type of air pollution in the form of waste energy—sound vibrations. Noise pollution will result from the construction activity, causing a temporary or short-term impact. The builders may have to observe limitations on the types of construction equipment and the hours of operation to minimize this negative effect on the environment. A long-term impact with respect to the generation of noise will be caused by the increased amount of vehicular traffic. This is another environmental factor that the consulting will have to address in the EIS.

Radiation is commonly defined as energy that flows through matter or through a vacuum. Ionizing radiation, in particular, plays invaluable roles in medical diagnosis and therapy, industrial process control, research, and numerous other areas. This ionizing energy flux may have adverse impacts on biological matter. Radiation sickness, cancer, shortened life, or immediate death may result from varying exposures. Radiation doses to living tissue are measured as grays or rads, units of absorbed energy, and sieverts or rems, units of relative biological damage. The general concern of the environmental engineer is radiation from anthropogenic sources, particularly the radioactive matters from nuclear power plants, radiation from natural sources like mine tailings, and radon, because it is ubiquitous. Wastes are handled in much the same manner as the hazardous wastes.

1.2.6 Other Environmental Factors

Not to be overlooked as all environmental factors in any land development project is the potential impact on local vegetation and wildlife. The destruction of woodlands and meadows to make room for new buildings and roads can lead to significant ecological problems, particularly if there are any rare or endangered species in the area. Cutting down trees and paving over meadows can cause short-term impacts related to soil erosion and stream sedimentation. On a long-term basis, it will cause the displacement of wildlife to other suitable habitats, presuming, of course, that such habitats are available nearby, otherwise, several species may disappear from the area entirely.

Human activity in wetland areas, including marshes and swamps, can be very damaging to the environment. Coastal wetlands are habitats for many different species of organisms, and the tremendous biological productivity of these wetland environments is a very important factor in the food chain for many animals. When wetlands are drained, filled in, or dredged for building and land development projects, the life cycle of many organisms is disrupted. Many species may be

destroyed as a result of habitat loss or loss of a staple food source. Wetlands also play important roles in filtering and cleaning water and in serving as reservoir for floodwaters. There is a definite need to control or restrict construction activities in wetland environments and to implement a nationwide wetlands protection program.

Environmental concerns related to general sanitation in a new community include food and beverage protection, insect and rodent control, industrial hygiene and occupational safety, and the cleanliness of recreation areas such as public swimming pools. These concerns are generally the responsibility of local departments.

1.3 The Development of Environmental Policy

Public policy is the general principal by which government branches—the legislative, executive, and judicial—are guided in their management of public affairs. The legislature (Congress) is directed to declare and shape national policy by passing legislation, which is the same as enacting law. The executive (president) is directed to enforce the law while the judiciary (the court system interprets the law when a dispute arises (see Figure 1.1)).

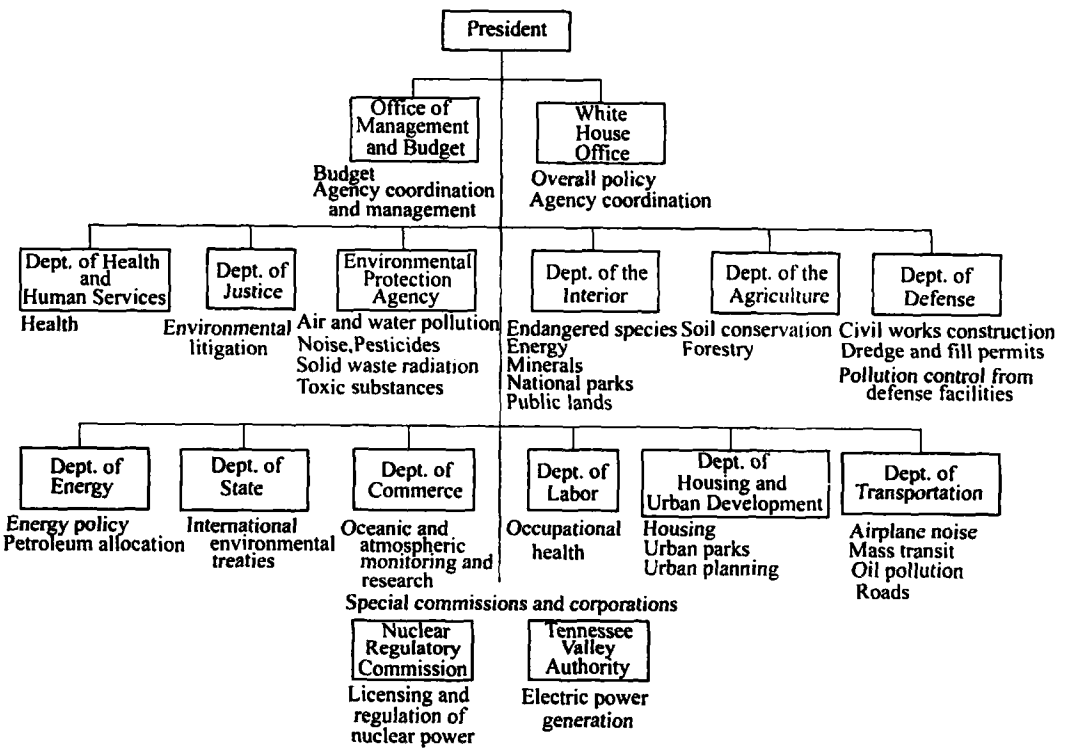

Figure 1.1 Major Agencies of the Executive Branch in the U.S.

(Major agencies of the executive branch are shown with their environmental responsibility)

When Congress considers certain conduct to be against public policy and against the public

good, it passes legislation in the form of acts or statutes. Congress specifically regulates, controls, or prohibits activity in conflict with public policy and attempts to encourage desirable behavior. Through legislation, Congress regulates behavior, selects agencies to implement new programs, and sets general procedural guidelines. When Congress passes environmental legislation, it also declares and shapes the national environmental policy, thus fulfilling its policy-making function (see Figure 1.2).

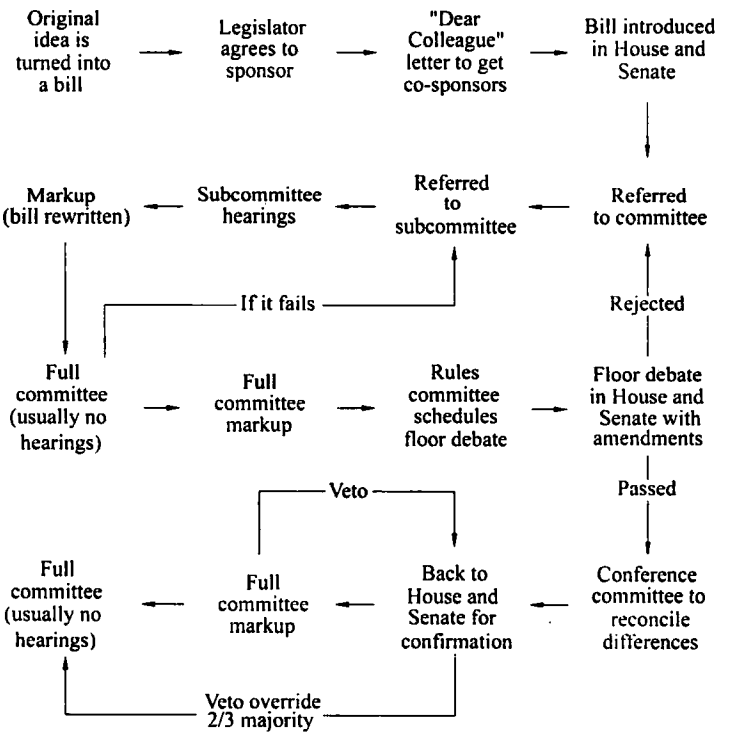

Figure 1.2 Passage of a Law

(This figure illustrates the path of a bill in the U.S. Congress from organization to becoming a law)

Over 90 years ago, President Teddy Roosevelt declared that nothing short of defending your country in wartime "compares in leaving the land even better land for our descendants than it is for us." The environmental issues that Roosevelt strongly believed in, however, did not become major political issues until the early 1970s.

While the publication of Rachel Carson's *Silent Spring* in 1962 is considered to be the beginning of the modern environmental movement, the first Earth Day on April 22, 1970, was perhaps the single event that put the movement into high gear. In 1970, as a result of mounting public concern over environmental deterioration—cities clouded by smog, rivers on fire, waterways choked by raw sewage—many nations, including the United States, began to address the most obvious, most acute environmental problems.

Public opinion polls indicate that a permanent change in national priorities followed Earth Day

1970. When polled in May 1971, 25 percent of the U. S. public declared protecting the environment to be an important goal—a 2 500 percent increase over the proportion in 1969.

During the 1970s, many important pieces of environmental legislation were enacted in the United States (see Figure 1.2). Many of the identified environmental problems were so immediate, so obvious, that it was relatively easy to see what had to be done and to summon the political will to do it (see Table 1.1).

Just as it was beginning to gain momentum, however, the environmental movement began to decline. When the energy crisis threatened to stall the North American economy in the early 1970s, environmental concerns quickly faded. By 1974, President Gerald Ford had proposed accelerating his administration's leasing program for offshore gas and oil drilling. A turn around in environmental policy was even more pronounced in the 1980s during the Reagan administration. Former Vice President Walter Mondale was fond of noting that President Ronald Reagan "would rather take a polluter to lunch than to court." During the mid-1980s, the environment was not a priority in the Reagan administration.

The period from 1970 to 1990, however, did bring forth some very tangible accomplishments in environmental policy. Among the most visible and quantifiable is the expansion of protected areas. During this period, federal parklands in the United States—excluding Alaska—increased 800 000 hectares (2 million acres), to 10.5 million (25.9 million acres). In Alaska, 18.3 million additional hectares (45 million acres) were protected, bringing the state's total to over 232 million hectares (573 million acres). Also, the extent of the water-ways included in the National Wild and Scenic Rivers System increased by more than 12 times, to some 15 000 kilometers (9 300 miles).

By the late 1980s, however, a new environmental awareness and concern began to surface as a major political issue. This was in part due to a number of highly visible environmental problems that appeared nightly on the evening news. Images of toxic waste (including hospital waste, such as used syringes) washing up on the nation's beaches and of the pristine waters of Alaska covered in oil from the Exxon Valdez spill made an impact on the public. Once again, the public reacted by organizing and putting pressure on the political system, and, as in 1970, the politicians began to respond. For the first time in the history of the United States, the environment became a key issue in a presidential campaign. In 1988, the environmental records of the two major candidates were hotly debated. Environmentalism was evolving as a major public issue. By the 1992 U. S. presidential election, the environment was established as a major campaign issue, a trend that continues today.

In many respects, the environmental movement of the 1970s and 1980s came of age in the 1990s. The linking of politics and science, and emotionalism and logic in a new environmental movement represented a significant integration of human thinking. It has been said that politics have always forged science, Prioritization of issues and political will determine where money will be spent. By the mid-1990s, it appeared that political will in the United States to address environmental concerns was on the rise.