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Environmental Pollution Control Technology

Liu Jingling Zhang Lulu Liu Zhijie



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Preface

Environment issue has become a complex issue involving many fields such as politics, economy, diplomacy, society, culture, science and technology with multiple dimensions. International negotiations on key environmental topics such as addressing climate change and conservation of biodiversity increasingly become the hot topic of foreign affairs and focus of interests of many countries in the world. This has something to do with deepening understanding of the international communities in the field of environment and development. In particular, there are four historic leaps of human understanding about eco environment issues. The first leap happened at the First United Nations Conference on the Human Environment in Stockholm, Sweden in June of 1972. This conference gives a warning to the whole world that there is "Only One Earth". The Declaration on the Human Development adopted by the conference stresses that "Man has constantly to sum up experience and go on discovering, inventing, creating and advancing." The second leap happened at the United Nations Conference in Environment and Development held in Rio de Janeiro, Brazil in June, 1992. This meeting for the first time considers economic development in the context of environmental protection, identifies the principle of "common but differentiated responsibilities" and puts forward sustainable development strategy. The third leap happened at the World Summit on Sustainable Development held in Johannesburg, South Africa in August of 2002. This meeting identifies that economic development, social progress and environmental protection are the three pillars for sustainable development. The fourth leap occurred at the United Nations Conference on Sustainable Development held in Rio de Janeiro, Brazil in June of 2012. Targeting the theme of "Build Green

Economy to Achieve Sustainable Development and Lift People out of Poverty” and “Institutional Framework for Sustainable Development”, this conference has discussed and adopted the outcome document The Future We Want centering on the three objectives of “Securing renewed political commitment for sustainable development”, “Assessing the progress and implementation gaps in meeting previous commitments” and “Addressing new and emerging challenges”. It has decided to launch the process for achieving the objectives of sustainable development and help developing countries enhance their capacity in sustainable development.

The commencement, growth and development of environmental protection cause of China keep the same pace with that of the world. As the biggest developing country in the world, China makes active contributions to the four leaps in the field of global environment and development. In particular, the Central Committee of Communist Party of China and the State Council put forward a series of new concepts such as the development of ecological civilization, ecological restoration of rivers and lakes, promotion of historic transformations of environmental protection and exploration of new path to environmental protection that protects the environment in the process of development and development in the process of environmental protection; release many major policy measures since the beginning of the “11th Five-Year Plan” period to facilitate important changes of environmental protection from understanding to practice.

In view of the difficulties such as still prominent imbalanced, uncoordinated and unsustained development issue, inappropriate industrial structure, increasing resource and environment constraints and evidently more social contradictions in the development of our country, the 18th National Congress of Communist Party of China closed in mid November of 2012 for the first time integrates the development of ecological civilization into the five overall arrangements for the cause of socialism with Chinese characteristics. This is a key innovation of the Chinese Government in both concept and practice of development; a

strategic option complying with the new trend of green and low-carbon development of the world; and an effective approach to facilitate our economy and society following the path of comprehensive, coordinated, sustainable and scientific development. The development of ecological civilization is both a key development issue and an important welfare issue. It is conducive to the improvement of eco environment quality, promotion of social harmony and stability and enhancement of sustainable development capacity. We must establish the idea of ecological civilization that respects, complies with and protects nature; put the development of ecological civilization at prominent position, and incorporate it into all aspects and whole process of economic, political, cultural and social development; strive for developing beautiful China, march toward new era of socialist ecological civilization, achieve sustainable development of the Chinese nation and make contributions to global ecological safety.

The Chinese Government firmly adheres to the independent foreign policy of peace, unswervingly follows the path of peaceful development and strives for developing a harmonious world of lasting peace and common prosperity. In international environment cooperation and exchanges, China firmly adheres to the principles of common but differentiated responsibilities, equity and respective capability; proactively lends a helping hand to developing countries, shoulders the obligations and responsibility for foreign aid within our capacity, actively strengthens the unity and cooperation with developing countries, jointly safeguards legitimate rights and interests of developing countries, supports stronger representation and voice of developing countries in international affairs, and will always be a reliable friend and sincere partner of developing countries.

With the Green Envoy Program of China South - South Environment Cooperation, Ministry of Environmental Protection has organized a range of environmental protection training courses for environmental officials and professionals of developing countries over the past few years with participants from the countries of regions like Africa, West

Asia, Oceania, Southeast Asia, Central Asia and Latin America, which have facilitated bilateral and multilateral environmental cooperation; strengthened friendship and mutual understanding and obtained good achievement. To better standardize the management of international environmental training and exchange activities in the future, Ministry of Environmental Protection has organized relevant experts to compile a series of books for environmental training under the Green Envoy Program of China South - South Environmental Cooperation. This series include six books that systematically summarize typical policies, laws and regulations, management skills and professional expertise in environmental protection field of China. With both professional theory and analysis on practical cases, this series of books fill the gap of the textbooks for training overseas participants in the field of environmental protection.

I believe that the publication of this series of books will showcase and publicize new concepts and successful practice of environmental protection of our country, especially important role in publicizing successful experience of our country in the development of ecological civilization and beautiful China.

周生贤

CONTENTS

Chapter 1 The Principle of Environmental Pollution Control	1
1.1 The basic theory.....	1
1.2 Environmental pollution control targets	4
1.3 Pollution control technology	9
1.4 High-technology outlook.....	15
References	17
 Chapter 2 Water Pollution Control Technology	18
2.1 Introduction	18
2.2 Physical method.....	21
2.3 Chemical method.....	28
2.4 Physicochemical method	36
2.5 Biological method	54
2.6 The technique process and reuse of wastewater	69
2.7 Summary and Outlook.....	77
References	77
 Chapter 3 Air Pollution Control Technology	79
3.1 Introduction	79
3.2 Air pollution control technology for stationary-source	81
3.3 The air pollution control technology of mobile- source	94
3.4 Summary and Outlook.....	105
References	106
 Chapter 4 Solid Waste Pollution Control Technology	107
4.1 Introduction	107
4.2 Solid waste treatment and disposal technologies.....	108
4.3 Industrial solid waste treatment and disposal technology.....	132
4.4 Hazardous waste treatment and disposal technology	135
4.5 Summary and Outlook.....	148
References	150

Chapter 5 Physical Pollution Control Technology	151
5.1 Introduction	151
5.2 The sound source control technology	154
5.3 Noise control technology	187
5.4 Noise Pollution Control Planning and Management	195
5.5 Other physical pollution prevention technology	200
5.6 Summary and Outlook	207
References	209
 Chapter 6 Ecological Recovery Technology	 210
6.1 Introduction	210
6.2 Ecological Engineering Design	212
6.3 Ecological Engineering Technology	222
6.4 Ecological engineering technology optimization	245
6.5 Summary and Outlook	272
References	272
 Chapter 7 Regional environmental systems engineering and technology	 274
7.1 Introduction	274
7.2 Environmental system information technology and simulation model	274
7.3 Regional/Watershed Planning Technology	302
7.4 Summary and Outlook	317
References	318
 Postscript	 319
Acknowledgements	321
About the authors	322

Chapter 1

The Principle of Environmental Pollution Control

1.1 The basic theory

The globality and complexity of the environmental problems is a new challenge faced by the mankind; managers, experts, and the public around the world attach great importance to it. Environmental Pollution Control Technology is the key technology of implementing sustainable development strategy. The principle of environmental pollution prevention and control is the optimization, application, and innovation of environmental pollution control technology and theoretical support.

The type of environmental pollution could be classified in various ways. In accordance with the environmental elements, it can be divided into air pollution, water pollution, soil pollution, and physical pollution. In accordance with the anthropogenic activities, it can be divided into industrial pollution, cities pollution, and agricultural pollution. In accordance with the nature and sources of pollution, it can be divided into chemical pollution, biological pollution, physical pollution, solid waste pollution, and energy pollution.

The features of environmental pollution as follows:

① Pollutants can enter the environment naturally or can be caused by human activities (for example from burning coal). Most pollution from anthropogenic activities occurs in or near urban and industrial areas, where pollutants are concentrated. Industrialized agriculture also is the major source of pollution.

② Pollutants could transform, metabolize, degrade or enrich in the environment through biological, physical or chemical reactions, which result in properties and concentration change of pollutants and then cause different harmful effects.

③ Pollutants affect the human body with a long time through air, water, soil and food in various ways. For example, disruption of life-support systems for humans and other species, damage to wildlife, human health, and property, nuisances such as noise and unpleasant smells, tastes, and sights.

Two approaches are commonly used to deal with pollution: ①to prevent

pollution come into the environment, or ②to clean it up if it did. Pollution prevention or pollution sources control can reduce or eliminate the generation of pollutants. Pollution can be prevented by the following “five Rs” of resource use: refuse, replace, reduce, reuse, and recycle.

Theory is the foundation and precondition for technology and management innovation, which determines development, practice and integration of environmental. The theory of sustainable development requires legal protection, technical support and management practice to build, in order to ultimately be built into national/regional environmental security and early warning system.

1.1.1 The theory of circular economy

Circular economy is a kind of ecological economy, which is the integration of cleaner production and comprehensive utilization of waste, in accordance with the material circulation of natural ecosystem and energy flow pattern reconstruction of the economic system, it is harmonious with the natural ecosystem material cycle.

Circular economy is based on the basis of constant and circulatory use of resource, which requires the economic activities in accordance with the natural ecological system pattern, forming a “resource-product-renewable resource” such a closed-loop model of material cyclic flow. The important symbol of resources utilization is the comprehensive, waste reutilization, reduction, and harmless. The main objectives is to achieve the sustainable use of resources, such as the resources with “ efficient use and low pollution emissions”.

Circular economy will become the main mode in future development in developing countries. At present, Guigang national ecological industry (sugar) demonstration zone and the south China sea, national ecological demonstration zone are carried out about the cycle test and pilot, for the promotion of circular economy in China has accumulated valuable experiences.

1.1.2 The life cycle theory

The life cycle theory may be involved in various stages of the product system. It is an application of self-organization of ecosystem structure and function and

the theory of ecological balance in the production and living. Life cycle is an important theoretical basis for the clean production, and aims at help environmental management. In the long term, that is, the tools and techniques of sustainable development.

Life Cycle Assessment (LCA) includes the entire life cycle of the product or the production and living activities. LCA studies environmental impact of the system from three areas: the ecosystem, human health and resources consumption, but does not deal with the economic and social impact. In accordance with the ISO definition, LCA is a technique that research to produce, use, and dispose the entire product life cycle from raw material (from the cradle - the grave - the cradle) may be involved in environmental aspects and potential impacts.

LCA has 20 years of development history, known as “environmental management tools” in the 1990s, in the 21st century, it is the most important utility tool at different levels of environmental protection and sustainable development, and plays an important role in cleaner production and energy conservation.

1.1.3 Complex systems theory

Complex system theory is a front direction in system science, the most active fields of science and hotspot after the combined with environmental sciences, which is the main task of complexity science. Its main purpose is to reveal the dynamics process of complex systems which is difficult to explain through existing scientific methods.

Compared with traditional reductionist approach, the different is the complex systems theory emphasizes combining holistic method with reductionist method to analysis system. Living systems, social systems, and environmental systems are complex systems, complex systems theory applied in large-scale integration and optimization of environmental technology, environmental simulation, and mathematical modeling have great significance.

The main difference with the traditional control system is as follows:

- ① Model: The system model is usually the subject and their interactions with the evolution of variable structure description.
- ② Objectives: to the overall behavior of the system.
- ③ The law: to explore the generally evolutionary dynamics law.

In the process of national, regional / watershed, and urban Environmental Pollution Control Technology optimization and integrated prevention and control process, more and more application of various types of environmental models, and broad application prospects.

1.1.4 Ecosystem management theory

Ecosystem management is driven by clear objectives, practical implementation under the supervision of policies and agreements, on the basis of ecological monitoring and ecological interactions, in accordance with the management to maintain the structure and function of ecosystem.

The purpose of ecosystem management is to overcome obstacles on the use of information obtained through the adaptive management. Ecosystem management should be applied ecological knowledge into natural resources management activities, the transfer from concept to practice need to consider the sustainability, complexity, and relevance, the characteristics of ecosystem dynamics, and the relationship between human and ecological systems, adaptability, and interpretability.

In recent years, sustainability has become the goal of natural resource management. In China, it has been made theory, technology innovation and good experience in natural resources management, industrial and agricultural ecological engineering, ecological city and new rural construction, and ecological restoration in the level of eco-city/community building, and watershed/wetland restoration.

1.2 Environmental pollution control targets

Environment problems, pollution features and stages of development have differences in different countries/ regions and scales, environmental pollution control target should give full consideration to the particularity of environmental issues.

The main goal of environmental pollution control as follows:

① Pollution control: prevention and control of large quantities of pollutants enter into the water, air and soil systems, and to ensure the safety of