"INOGATE Technical Secretariat & Integrated Programme in support of the Baku Initiative and the Eastern Partnership energy objectives" Project

BUILDING PARTNERSHIPS FOR ENERGY SECURITY

www.inogate.org
Training Presentation 5
Introduction to Modern Landfill Management Principles

By Jes Kromann Bak, Senior Waste Management Expert
November, 2014
Tbilisi, Kutaisi, Georgia
Landfilling of waste in EUROPE and Denmark

- According to the EU Landfill Directive, landfilling of biodegradable MSW must be reduced substantially.
- Waste hierarchy: disposal is the last option in waste management.
- In 1997, Denmark implemented a landfill ban on biodegradable MSW. Only 1-2% of the amount landfilled in 1995 is going to landfills.
- Situation varies substantially in different Member States.
MUNICIPAL WASTE TREATMENT IN 2010 BY the EU MEMBER STATE

Source: Eurostat.
landfill management in old fashioned way

- Contamination of ground- and surface water due to leachate generation and surface waste runoff
- Risks of explosions due to landfill gas intrusion into adjacent buildings
- Substantial nuisances to the surroundings, such as noise, dust, wind-blown litter, odours, birds, vermin's and insects.
Main principals of modern landfill operation

- Landfill design – phase-wise development manner, environmental protection measures adapted to the waste to be disposed
- Landfill operation – waste reception procedures; special disposal techniques; leachate, surface runoff and landfill gas management
- Monitoring of impact on environment
- Successive closure and aftercare
Landfill design: Phasewise development

- Possibility of separate disposal of different waste streams in separate waste/working cells
- Reduction of leachate generation
- Minimal area of exposed waste, which means less litter and odours
- Costs for landfill construction and operation are distributed throughout the whole period of landfill operation
Landfill design: Waste cell construction (2)

Planning a modern landfill:

- Site investigation
- Layout for Landfill Management Facilities
- Detailed design and tendering
- Supervision
- Training
Landfill design – site investigation

Before establishing a new Landfill - Waste Management Facility – several investigations must be carried out:

- **Geotechnical and Hydro geological investigations**
  - Geotechnical drillings
  - Soil analysis
  - Ground Water analysis and monitoring
  - Ground Water pumping tests and modeling

- **Environmental Impact Assessment**
  - Noise
  - Odor
  - Pollution of groundwater
  - Effects on animals and flora
  - Infrastructure
  - Etc.
Landfill design – general layout

For a modern landfill center the typical layout can include:

- Reception area
  - Welfare building
  - Office
  - Weight Bridge
  - Work shop
  - Leachate collection and treatment

- Landfill area
  - Landfill areas for several waste fractions
  - Soil or Waste treatment
  - Composting sites
Landfill design: Waste cell construction

- Surface Liner System
- Gas Collection System
- Leachate Collection System
- Bottom Liner System
- Geological Barrier
- Groundwater Table
The most important part of the detailed design is:

- **The liner system (Protection of Ground Water)**
  - Geological barrier (clay or bentonite)
    - In-situ clay
    - Installed clay liner
  - Artificial liner (HDPE)
    - Smooth or rough
  - Geotextile
    - Woven or non-woven

- **The leachate collection system**
  - Leachate drains
  - Drain and protection layer
  - Main leachate collection and transportation system

- **Protection against slides**
  - Geogrids
Landfill design – leachate collection

In a typical design the leachate collection system is a combination of:

- Main drain
- Side drain
- Perimeter drain
- Drain and protection layer
- Leachate wells – typically with pumps

The design is particularly depending on the leachate production (rain).
Landfill design – supervision and slides

Tests during installation of geological barrier and artificial liner are extremely important for the final result.

Tests for the artificial liner is typically carried out on site and controlled at an external laboratory.

A very important factor in the landfill design is to secure the landfill against landslides.

To secure the landfill, the slopes on the embankments is designed to avoid slopes. In some cases it is necessary to secure the slopes with geogrids.
Landfill operation: reception procedures

• Only waste types specified by EWC codes and included into so-called Positive List for a particular landfill can be accepted for disposal.
• Separate Positive Lists for each waste cell depending on the category of waste (inert, non-hazardous, hazardous and in Denmark also mineral waste)
• At the gate the required documentation of the waste received is checked
• The waste undergoes visual inspection after it has been unloaded at the tipping area. Metals and other recyclable items are removed
Landfill operation: disposal techniques (1)

- Each waste cell shall only have one tipping area of a limited size. Only a few waste vehicles should be able to unload simultaneously.
- The waste is pre-crushed by several passes of compactor before it is spread into 30-50 cm thick layers and thoroughly compacted.
- Special procedures for the first layer of waste
- Different compaction techniques are used depending on the waste type and landscape design of the landfill.
Benefits of extensive compaction:
- prolonged lifespan of the landfill
- reduction of settlements
- better biochemical degradation
- less environmental impact to the surroundings due to wind-blown litter, odour, vermin and etc.

Tipping edge operation only method is only used when disposing sludge and bulky waste as the compaction density is rather low.
Landfill operation: disposal techniques (3)

At the end of each working day the disposed and compacted waste shall be covered with a thin layer of soil or alike, so-called daily cover. The daily cover prevents wind-blown litter, generation of odors, access for vermin, birds and insects to the waste.
Each waste cell is closed as soon as it has been filled up until the final level.

It includes establishment of the final cover, surface runoff diversion system, landfill gas management system (extraction system).

The final cover has to isolate waste from the surrounding environment, minimize leachate generation and control landfill gas emissions.
Landfill operation: successive closure/ recultivation (2)

**Construction of the final cover:**
- bearing layer (~ 30 cm thick, sandy material, suitable for gas drainage)
- liner (different materials can be suitable)
- drainage layer (≥ 20 cm thick, high permeability)
- recultivation layer (≥ 75 cm thick, cohesive material) and
- vegetation

**Benefits of the successive closure:**
- Costs for landfill closure/rehabilitation are distributed throughout the whole period of landfill operation.
- Reduced exposure of the landfilled waste to the surrounding environment and therefore reduction of nuisances.
The period from landfill closure until leachate, surface runoff and landfill gas meet discharge requirements for local recipients and the environmental protection systems can be closed/shut off.

The length of the period from 30 to ? Years

During this period:

- leachate/surface runoff/landfill gas collected and treated;
- active environmental protection systems are maintained;
- landfill body checked regularly for settlements and possible damages to the final cover repaired;
- environmental monitoring procedures continued, however, in reduced extent.
Landfill Monitoring: during operation and aftercare periods

• Metrological data – precip., temp., wind, evap., atm. humidity
• Leachate quantity and quality measured separately at each point of discharge (each waste cell)
• Groundwater quality upstream and downstream the landfill
• Quality of surface runoff and close recipient
• Potential landfill gas emissions (CH$_4$, CO$_2$, H$_2$S, H$_2$ etc.) and atmospheric pressure
• Topography of the landfill body – structure, composition and setting behaviour.
Use of the Modern landfill management principals at your landfills/dumpsites (1)

**Improved infrastructure:**
- Defining of landfilling area
- Fencing
- Surrounding dams
- Paving of internal access roads
Use of the Modern landfill management principals at your landfills/dumpsites (2)

**Improved landfill operation:**

- landfill operation manual
- waste reception control
- phase-wise filling of the landfill area
- techniques of waste disposal
- daily cover
- successive closure/recultivation
- other daily operations – collection of windblown litter, cleaning of internal roads, maintenance of landfill equipment.
Any Questions?

Thank you