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Key issues study on the operation management of medical waste incineration disposal facilities

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Abstract

This paper, according to the characteristics of the medical waste incineration technologies and processes and on the basis of systematically analyzing the pollutants generation nodes and release characteristics during the incineration disposal of medical waste, discusses key problems and contents to be highlighted concerning the operation management of medical waste incineration facilities from the perspective of pollution control by combination with our current main problems with regard to this, proposes to improve the capability of operation management of medical waste incineration facilities on the basis of full use of the best available technology and puts forward appropriate countermeasures for the facilities operation around the source classification, process control, performance control, supervision and management and other aspects. This can be used by the medical waste incineration unit and the environmental protection departments at all levels for reference in the operation and supervision and management of medical waste incineration disposal facilities.

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1. Basic Composition and Pollutant Control Nodes of Medical Waste Incineration Facilities

Medical waste incineration disposal technology remains an important option in our medical waste disposal technologies and plays an important role. Medical waste incineration facilities are generally composed of the waste feeding system, incineration system, flue gas purification system and slag treatment system etc. The waste preparation and supply, incineration and flue gas purification facilities vary from medical waste disposal facilities, so the medical waste incineration technology presents various

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combinations. Figure 1 shows the hardware composition and pollutant control measures of the medical waste incineration facilities.

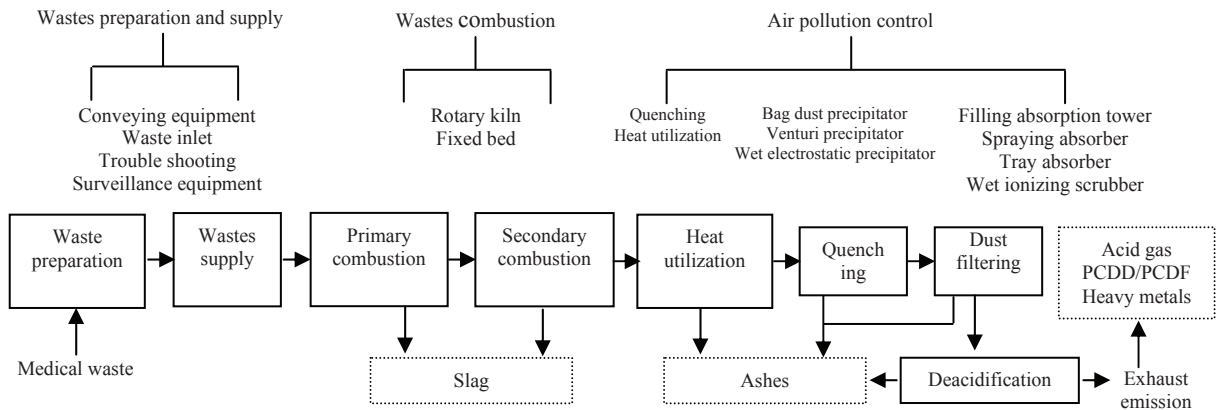


Figure 1 Hardware composition and pollutant control measures of the medical waste incineration facilities

As seen from Figure 1, one set of incineration facility can have various forms of unit design and system configuration; for medical waste incineration facility, the chemical and thermal dynamics characteristics of the waste determine the size and operating condition (temperature, excess air and flow rate) of the incineration facility and the configuration of the subsequent flue gas treatment system and slag disposal system, as well as the stoichiometric combustion air demand and the air flow rate and composition at combustion, and appropriate design parameters and process parameters are determined based on the treatment capacity and requirements; for example, different types of dust precipitation and absorption towers will be used for flue gas purification to ensure the stability and efficiency of the medical waste incineration. However, regardless of the design form, we must take seriously the control of pollutants generated during the incineration of medical waste, such as dioxins/furans, heavy metals and acidic gases. Therefore, on the other hand, to ensure the technology used in one set of disposal facility is the best available technology, we should take practical environmental management measures during the facilities operation management, to achieve organic combination of the construction with the facilities operation management. For the problems of engineering technology and facilities operation management, the Ministry of Environmental Protection of the PRC has issued the Guidelines on Best Available Technologies of Pollution Control for Medical Waste Treatment and Disposal (HJ-BAT-8) and the Technical Specifications for Centralized Incineration Facility (HJ/T177-2005), which, around the pollution control in the process of medical waste treatment and disposal, put forward technical and management requirements respectively from technology selection, engineering construction and facilities operation for compliance and reference by relevant units and practitioners in the industry.

2. Analysis of Problems in the Operation of Medical Waste Incineration Facilities

China follows the general idea of centralized disposal and rational layout in the planning and construction of medical waste disposal facilities [4, 5]. As for the construction, China sets a city as a planning unit and establishes centralized medical waste disposal facilities to receive medical waste from all counties within reasonable transportation radius. Decentralized disposal by hospitals are generally not encouraged and allowed. In addition to constructing centralized medical waste disposal facilities in each city at the regional level, the cities in the area with developed transportation and intensive towns are

encouraged to jointly construct or share centralized medical waste disposal facilities; hazardous waste facilities and medical waste facilities should be constructed in a coordinated way, and centralized hazardous waste disposal facilities should also treat the medical waste generated by hospitals in the city. In terms of the risk control, an idea of whole-process management is reflected; as medical waste features infectious and contagious, cytotoxic and radioactive hazards, it should be treated in a fully closed state from the production source to final disposal and be isolated from the people and the environment; strict management and control are carried out on medical waste throughout the whole process from production, separate collection, warning labels, sealed packaging and transport, storage to environmentally sound disposal, namely, in all links from “cradle” to “grave”.

In terms of the incineration technology, the incineration has many advantages in the disposal of hazardous waste and medical waste. The incineration technology can achieve the environmentally sound disposal, reduction and recycling of the waste, but it has also its limitation; for example, the flue gas generated from the incineration process will cause environmental pollution, especially, dioxins/furans have been listed as POPs in the international convention for control [6], and the difficult control of the incineration process, complex management and insufficient monitoring methods have brought many difficulties for the facilities operation and the supervision of environmental protection departments. Comprehensive analysis shows that the problems of domestic medical waste incineration facility operation and management mainly lie in the emphasis of end control and the negligence of process control; the emphasis of administrative management and the negligence of technical management; the emphasis of engineering construction and the negligence of capacity building. This has resulted in that medical waste disposal facilities operation is difficult to achieve the facilities operation management level matching with their technical performance; the supervision and management of local environmental protection departments, due to lack of knowledge and understanding of specific technologies and facilities, make the supervision and management personnel difficult to ascertain the key links, contents, and appropriate methods in terms of the supervision and management of medical waste incineration disposal facilities. The above problems bring about hazards for environmental safety during the incineration of medical waste. In fact, it is difficult for the government departments to realize fully continuous monitoring of the waste management facilities and identify the violations in a timely manner. However, good medical waste management model can better promote the environmental behavior of the facility operators, and push them to be actively involved in the management of hazardous waste, thus achieving the safe disposal of the medical waste. This means, by taking the priority measures and by combination with the specific process and technical characteristics, starting from the pollution control, clarifying the key issues for the medical waste incineration process, and comprehensively promoting the life-cycle and whole-process management philosophy, so that the facility operators know the phenomenon and result, but also know the reasons, the environmental supervision and management personnel have rules to follow in the process of their supervision and management, and that the public know how the government and the facility operators ensure the standardization and compliance of environmental protection facilities operation. The realization of above goals requires recognizing key issues on the operation management of medical waste incineration facilities and putting forward targeted countermeasures.

3. Operation Management Strategies for Medical Waste Incineration Facilities

To focus on the source classification to make it in line with the end pollution control method. Internal medical waste management of the medical institutions is essential, as on the one hand, it relates to the ability to effectively eliminate the infection of medical waste to reduce the hazards to humans and the environment and on the other hand, different medical waste disposal technologies have different needs and require the medical institutions to implement scientific classification. First, to reduce the amount

from the source of the medical waste, in particular, there is a certain gap in the reduction control of the medical waste incineration source such as chlorine source with developed countries, which is also one of the main reasons why the flue gas from the hazardous waste incineration is difficult to treat and not up to standard. Although China has put forward certain requirements for the materials of medical waste bags from the standard level, prohibiting the use of PVC and other chlorinated materials in the manufacture of medical waste bags, but on the one hand, the management problem in the field of hazardous waste involves not just medical waste, on the other hand, due to the slow progress in environmental law enforcement and materials substitution, there is no basic policy orientation, resulting in ineffective control of hazardous waste and medical waste source reduction. To fundamentally reduce the chlorine source generating dioxins/furans, a fundamental solution to eliminate the generation of dioxins/furans from the hazardous waste incineration is to minimize the waste generated at the source, which has been increasingly and clearly accepted throughout the world. Only the reduction of the chlorine source generating dioxins/furans at the source can ensure the reduction of the final discharge volume fundamentally, and reduce the load of the follow-up flue gas treatment. In terms of the heavy metal, the mercury is the most ordinary in medical waste, so how to remove the mercury in the process of medical waste classification is the key to promoting the discharge up to standard at the end.

To take the process control as the core to promote the combination of process control and end control, and promote the standardized operation management of the facilities. The operation of medical waste incineration facilities mainly aims to dispose of the medical waste, and prevent various pollutants generated during the disposal, including air pollutants, wastewater and solid waste, and in particular, to control dioxins/furans, and how to ensure the appropriate process parameters is critical, for example, the temperature in the incineration furnace is required to reach 850 °C, the flue gas should stay in the furnace for more than 1s, and the combustion efficiency should be greater than 99.99% [7]. Therefore, the medical waste incineration facilities operators should, combined with the characteristics of their own technologies and facilities, take the process control as the core, pay attention to both the source classification and end control, start from such links as the medical waste feeding system, incineration system, flue gas purification system, slag treatment system, wastewater treatment system and automatic control system, establish and improve various regulations and rules by combination with their own conditions, strengthen personnel training, take production safety and emergency prevention and protection measures, monitor the discharge of pollutants from incineration facilities and keep monitoring records of and evaluate the surrounding environment of the disposal units to ensure standardized operation and management of medical waste incineration facilities. The Technical Specifications for Construction of Centralized Incineration and Disposal Project of Medical Wastes (HJ/T177-2005) issued by the Ministry of Environmental Protection of the PRC can be used as an important basis for centralized incineration unit of medical waste to implement the operation management.

To take the performance control as the guarantee to carry out the performance assessment of medical waste incineration facilities and promote high-level and stable operation of the disposal facilities. To determine whether one set of facility discharges pollutants as required and whether it is suitable for specific waste disposal, it is required to carry out a systematic assessment combined with the characteristics of the waste and the working condition of the facility. Therefore, to verify the performance of one set of facility in a scientific and systematic way, it is required to adopt one performance testing and evaluation method integrating the characteristics of the waste, working condition and performance of the facility, discharge of pollutants and operating parameters of the facility and covering the whole process. With regard to this, the Ministry of Environmental Protection of the PRC has issued the Technical Specification of Performance Testing for Facilities of Hazardous Waste (including Medical Waste) Incineration (HJ561-2010), specifying that the organic combination of four indicators including the waste characteristics, system performance, flue gas emission and equipment operating parameters should be

fully considered, medical waste should be considered under boundary conditions and normal conditions, and that standard waste should be used as the reference of the incineration facility performance testing and evaluation to determine specific performance of the incineration facility. For the facility which is evaluated up to standard, it is required to clarify the corresponding waste characteristics, working condition parameters and main operating parameters under the discharge up to standard; otherwise, the facility not up to standard should be renovated and another testing and evaluation should be conducted. Although the implementation of this technical specification has not yet been included in normal work, international experience shows that it is necessary to explore a practical performance evaluation method for our management and disposal of hazardous waste (medical waste) to regulate the operation and management of medical waste incineration facilities in China. Therefore, we should carry out targeted performance testing by combination with different incineration processes, to provide basis for exploring the performance of specific facilities, issuing permits and carrying out appropriate environmental monitoring.

To formulate regulations and methods by way of supervision and management to make the supervision and management scientific and standardized. It is also the key for pollution control to take practical and effective measures by local competent department of environmental protection administration to promote safe operation of the facilities from the perspective of supervision and management. To promote the supervision and management of medical waste non-incineration facilities, the Ministry of Environmental Protection of the PRC has issued the Technical Specifications for the Supervision and Management to the Operation of Incineration Disposal Facilities for Medical Waste (HJ516-2009); the competent department of environmental protection administration can supervise and manage the operation of centralized medical waste incineration facilities by way of written examination, site verification and remote monitoring; the local competent department of environmental protection administration should, before the supervision and inspection, collect data based on actual needs, identify the focus, contents and evaluation criteria of the inspection on the basis of carefully studying and reading relevant information or technical evaluation report provided by centralized medical waste incineration units, develop the supervision and inspection implementation plan, establish standardized supervision archive and management system for the operation of centralized medical waste incineration facilities and inspect the basic operating conditions of medical waste incineration units, operating process of incineration facilities, configuration and operating effect of pollution prevention and control facilities, as well as production safety and labor protection measures. What's most critical is, by combination with the characteristics of different medical waste incineration facilities and around the life-cycle and whole-process management philosophy, to start from the risk control and achieve pollution prevention and control and clean production, to make the supervision and management to the operation of centralized medical waste incineration facilities standardized and institutionalized.

4. Conclusion

The management to the operation of medical waste incineration facilities is an important problem confronted after the construction of hazardous waste and medical waste disposal facilities in China. The planning solves the construction problems of the hardware facilities, but the software problems such as the management to the facilities operation closely related to the pollution control must also be solved. For the incineration of medical waste, we should, on one hand, based on the life cycle characteristics of the medical waste, start from the source to do well the waste reduction at the source and the source classification of the waste, and effectively cut off the production source of dioxins/furans and other pollutants; on the other hand, we should pay attention to the management to the operation of disposal facilities during disposal to fully promote the standardization of the facilities operation, standardize the

operation management by improving the facilities of the disposal unit and actively apply the best environmental practice to ensure the attainment; third, we should start from the perspective of the whole-process management, go to the process control from the end control and pay attention to the connection from the incineration materials control, automatic control of the process parameters to the local environmental supervision and management system. This is the only road to the safe operation management of medical waste incineration facilities in China.

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