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Use incentive approach to promote BAT/BEP for centralized incineration facilities of medical waste in China

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Abstract

The GEF project of environmental sustainability management for medical waste in China has been developed and implemented. The overall objectives of the project are to incorporate the concept of overall-process management in life cycle of medical waste into medical waste management and disposal of China, facilitate BAT/BEP application and promotion, improve China's abilities of medical waste management and disposal, promote reduction of medical waste and realize the target of harmlessness, by introducing the advanced experiences in medical waste management and disposal from foreign countries. Currently, most of the activities in demonstration stage have already been completed, and it is expected to reach the dioxin concentration of 0.1 ngTEQ/m³ in flue gas of 15 incineration (including pyrolysis) facilities. Hence, the project decides to implement the incentive plan among eligible medical waste incineration facilities in China. In this plan, a process with steps as application, review, examination, technical transformation, verification and award was designed. To standardize and externalize the process, an entire package of files including principles, guidelines, quota and criteria, table and checklist templates were developed, considering all the involved stakeholders. As a result, with active involvements and contribution of the MEP, local governments, enterprises, experts and monitoring instructions, the incentive plan vigorously guided and promoted BAT/BEP replication and application for medical waste disposal, avoided and reduced the generation and emission of dioxin POPs and other toxic substances. Currently, there are 8 incinerators which realized the aim of controlling their dioxins emission under limited concentration of 0.1ng TEQ/m³ in the flue gas.

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1. Introduction

China produces approximate 1,780 tons medical waste (MW) per day. MW incineration was recognized as one of the key release sources of PCDD/Fs in China, and therefore was listed into the inventory of foremost controlled sources by China's National Implementation Plan (NIP). As required by Article 5 of the Stockholm Convention¹ on Persistent Organic Pollutants, China give priorities to take measures to reduce releases of PCDD/Fs and and other unintentionally produced POPs (UP-POPs), by means of the application of best available techniques and best environmental practices (BAT/BEP).

Following the outbreak of Severe Acute Respiratory Syndrome (SARS) in June 2003, the Government moved quickly to establish the National Plan for Construction of Facilities for Disposal of Hazardous Waste and Medical Waste (NPHMW), in which China is committed to construct 332 dedicated MW disposal facilities across the country. Similar with the practice in many other developing countries, the NPHMW envisaged adopting incineration as the technology of choice for most of these facilities at first. Under the influence of BAT/BEP concept, nearly half of the facilities which are almost minor ones turned to choose the non-incinerations technologies, such as autoclave, microwave and chemical disinfections, which are alternative and supplementary to incinerations and could avoid emissions of PCDD/Fs and other UP-POPs. However, there are still about half facilities using incineration like rotary kiln and pyrolysis (continuous or by-batch feeding).

In order to fulfill the obligations of Stockholm Convention, and implement NIP, Ministry of Environmental Protection of the People's Republic of China (MEP, designating its branch "FECO"-- Foreign Economic Cooperation Office) and the United Nations Industrial Development Organization (UNIDO) jointly developed and executed the full-size project of Environmental Sustainability Management for Medical Waste in China in support of Global Environment Facility (GEF)². Integrating with the implementation of NPHMW, this project was to promote the adoption of BAT/BEP in MW disposal and treatment sector, ultimately reducing environment pollution and protecting human health. There have been three incineration facilities (each stands for a representative incineration type) selected for BAT/BEP demonstration, aiming to reduce PCDD/Fs release (in flue gas) down to 0.1ngTEQ/m³, by means of engineered and managing methods. To further promote BAT/BEP for MW incineration in China, the project designed and kicked off an incentive plan³ for centralized incinerators to compensate for up to 15 facilities to decrease their PCDD/Fs release limitation in the flue gas from 0.5ngTEQ/m³ to 0.1ngTEQ/m³. The successful implementation of the incentive plan will substantially promote the revision of Pollution Control Standard⁴ for Hazardous Wastes Incineration (GB18484-2001) in which the PCDD/Fs release limitation in the flue gas will be decreased from 0.5ngTEQ/m³ to 0.1ngTEQ/m³, and furthermore promote the replication of BAT/BEP nationwide. In this abstract, the mechanism and framework of the incentive plan will be laid out and discussed.

Nomenclature

MW	medical waste
PCDD/Fs	polychlorinated dibenzo- <i>p</i> -dioxins and dibenzofurans, also as dioxins
NIP	National Implementation Plan for the Stockholm Convention on POPs
UP-POPs	unintentionally produced POPs
BAT/BEP	best available techniques and best environmental practices
SARS	severe acute respiratory syndrome
NPHMW	national plan for construction of facilities for disposal of hazardous waste and medical waste
MEP	ministry of environmental protection
UNIDO	united nations industrial development organization

2. Mechanism and methodology

2.1. Necessity Analysis

According to the requirements of current Pollution Control Standard⁴, the limit of PCDD/Fs emission concentration into atmosphere from incinerator is 0.5 ngTEQ/m³. The revision of the standard is on-going currently, and influenced by the project the limit will be decreased to 0.1 ngTEQ/m³. However, more monitoring data and technical practice information are required to verify the possibility of the application of BAT/BEP not only at demonstration level but also at a massive replication level. Hence, it is necessary to regulate the facilities reaching 0.1 ngTEQ/m³ by economic incentives and based on the industrial market, to accelerate and support the revision process.

2.2. Technical Feasibility Analysis

The three BAT/BEP technical demonstrations of rotary kiln, continuous pyrolysis and by-patch pyrolysis have completed and will enter the summary stage. The technical proposals and successful experiences advanced the revision of the corresponding technical engineering regulations and will provide practical references for the incentive plan. Additionally, Guidance of Best Available Techniques for Pollution Control of Medical Waste Disposal (trial) (HJ-BAT-8) (BAT guidance)⁵ has already been issued, which will provide important technical guidance and basis for the incentive plan. In terms of supervision, several law and regulations such as revision of Laws of Environmental Protection, Judicial Interpretation on Several Issues of Applicable Laws to Deal with the Environmental Pollution Criminal Cases, and Notice on Further Strengthening the Medical Waste Management, were issued to compel and regulate enterprises to take active actions to meet the above pollution control standard and technical regulations.

Currently, there are more than 100 centralized medical waste incinerators (including those for joint disposal of medical waste and hazardous waste) running in China, most of which can reach a disposal scale of 5 ton/day. Beyond the demonstrations, the monitoring data of PCDD/Fs emission in flue gas of some MW incinerators shows that some facilities can or have good potential to reach 0.1 ngTEQ/m³. Therefore, the general situation of disposal facilities and the existing monitoring data show a solid foundation for the incentive plan.

2.3. Economic Rationality and Effectiveness Analysis

The budget plan of incentive plan includes RMB 15 million Yuan awarded for the enterprises (15 incineration disposal enterprises reaching 0.1 ngTEQ/m³ will be awarded with RMB 1 million Yuan respectively) and about RMB 1 million Yuan as evaluation and management fees of incentive plan, i.e. RMB 16 million Yuan in total as budget fund (about USD 2.4 million dollars, based on exchange rate of 6.2).

In the incentive plan, the main calculation basis is as below:

- Investment cost of flue gas purification facility

According to the engineering investment budget of the three BAT/BEP technical demonstrations, investment for equipment eligible for awarding can reach RMB 2 million to 4 million Yuan (that incorporating SCR technology. However, SCR catalyst for purification of flue gas generated in medical waste incineration accounts for a large proportion in the cost and is monopolized by foreign companies, and the delivery time is long, thus the newly upgraded facilities in the incentive plan is not available for use basically), and the total investment is RMB 3 million to 10 million Yuan. According to equipment estimate in BAT guidance, investment for flue gas purification facility is RMB 1.5 million to 2 million Yuan for the rotary kiln medical waste incinerator with disposal capacity larger than 10 t/d, and that for pyrolysis incineration facility with disposal capacity of 5 t/d-10 t/d is RMB 1 million to 1.5 million Yuan. Based on the data above, investment for flue gas purification facilities may be determined as RMB 1.5 million Yuan (equipment expenses only).

- 2. Operating cost during the implementation of the project (1 year)

A rotary kiln incinerator consumes 45 kg~150 kg diesel fuel, 300 kW•h~400k kW•h electric energy and 10 t~14 t water annually. It runs 330 days per year, and 24 hours per day, and its operating cost is determined as RMB 3,000 Yuan/t (2,500-3,500 Yuan/t actually), thus its annual operating cost is RMB 9.9 million Yuan.

A pyrolysis incinerator consumes 15 kg~30 kg diesel fuel, 400 kW•h~500 kW•h electric energy and 3 t~6 t water annually. It runs 330 days per year, and 20 hours per day, with the operating cost determined as RMB 2,000 Yuan/t (RMB 1,500 – 2,500 Yuan/t actually) and the disposal capacity of 8 t/d, thus its annual operating cost is RMB 5.28 million Yuan.

• 3.Summary and Discussion

To sum up, in consideration of investment for upgrading of the flue gas purification equipment only, the incentive fund of RMB 1 million Yuan accounts for 67% in the investment, and the other 33% is undertaken by the enterprise itself. In further consideration of annual operating cost and other capital factors, the proportion undertaken by the enterprise itself may reach 1:5-1:10, which is compatible with the designed fund proportion of 1:4 for the whole medical waste project. In the context that a new emission standard will be issued, it becomes a general trend to promote the medical waste incinerators to reach 0.1 ngTEQ/m³. It is attractive for an enterprise with long-term perspective to obtain RMB 1 million Yuan incentive funds and to participate the incentive plan of the project.

3. Design and instructure of incentive plan

3.1. General Workflow

The incentive plan includes 5 stages in all as Fig.1 shows.

- 1. Preparation stage. FECO will organize research forces to prepare the action program and application guidance of the incentive plan, invite the competent authorities, incineration enterprises, the headquarters of incineration enterprises, equipment suppliers and relevant authorities and organizations to attend the briefing meeting, introduce the incentive plan and listen to the opinions from all parties.
- 2. Application stage. FECO will release the approved application announcement and guidance for incentive plan on relevant media platform, organize the related parties to hold an explanation meeting, and introduce the contents and requirements of incentive plan to the entities willing to participate. Eligible entities (applicant) shall make preparations according to the requirements in the guidance for application and submit the application files to FECO. Approval and recommendation shall be obtained from the local competent environmental protection authority (provincial or municipal) before application. The deadline of application may be postponed as appropriate if there are less than 15 applicants.
- 3. Examination stage. FECO will perform formal examination in terms of integrity, normativity and effectiveness for the application files. Comments of formal examination will be provided to the applicant within five (5) work days after the application files have been received. The applicant shall supplement the application files as required within five (5) work days. FECO will make technical examination in terms of technical feasibility and operability for the application files passing formal examination (on-site re-examination will be performed when necessary) and provide comments of technical examination. The applicant shall submit the revised technical proposal within ten (10) work days. FECO will sign an agreement of incentive plan with the applicant passing technical examination (qualified applicant). FECO will negotiate with UNIDO if less than 15 applicants pass the examination finally.
- 4. Implementation Stage. The qualified applicant shall conduct relevant activities according to the technical proposal after signing the agreement of initiative campaign, and accept the dispatching and inspection of FECO. If the actual implementation process varies largely from the technical proposal, the qualified applicant shall inform FECO in a timely manner to actively consult for solution. After completing the activities listed in the technical proposal, the qualified applicant shall entrust an entity certified for dioxin monitoring to monitor the

dioxin emission in flue gas of the target facility. The monitoring and sampling process shall be witnessed by a person of FECO or an authorized representative of FECO, and the representative of competent environmental protection authority at the local place where the enterprise is located. The applicant with monitoring results compatible with the judgment criteria may submit a summary report for the incentive plan to FECO, and submit the application for on-site verification.

- 5. Verification, Awarding and Summary Stage. FECO will organize an expert group to perform on-site verification at the place of applicant, and provide comments for the verification. A dioxin monitoring organization may be entrusted to re-examine and monitor dioxin emission in the flue gas of disposal facility based on the needs of on-site verification. FECO will award the qualified applicant eligible for awarding according to the agreement of incentive plan.

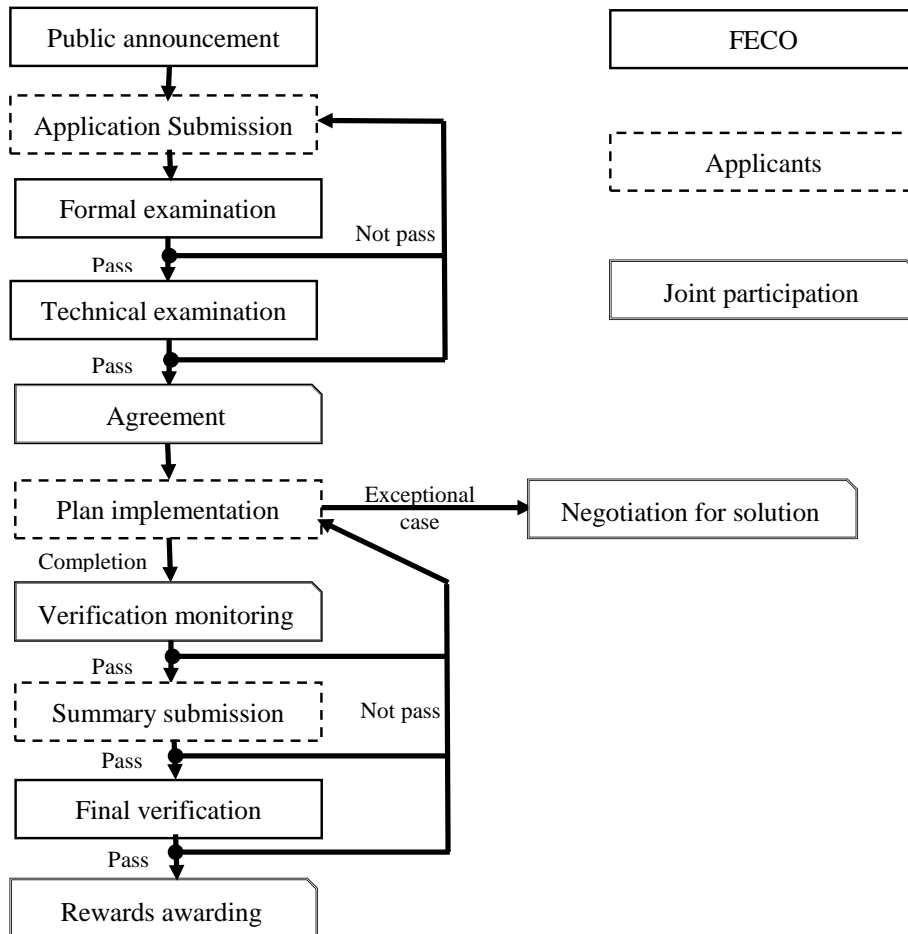


Fig.1. A general flowchart of the incentive plan

3.2. Implementation Principles

- 1. Voluntariness. The domestic medical waste incineration disposal enterprises (legal entities) may file applications voluntarily based on the operation conditions and emission levels of their facilities.

- 2. Wide into severe out. Any medical waste incineration disposal enterprise eligible for application as required the Guidance may file an application. However, the incentive funds provided to domestic medical waste incineration disposal enterprises meeting all the criteria for incentives defined in the Guidance must be managed, audited and paid by Foreign Economic Cooperation Office of Ministry of Environmental Protection (hereinafter referred to as FECO) uniformly.
- 3. Openness and fairness. All the requirements specified for the incentive plan and the main implementation process are in the open, and the incentive criteria are set in the spirit of fairness.
- 4. Guidance and encouragement. Those incineration disposal enterprises, which have reached the incentive criteria specified in the Guidance by raising investment, upgrading equipment and strengthening management relying on their own efforts, will be provided with one-time incentive funds, as demonstration and guidance for technology and management improvement in the medical waste disposal industry.

3.3. *Qualifications of Applicants*

The applicants shall meet the all following requirements:

- 1. An applicant must be an independent legal entity within the territory of the People's Republic of China, which mainly specializes in medical waste disposal via incineration. The applicant must have a valid business license for hazardous waste disposal.
- 2. The facility covered in the application shall be of centralized disposal type, approved by the provincial or municipal competent environmental protection authority and serving the corresponding region.
- 3. The designed disposal capacity (unit set) of facility covered in the application shall be above 5 ton/day (included), and the annual disposal capacity for medical wastes (unit set) shall be above 1000 ton (included) (excluding the facility with a license obtained less than one year ago or at the stage of pilot running).
- 4. The monitoring result of pollutant release of an applicant within one year before application shall meet the requirement of emission limit in Pollution Control Standard for Hazardous Wastes Incineration.
- 5. The applicant must be law-abiding, honest and faithful (having valid business license and pollutant release license).

3.4. *Incentive quota and judgment criteria*

An applicant with incinerator eligible for incentive within the incentive period will be provided with RMB 1 million Yuan in one time. The incentive object shall be in compliance with the following judgment criteria:

- 1. Have completed all contents listed in the technical proposal which has been submitted and approved;
- 2. In the monitoring results verified, the dioxin concentration in flue gas shall not be larger than 0.1 ng-TEQ/Nm^3 , and the emission levels of other pollutants shall be within the limits defined in Pollution Control Standard.
- 3. The applicant shall provide records of operation parameters for the incinerator in normal operating conditions for a month within the incentive period (according to "best available process parameters" in BAT guidance).
- 4. Meet the main requirements in BAT guidance.

- 5.The facility covered in the application shall meet the requirements in Technical Specifications of Engineering Construction for Centralized Incineration Disposal of Medical Wastes.

4. Results and discussion

The Notice of the incentive plan was published on June 4th, 2014 and an explanation meeting was held jointly by FECO and UNIDO in Beijing, June 17th 2014. By the end of 2014, there were 15 incinerators of 13 enterprises passed the examinations and won the qualification to pursue for the incentive fund (see Fig. 2). Until the end of May 2015, there are 8 incinerators passed the verification of the incentive plan.

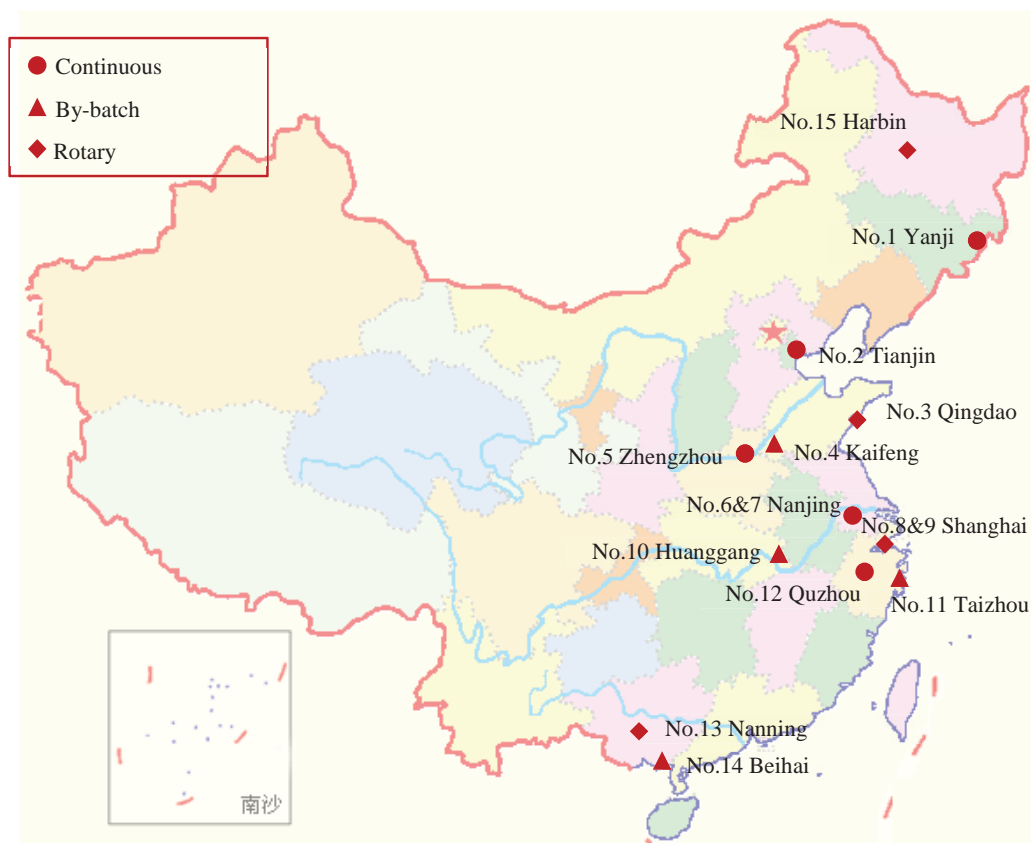


Fig. 2. The distribution of qualified participant incinerators

In consideration of possible failure and quit of some incinerators, it is necessary to prepare for the successive activities. The following plans are suggested: 1. Make a complementary recruit. If the qualified incinerators exceed the gap, the incentive fund will be awarded with the method of first come first served. 2. Encourage replacement of incinerators with non-incineration technologies.

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