Thermal Treatment

1. Incineration / combustion

→ Burning of refuse at high temperatures in furnaces, called incinerators.

→ Only the combustible matter, such as garbage, rubbish and dead animals are burnt and the incombustible matter like broken glass, china ware, metals etc are separated out for recycling and reuse before burning the solid waste

→ Incinerators being useful for burning city refuse, are quite useful for burning the hazardous solid and liquid wastes of the hospitals and the industries.

→ Rotary kiln type of incinerators and liquid waste incinerators are widely used for disposal of hazardous biomedical & industrial wastes.

Conventional Incinerator for incinerating Municipal solid waste

→ Large sized incinerators are called destructors and they can burn 100 to 150 tonnes of refuse per hour

→ A destructor consists of a furnace chamber, combustion chamber, expansion chamber and a tall chimney (25m).

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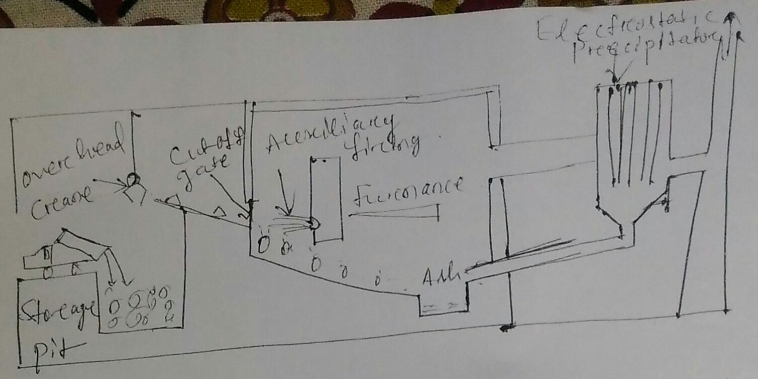

→ While operating the incinerators, the following points should be carefully observed.

(i) The charging should be thorough & rapid.

(ii) Each batch of refuse entering the furnarance should be well mixed and adjusted to provide complete combustion.

→ Refuse containing 80% garbage & 20% rubbish will normally burn without any auxiliary fuel and preheated to about 150°C.

→ The refuse containing 50 to 60% garbage & 40 to 50% rubbish will burn satisfactorily without any pre-heated air.

→ If the percentage of garbage is less than 50%, flashy fire may result.

(iii) The temperature should be greater than 670°C.

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Merits.

→ This is the most sanitary method of refuse disposal & complete destruction of pathogenic bacteria and insect

→ There is no odour or dust nuisance.

→ It requires very less space for refuse disposal

Demerits.

→ It is a very costly method.

→ Solid wastes should have a high calorific value.

→ Smoke, odour & ash nuisance may result.

2. Pyrolysis.

→ Heating in closed containers in oxygen free atmosphere.

→ The application of pyrolysis to hazardous waste treatment leads to a two-step process for disposal.

* In the 1st step, wastes are heated, separating the volatile contents from non-volatile char & ash.

* In the 2nd step, volatile components are burned under proper conditions.

→ Pyrolysis treatment is endothermic & generally done at 425 to 760°C.

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→ Wastes with the following characteristics are especially amenable to pyrolysis.

* Sludge material that is either too viscous, too abrasive.
* Wastes such as plastic undergo thermal processing.

3. Gasification

→ The gasification process involves the partial combustion of a carbonaceous fuel to generate a combustible fuel gas rich in carbon monoxide and hydrogen.

→ A gasifier is basically an incinerator operating under reducing conditions.

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Land filling

→ In this method of refuse disposal, refuse is carried and dumped into the low lying area.

→ The refuse is dumped and compacted in layers of about 0.5m thickness.

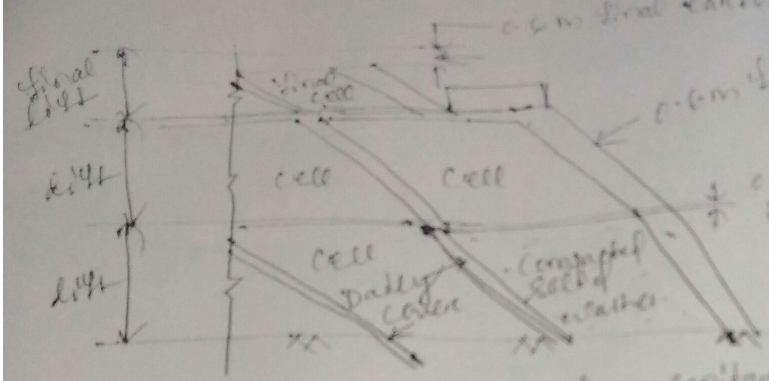
→ The depth of filling becomes about 1.5m, it is covered by good earth of about 15cm thickness. This cover of good earth is called the daily cover.

→ The filling of refuse is actually done in sanitary land filling by dividing the entire land-fill area into smaller portions, called cells.

→ These cells are initially filled with daily compacted refuse of about 1.5m depth.

→ After filling all the cells with first lift, the second lift is laid in about 1.5m height and covered with good earth cover of about 0.15 depth called the intermediate cover.

→ The process will continue till the top most lift is filled up, over which the final cover of good earth of about 0.6m depth shall be laid and compacted



(Sectional view of a sanitary land fill)

Advantages

→ Simple & economical.
→ No costly equipment required.
→ Separation of waste not required.
→ No residue / by product left out.

Disadvantages

→ Space may not be available all the time
→ Evolution of foul gases
→ Fly nuisance
→ Leachate formation & ground water contamination

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Landfill operations & processes.

1. Landfill Design
   - → foundation design
   - → Liner design.
   - → Leachate collection & gas collection.
   - → Drainage design.
   - → filling design.
   - → Runoff collection.
   - → Closure design.

2. Landfill operation.
   - → Waste inventory.
   - → cell layout.
   - → cells for hazardous waste.

3. Bioreactor Landfill (Biochemical reaction in landfill)
   - → Biological decay rates
   - → Slowly biodegradable.
   - → Rapidly "
   - → Non-biodegradable.

4. Leachate Management.
   - → collection.
   - → Treatment
   - → Monitoring
   - → Reuse.

5. Landfill gas management
   - → Monitoring.
   - → collection
   - → using
   - → quantity & quality

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6. Env Monitoring.

- → Air quality of odour monitoring.
- → CH_4, H_2S etc.
- → G.W Monitoring.

Gas production in landfill.

→ Gas production reaches peak in 24 years.

$$C_aH_bO_cN_dF_f + \left(a - \frac{b}{4} - \frac{c}{2} + \frac{3}{2}f\right) H_2O \rightarrow \left(\frac{a}{2} + \frac{b}{8} - \frac{c}{4} - \frac{3f}{8}\right) CH_4 + \left(\frac{a}{2} - \frac{b}{8} + \frac{c}{4} + \frac{3f}{8}\right) CO_2 + dNH_3$$

Factors to be considered in the design of operation of landfill.

1. Accell to the size.
2. Cell design of construction.
3. Cover material.
4. Equipment requirements.
5. Fire prevention.
6. Land area.
7. Drainage arrangement.
8. gas recovery.
9. protection of underground water.
10. Liffere control.

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