Current Status of Technology and Standards of domestic Solid Waste Incineration in China

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Abstract: This paper sorts and analyzes current technologies and standards, as well as existing problems and demands in the domestic solid waste incineration industry in China, in order to further promote the establishment of domestic solid waste incineration standard system in China, standardize key technologies, devices and processes of efficient waste incineration, and promote the manufacture and utilization of advanced equipment, thus providing solid technical support and guarantee for the enhancement of overall performance level and pollutant up-to-standard emission of domestic solid waste incineration industry in China.

1. Current Status of Technologies of Waste Incineration in China

The principle of waste disposal is harmless, reduction and recycling. In various countries, main modes of harmless treatment of domestic solid wastes include landfill, compost and incineration; wherein, the waste-to-energy of domestic solid waste incineration is a kind of new technology developed in recent 30 years. Compared with landfill, it can save a lot of land resources and reduce potential secondary pollution; in addition, it can conduct waste-to-energy recycling. Therefore, it becomes a main mode of waste disposal of developed countries in recently years. Especially in metropolis where the land resources are insufficient with dense population, waste-to-energy is usually the optimal solution of solid waste harmless disposal.

There are more than 2,100 sets of domestic solid waste incineration plants around the world, and the annual domestic solid waste incineration amount is about 230 million tons. Most of them are distributed in developed countries and regions, wherein, the number of waste-to-energy projects is about 1,200. According to data analysis in 2015, the domestic solid waste incineration amount in 22 countries in European Union is about 90 million tons, accounting for 40% of global amount; in developed countries, Japan, the USA and Germany have the most domestic solid waste incineration amounts, with annual incineration amounts of 34.90 million tons, 27 million tons and 25 million tons respectively. From 2001 to 2015, the domestic solid waste-to-energy projects in Europe have continuously developed; the annual solid waste disposal capability rise from 52.84 million tons to 90.60 million tons, with annual average growth rate of 7.2%.

Main process of waste incineration includes waste collection and treatment, incineration, power generation, flue gas purification and treatment, furnace slag and flying ash removal and leachate treatment. At present, among domestic solid waste incineration technologies which are widely applied and are relatively mature, the grate furnace accounts for 75% of the total amount, and the fluidized bed furnace accounts for 25%. Along with the enhancement of national emission standards of pollutants, the application steps of fluidized bed incineration technology slows down and the grate furnace becomes mainstream technology in the application of solid waste incineration industry gradually.
However, the environmental protection devices in solid waste incineration are different in quality, efficiency and safety, lack of scientific comprehensive evaluation standard and basis, and there are non-qualified products in the market whilst the competition of low-quality homogenized products is fierce when the high-quality devices are in short supply; new grate furnace devices and technologies have no standards, the performance effect of solid waste incineration facilities are unsatisfied, since there is no scientific evaluation standards for guidance and specification. Therefore, it is urgent to sort and analyze current standards, existing problems and demands of the solid waste incineration industry, so as to further promote the establishment of domestic solid waste incineration standard system in China, standardize key technologies, devices and processes of efficient domestic solid waste incineration, and promote the application and utilization of advanced technical equipment, thus providing solid technical support and guarantee for enhancement of overall operational performance and pollutant up-to-standard emission of domestic solid waste incineration industry in China.

2. Current Status of Standards in Waste Incineration Field in China

According to statistics, there are 42 standards related to domestic solid waste incineration in China; wherein, there are 17 national standards and 25 industrial standards. Among national standards, 2 of them are mandatory national standards, 2 of them are mandatory national occupational health standards, 13 of them are optional national standards. Among industrial standards, 8 of them are environmental protection industry standards, 6 of them are urban construction industry standards, 6 of them are mechanical industry standards, and 5 of them are power industry standards. The detailed standards are as shown in Table 1.

| S/N | Standard No. | Standard Name                                                                 | Standard Type                      |
|-----|--------------|-------------------------------------------------------------------------------|------------------------------------|
| 1   | GB 14554-1993 | Emission Standards for Odor Pollutants                                        | Mandatory National Standard        |
| 2   | GB 18485-2014 | Standard for Pollution Control on the Municipal Solid Waste Incineration       | Mandatory National Standard        |
| 3   | GBZ 1-2010    | Hygienic Standards for the Design of Industrial Enterprises                   | Mandatory National Occupational Health Standard |
| 4   | GBZ 2.1-2019  | Occupational Exposure Limits for Hazardous Agents in the Workplace Part 1: Chemical Hazardous Agents | Mandatory National Occupational Health Standard |
| 5   | GB/T 14675-1993 | Air Quality – Determination of Odor – Triangle Odor Bag Method                | Optional National Standard         |
| 6   | GB/T 14676-1993 | Air Quality – Determination of Trimethylamine – Gas Chromatography             | Optional National Standard         |
| 7   | GB/T 14677-1993 | Air Quality – Determination of Toluene, Dimethyl Benzene and Styrene – Gas Chromatography | Optional National Standard         |
| 8   | GB/T 14678-1993 | Air Quality – Determination of Sulfuretted Hydrogen, Methyl Sulphhydril, Dimethyl Sulfide and Dimethyl Disulfide – Gas Chromatography | Optional National Standard         |
| 9   | GB/T 14679-1993 | Air Quality – Determination of Ammonia – Sodium Salicylate-sodium Hypochlorite Spectrophotometric method | Optional National Standard         |
| 10  | GB/T 14680-1993 | Air Quality – Determination of Carbon Disulfide – Diethylamine Spectrophotometric Method | Optional National Standard         |
| 11  | GB/T 16157-1996 | The Determination of Particulates and Sampling Methods of Gaseous Pollutants | Optional National Standard         |
| No. | Standard Code | Standard Title                                                                 |
|-----|---------------|-------------------------------------------------------------------------------|
| 12  | GB/T 16618-1996 | Emitted from Exhaust Gas of Stationary Source General Principles for Thermal Insulation Technique of Industrial Furnaces Optional National Standard |
| 13  | GB/T 18750-2008 | Municipal Solid Waste Incinerator and Boiler Optional National Standard |
| 14  | GB/T 25032-2010 | Municipal Solid Waste Incineration Bottom Ash Aggregate Optional National Standard |
| 15  | GB/T 29152-2012 | Flue Gas Cleaning System for Municipal Solid Waste Incineration Waste Pyrolysis and Incineration Treatment Device Optional National Standard |
| 16  | GB/T 35251-2017 | Municipal Solid Waste Fluidized Bed Incineration Boiler Optional National Standard |
| 17  | GB/T 34552-2017 | Stationary Source Emission – Determination of Hydrogen Chloride – Mercuric Thiocyanate Spectrophotometric Method Environmental Protection Industry Standard |
| 18  | HJ/T 27-1999   | Stationary Source Emission – Determination of Nitrogen Oxide – Ultraviolet Spectrophotometric Method Environmental Protection Industry Standard |
| 19  | HJ/T 42-1999   | Stationary Source Emission – Determination of Nitrogen Oxide – N (1-naphthyl) – ethylenediamine Dihydrochloride Environmental Protection Industry Standard |
| 20  | HJ/T 43-1999   | Stationary Source Emission – Determination of Carbon Monoxide – Non-dispersive Infrared Absorption Method Environmental Protection Industry Standard |
| 21  | HJ/T 44-1999   | Exhausted Gas of Stationary Source Iodine Titration Environmental Protection Industry Standard |
| 22  | HJ/T 56-2000   | Exhausted Gas of Stationary Source Fixed-potential Electrolysis Method Environmental Protection Industry Standard |
| 23  | HJ/T 57-2000   | Exhausted Gas of Stationary Source Fixed-potential Electrolysis Method Environmental Protection Industry Standard |
| 24  | HJ 629-2011    | Sulphur Dioxide. Non-dispersive Infrared Absorption Method Environmental Protection Industry Standard |
| 25  | HJ 693-2014    | Nitrogen Oxides – Fixed Potential by Electrolysis Method Environmental Protection Industry Standard |
| 26  | CJJ 90-2009    | Technical Code for Projects of Municipal Solid Waste Incineration Urban Construction Industry Standard |
| 27  | CJ/T 118-2000  | Municipal Solid Waste Incinerator Urban Construction Industry Standard |
| 28  | CJ/T 290-2008  | The Disposal of Sludge from Municipal Wastewater Treatment Plant — Sludge Quality for Separate Incineration Urban Construction Industry Standard |
| 29  | CJ/T 432-2013  | Technical Requirements of Waste Grab Cranes in Municipal Solid Waste Incineration Plant Urban Construction Industry Standard |
| 30  | CJ/T 531-2018  | Testing, Sampling and Sample Preparation of Slag and Ash from Waste Incinerator Urban Construction Industry Standard |
| 31  | CJ/T 538-2019  | Technical Requirements for MSW Incineration Fly Ash Stabilization Treatment Facilities Mechanical Industry Standard |
| 32  | JB/T 10192-2012| Specification for Small-sized Incinerator Mechanical Industry Standard |
| 33  | JB/T 10249-2001| Specification of MSW Incineration Boilers Mechanical Industry Standard |
As shown in Table 1, the overall quantity of standards related to solid waste incineration in China is relatively small. The standards are not complete in design, manufacturing, production, operation, inspection and detection, safety management and energy conservation and environmental protection. It is urgent to increase scientific research investment and formulate technical standard systems. Main problems which the standardization of solid waste incineration field is confronted as following:

- **Narrow standard coverage.** At present, different industries formulate their own standards respectively, and there are a lot of repetition and vacancy. For example, with regard to waste treatment capability, JB/T 10192-2012 standard is applicable to various types of incineration boilers with treatment capability smaller than 50t/d, but it only rules the requirements for classification, name, technical requirements, inspection method, sampling and inspection rules of domestic solid waste incineration boiler; CJ/T118-2000 standard is applicable to contents such as design, manufacturing, installation, sales, running and repair of domestic waste incineration boiler with treatment capability more than or equivalent to 100t/d but not more than 500t/d; JB/T 12121-2015 rules the design, manufacturing, installation, sales, running and repair of large-sized waste incineration boiler with treatment capability more than 350t/d.

- **Insufficient standard pertinence.** China has introduced numerous models of waste incineration equipment but failed to summarize and research incineration equipment technologies suitable for national conditions based on that, and have not established standard system to standardize the whole chain of production, operation management, inspection, detection, safety and environmental protection.

- **Lack of adapting to development.** At present, there is no standard in efficiency evaluation and energy conservation management targeting solid waste incineration equipment. Considering energy conservation and emission reduction pressure, and to facilitate production, operation and management of the solid waste incineration facilities, it would be better to formulate standards in waste incineration equipment efficiency and energy conservation management as soon as possible, thus standardizing efficiency evaluation and promoting energy conservation management of the solid waste incineration equipment.

- **Emphasizing terminal while neglecting process.** Among existing standards, the index requirements for final steps such as safety & environmental production of waste incineration equipment are relatively clear, but the development of process control standards is neglected. Considering special characteristics of combustion, there should be complete process control standards in design, manufacturing, installation,
inspection, detection, repair and safety management of the solid waste incineration equipment, so as to support and guarantee final realization of safety and environmental protection indexes.

In conclusion, the construction of a logical standard system with optimized structure is in favor of enhancing the solid waste incineration system, as well as increase efficiency of standard development and application; in addition, it has important theoretical meaning and practical value for the development of domestic solid waste incineration system, which will bring realistic economic and social benefits as well as long-term strategic meanings in promoting development of waste incineration in China.

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