

ENERGY & WASTE
MANAGEMENT



China's Best Available Techniques (CBAT) – Reference Document for Waste Incineration

Jisheng LONG, Xuejun JIAO, Li BAI, Jianping LI,
Hailiang DU and Yiru HUANG

China's Best Available Techniques (CBAT) – Reference Document for Waste Incineration

Jisheng LONG, Xuejun JIAO, Li BAI, Jianping LI, Hailiang DU
and Yiru HUANG

As China's urbanization rate surpasses 65%, municipal solid waste in Chinese cities exceeds 250 million tons annually. Safe and sustainable waste management has become an unavoidable challenge. Municipal solid waste incineration for power generation, offering reduction, resource recovery, and harmless treatment, has evolved from early exploratory technology into the mainstream method for urban waste management. After more than 30 years of development, China has built the world's largest municipal waste incineration system, with a processing capacity exceeding 1.12 million tons per day in 2024, supported by leading-edge technology.

This book presents a comprehensive overview of the waste incineration industry in China, covering policies and standards, technological innovation, and future trends. It highlights best practices and lessons learned, offering practical guidance for developing countries facing similar waste management challenges, while contributing "Chinese wisdom" and "Chinese solutions" to global environmental governance and low-carbon development.

ISBN : 978-2-7598-3973-5



edp sciences
www.edpsciences.org

SCIENCE PRESS

Jisheng LONG, Xuejun JIAO,
Li BAI, Jianping LI,
Hailiang DU and Yiru HUANG

China's Best Available Techniques (CBAT) – Reference Document for Waste Incineration



SCIENCE PRESS



The original edition of this book was published in Chinese by Science Press (Beijing) in 2026. ISBN 978-7-03-084655-6.

Printed in France

EDP Sciences – ISBN(print): 978-2-7598-3973-5 – ISBN(ebook): 978-2-7598-3974-2
DOI: 10.1051/978-2-7598-3973-5

All rights relative to translation, adaptation and reproduction by any means whatsoever are reserved, worldwide. In accordance with the terms of paragraphs 2 and 3 of Article 41 of the French Act dated March 11, 1957, “copies or reproductions reserved strictly for private use and not intended for collective use” and, on the other hand, analyses and short quotations for example or illustrative purposes, are allowed. Otherwise, “any representation or reproduction – whether in full or in part – without the consent of the author or of his successors or assigns, is unlawful” (Article 40, paragraph 1). Any representation or reproduction, by any means whatsoever, will therefore be deemed an infringement of copyright punishable under Articles 425 and following of the French Penal Code.

This book cannot be reproduced or used for training artificial intelligence systems. Text and data mining is prohibited in accordance with Article 4(3) of Directive (EU) 2019/790.

The printed edition is not for sale in Chinese mainland.

© Science Press, EDP Sciences, 2026

Foreword

This volume provides a systematic exposition of China's WtE policy landscape, technological advancements, and future trajectories. It distills the sector's most impactful practical achievements and, through the exemplary practices of industry leaders like SUS ENVIRONMENT, presents valuable "Chinese wisdom" and "Chinese solutions" for advancing global sustainable waste management and low-carbon development.

China's experience offers a compelling case study of how coherent public policy, industrial capability, and technological innovation can converge to address the complex challenges of rapid urban growth. Over the past decades, the country has moved from fragmented disposal practices to an increasingly integrated system in which waste-to-energy plays a central and strategic role. As China's urbanization rate surpasses 65%, its cities now generate over 250 million tonnes of municipal solid waste (MSW) annually, presenting a pressing environmental imperative. Waste-to-energy (WtE) has emerged as the predominant approach, leveraging its distinct advantages in volume reduction, energy recovery, and environmentally sound treatment to become the bedrock of China's modern waste management framework.

Through more than three decades of dedicated development, China has established the world's most extensive WtE infrastructure, with daily processing capacity exceeding 1.12 million tonnes. This extraordinary expansion is underpinned by a robust triad of policy frameworks, technological innovation, and operational expertise and efficiency.

A comprehensive scheme of regulations and standards governs the entire project lifecycle—from site selection and engineering design to operational oversight and emissions control. Continuously refined and supported by targeted incentives, this framework has been instrumental in guiding the industry's high-quality development on a scale.

Technologically, China has achieved remarkable breakthroughs with the independent development of large-scale mechanical grate incinerators capable of processing 1200 tonnes per day, specifically engineered for high-moisture, low-calorific waste. The establishment of an integrated technological chain-featuring high-efficiency power generation, ultra-low flue gas emissions, near-zero leachate discharge and comprehensive by-product utilization-demonstrates the sector's advanced capabilities. Particularly noteworthy, China's sophisticated leachate treatment system has yielded valuable insights applicable to waste management challenges across Southeast Asia and other regions.

With over 1000 WtE facilities commissioned nationwide, China has accumulated substantial engineering expertise in managing complex operational conditions, optimizing construction efficiency, and pioneering eco-industrial park models for synergistic treatment of municipal solid waste streams.

Dr. Long Jisheng, the chief editor (of this publication), has been pivotal in this sector's evolution. Following extensive international practice, he founded SUS ENVIRONMENT Co., Ltd. in 2008. Under his visionary leadership, the team has pioneered next-generation mechanical grate incinerator technology, advanced combustion control technologies, and cutting-edge emission purification processes, achieving complete technological independence and ending reliance on imported solutions. Through its groundbreaking design paradigms centered on "energy-efficiency" and "emission control", SUS ENVIRONMENT has been instrumental in transforming public perception from "Not In My Backyard (NIMBY)" to "Please In My Backyard (PIMBY)".

China's journey reflects the importance of long-term policy consistency, continuous technological upgrading, and transparent environmental standards in achieving both climate mitigation and resource efficiency objectives. As the global waste and resource management sectors seek pathways consistent with climate goals and circular economy ambitions, constructive international dialogue and knowledge exchange remain essential. It is my hope that this publication will contribute meaningfully to that dialogue and foster further collaboration between China and the global waste management community in advancing sustainable, low-carbon solutions for the future.

James Law
President
International Solid Waste Association (ISWA)
January 2026

Preface

As a core pillar of urban solid waste management, municipal solid waste incineration achieves waste reduction, resource utilization, and harmless disposal while enabling efficient energy recovery. It serves as a critical pathway for advancing the circular economy and achieving China's carbon peak and neutrality targets. Though China's waste-to-energy (WtE) industry emerged relatively late, three decades of vigorous development have propelled the sector from early technology introduction and assimilation to a new era of independent innovation and global leadership, establishing a distinctive high-quality development paradigm for the industry.

The evolution of China's WtE technology can be divided into four distinct developmental stages. The exploratory stage (late 1980s–2000) began with the commissioning of Shenzhen's first modern WtE plant and key national research and development (R&D) projects under China's Eighth Five-Year Plan. This period initiated domestic technological and equipment R&D, achieving a pivotal breakthrough from full import dependence to partial localization of core equipment. The growth stage (2001–2005) marked the gradual improvement of policy and standard frameworks alongside increasingly stringent environmental requirements. Domestically manufactured grate incinerators were widely promoted and applied, while the integrated flue gas purification process consisting of semi-dry deacidification, activated carbon injection and bag filter became the mainstream technical solution. Synchronous progress was also made in leachate and fly ash treatment technologies, with a large number of modern WtE plants completed and commissioned. Driven by the national ecological civilization strategy, the industry entered a rapid development stage from 2006 to 2020, marking its golden development period. Large-scale mechanical grate incinerators with independent intellectual property rights, featuring a single-unit capacity of up to 850 tonnes per day, dominated the domestic market. Cutting-edge technologies including ultra-low flue gas emission control, medium- and high-parameter power generation, and intelligent system control achieved continuous iterative upgrading. China has since ranked first globally in

total municipal solid waste treatment capacity, delivering a host of world-class benchmark engineering projects. Since 2021, the industry has entered a steady and innovation-driven development stage. Against a backdrop of slowing market expansion, the industry focus has shifted toward lean operation, cost reduction and efficiency enhancement. Current technological research prioritizes large-scale unit design, high-efficiency operation, intelligent management, and low-carbon transformation, while domestic enterprises are actively expanding overseas business under the Belt and Road Initiative.

Throughout this development trajectory, China's indigenous technological innovation has attained globally recognized achievements. In core equipment research and application, leading enterprises including SUS ENVIRONMENT, SANFENG ENVIRONMENT and EVERBRIGHT ENVIRONMENT have independently developed and widely applied super-large mechanical grate incinerators. These units are specially optimized to suit the characteristics of China's municipal solid waste: high moisture content, low calorific value and complex composition. These incinerators reach a maximum single-unit processing capacity of 1200 tonne/day, meeting internationally advanced standards in waste adaptability, combustion efficiency and core component service life.

In terms of high-efficiency energy utilization, the domestic WtE industry has overcome the technical bottleneck of high-temperature corrosion in high-parameter waste heat boilers. Mainstream steam operating parameters have been progressively upgraded from medium-temperature and medium-pressure (4.0 MPa/400 °C), to medium-temperature and sub-high-pressure (6.5 MPa/450 °C), and further to medium-temperature and super-high-pressure (13.5 MPa/450 °C/485 °C). Combined with advanced technologies such as external dehumidification coupled with main steam reheating (MSR), these upgrades have raised the power generation efficiency of WtE plants from the traditional 20%–25% to over 30%, representing a landmark leap in industrial energy conversion performance.

In advanced pollution control, China has established the world's most stringent flue gas emission standards for WtE plants and pioneered a comprehensive ultra-low emission process system: selective non-catalytic reduction + semi-dry scrubber + dry sorbent injection + activated carbon injection + bag filter + selective catalytic reduction + wet scrubber. This integrated technical system ensures that emissions of particulate matter, sulfur dioxide, nitrogen oxides and other key pollutants are consistently maintained below regulatory limits.

Regarding by-product utilization and co-processing, China's WtE industry has formed a complete set of mature resource recovery technologies. These include fly ash treatment technologies such as water washing desalination coupled with cement kiln co-processing, low-temperature thermal decomposition coupled with water washing treatment, and high-temperature melting, as well as high-efficiency slag sorting technologies that realize metal recovery and the reuse of remaining tailings as construction raw materials. Beyond by-product recycling, innovative multi-source solid waste co-disposal modes have been developed, covering dried sludge, kitchen waste, and clinical waste co-processing. These practices have effectively improved facility utilization efficiency and strengthened the overall capacity of urban solid waste integrated management.

In the field of digitalization and intelligent operation, China's WtE industry has taken the lead in applying artificial intelligence (AI), machine vision, digital twins and other emerging technologies to incineration process control. Independently developed AI-based intelligent combustion optimization systems have enabled a fundamental shift from empirical manual regulation to data-driven smart combustion, greatly improving the operational stability, economic efficiency and environmental performance of WtE plants.

This book systematically establishes the complete knowledge framework and technical roadmap for municipal solid waste incineration power generation in China, covering policy and standard systems, technical principles, equipment systems, innovative engineering practices, operational management, and intelligent low-carbon development. It elaborates on full-process core technologies including waste receiving and storage, grate incineration, waste heat recovery, flue gas purification, leachate treatment, and ash-slag disposal. Meanwhile, the book highlights China's independent technological innovations and representative engineering practices in frontier fields, including large-scale grate equipment, high-parameter power generation, ultra-low emission control, intelligent operation, multi-waste collaborative treatment, and carbon capture, utilization and storage.

This book was authored by Jisheng Long, Xuejun Jiao, Li Bai, Jianping Li, Hailiang Du, and Yiru Huang, with valuable contributions from Yacheng Liu, Yang Cao, Zhaohui An, Yantao Wang, Yue Gong, Qianqian Yao, Honglei Hu, Chaojun Wen, Jingying Huang, Dekun Yang, Lu Chen, Jianguo Han, Jian Liu, Shujia Liu, Meilin Zhu, Di Wang, Haowen Yan, Qibin Yuan, Chongzhen Fu, Yilian Wu, Zhangfeng Hao, Yang Yang, Po Zhang, Dawei Qian, Liangliang Yang, Yunfeng Lao, Yuling Wen, Rui Gong, Haocheng Zhu, Fali Hu, Yong Dai, Bin Li, Yiyang Zhang, Jiachen Hu, Jidong Liu, Bei Li, Zhiwei Hu, Xiaoming Wang, Yifeng Chen, Youdong Wang, Yue Wang, Fei An, Shudong He, Zhiwei Liu, Chengxu Feng, Wangxiang Chen, Ting Yao, and Danian Ruan. The authors sincerely thank all contributors for their dedication and rigorous efforts in the compilation of this book. We hope this work can serve as a valuable reference for advancing global municipal solid waste incineration power generation technologies and promoting the green, low-carbon and intelligent development of the industry. Due to the limitations of the authors' knowledge and experience, inadvertent omissions and deficiencies may remain in the text. All valuable comments and corrections from readers are warmly welcomed.

Contents

Foreword	III
Preface	V
CHAPTER 1	
Policy and Standard System for Waste-to-Energy of China	1
1.1 Key Policy Framework for Solid Waste Treatment Industry of China ..	1
1.1.1 Management System for MSW Treatment Industry of China ..	2
1.1.2 Legal and Policy Framework for WtE in China	3
1.2 Standard System Related to MSW Incineration and Solid Waste Industry in China	8
1.2.1 Standards Related to WtE Industry	8
1.2.2 Key Standards	9
CHAPTER 2	
Development and Innovative Practice of WtE Technology in China	23
2.1 Overview of WtE Technology Development	23
2.1.1 Exploration Period of China's WtE Technology	24
2.1.2 Preliminary Development Period of China's WtE Technology ..	27
2.1.3 Rapid Development Period of China's WtE Technology	27
2.1.4 Stable Development Period of China's WtE Technology	28
2.2 Composition of WtE System	30
2.2.1 Waste Receiving and Storage System	30
2.2.2 Incineration System	30
2.2.3 Waste Heat Recovery and Utilization System	30
2.2.4 Flue Gas Treatment System	30
2.2.5 Residue Treatment System	31
2.2.6 Incineration Control System	31
2.2.7 Leachate Treatment System	31
2.3 Innovation and Practice in China's WtE Technology	32
2.3.1 Large-Scale Mechanical Grates	32
2.3.2 High-Efficiency Power Generation Technology	34
2.3.3 Ultra-Low Emission Technology for Flue Gas Pollutants	37

2.3.4	Efficient Leachate Treatment	40
2.3.5	Residue Resource Utilization	43
2.3.6	Smart Incineration Control Technology	46
2.3.7	Carbon Capture and Online Carbon Emission Monitoring Technology	48
CHAPTER 3		
	Waste Composition and Receiving	53
3.1	Trends in Waste Composition and Calorific Value	53
3.1.1	Trends in Waste Composition and Calorific Value	53
3.2	Waste Receiving, Storage, and Charging	55
3.2.1	Waste Receiving System	55
3.2.2	Waste Storage System	63
3.2.3	Waste Charging System	68
3.2.4	Waste Bunker Insulation and Heating	71
CHAPTER 4		
	Waste Incinerators and Waste Heat Boilers	73
4.1	Waste Incineration Grate, Charging & Slag Extractor System	73
4.1.1	Overview of Waste Incinerators	73
4.1.2	Composition of Waste Incinerator	74
4.2	Furnace Main Control Temperature	78
4.2.1	Furnace Temperature Control	79
4.2.2	Calculation Methods for Furnace Main Control Temperature . .	80
4.2.3	Current Regulatory Methods in China	83
4.2.4	Furnace Main Control Temperature Safeguard Measures	84
4.3	Refractory Materials	84
4.3.1	Refractory Materials	84
4.3.2	Hanging Brick	86
4.4	High-Parameter Waste Heat Boilers	93
4.4.1	WtE Boiler	93
4.4.2	Key Performance Indicators of Waste Heat Boilers	96
4.4.3	Structural Types of Waste Heat Boilers	100
4.4.4	High-Parameter Waste Heat Boilers	102
4.5	Boiler Corrosion Protection	109
4.5.1	Anti-Corrosion Technologies	109
4.5.2	Application of Anti-Corrosion Technologies	109
4.6	Boiler Sootblowing Technology	116
4.6.1	Soot Cleaning Methods	116
4.6.2	Analysis of Soot Cleaning Effectiveness	121
CHAPTER 5		
	Heat Recovery for Power Generation and Heating	129
5.1	Evaluation of Energy Utilization Efficiency	129

5.1.1	Calculation of Energy Utilization Efficiency	129
5.1.2	Energy Efficiency Evaluation Indicators	130
5.2	Overall Power Generation Efficiency	131
5.2.1	Calculation of the Overall Power Generation Efficiency	131
5.2.2	Main Factors Influencing Overall Power Generation Efficiency	132
5.3	Turbine & Generator	134
5.3.1	Turbine	134
5.3.2	Generator	136
5.4	High Back Pressure Turbine Heating	136
5.4.1	Technical Principle	137
5.4.2	Project Examples	137
5.5	Deep Utilization of Flue Gas Waste Heat	140
5.5.1	Technical Classification	140
5.5.2	Technical Principles	140
5.5.3	Technical Comparison	142
5.6	Mobile Heat Supply	143
5.6.1	Mobile Heat Supply Technology	144
5.6.2	Application Cases	145

CHAPTER 6

Flue Gas Cleaning Process		147
6.1	Overview of Flue Gas Pollutants	147
6.2	Particulate Matter Removal	149
6.2.1	Primary Dust Removal Technologies	149
6.2.2	Case Analysis	151
6.3	Semi-Dry and Dry Deacidification Processes	152
6.3.1	Semi-Dry Deacidification Process	152
6.3.2	Dry Deacidification Process	155
6.3.3	Circulating Dry Deacidification Process	155
6.3.4	In-Furnace Calcium Injection Deacidification Process	159
6.4	Wet Scrubbing Deacidification	159
6.4.1	Process Description	160
6.4.2	Case Analysis	161
6.5	NOx Control Technologies	161
6.5.1	SNCR Denitration Process	162
6.5.2	SCR Denitration Process	162
6.5.3	PNCr Denitration Process	163
6.5.4	FGR Process	164
6.5.5	Selection of Denitrification Processes	165
6.5.6	Case Analysis	165
6.6	Dioxins and Heavy Metals Removal	167
6.6.1	Dioxins Removal Technologies	167
6.6.2	Heavy Metal Removal Technologies	170
6.7	Ultra-Low Emission Technologies for Flue Gas	171
6.7.1	Overview of Ultra-Low Emissions	171

6.7.2	Ultra-Low Emission Combined Processes	172
6.8	Online Continuous Emission Monitoring	173
6.8.1	Basic Components and Functions of CEMS	173
6.8.2	Requirements for “Installation, Display, and Networking”	174
6.8.3	Standard CEMS Configuration in China’s Waste Incineration Sector	175

CHAPTER 7

Treatment of Fly Ash		179
7.1	Characteristics of Fly Ash	179
7.1.1	Physical Characteristics of Fly Ash	179
7.1.2	Chemical Composition and Mineral Phase Analysis of Fly Ash	180
7.1.3	Pollutant Occurrence Characteristics of Fly Ash	181
7.2	Fly Ash Stabilization Treatment	181
7.2.1	Fly Ash Solidification/Stabilization Technology	181
7.2.2	Landfill Operation	184
7.2.3	Fly Ash Stabilization Project Case	184
7.3	Fly Ash Resource Utilization	185
7.3.1	Co-Processing in Cement Kilns with Water Washing and Desalination	186
7.3.2	High Temperature Melting Technology	188
7.3.3	Low Temperature Thermal Decomposition-Washing Technology	190
7.3.4	Fly Ash Return to Furnace Technology	192
7.3.5	Foamed Ceramics Technology	193
7.3.6	Technology Comparison	194

CHAPTER 8

Slag Resource Utilization		199
8.1	Slag Characteristics	199
8.1.1	Slag Physical Characteristics	199
8.1.2	Slag Chemical Characteristics	200
8.1.3	Slag Management Requirements	200
8.2	Slag Resource Utilization	201
8.2.1	Policies on Slag Resource Utilization	201
8.2.2	Pathways for Slag Resource Utilization	201
8.2.3	Introduction to Slag Resource Utilization Processes	202
8.2.4	Typical Slag Resource Utilization Case	204

CHAPTER 9

Leachate Treatment		207
9.1	Leachate Production and Water Quality	207
9.1.1	Leachate Production	207
9.1.2	Leachate Quality	209

9.2	Treatment Standards and Processes	209
9.2.1	Treatment Standards	209
9.2.2	Treatment Process	210
9.3	Operation of Leachate Treatment System	214
9.3.1	Anaerobic System	214
9.3.2	MBR-Biochemical System	215
9.3.3	MBR-Ultrafiltration System	216
9.3.4	Nanofiltration System	217
9.3.5	Reverse Osmosis System	218
9.3.6	DTRO Concentrate Reduction System	219
9.4	Case Project	219
9.4.1	Design Influent Water Quality	220
9.4.2	Designed Effluent Water Quality	220
9.4.3	Actual Operating Water Quality	221

CHAPTER 10

Biogas Utilization		223
10.1	Biogas Co-Combustion	223
10.1.1	Introduction to Components of Biogas	223
10.1.2	Emergency Combustion Torch of Biogas	223
10.1.3	Biogas Co-Combustion in Furnaces	224
10.2	Power Generation from Biogas Internal Combustion Engines	226
10.3	Biomethane	227
10.3.1	Introduction to Biogas Purification Process	227
10.3.2	Biogas Dehydration	227
10.3.3	Biogas Desulfurization	229
10.3.4	Carbon Dioxide Removal	230
10.3.5	Application Cases	232

CHAPTER 11

Odor, Noise, and White Plume Control		235
11.1	Odor Control	235
11.1.1	Types and Sources of Odors in WtE Plants	235
11.1.2	Odor Control Standards for MSW Incineration Plants	235
11.1.3	Primary Odor Control Measures	238
11.2	Noise Control	243
11.2.1	Noise Emission Standards	243
11.2.2	Noise Control Measures	244
11.3	White Plume Control	247
11.3.1	White Plume Elimination Technology in the Turbine Room	247
11.3.2	Stack Flue Gas White Plume Elimination Technology	249

CHAPTER 12

Waste Incineration Control and Intelligent Optimization Operation 257

12.1 Automatic Combustion Control 257

12.1.1 National Regulations and Industry Standards
for Combustion Automation: Requirements
and Recommendations 257

12.1.2 Introduction to General Technical Solutions for ACC
System 261

12.1.3 Technical Characteristics of Multi-Source Solid Waste
Co-Processing Combustion Control 265

12.1.4 Application Cases of Combustion Automation Technology . . 268

12.2 Intelligent Optimization Control for Waste Incineration 269

12.2.1 AI-Powered Intelligent Optimization Control System 270

12.2.2 Furnace Flame Image Recognition Technology and Flue
Gas Cleaning Optimization 273

12.2.3 Field Implementation of Intelligent Control Optimization
System for Waste Incineration 275

12.3 Industrial TV Monitoring System 276

12.3.1 Large Screen in Central Control Room 276

12.3.2 Equipment Monitors 277

12.3.3 Environmental Monitoring Display Screen in Plant Area . . . 278

CHAPTER 13

Digital Operation Management of WtE Plants 281

13.1 Waste Crane Automation 281

13.1.1 Overview of Waste Crane Automation 281

13.1.2 System Functions and Automatic Operation Principles 282

13.1.3 Application Value of Waste Crane Automation 285

13.2 Plant-Wide Digital Operation Management and Control System . . . 285

13.2.1 Introduction to Digital Operation Management
and Control System 286

13.2.2 Application Benefits 297

CHAPTER 14

Application of Simulation Systems in WtE Plants 299

14.1 Overview of Simulation Systems 299

14.1.1 Composition of Simulation Systems 299

14.1.2 Basic Functions and Performance Requirements
of Simulation Systems 302

14.2 Application of Simulation Systems in Training 304

CHAPTER 15

Co-Processing of Multi-Source Solid Waste in WtE Plants 307

15.1 Co-Processing of Sewage Sludge 307

15.1.1	Process Flow of Sludge Drying Co-Processing in WtE Plants	308
15.1.2	Wet Sludge Reception, Storage, and Conveyance	309
15.1.3	Sludge Drying System	309
15.1.4	Co-Incineration of Dried Sludge in Furnace	310
15.1.5	Odorous Gas and Wastewater Treatment	312
15.1.6	Application Cases of Sludge Drying Co-Incineration	313
15.1.7	Other Co-Processing Technologies for Municipal Sludge	315
15.2	Co-Processing of Kitchen Waste	317
15.2.1	Overview of Kitchen Waste	317
15.2.2	Co-Processing of Kitchen Waste through Incineration	317
15.3	Co-Processing of Industrial Organic Solid Waste	322
15.3.1	Reception and Storage of Industrial Organic Solid Waste	322
15.3.2	Modification and Adjustment of the Incineration System	323
15.3.3	Modification and Adjustment of Flue Gas Treatment System	325
15.4	Co-Processing of Clinical Waste	326
15.4.1	Types and Characteristics of Clinical Waste	326
15.4.2	Co-Processing Technologies for Clinical Waste	326
15.4.3	Case Studies of Co-Processing Clinical Waste	332
CHAPTER 16		
Trends in Intelligent and Low-Carbon Development		335
16.1	Smart Power Plants	335
16.1.1	Definitions and Characteristics of Smart Power Plants	335
16.1.2	Application Prospects of Smart Power Plants in WtE Facilities	336
16.1.3	Summary	340
16.2	Zero-Carbon Park	340
16.2.1	Zero-Carbon/Negative-Carbon Eco-Industrial Park Model	341
16.2.2	Construction of High-Efficiency Low-Carbon Incineration Plants	343
16.2.3	Summary	344
References		347

Chapter 1

Policy and Standard System for Waste-to-Energy of China

The waste-to-energy (WtE) industry of China began in the late 1980s, gradually progressing through exploration, initial development, rapid development, and stable development phases. Over the past three decades of WtE development, policy support, demand drivers, and technological advantages have emerged as the three most critical driving factors. The introduction of a series of policies has mobilized local governments and enterprises, effectively driving the development of the full industry chain for waste incineration. Concurrently, China has actively advanced standardization efforts to regulate technical standards, enhance technical exchange and collaboration, and improve industrial technological capabilities and innovation capacity by integrating it into industrial policies. It is precisely this series of promulgated laws, regulations, policies, and standards that has effectively driven the rapid and high-quality development of the WtE industry.

1.1 Key Policy Framework for Solid Waste Treatment Industry of China

The municipal solid waste (MSW) treatment industry of China has established a systematic and well-developed management system and policy framework, forming a governance pattern characterized by central coordination, local implementation, and multi-department collaboration. The policy system covers multiple dimensions, including comprehensive planning, fiscal and tax support, and technical standards, comprehensively utilizing economic incentives and market mechanisms to promote the construction of treatment facilities and technological innovation. This has effectively advanced waste treatment towards reduction, resource recovery, and harmlessness, creating a favorable development environment for modern treatment methods such as WtE.

1.1.1 Management System for MSW Treatment Industry of China

China implements a five-tier government management system comprising the State Council—province and municipality directly under the Central Government—prefecture-level city—county, city—township, and town. In waste management administration, the State Council, provincial, and county and city governments play crucial roles. Specifically, ministries under the State Council are primarily responsible for formulating regulations, policies, and standards. Provincial governments mainly oversee policy implementation (some provinces also establish provincial-level policy standards). County and city governments serve as executive entities and are responsible for planning and constructing waste collection and disposal facilities, as well as fee collection and payment.

The administrative departments of the waste management industry primarily involve the Ministry of Housing and Urban–Rural Development (MOHURD), the Ministry of Ecology and Environment (MEE), the National Development and Reform Commission (NDRC), and the Ministry of Finance (MOF) at both national and local levels. The main responsibilities of each department are shown in figure 1.1. MOHURD primarily guides the technical direction of industry, and issues industry standards, construction standards, and technical specifications. MEE focuses on formulating pollutant emission policies and supervising pollutant emissions. NDRC is responsible for releasing industrial policies (such as concession operations and electricity pricing), formulating plans and policies, and managing investment approvals and supervision. MOF mainly develops fiscal policies, funding arrangements, fiscal subsidies, and incentives. Additionally, multiple national and industry departments form the National Patriotic Health Campaign Committee, an advisory and coordinating organization within the State Council, tasked with unified leadership and coordination of patriotic health-related work, and directing nationwide concerted actions on waste management issues. This committee has issued a series of early waste management policies, such as Notice on the report of handling municipal waste to improve environmental sanitation (State Council General Office Document [1986] No. 57) and Notice on several suggestions regarding solving domestic waste problems of China (State Council Document [1992] No. 39), which have propelled the development of WtE. Furthermore, the advancement of WtE has also relied on joint efforts by industry associations such as the China Association of Urban Environmental Sanitation, the China Association of Environmental Protection Industry, and the China Association of Circular Economy. These associations assist government departments in conducting industry research and information collection, facilitating communication among industry stakeholders, standardizing industry operations, establishing standards, building industry exchange platforms, and uniting various industry players to promote the high-quality development of the environmental sanitation sector of China.

References

- [1] China Association of Urban Environmental Sanitation, Guangdong Environmental Sanitation Association. (2018) China Municipal Solid Waste-to-Energy Development Report (1988–2018) [R]. China Association of Urban Environmental Sanitation, Beijing (in Chinese).
- [2] Yang N., Shao L. M., He P. J. (2018) Study on the moisture content and its features for municipal solid waste fractions in China [J], *China Environ. Sci.* **38**(03), 1033–1038 (in Chinese).
- [3] Wei X. X., Wang X. M., Li L., *et al.* (2018) Temporal and spatial characteristics of municipal solid waste generation and treatment in China from 1979 to 2016 [J], *China Environ. Sci.* **38**(10), 3833–3843 (in Chinese).
- [4] Cheng J., Dong X. D. (2017) Physical and chemical characteristics of municipal solid waste in Shanghai [J], *Environ. Sanit. Eng.* **25**(04), 36–40 (in Chinese).
- [5] Ren X. L., Wang X. Y., Zhang X., *et al.* (2024) Municipal solid waste characteristics in Beijing under the background of waste classification [J], *Environ. Impact Assessment* **46**(04), 58–63 +76 (in Chinese).
- [6] Yang X. Y., Jia Y., Zhong J., *et al.* (2021) The preliminary impact and suggestion on the collection and transportation system of MSW compulsory classification in Shanghai [J], *Environ. Sanitation Eng.* **29**(06), 67–70+81 (in Chinese).
- [7] Wang X. (2020) Investigation on the composition of domestic waste in commercial and administrative areas of Shenyang City [J], *Urban Rural Stud.* 386 (in Chinese).
- [8] Fu F. Y., Xu Y. J., Xia J. Y., *et al.* (2023) Carbon emissions analysis of municipal solid waste treatment in Suzhou After waste classification [J], *J. Nanjing Normal Univ. (Nat. Sci. Ed.)* **46**(03), 133–140 (in Chinese).
- [9] Han Z. D., Li X. R., Bi F., *et al.* (2019) Classified collection and transportation patterns of rural domestic wastes in China: a case study of Hangzhou [J], *J. Agro-Environ. Sci.* **38**(03), 688–695 (in Chinese).
- [10] Chen F. K. (2024) Study on the characteristics of domestic waste production and discharge in Hefei City centre and its environmental correlation [D], *Anhui Univ. Sci. Technol* (in Chinese).
- [11] Jiang X., Song W., Wang F. S. (2021) Analysis on the present status-problems and countermeasures of municipal solid waste classification management in Jinan [J], *Environ. Sanitation Eng.* **29**(05), 36–40+45 (in Chinese).
- [12] Wang X. B., Liu A. Q., Zhong H. Q., *et al.* (2023) Characteristics of municipal solid waste in some urban agglomeration in the past five years [J], *Environ. Sci.* **44**(11), 6421–6432 (in Chinese).

- [13] Gao M. J. (2021) Optimization of municipal solid waste classification method of Chongqing based on material flow analysis [D], *Chongqing Univ.* (in Chinese).
- [14] Qu Q. W., Shen W., Xuan J., *et al.* (2024) Composition analysis and treatment of domestic waste—based on the investigation in Wenjiang District, Chengdu City [J], *China Res. Compr. Util.* **42**(11), 133–136 (in Chinese).
- [15] Zhang P. (2019) Physical composition and characteristics of municipal solid waste in Urumqi City [J], *Reg. Governance* **22**, 68–71 (in Chinese).
- [16] Liu Y. X., Li W. T., Wang M. J., *et al.* (2019) Physical composition and characteristics analysis of the municipal solid waste(MSW) in XI'AN[C]//branch of environmental management, chinese society for environmental sciences. Proceedings of the 2019 Annual Academic Conference of Chinese Society for Environmental Sciences—Sub-Forum on Innovation and Application of Environmental Engineering Technologies (Part I). Powerchina Northwest Engineering Corporation Limited, 226–229+181 (in Chinese).
- [17] Wang Y. T., Cao Y. (2019) Analysis on garbage caloric value in MSW incineration power plant in China [J], *Environ. Sanit. Eng.* **27**(05), 41–44 (in Chinese).
- [18] Shanghai Municipal Solid Waste-to-Energy Facilities [M]. (2024) China Electric Power Press, Beijing, pp. 179–192 (in Chinese).
- [19] Wu B. B., Song W., Pu Z. H. (2019) Analysis on technology and management status of comprehensive utilization projects of bottom ash from municipal waste incineration plant [J], *Environ. Sanit. Eng.* **27**(03), 9–11 (in Chinese).
- [20] Xia Y., Zhang H., Shao L. M., *et al.* (2017) Speciation and recoverability of valuable metals in municipal solid waste incineration bottom ash [J], *Res. Environ. Sci.* **30**(04), 586–591 (in Chinese).
- [21] Shi A. J., He P. J., Shao L. M., *et al.* (2004) Engineering characteristics of cinder from municipal domestic refuse incinerator [J], *Environ. Eng.* **01**, 47–50+4 (in Chinese).
- [22] Li Y. P., Cong H. L. (2025) Study on collaborative disposal of medical waste and food waste in MSW incineration power plant [J], *Power Syst. Eng.* **41**(04), 31–34 (in Chinese).
- [23] Wang G. B., Zheng R. D., Deng F. F., *et al.* (2025) Optimization of anaerobic biogas utilization from domestic waste leachate basedon amine process purification technology: a case study of Hangzhou Linjiang waste incineration biogas purification project [J], *China Biogas.* **43**(03), 83–87 (in Chinese).
- [24] Liu F., Wen B., Sun J. T., *et al.* (2025) Development of odor control technology and its application in domestic waste incineration power plant [J/OL], *Biol. Chem. Eng.* **11**(4), 253–256 (in Chinese).
- [25] Jiao X. J., Zhang G. X., Shen Y. L., *et al.* (2020) Review and analysis on waste to energy policies in China [J], *Environ. Sanit. Eng.* **28**(06), 57–65 (in Chinese).
- [26] Du H. L., Jiao X. J., Wang R. F., *et al.* (2019) Trend analysis on leachate yield of domestic waste incineration power plant [J], *Environ. Sanit. Eng.* **27**(04), 48–50, 54 (in Chinese).
- [27] Sun X. Y., Han Z. M., Jiao X. J. (2020) Discussion on the calculation model of flue gas temperature in waste incineration furnace: meet the supervision requirements that the flue gas stays above 850 °C for 2 s [J], *Environ. Sanit. Eng.* **28**(05), 48–53 (in Chinese).
- [28] Duan P. Q., Li Y. X., Bai L. C. (2025) White smoke generation source and control in domestic waste incineration plants [J], *Environ. Sanit. Eng.* **33**(03), 102–106, 113 (in Chinese).
- [29] Hu H. L., Long J. S., Wu Y. Z. (2025) Corrosion causes and optimization scheme for flue gas recirculation equipment in waste to energy incineration plants [J], *Environ. Sanit. Eng.* **33**(03), 97–101 (in Chinese).
- [30] Liu Y. C. (2024) Comparative analysis of castable and hanging brick for refractory of municipal solid waste incinerator boiler [J], *Boiler Technol.* **55**(01), 59–63, 74 (in Chinese).
- [31] Qu Z. P., Zhang B. B., Xie G. X., *et al.* (2023) Research progress on protection technology for waste incinerator heating surfaces [J], *J. Chin. Soc. Corros. Prot.* **43**(03), 452–459 (in Chinese).