Sanitary landfill design and operations

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Where do we want to be?
Options for Managing Open Dumps
Overview of Options for Managing Open Dumps

- Business as usual – not recommended
- Improvements in operation & management to reduce impacts
- Close by
  - covering waste in place or piggybacking
  - close by removing wastes from the site (mining/recycling and excavation)
  - close and establish a controlled landfill or a sanitary landfill
Overview of Options for Managing Open Dumps

- Closure of Waste in Place
- Closure of Waste in Place by Piggybacking
- Closure as a Controlled Landfill
- Close by removing wastes from the site (mining/recycling and excavation)
- Close and establish a Sanitary Landfill
Overview of Options for Managing Open Dumps

- Controlled
  - Simple non engineered measures
- Engineered
  - Simple engineering eg impermeable cap
- Sanitary
  - Sophisticated engineering of base, sides and surface
- Bioreactor landfill?
What is a Sanitary Landfill?

- Permitted and planned
- Engineered to a specification
- Leachate collection and treatment
- Landfill gas collection and treatment
- Sound operational practices (See ISWA Landfill Operations Guidelines)
- Monitoring
- Long-term aftercare
Classes of Sanitary Landfills

- Sanitary Landfill for Inert Wastes
- Sanitary landfill for Non-hazardous Waste
- Sanitary Landfill for Hazardous wastes
Engineering Requirements - Geological Barrier

- inert landfill: \( k = \text{or} < 1 \times 10^{-7} \text{ m/s, thickness} = \text{or} > 1\text{m} \)

- non-hazardous*: \( k = \text{or} < 1 \times 10^{-9} \text{ m/s, thickness} = \text{or} > 1\text{m} \)

- hazardous*: \( k = \text{or} < 1 \times 10^{-9} \text{ m/s, thickness} = \text{or} > 5\text{m} \)

*requires an additional artificial sealing liner and a drainage layer = or > 0.5m thickness
Lining Materials

- Naturally occurring mineral – clay/silts/shales
- Bentonite enriched soils
- High Density Polyethylene
- Geo-synthetic clay
Single Clay Liner

- Easiest to install
- Clay materials often readily available
- Minimum of 1 metre thickness
- Compacted in 150 mm lifts
- Strive for permeability of less than $10^{-7}$ m/s inert landfills and $10^{-9}$ m/s for non-hazardous and hazardous
- Regular in-situ testing using nuclear density gauges
- Core samples on completion for laboratory testing
- Construction Quality Assurance
Composite Liners

- Clay liner is the base
- Geomembrane (usually HDPE) is placed above clay in direct contact with clay
- Research and several decades of practice have demonstrated these liners provide excellent protection of the environment
- A requirement for non-hazardous and hazardous waste landfills
Liner configurations

- **Compacted Clay Liner**
- **Single Synthetic Layer**
- **Composite Liner**
Development of a sanitary landfill
Final Cover Systems for Landfills

- Provides protection for human health and the environment
- Promotes surface water runoff
- Reduces surface water infiltration
- Provides protection against air ingress and the potential for fires
- Improves landfill gas generation
- Improves ability to collect landfill gas
- Reduces odours
- Provides vector control
Landfill Gas

- Produced with solid waste decomposition
- Amount & composition dependent on solid waste characteristics
- Increase in organics equals an increase in gas generation
- Can be used to create energy
- Gas generation ends with end of decomposition
- Mixture of
  - Methane (CH\textsubscript{4})
    - 50% to 60%
  - Carbon Dioxide (CO\textsubscript{2})
    - 40% to 50%
  - Non Methane Organic Compounds (NMOCs) - Trace
Landfill Gas treatment

- Flaring
- Source of energy
- Source of heat
- Vehicle fuel
- Gas for domestic consumption
Leachate

- Caused by
  - Precipitation
  - Surface Water
  - Run-on
- Dissolved and Suspended Contaminants
  - Inorganics
  - Organics
  - Microorganisms
- Varies with type of waste
- Varies with age of landfill
- Requires treatment
Operations

- Site Roads
- The Use of Daily Cover
- Bird Control
- Wheel Cleaning
- Litter Control
- Vector Control
- Managing the Working Face
- Waste Compaction
- Landfill Fires
- Stormwater and Sediment Control
- Waste Control at Landfills
- Leachate Control
- Odour Control
- Landfill Gas Management
- Site Safety and Security
Helpful Web Resources

- Global Methane Initiative [https://www.globalmethane.org/landfills/](https://www.globalmethane.org/landfills/)
Thank you

- Please feel free to contact me for any further information

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