

Municipal Solid Waste Management

FUNDAMENTALS

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What is waste?

- Useless, unwanted or discarded material resulting from agricultural, commercial, communal and industrial activities
- Municipal Solid Waste (MSW) – term for solid waste discarded from residential and commercial establishments

Types:

- Garbage
- Ashes & residues
- Combustible and non-combustible
- Bulky waste
- Street waste
- Dead animals
- Vehicles
- Construction and demolition waste



Sources:

- Residential
- Commercial
- Institutions
- Industrial
- Agricultural
- Municipal
- Open sources

Composition of MSW

Compostable / Bio-degradable matter = 30% - 55%
(can be converted into manure)

Inert material = 40% - 45% (to go to landfill)

Recyclable materials = 5% - 10%
(Recycling)

These percentages vary from city to city depending on food habits



Source: www.ncrpb.nic.in (Master Plan Preparation for Solid Waste Management)

Physical properties of solid waste

- Density – Depends on composition of wastes (higher in organic waste and lower in commercial waste)
 - Overall bulk density calculated for waste having materials of different densities
- Particle size and distribution – Difficult to characterize because of waste heterogeneity
- Moisture content – Weight loss (%) when a sample of solid waste is dried to a constant weight at a temperature of 100-150°C
 - Dry weight = Total weight – Moisture content

Ultimate analysis of MSW

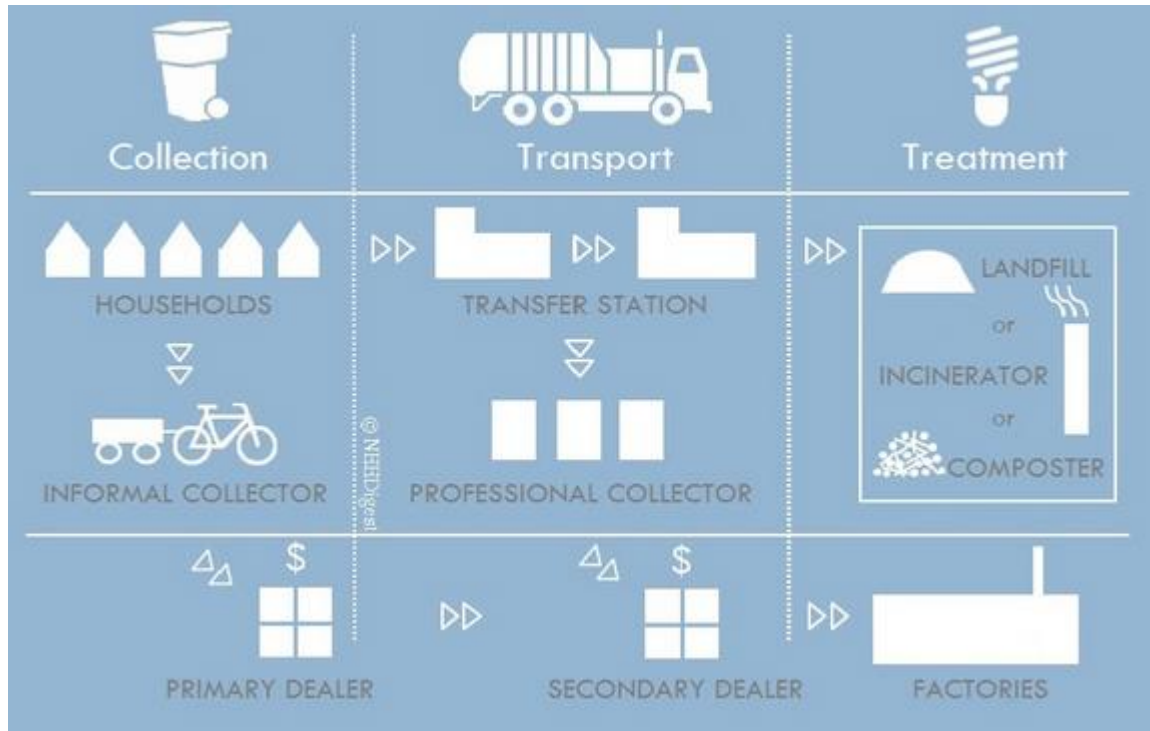
- Defined as the total elemental analysis to determine % of elements (C, H, O, N, S) present in waste
- Oxygen value calculated by subtracting all other components (including ash and moisture)
- Used to characterize the chemical composition of organic fraction of waste – assess the stability of the waste as a fuel
- **Proximate analysis of MSW**
 - More specific compared to ultimate analysis
 - Determines moisture and ash content, volatile matter and fixed organic content
 - Assess capability of MSW as fuel

Heating value of waste

- Heat value of waste is energy released when waste is burned
- Heat value directly proportional to carbon content of waste; inversely proportional to ash and moisture content
- Heat value calculated using:
 - Dulong formula
 - Modified Dulong formula
 - Khan equation
- C/N ratio: Ratio of carbon to nitrogen in waste (preferred range – 20 to 35)
- Heat of combustion: estimated by combusting samples in a boiler and measuring heat output/ using lab scale bomb calorimeter/ ultimate analysis

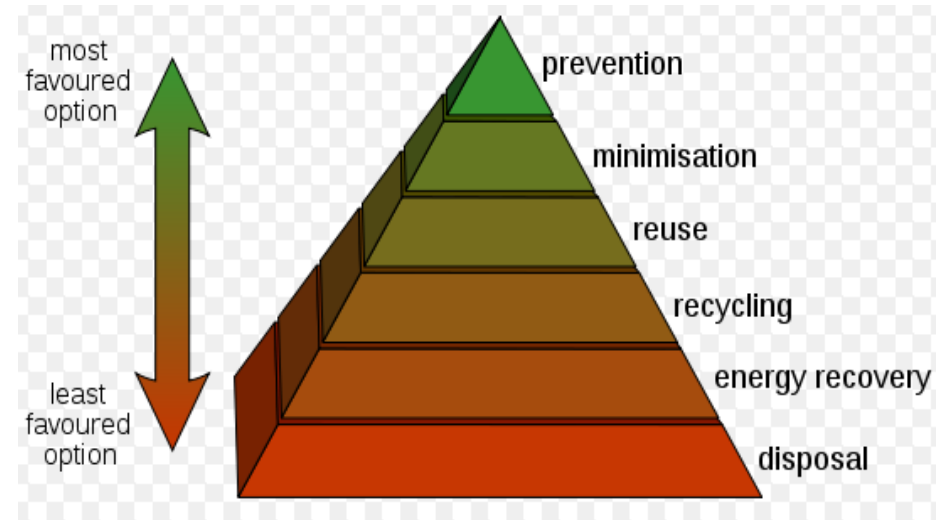
Management of solid waste

Steps in management of solid waste



Source: Municipal Solid Waste Management in China – An infographic
www.needigest.com

Waste management hierarchy

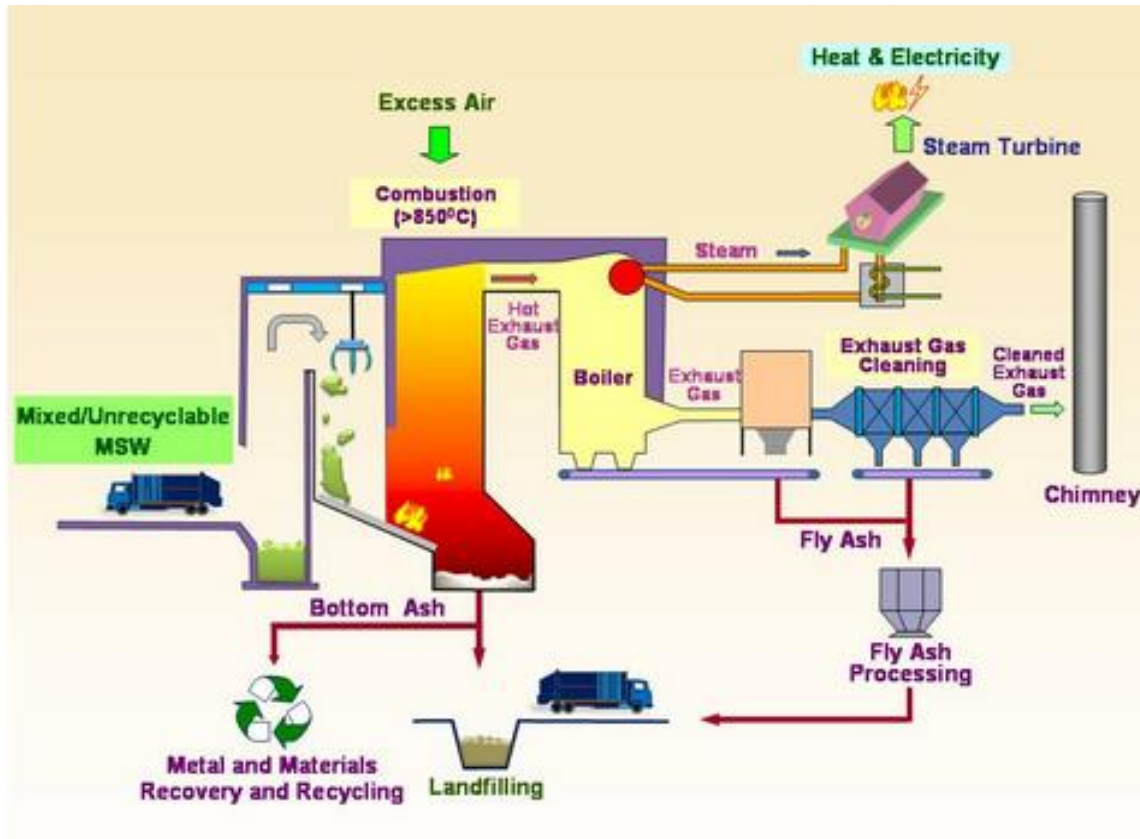


Source: Wikipedia (Waste hierarchy)
http://en.wikipedia.org/wiki/Waste_hierarchy

Steps in management of solid waste

- Generation
- Collection
 - On-site handling and storage
- Handling and separation
- Transfer and transport
- Treatment facilities
 - Incineration or mass burn
 - Composting
 - Landfill

Incineration of solid waste



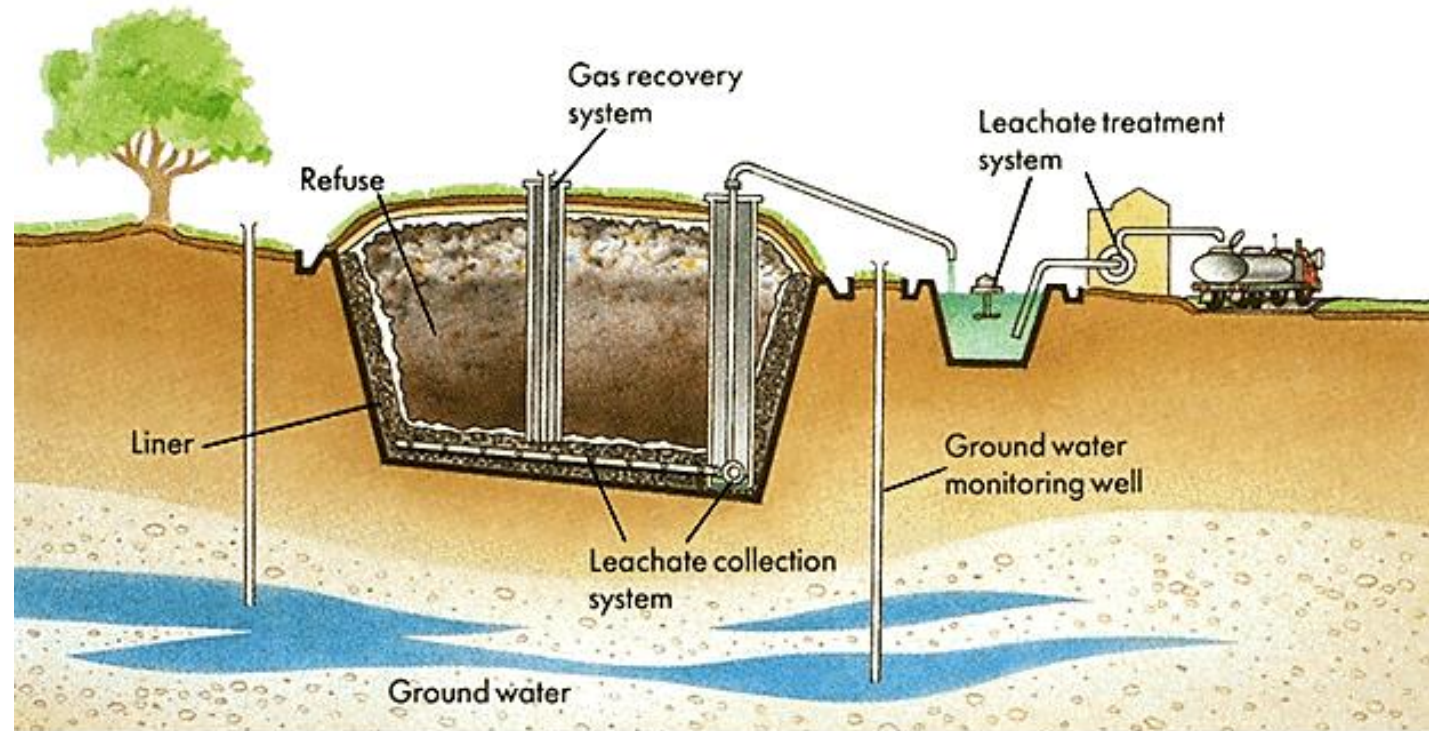
Source: www.epd.gov.hk

Problems and Solutions: Environmental Protection Department

- Energy derived from mass burning of MSW is poor compared to a fuel – due to high organic matter and moisture content
- Environmental considerations
 - Emission of gases (SO_x , NO_x , CO_2)
 - Heavy metals released through emission gases (Hg, Cd, Pb)
 - Odour
 - Dispersion of particulate matter

MSW Landfill

- Sanitary landfill
 - Composite liner
 - Landfill cover system
 - Leachate generation and control
 - Landfill gas production – energy generation from capture of landfill gas
 - Closure
 - Post-closure care activities

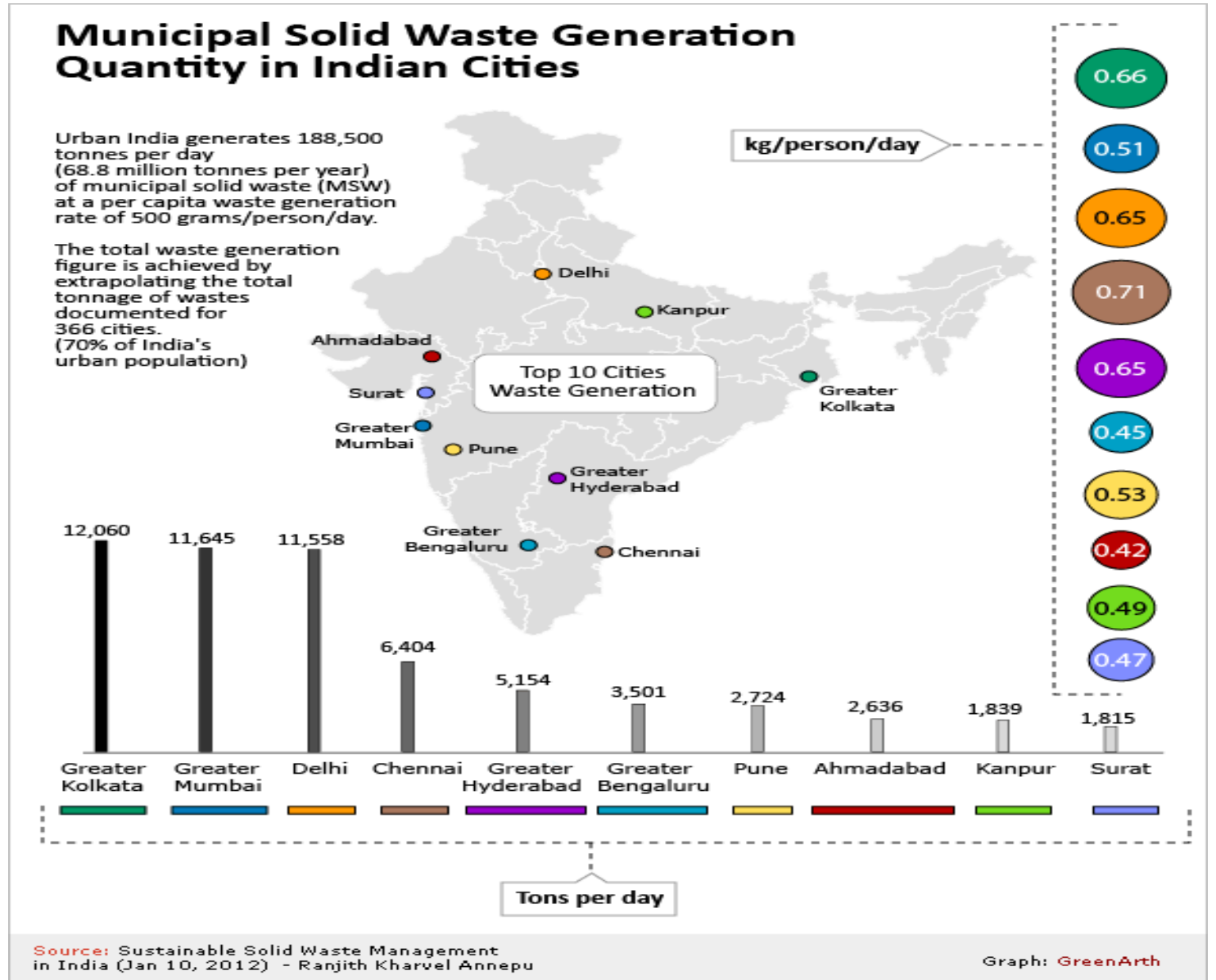


Source: www.oocities.org

An evaluation of proposed sanitary landfill: Davao City

MSW in India

Solid waste management is the need of the hour.



Source: www.greenarth.com

Thank you!

SUGGESTED READING:

“WASTE MANAGEMENT PRACTICES: MUNICIPAL, HAZARDOUS AND INDUSTRIAL” BY JOHN PICHTEL (PARTS I & II)