



Methane to Markets

***Lesson1: Landfill and Landfill Gas
Basics***

The Modern Sanitary Landfill

- Landfills are a Method of Disposing of Solid Wastes on Land Without Creating Nuisances or Hazards to Human Health of the Environment.

Landfill Basics

- Protection of Human Health and the Environment
 - Better air quality
 - Groundwater protection
- Operations that Affect Landfill Gas Generation
 - Compaction
 - Daily cover
 - Leachate control

Modern Sanitary Landfill



Landfill Liners

- Liners provides containment of contaminants.
- Reduces groundwater contamination.
- Reduces landfill gas migration.

Clay Liners

- Easiest to install.
- Readily available.
- Generally 60 cm thick.
- Compacted in 15cm lifts.
- Strive for permeability of less than 10^{-6} cm/sec.

Landfill Clay Liner



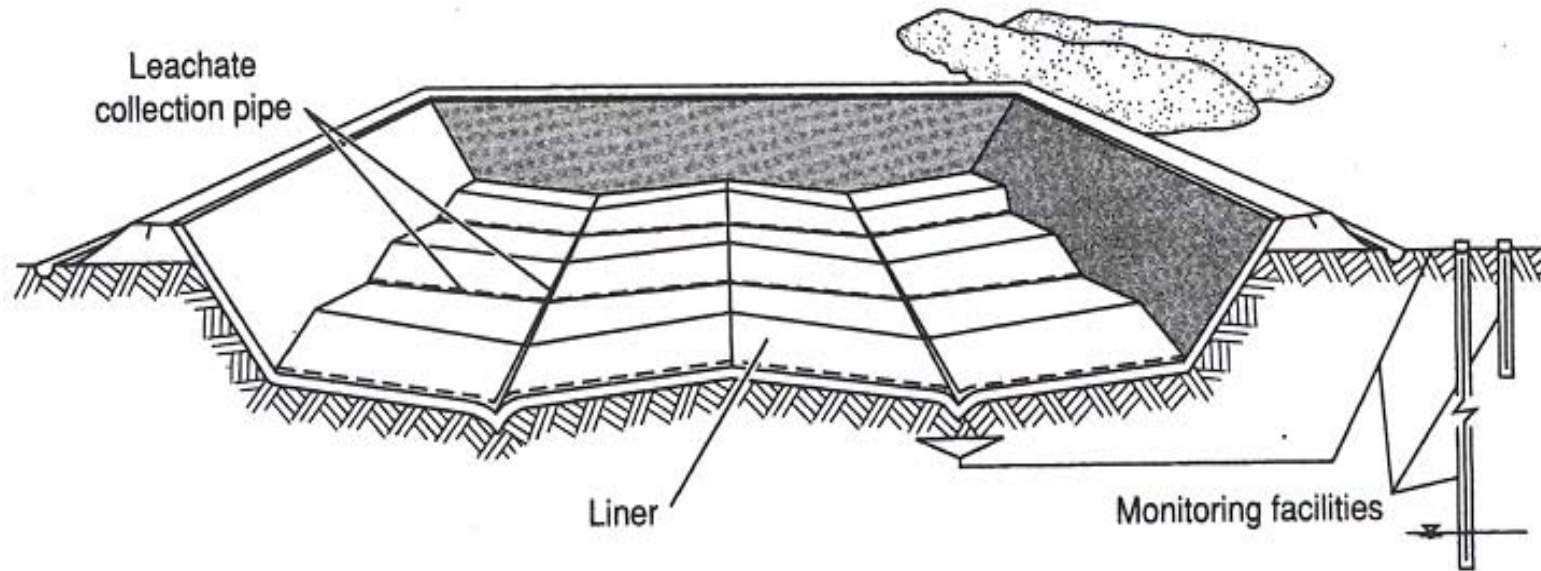
Composite Liners

- Uses clay liner as the base.
- Add geomembrane above clay.
- Provides greater protection of the environment.

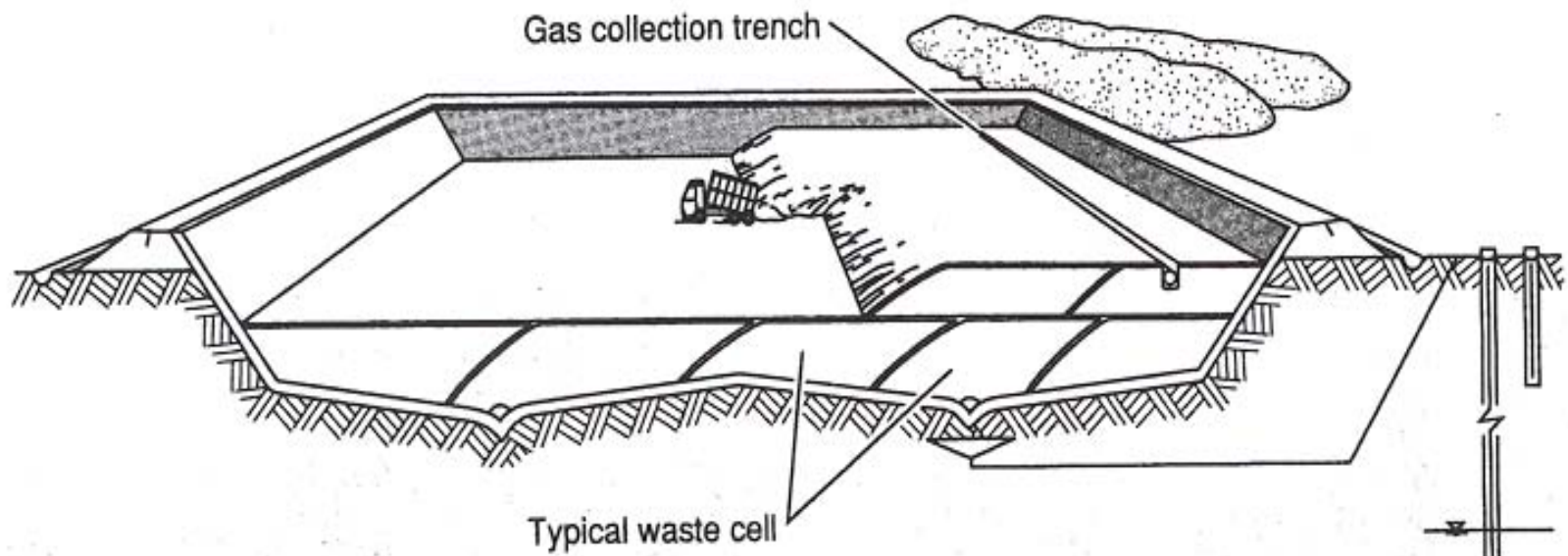
Landfill Composite Liner



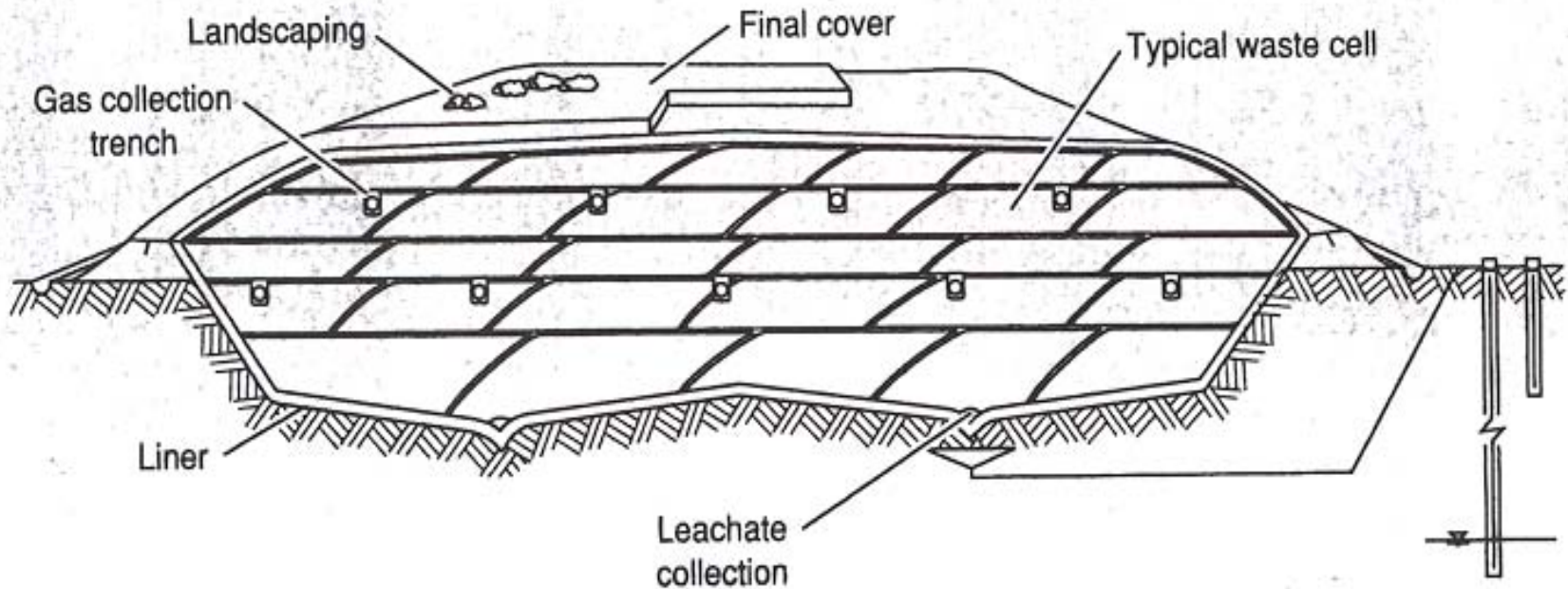
Development of a Landfill



Landfill During Operations



Completed Landfill



Final Cover

- Provides protection for human health and environment
- Provides barrier for stormwater runoff
- Provides protection against fire
- Reduces stormwater infiltration
- Improves landfill gas generation
- Improves ability to collect landfill gas
- Reduces odors
- Provides vector control

Final Cover Components

- **Constructed Soil Cover**
 - Clay or low permeable soil (60 cm)
 - Vegetative layer – soil to support vegetation (15 to 30 cm)
- **Geomembrane**
 - Can be used to further reduce infiltration.
 - If used should be above clay cap.
 - Should be in direct contact with clay.

Final Cover Components

- Stormwater controls
 - Object is to remove stormwater before it becomes leachate
 - Should prevent erosion of final cover
 - Benches can be used on steep slopes
 - Rip rap and gabions can be used in high erosion areas
 - Top of landfill should be graded to promote runoff (i.e., dome shape)

Final Cover Maintenance

- Inspect cover monthly
 - Fill cracks with soil
 - Repair erosion
 - Mow vegetation during growing season
 - Re-grade low areas to prevent ponding
 - Add soil 60 cm deep to areas with visible smoke

Landfill Gas

- Produced with solid waste decomposition in anaerobic conditions
- Amount & composition dependent on solid waste characteristics
- Increase in organics equals an increase in gas generation
- Can be used to create energy
- Gas production ends with end of decomposition

Landfill Gas: Typical Composition

- Methane (CH_4)
 - 50% to 60%
- Carbon Dioxide (CO_2)
 - 40% to 50%
- Non Methane Organic Compounds (NMOCs) - Trace
- Heating Value
 - 500 Btu/standard cubic foot (scf)
- Moisture Content
 - Saturated

Methane (CH₄)

- Colorless
- Odorless and tasteless
- Lighter than air
- Relatively insoluble in water
- Highly explosive
 - LEL = 5% in Air
 - UEL = 15% in Air

Landfill Gas

- Why is methane a greenhouse gas?
 - Methane absorbs terrestrial infrared radiation (heat) that would otherwise escape to space (GHG characteristic)
- Methane as GHG is over 20x more potent by weight than CO₂
- Methane is more abundant in the atmosphere now than anytime in the past 400,000 years and 150% higher than in the year 1750

Summary

- Modern sanitary landfills have measures/programs in place to protect the environment and public health.
- Landfill liners can be either synthetic or clay based.
- Installing final cover on a landfill is critical to managing waste.
- Landfill gas is a natural byproduct of the decomposition of solid waste and needs to be managed appropriately.