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环境工程专业英语

羌宁 编

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前　　言

《环境工程专业英语》是为提高高等学校环境专业学生的专业文献阅读能力和应用水平而编写的。课文题材广泛，选材上注意专业领域的覆盖面与知识的新颖性，除可满足课堂教学所需外，兼有提供课外阅读材料的功能。

全书共25章，包括环境与可持续发展，生态系统基础知识，环境工程师的职能，空气污染及控制，城市固体废物的全过程管理，有毒有害化学废物的处理处置，噪声及其控制，环境影响评价，国外的环境立法，给水工程和废水管道收集，废水的处理、处置和回用以及废水污泥的处理、处置等，还涉及废水处理工程的设计、运行管理和项目实施等方面，并简要系统地介绍了当今环境保护方面的新思维和科技成就。

为读者能较快扩展专业词汇，在课文中对一些专业词汇和术语用下划线提示，书后附有课文中出现过的词汇和专业术语总表并标注了第一次在书中出现的章号，以便于读者查阅；同时还对课文中的一些较难的句子和段落予以注释，以便于读者理解。

本书力图为读者在环境工程英语阅读能力的提高方面起到引路的作用，除适用环境工程大学三年级以上学生的专业英语学习外，还适用于研究生和有关专业技术人员作为英文环境工程导论阅读材料使用。

限于编者的水平，教材中可能会出现错漏，望读者指正。

编者

2004年6月

内 容 提 要

本书旨在提高环境专业学生的专业文献阅读和应用水平，书中介绍了环境工程领域涉及的水、大气的污染与控制，固体废物的全过程管理，有害废物的处理处置，噪声及其控制，环境影响评价，环境立法，环境与可持续发展等内容，并简要介绍了当今环境保护方面的新科技。编者根据教学中学生易犯的错误在书中有重点地解释说明，具有很强的针对性。书后的单词表注有该词在正文中的首次出处，便于检索。

本书可作为高等院校环境工程专业本科生教材，也可供环境工程专业研究生及相关专业人员使用。

Contents

Chapter 1 Environmental Issue

Today we stand at the threshold of a major change in our approach to environmental issues. Two paths lie before us. One is business as usual, the approach to environmental issues we have taken for the past 30 years, an approach that has produced many advances but also many failures. This path has emphasized confrontation, emotionalism, a lack of understanding of basic facts about the environment and of how natural ecological systems function and a willingness to base solutions on political ideologies and on ancient myths about nature.

The second path offers the potential for long-lasting, successful solutions to environmental problems. This approach seeks to move from confrontation to cooperative problem solving, from explaining the environment in terms of ancient myths about nature to providing a sound scientific basis from which to view environmental issues.

1.1 Environmental Problems

The environmental problems we face—population growth, wasteful use of resources, destruction and degradation of wildlife habitats, extinction of plants and animals, poverty, and pollution—are interconnected and are growing exponentially. For example, world population has more than doubled in only 44 years, from 2.5 billion in 1950 to 5.8 billion in 1996. Unless death rates rise sharply, it may reach 8.2 billion by 2025, 10～11 billion by 2050, and 14 billion by 2100. Global economic output—much of it environmentally damaging—has increased almost six fold since 1950.

Each year more forests, grasslands, and wetlands disappear, and some deserts grow larger. According to a recent study by Conservation International, human activities have modified or disturbed 73% of the earth's land area (if we exclude uninhabitable areas of rock, ice, desert, and steep mountain terrain). Vital topsoil is washed or blown away from farmland, cleared forests, and construction sites—clogging streams, lakes, and reservoirs with sediment. Many grasslands have been overgrazed and fisheries overharvested. In a growing number of places, underground water is pumped from wells faster than it can be replenished. Oceans, streams, and the atmosphere are used as trash cans for a variety of wastes, many of them are toxic. According to some estimates, we drive two to eight wildlife species to extinction every hour.

Burning fossil fuels (oil, coal, and natural gas), and cutting down and burning forests, raise the amount of carbon dioxide and other heat-trapping gases in the lower atmosphere. Within the next 40～50 years, the earth's climate may become warm enough to disrupt agricultural productivity, alter water distribution, drive countless species to extinction, and cause economic chaos. Extracting and burning fossil fuels pollutes the air and water and disrupts the land. Other chemicals we add to the air drift into the upper atmosphere and deplete ozone gas, which filters out much of the sun's harmful ultraviolet radiation. Toxic wastes from factories and mines poison the air, water, and soil. Agricultural pesticides contaminate some of our drinking water and food.

1.2 Living Sustainably

What are Solar Capital, Earth Capital, and Sustainability? Our existence, lifestyles, and economies depend completely on the sun and the earth, a blue and white island in the black void of space. We can think of energy from the sun as solar capital, and we can think of the planet's air, water, soil, wildlife, minerals, and natural purification, recycling, and pest control processes as earth capital (Figure 1.1). The term environment is often used to describe these life-support systems; in effect, it's another term for solar capital and earth capital.

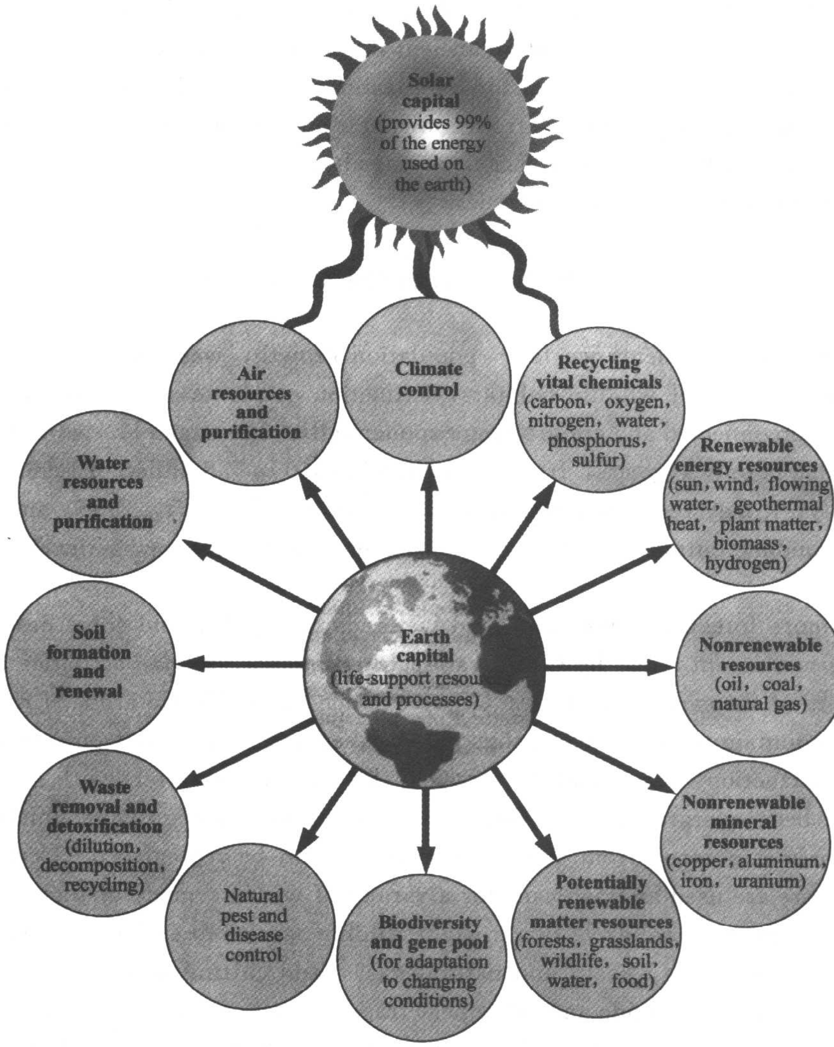

Figure 1.1 Solar and earth capital consists of the life-support resources and processes provided by the sun and the planet for use by us and other species. These two forms of capital support and sustain all life and all economies on the earth.

A sustainable society manages its economy and population size without exceeding all or part of the planet's ability to absorb environmental insults, replenish its resources, and sustain human and other forms of life over a specified period, usually hundreds to thousands of years. During this period, it satisfies the needs of its people without degrading or depleting earth capital and thereby jeopardizing the prospects of current and future generations.

Living sustainably means living off of income and not depleting the capital that supplies the income. The same lesson applies to earth capital (Figure 1.1). With the help of solar energy, natural processes developed over billions of years can indefinitely renew the topsoil, water, air, forests, grasslands, and wildlife on which we and other forms of life depend, so long as we don't use these potentially renewable resources faster than they are replenished.

Some of the earth's natural processes also provide flood prevention, build and renew soil, slow soil erosion, and keep the populations of at least 95% of the species we consider pests under control. Living sustainably involves not disrupting or diminishing these and other processes provided by nature (Figure 1.1).

Is Our Present Course Sustainable? The Scientific Consensus Environmentalists and many leading scientists believe that we are depleting and degrading the earth's natural capital at an accelerating rate as our population and demands on the earth's resources and natural processes increase exponentially.

On November 18, 1992, 1680 of the world's senior scientists from 70 countries, including 102 of the 196 living scientists who are Nobel laureates, signed and sent an urgent warning to government leaders of all nations. According to this warning,

The environment is suffering critical stress...Our massive tampering with the world's interdependent web of life—coupled with the environmental damage inflicted by deforestation, species loss, and climate change—could trigger widespread adverse effects, including unpredictable collapses of critical biological systems whose interactions and dynamics we only imperfectly understand. Uncertainty over the extent of these effects cannot excuse complacency or delay in facing the threats...No more than one or a few decades remain before the chance to avert the threats we now confront will be lost and the prospects for humanity immeasurably diminished...Whether industrialized or not, we all have but one lifeboat. No nation can escape injury when global biological systems are damaged...We must recognize the earth's limited capacity to provide for us.

Also in 1992, the prestigious U. S. National Academy of Sciences and the Royal Society of London issued a joint report—their first ever—which begins,

If current predictions of population growth prove accurate and patterns of human activity on the planet remain unchanged, science and technology may not be able to prevent either irreversible degradation of the environment or continued poverty for much of the world.

These two major warnings don't represent the views of a small number of scientists but the consensus of the mainstream scientific community. Some other analysts, mostly economists, disagree. They contend that there are no limits to human population growth and economic growth that can't be overcome by human ingenuity and technology.

1.3 Resources

What Is a Resource? In human terms, a resource is anything we get from the environment (the earth's life-support systems) to meet our needs and desires. However, all forms of life need resources such as food, water, and shelter for survival and good health.

Some resources, such as solar energy, fresh air, wind, fresh surface water, fertile soil, and wild edible plants, are directly available for use by us and other organisms. Other resources, such as petroleum (oil), iron, groundwater (water occurring underground), and modern crops, aren't directly available. They become useful to us only with some effort and technological ingenuity. Petroleum, for example, was a mysterious fluid until we learned how to find it, extract it, and refine it into gasoline, heating oil, and other products that could be sold at affordable prices. On our short human time scale, we classify material resources as renewable, potentially renewable, or nonrenewable.

What Are Renewable Resources? Solar energy is called a renewable or perpetual resource because on a human time scale this solar capital is essentially inexhaustible. It is expected to last at least 6 billion years as the sun completes its life cycle.

A potentially renewable resource can be replenished fairly rapidly (hours to several decades) through natural processes. Examples of such resources are forest trees, grassland grasses, wild animals, fresh lake and stream water, groundwater, fresh air, and fertile soil.

One important potentially renewable resource for us and other species is biological diversity, or biodiversity, which consists of the different life forms (species) that can best survive the variety of conditions currently found on the earth. The earth's vast inventory of life forms and biological communities are a vital part of the earth capital that supports life on the planet.

However, potentially renewable resources can be depleted. The highest rate at which a potentially renewable resource can be used indefinitely without reducing its available supply is called its sustainable yield. If a resource's natural replacement rate is exceeded, the available supply begins to shrink, a process known as environmental degradation. Several types of environmental degradation can change potentially renewable resources into nonrenewable or unusable resources.

Renewable Resources and the Tragedy of the Commons. One cause of environmental degradation is the overuse of common-property resources, which are owned by no one (or by everyone) but are available to all users free of charge. Most are potentially renewable. Examples include clean air, the open ocean and its fish, migratory birds, publicly owned lands (such as national forests, national parks, and wildlife refuges), gases of the lower atmosphere, and space.

In 1968 biologist Garrett Hardin called the degradation of common-property resources the tragedy of the commons. It happens because each user reasons, "If I don't use this resource, someone else will. The little bit I use or pollute is not enough to matter." With only a few users, this logic works. However, the cumulative effect of many people trying to exploit a common-property resource eventually exhausts or ruins it. Then no one can benefit from it, and therein lies the tragedy.

One solution is to use common-property resources at rates below their sustainable yields or overload limits by reducing population, regulating access, or both. Unfortunately, it is difficult to determine the sustainable yield of forest, grassland, or an animal population, partly because yields vary with weather, climate, and unpredictable biological factors, and because getting and updating such data is expensive.

These uncertainties mean that it is best to use a potentially renewable resource at a rate well below its estimated sustainable yield. This is a prevention or precautionary approach designed to reduce the risk of environmental degradation. This approach is rarely used because it requires hard-to-enforce regulations that restrict resource use and thus conflict with the drive for short-term profit or pleasure.

Another approach is to convert common-property resources to private ownership. The reasoning behind this is that owners of land or some other resource have a strong incentive to see that their investment is protected. However, this approach is not practical for global common resources, such as the atmosphere, the open ocean, and migratory birds that cannot be divided up and converted to private property. Experience has also shown that private ownership can lead to short-term exploitation instead of long-term sustainability.

Some believe that privatization is a better way to protect nonrenewable and potentially renewable resources found on publicly owned lands than relying on command-and-control government regulations and bureaucracies. Most environmentalists disagree. They point out that widespread pollution and environmental degradation have resulted from the removal of nonrenewable mineral resources and unsustainable use of potentially renewable soil, grasslands, forests, and wildlife resources on privately owned lands.

Many environmentalists agree that the command-and-control approach to use of resources on public lands (such as national parks, wildlife refuges, and wilderness areas) has some serious problems. They and some free-market economists are seeking users-pay solutions to replace the current taxpayers-pay approach to use of such publicly owned resources. This would involve a mix of marketplace incentives coupled with regulations that require users to pay a fair price for all resources extracted from public lands and to be responsible for preventing or cleaning up any environmental damage caused by resource extraction or use.

What Are Nonrenewable Resources? Resources that exist in a fixed quantity in the earth's crust and thus theoretically can be completely used up are called nonrenewable, or exhaustible, resources. On a time scale of millions to billions of years, such resources can be renewed by geological processes. However, on the much shorter human time scale of hundreds to thousands of years, these resources can be depleted much faster than they are formed.

These exhaustible resources include energy resources (coal, oil, natural gas, and uranium, which cannot be recycled), metallic mineral resources (iron, copper, and aluminum, which can be recycled), and nonmetallic mineral resources (salt, clay, sand, and phosphates, which are usually difficult or too costly to recycle). A mineral is any hard, usually crystalline material that occurs naturally. Soil and most rocks consist of two or more minerals. We know how to find and extract more than 100 nonrenewable minerals from the earth's crust. We convert these raw materials into many everyday items and then we discard, reuse, or recycle them.

In practice, we never completely exhaust a nonrenewable mineral resource. However, such a resource becomes economically depleted when the costs of exploiting what is left exceed its economic value. At that point, we have five choices: recycle or reuse existing supplies (except for nonrenewable energy resources, which cannot be recycled or reused), waste less, use less, try to develop a substitute, or do without and wait millions of years for more to be produced.

Some nonrenewable material resources, such as copper and aluminum, can be recycled or reused to extend supplies. Recycling involves collecting and reprocessing a resource into new products. For example, glass bottles can be crushed and melted to make new bottles or other glass items. Reuse involves using a resource over and over in the same form. For example, glass bottles can be collected, washed, and refilled many times.

Recycling nonrenewable metallic resources requires much less energy, water, and other resources and produces much less pollution and environmental degradation than exploiting virgin metallic resources. Reuse of such resources requires even less energy and other resources than recycling, and it results in less pollution and environmental degradation.

Nonrenewable energy resources, such as coal, oil, and natural gas, can't be recycled or reused. Once burned, the useful energy in these fossil fuels is gone, leaving behind waste heat and polluting exhaust gases. Most of the per capital economic growth has been fueled by relatively cheap nonrenewable oil, which is expected to be economically depleted within 40～80 years.

Most published estimates of the supply of a given nonrenewable resource refer to reserves: known deposits from which a usable mineral can be profitably extracted at current prices. Reserves can be increased when new deposits are found or when price increases make it profitable to extract identified deposits that were previously considered too expensive to exploit.

Depletion time is the time it takes to use up a certain proportion—usually 80%—of the reserves of a mineral at a given rate of use. The shortest depletion time assumes no recycling or reuse and no increase in reserves. A longer depletion time assumes that recycling will stretch existing reserves and that better mining technology, higher prices, and new discoveries will increase reserves. An even longer depletion time assumes that new discoveries will further expand reserves and that recycling, reuse, and reduced consumption will extend supplies. Finding a substitute for a resource dictates a new set of depletion curves for the new resource.

Some environmentalists and resource experts believe that the greatest danger may not be the exhaustion of nonrenewable resources but the damage that their extraction, processing, and conversion to products do to the environment in the form of energy use, land disturbance, soil erosion, water pollution, and air pollution.

1.4 Pollution

What Is Pollution and Where Does It Come From? Any addition to air, water, soil, or food that threatens the health, survival, or activities of humans or other living organisms is called pollution. Most pollutants are solid, liquid, or gaseous by-products or wastes produced when a resource is extracted, processed, made into products, or used. Pollution can also take the form of unwanted energy emissions, such as excessive heat, noise, or radiation.

Pollutants can enter the environment naturally (for example, from volcanic eruptions) or through human (anthropogenic) activities (for example, from burning coal). Most pollution from human activities occurs in or near urban and industrial areas, where pollutants are concentrated. Industrialized agriculture is also a major source of pollution. Some pollutants contaminate the areas where they are produced; others are carried by winds or flowing water to other areas. Pollution does not respect local, state, or national boundaries.

Some pollutants come from single, identifiable sources, such as the smokestack of a power plant, the drainpipe of a meat-packing plant, or the exhaust pipe of an automobile. These are called point sources. Other pollutants come from dispersed (and often difficult to identify) nonpoint sources. Examples are the runoff of fertilizers and pesticides (from farmlands, golf courses, and suburban lawns and gardens) into streams and lakes, and pesticides sprayed into the air or blown by the wind into the atmosphere. It is much easier and cheaper to identify and control pollution from point sources than from widely dispersed nonpoint sources.

What Types of Harm Do Pollutants Cause? "Unwanted effects of pollutants include disruption of life-support systems for humans and other species, damage to wildlife, damage to human health, damage to property, and nuisances such as noise and unpleasant smells, tastes, and sights." Three factors determine how severe the harmful effects of a pollutant are. One is its chemical nature: how active and harmful it is to living organisms. Another is its concentration: the amount per unit of volume or weight of air, water, soil, or body weight. One way to lower the concentration of a pollutant is to dilute it in a large volume of air or water. Until we started overwhelming the air and waterways with pollutants, dilution was the solution to pollution. Now it is only a partial solution. The third factor is a pollutant's persistence: how long it stays in the air, water, soil, or body. Degradable, or nonpersistent, pollutants are broken down completely or reduced to acceptable levels by natural physical, chemical, and biological processes. Complex chemical pollutants broken down (metabolized) into simpler chemicals by living organisms (usually by specialized bacteria) are called biodegradable pollutants. Human sewage in a river, for example, is biodegraded fairly quickly by bacteria if the sewage is not added faster than it can be broken down.

Many of the substances we introduce into the environment take decades or longer to degrade. Examples of these slowly degradable, or persistent, pollutants include the insecticide DDT and most plastics.

Nondegradable pollutants cannot be broken down by natural processes. Examples include the toxic elements lead and mercury. The best ways to deal with nondegradable pollutants (and slowly degradable pollutants) are to not release them into the environment or to recycle or reuse them. Removing them from contaminated air, water, or soil is an expensive and sometimes impossible process.

We know little about the possible harmful effects of 90% of the 72000 synthetic chemicals now in commercial use and the roughly 1000 new ones added each year. Our knowledge about the effects of the other 10% of these chemicals is limited, mostly because it is quite difficult, time-consuming, and expensive to get this information. Even if we determine the main health and other environmental risks associated with a particular chemical, we know little about its possible interactions with other chemicals or about the effects of such interactions on human health, other organisms, and life-support processes.

Solutions: What Can We Do About Pollution? There are two basic approaches to dealing with pollution: prevent it from reaching the environment or clean it up if it does. Pollution prevention, or input pollution control, is a throughput solution. It slows or eliminates the production of pollutants, often by switching to less harmful chemicals or processes. Pollution can be prevented (or at least reduced) by the three-Rs of resource use: reduce, reuse, and recycle.

Pollution cleanup, or output pollution control involves cleaning up pollutants after they have been produced. This is an important approach, but environmentalists have identified several problems with relying primarily on pollution cleanup. First, it is often only a temporary bandage as long as population and consumption levels continue to grow without corresponding improvements in pollution control technology. For example, adding catalytic converters to cars has reduced air pollution, but increases in the number of cars and in the total distance each travels (increased throughput) have reduced the effectiveness of this cleanup approach.