Recommendation for Incinerator Procurement

This incinerator recommendation is based upon an estimated annual volume of 300,000 lbs/year of medical waste, which is the average medical waste generation rates for Tanzanian hospitals.[1]

I. Issues for Consideration During Planning:

1. **Best practice emission guidelines should be considered when selecting an appropriate incinerator, such as the US EPA standards [2] and the European Union standards, in addition to country standards.[3]**

2. **Other specific waste parameters that should be assessed at the planning stage for determining the most suitable type and size of incinerator:[4]**

   - Current extent of waste production and types of healthcare waste
   - Estimated future waste production
   - Production of incinerable waste per day (and per bed per day)
   - All the physical parameters that determine the suitability of waste for incineration, such as low heating value and moisture content

3. **Incinerators designed especially for treatment of health-care waste should operate at temperature 1200°C.**

4. **Characteristics of waste suitable for incineration:**

   - Low heating value: above 2000 kcal/kg (8370 kJ/kg) for single-chamber incinerators, and above 3500kcal/kg (14640kJ/kg) for pyrolytic double-chamber incinerators
   - Content of combustible matter must be above 60% of the total mass
   - Content of non-combustible solids must be below 5% of the total mass
   - Content of non-combustible fines must be below 20% of the total mass
   - Moisture content must be below 30% of the total mass

5. **Waste types not to be incinerated:**

   - Pressurized gas containers
   - Large amounts of reactive chemical waste
   - Silver salts and photographic or radiographic wastes
   - Halogenated plastics such as polyvinyl chloride (PVC)*
   - Waste with high mercury or cadmium content, such as broken thermometers, used batteries, and lead-lined wooden panels
   - Sealed ampoules or ampoules containing heavy metals

**PVC can be included if burned at 1200°C and where it accounts for less than 10% of the waste being incinerated. Although combustion of plastics contribute to dioxin/furan emissions, as well as heavy metals, hospitals will inevitably need to burn a small amount of plastics, such as those found in*

disposed sharps. To ensure proper incineration of the plastic, it is essential to churn the waste, heat the waste to the right temperature, provide rapid cool down, and allow for adequate incineration time. An air scrubber may be a wise addition to an incinerator that is being used to burn PVC.

II. <u>Recommended Incinerator Type:</u>

1. <u>Dual-Chamber Pyrolytic Incineration</u>

- Uses controlled air incineration or double-chamber incineration
- Most reliable and commonly used treatment process for health-care waste
- May be specially designed for hospitals
- Normally does not require exhaust-gas cleaning equipment for typical hospital incinerators that have the capacity of less than 1 ton per day
- Ash should contain less than 1% unburnt material
- The pyrolytic incinerator comprises a pyrolytic chamber and a post-combustion chamber that should be of steel with an internal lining of re-factory bricks, resistant to corrosive waste or gas and to thermal shock

  Pyrolytic Chamber: the waste is thermally decomposed through an oxygen-deficient, medium-temperature combustion process (800– 900°C), producing solid ashes and gases. The pyrolytic chamber includes a fuel burner, used to start the process. The waste is loaded in suitable waste bags or containers (feed opening should be large enough to allow loading of this packed waste). Should be sufficient in size to allow a residence time for the waste of 1 hour. It should contain baffles or dampers to increase the mixing of waste with the air inflow.

  Post-Combustion Chamber: The gases produced in this way are burned at high temperature (900–1200°C) by a fuel burner in the post-combustion chamber, using an excess of air to minimize smoke and odors. Gas residence time should be at least 2 seconds and air inflow with 100% excess oxygen and high turbulence should be ensured.

- Adequate for the following waste categories: Infectious waste (including sharps) and pathological waste; Pharmaceutical and chemical residues (causes disintegration of most residues; however, only small amounts (e.g. 5% of total waste load) of these wastes should be incinerated in this process
- The equipment is relatively expensive to purchase, and expensive to operate and maintain. Well trained personnel are required

<u>Case Study: De Monfort[5]</u>

In Africa, the World Health Organization (WHO) is promoting small-scale, dual-chamber De Monfort incinerators with respective Ministries of Health. Fuel and waste preparation equipment are the main operating costs, but other costs may include operating charges, maintenance, and higher operator skills. Construction costs for the various types in Tanzania normally range from 1,000 to 2,500 USD.

There have been reports of these incinerators as inoperative or operating below standards. Some hospitals have rebuilt their incinerators a number of times due to breakdown. **Budgeting adequately for enhanced operation, training, and maintenance can reduce risk of these incinerators breaking down.**

Note, in Tanzania, EEPCO designed and constructed onsite De Montfort Mark III incinerators, with support also from the Tanzanian Ministry of Health, for Handeni District Hospital, TOHS, Sekutoure Mwanza, Magu and the Tanzania Food and Nutrition Institute.[6]

III. Not Recommended Treatment and Disposal

1. Single-chamber incineration

Significant emissions of atmospheric pollutants; very inefficient in destroying thermally-resistant chemicals and drugs

**Can meet minimum requirements for incinerators.*

2. Drum or brick incinerator

Destroys only 99% of microorganisms; no destruction of many chemicals and pharmaceuticals; massive emission of black smoke, fly ash, toxic flue gas, and odors

**Can meet minimum requirements for incinerators.*

3. Rotary Kiln

High operating and investment cost; should be located in industrial areas or "parks" and operated by a specialist waste disposal agency

**Highly effective for regional healthcare waste incineration; can handle normally .5-3 tons of waste per hour.*

4. Wet thermal treatment

Inadequate for anatomical, pharmaceutical, and chemical waste that is not readily steam-permeable

*****Autoclaving*** *is an efficient wet thermal disinfection process. Typically, autoclaves are used in hospitals for the sterilization of reusable medical equipment. They allow for the treatment of only limited quantities of waste and are therefore commonly used only for highly infectious waste, such as microbial cultures or sharps. It is recommended that all general hospitals, even those with limited resources, be equipped with autoclaves. Note, minimum contact times and temperatures will depend on several factors such as the moisture content of the waste and ease of penetration of the steam. Research has shown that effective inactivation of all vegetative microorganisms and most bacterial spores in a small amount of waste (about 5–8 kg) requires a 60-minute cycle at 121°C (minimum) and 1 bar (100 kPa); this allows for full steam penetration of the waste material.*

5. Microwave Irradiation

High investment costs and operating costs; potential operation and maintenance problems; newer technology that is not yet recommended for developing countries

*This is a newer technology that is considered environmentally friendly and will be probably recommended for wider spread use in coming years.

6. Chemical disinfection
Uses hazardous substances; inadequate for pharmaceutical, chemical, and some types of infectious waste

7. Encapsulation
Not recommended for non-sharp infectious waste

8. Safe burying
Safe only if access to site is limited and certain precautions are taken; not applicable to the BMC's surrounding urban environment

9. Inertization
Not applicable to infectious waste

References:

[1]http://gefmedwaste.org/downloads/Report:%20Needs%20Assessment%20for%20Hospitals%20in%20African%20Countries%20in%20Relation%20to%20Infectious%20Waste%20Treatment.pdf
[2]http://www.epa.gov/ttnatw01/129/hmiwi/rihmiwi.html
[3]http://europa.eu/legislation_summaries/environment/waste_management/l28072_en.htm
[4]http://www.who.int/water_sanitation_health/medicalwaste/077to112.pdf
[5]http://gefmedwaste.org/downloads/Report:%20Needs%20Assessment%20for%20Hospitals%20in%20African%20Countries%20in%20Relation%20to%20Infectious%20Waste%20Treatment.pdf
[6] http://www.eepco-tz.org/2006/medical-waste-incinerators/