FACT SHEET

Recent Developments in Clinical Waste Treatment Technologies

1. Background

1.1 The Bills Committee on Waste Disposal (Amendment) Bill 2005, at its meeting on 8 July 2005, requested the Research and Library Services Division to provide information on new developments in clinical waste treatment technologies since the Government published the "Review of Alternative Technologies for the Treatment of Clinical Waste" (The 2000 Review) in 2000. The expert review in the 2000 Review recommended that the Government could adopt high-temperature incineration as a medium-term clinical waste treatment option, but in the longer term, the Government should keep abreast of developments in various technologies alternative to incineration.[1]

2. Treatment technologies alternative to incineration

2.1 A literature review on clinical waste treatment methods in places outside Hong Kong, such as the United States (US), the United Kingdom (UK), Australia, New Zealand and Taiwan, has not revealed any new notable non-incineration technologies other than those mentioned in the 2000 Review.[2] The non-incineration technologies currently available and applicable to clinical waste include:

(a) Autoclaving or steam sterilizing, a wet thermal disinfection process in which the waste is sterilized under pressure by saturated steam at a temperature between 121℃ and 131℃ in a pressure vessel or an autoclave;

(b) Microwave disinfection, an electromagnetic wave thermal disinfection process involving the use of high-intensity radiation to heat the moisture inside the waste;

(c) Pyrolysis, a process of chemical decomposition of organic materials by heat of up to 2 500℃ in the absence of oxygen;

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1 Environmental Protection Department (2000), p. 66.

2 Environmental Protection Department (2000), US Environmental Protection Agency (2005), Environment Agency (2005), Waste Management Association of Australia (2004), Environment, Transport and Works Bureau (2002), and the website of the World Health Organization, available from: http://www.epa.gov/epaoswer/other/medical/mwfaqs.htm [Accessed July 2005].

(d) Gasification, a process similar to pyrolysis but where the waste to be treated has a high carbon content and is heated to a temperature as high as 1 300℃ with a limited amount of oxygen;

(e) Chemical disinfection, a process of using chemicals, such as sodium hypochlorite, formaldehyde, chlorine dioxide and ozone gas, to kill or inactivate pathogens in the waste;

(f) Plasma-based systems, which use high-temperature (up to 10 000℃) ionized gas to convert the waste to a vitrified substance with separation of molten metal; and

(g) Irradiation, a process of using electron beam or other high energy particles emitted from radioisotopes to disinfect the waste.

3. Recent developments in non-incineration technologies

3.1 In recent years, some of the non-incineration technologies have not only been approved or adopted by regulatory authorities in overseas places,[3] but also made significant advances in their application. In the UK, several case studies from technology users and suppliers indicate that the waste treatment industry is seeking to combine various non-incineration technologies to treat wastes and produce heat and power. For instance, starting from 2004, a waste treatment plant has processed wastes by a sequential combination of pyrolysis, gasification and high temperature oxidation. The plant claims that the waste treatment system using such technologies can recover up to 80% of the energy value of the waste as usable power and heat.[4] The Environment Agency[5] in the UK also opines that this new treatment system has low visual impact and emissions, and can handle a wide range of both solid and liquid wastes, including clinical waste. The drawbacks are that the system involves medium to high cost, and may have unforeseeable risks due to the relatively new technology.

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[3] Non-incineration technologies have been becoming more common in overseas places such as the US, the UK, Australia and New Zealand. In Taiwan, besides the commonly used incineration, microwave and chemical disinfections have been legally approved for use since July 2001 and December 2001 respectively. Studies are being conducted to assess the safety, emissions, ease of operation and reliability of non-incineration technologies. For example, in the US, the Underwriters Laboratories, an independent, non-profit-making product-safety testing and certification organization, has been drafting standards for alternative treatment technologies. Further information is available from: http://www.ul.com/eph/medicalwasteindex.htm [Accessed July 2005].

[4] *Compact Power – Sequential Pyrolysis, Gasification and High-Temperature Oxidation*, available from: http://www.environment-agency.gov.uk/wtd/679004/679021/679047/690537/?version=1&lang=_e [Accessed July 2005].

[5] Established by the 1995 Environment Act, the Environment Agency is a non-departmental public body sponsored by the UK government's Department for Environment, Food and Rural Affairs and the National Assembly for Wales. The Agency aims to prevent damage to the environment by providing education and guidance.

3.2 A report published by the World Health Organization (WHO) in 2004 remarked that several small-scale innovative clinical waste treatment technologies, including the solar-powered autoclave and the boiling chamber with mechanical grinder and compactor,[6] had been under development. In particular, the developer of the solar-powered autoclave claimed that the technology using readily available materials could provide cheap, non-burn, portable sterilization to rural areas and operate in both sunny and cloudy conditions.[7] Other technologies under development, as mentioned in the report, included the application of sufficient heat to melt the whole syringes into a consolidated mass in which needles were embedded, and the enhancement of recycling.[8] The report stated that in developed countries, many hospitals and other clinical waste generators *"have moved away from incineration to autoclaving, responding to increasingly stringent emission controls, cost arguments and public acceptance"*.[9]

4. Recent reviews on incineration

4.1 In the past several years, there has been no significant development in the incineration technology. While incineration is still a widely used clinical waste treatment technology, information released by WHO in October 2004 indicated that *"in the past few years there has been growing controversy over the incineration of health-care waste"*.[10] Incineration may produce toxic air pollutants such as dioxins and furans, particularly when wastes are burnt at temperatures below 800℃ or when plastics that contain polyvinyl chloride are burnt. Even in incinerators with temperatures above 800℃, when temperatures are not uniform, toxic air pollutants can form in cooler pockets or during start-up or shut-down periods. WHO opines that incineration may provide *"an interim solution"* especially for developing countries where alternative treatment technologies, such as autoclaving and microwave disinfection, are limited, but in the long term, promotion of non-incineration technologies should be scaled up.[11]

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6 The solar-powered autoclave, developed by a group of professionals from the Sydney University in Australia, and the boiling chamber with mechanical grinder and compactor, developed by a professional from the Newcastle upon Tyne Hospitals NHS [National Health Service] Trust Freeman Hospital in England, were the winners of the MedWaste Contest organized in 2003 by the Health Care Without Harm, an international coalition of hospitals, medical and environmental health groups and professionals, and community groups, etc.

7 Health Care Without Harm (2003a).

8 Batterman (2004), p. 11.

9 Batterman (2004), p. 10.

10 World Health Organization (2004b).

11 World Health Organization (2004b).

4.2 Another report published by WHO in 2004 also recommended that WHO should view incineration as a "*transitional means of health-care waste disposal*".[12] The report remarked that in developed countries, safe and effective waste treatment options, such as autoclaving, were increasingly available, and their costs appeared competitive with small-scale clinical waste incinerators. However, the report opined that the availability of incineration might *"negatively affect"* the development and use of such preferred treatment technologies.[13]

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[12] Batterman (2004), p. 50.
[13] Batterman (2004), pp. 48-50.

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