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Preface

China is the largest producer of organic wastes in villages and towns in the world. In accordance with data released by the Ministry of Environmental Protection of the People's Republic of China, the pollution from agricultural source accounts for 1/3 ~ 1/2 of the total pollution in China, so it has become an important source of water, soil and air pollution in rural areas. The resourceful utilization of organic wastes in villages and towns in China is challenged by the difficulties including the lack of applicable technologies and equipment. Based on this, research and development as well as optimization and upgrading of key technologies and equipment, such as energy, fertilization, forage, and materialization are carried out, so as to realize the unification of resource technologies and equipment. Aiming at this, this book systematically introduces the research on technologies for differentiated resourceful utilization of organic wastes of villages and towns. Around the main clue of the differentiated resourceful utilization of organic wastes in villages and towns, this book focuses on general thinking of the identification of source characteristics of organic wastes, integration of generic technologies, development of key technologies and research on management modes.

In this book, we (1) introduced the current situation of organic wastes in villages and towns in China and the necessity of Research on key technologies and practical equipment for differentiated resourceful utilization of organic wastes, (2) gave some high-efficient anaerobic fermentation technology including pre-treatment and evaluation methods on fermenting materials and the energy they produced, as well as the low-cost, energy-saving equipment, (3) proposed a series of biological aerobic treatment methods, including preparation of bacteria agent, method of humification, control of secondary pollution, quality evaluation of composting products, research and development of composting equipment, etc, (4) also introduced the development of the standard system for differentiated resourceful utilization of organic wastes in villages and towns, So that readers not only understand the treatment technology, but also understand its treatment standards and policies, (5) finally provided some projects of rural waste treatment based on the policies, standards and technical methods introduced in previous contents.

The content of this book includes the current status, technologies, policies and standards of organic waste disposal in villages and towns in China as well as engineering cases. It can be used as a reference for workers, technicians and rural living environment managers in the waste treatment industry.

Due to the limited level of editors, there are unavoidable omissions in the book, so please oblige us with your valuable comments.

Beijing, China

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Abbreviations

AGE	Agarose gel electrophoresis
BES	2-bromoethanesulfonate
C/N	Carbon-nitrogen
CHMP-AF	Combined production of hydrogen and methane via anaerobic fermentation
COD	Chemical oxygen demand
CPC	National Congress of the Communist Party of China
CSTR	Continuous stirred tank reactor
DOM	Dissolved organic matter
EEM	Excitation-emission matrix
EPA	Environmental protection agency
Ex/Em	Excitation/Emission
FRI	Fluorescence regional integration
FVWs	Fruit–vegetable wastes
GC-MS	Gas chromatography-mass spectrometry
GI	Germination index
HULIS-C	Carbon in humic-like substances
LCFAs	Long-chain fatty acids
PADRs	Piggery anaerobic digested residues
PARAFAC	Blind parallel factor
PCR	Polymerase chain reaction
PCS	Peptone cellulose solution
PLC	Programmable logic controller
PPP	Public private partnership
sCOD	Soluble chemical oxygen demand
SEM	Scanning electron microscope
TCA	Tricarboxylic acid
TN	Total nitrogen
TOC	Total organic carbon
TS	Total solid

VFA	Volatile fatty acid
VOCs	Volatile organic compounds
VS	Volatile solid

Chapter 1

Introduction



Abstract According to statistical bulletin of urban and rural construction, there were 20,883 towns and 10,872 villages in total in China and the total rural population was 9.58×10^8 by the end of 2016. The total investment in the construction of villages and towns in China was 1.5908×10^{12} yuan, while the investment in environmental health was 4.23×10^{10} yuan, accounting for 10.5% of the total investment in construction of municipal utilities. At the end of 2016, water supply in built-up area of towns was 83.86% and daily water consumption per capita was 99.01 L. Fuel gases were supplied for 49.52% of the population and road area per capita was 12.84 m². Moreover, density of culverts in drainage pipelines was 6.28 km/km² and park and green area per capita reached 2.46 m². Centralized water supply was realized in 68.7% of the administrative villages in China and sanitary sewage and household wastes are separately disposed in 20 and 65% of administrative villages. The infrastructure construction and quality of living environment in villages and towns have been significantly improved. However, the 13th Five-Year Plan for Comprehensive Improvement of Rural Environment of the People's Republic of China shows that 40% of villages still lack of wastes collection and disposal facilities and have prominent problem of dirty, disorderly and bad environment caused by waste pollution in villages and towns. Therefore, it is urgent to take effective measures to make up the shortcoming of controlling waste pollution in villages and towns.

1.1 Current Situations of Construction of Villages and Towns and Environmental Protection in China

According to statistical bulletin of urban and rural construction, there were 20,883 towns and 10,872 villages in total in China and the total rural population was 9.58×10^8 by the end of 2016. The total investment in the construction of villages and towns in China was 1.5908×10^{12} yuan, while the investment in environmental health was 4.23×10^{10} yuan, accounting for 10.5% of the total investment in construction of municipal utilities. At the end of 2016, water supply in built-up area of towns was 83.86% and daily water consumption per capita was 99.01 L. Fuel gases were supplied for 49.52% of the population and road area per capita was 12.84 m².

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China is the largest producer of organic wastes in villages and towns in the world. According to statistics, annual discharge of livestock manures is 2.61×10^9 tons, along with 7.0×10^8 tons of crop straws, 2.5×10^4 tons of plastics including abandoned agricultural films, and 1×10^8 – 1.5×10^8 tons of vegetable wastes. In accordance with data released by the Ministry of Environmental Protection of the People's Republic of China, the pollution from agricultural source accounts for 1/3–1/2 of the total pollution in China, so it has become an important source of water, soil and air pollution in rural areas. China, as a country with the greatest capacity of breeding livestock and poultry in the world, has more than 8×10^4 large-scale farms with more than ten thousand livestock and poultries. Livestock and poultries in these farms discharge over 2×10^9 tons of excrements each year, which seriously damages farm lands and underground water. Agricultural waste resources are very rich and have huge production in China. They are mainly distributed in major grain producing areas, such as Hebei, Inner Mongolia Autonomous Region, Liaoning, Heilongjiang, Shandong, Hubei, Hunan, Jiangxi, Anhui, Sichuan and Yunnan. Based on the calculation of agricultural output in China, totally about 7×10^8 tons of straw resources are produced in each year, in which about 5×10^8 tons can be collected, while the utilization rate is only 33%. With the sustained and rapid development of Chinese economy and the continuous promotion of new urbanization construction, the industrial pattern and consumption mode of villages and towns have undergone significant changes. However, treatment and disposal techniques for organic wastes in villages and towns are still in the initial stage, so facilities for collecting and disposing wastes are inadequate. Moreover, a lot of wastes are piled up in open air or simply filled, which causes secondary pollutions of a lot of leachate and malodorous gas, wastes resources and breeds germs, greatly harming human healthy. At present, rural ecological environment has become a prominent shortcoming in building a moderately prosperous society in all respects. To promote ecological civilization, build beautiful villages and resolutely fight against ecological environmental pollution, the control of agricultural non-point source pollution is the key.

Since implementing the policy of “award for promoting governance” in 2008, China has issued more than 10 normative documents and allocated 3.15×10^{10} yuan of special funds for rural environmental protection. Jiangsu province and the Ningxia Hui Autonomous Region have been selected as pilots of large-scale continuous environment improvement covering the whole province, so as to guide and promote

continuous improvement of rural environment in the whole country. In 14,000 monitoring sites in 700 counties across China, rural environmental health, involving the harmless treatment of rural sewage, wastes, and excrements, the soil hygiene and the vector control has been monitored. By the end of 2014, 5.9×10^4 villages had carried comprehensive environmental improvement, directly benefiting more than 1.1×10^8 people, so comprehensive improvement of rural environment has achieved remarkable results. Since the 18th National Congress of the Communist Party of China (CPC), General Secretary of the Central Committee of CPC Xi Jinping has attached great importance to ecological civilization construction and rural environmental protection and put forward a series of new ideas, judgments and requirements on building ecological civilization and strengthening environmental protection. He stressed that if China wants to be a beautiful country, the countryside must be beautiful, and a beautiful country relies on beautiful countryside. China will continue to promote the construction of new socialist countryside and build a happy homeland for farmers. China should pay attention to ecological and environmental protection in new rural construction, carry out comprehensive improvement of the rural living environment according to local conditions, change the dirty, messy and poor conditions in rural areas as soon as possible, and give farmers a clean and tidy living environment. In February, 2018, the State Council issued No. 1 document of the central government, namely, the Opinions of the CPC Central Committee and the State Council on Implementing the Strategy of Rural Revitalization. It is proposed to strengthen the prevention and control of agricultural non-point source pollution, carry out green development in agriculture and realize input reduction, cleaner production, waste resource recovery and ecological industrial mode. Obviously, strengthening rural environmental protection is an inevitable requirement for building ecological civilization, an important task of balancing urban and rural development, and an urgent need to improve and guarantee people's livelihood. To build a moderately prosperous society in all respects, rural areas are the top priority, while the environment is the key. Rural environment is not only the weakest point, but also the most potential breakthrough point and innovation point.

1.2 Necessity of Differentiated Resourceful Utilization of Organic Wastes in Villages and Towns

With the constant and rapid development of economy, villages and towns in China have rapidly entered the society of commodity of modern market economy from the self-supporting agricultural society. Household goods in villages and towns have been separated from most local production activities. Planting has been almost completely separated from breeding and the closed-circuit production mode of organic matter in the production and life of villages and towns has been completely cut off by modern agriculture and sustainable commercialization, mechanization and scale modes. Subsequently, the output of a large number of organic wastes in villages and towns increases sharply, while relevant treatment and disposal technologies and supporting