The Impact of Elevated Leachate Levels on LFG Generation and Recovery at MSW Landfills in Asia

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Bryce Lloyd
Organic Waste Technologies (HK) Ltd.
Presentation Outline

- Formation of Leachate?
- Observations at LF sites in Asia
- Impacts Due to High Leachate Levels
- Leachate Collection
- Leachate Treatment
- Minimization of Leachate
- Improving LFG Recovery
- Q&A
Landfill Leachate

Formed from a combination of sources

- Moisture deposited with the waste
- Moisture from decomposition process
- Moisture contacting the waste (i.e. not diverted away from waste)
- Infiltration of precipitation though cover materials
- Groundwater or tidal influences – through un-lined areas
Leachate Characteristics

- Black liquid (Anoxic and Acetic)
- Strong Odor
- High in Total Dissolved Solids (TDS)
- High in metals & chlorinated compounds
- High in Ammonia, BOD, and COD
- Also high in
  - Hydrogen Sulfide
  - Mercaptans
  - Other VOCs
- Foam – methane in solution
Observations at Sites in Asia

- Wet waste with high organic fraction
- Unconfined tipping areas
- Scavengers
- Poor cover conditions
- Lack of surface water management
- Elevated leachate levels
- Inadequate leachate treatment systems
- Slope Failures
- Discharge to nearby rivers and lakes

Lower LFG Recovery Rates!
Full of Leachate!
Signs of High Leachate Levels

Visual
- Foam from leachate or gas wells / boreholes
- Seepage along landfill slopes
- Excavation (trenches / pits) full of leachate
- Discoloration of nearby water bodies
- Leachate in surface water channels
- Ponds on landfill surface
- Slope Failures

Quantitative
- Measurement of liquid levels in vertical wells / boreholes
- Sampling and analyses of leachate characteristics
Signs of Leachate
Pond on LF surface
Impacts to LFG production

- Elevated leachate levels can reduce LFG generation and collection efficiency
  - Impedes methane production process
    - Excessive Ammonia levels
    - Excessive moisture percentage
  - Reduces LFG collection efficiency
    - LFG collection components flooded
    - Dewatering required

- Other Operational Impacts
  - Overloads leachate collection and treatment systems
  - Seepage can overload surface water management systems
  - Erosion and potentially Slope failures
LFG and ER decrease
Environmental Impacts

• Leachate Contamination and Potential Toxicity Issues
  – Groundwater contamination – in some areas this means drinking water!
  – Contamination of rivers and lakes
  – Aquatic ecosystem toxicity,
    • Detrimental to fish population and fishing industries
  – Odor issues (Ammonia, H2S, Mercaptans)
  – Potential hazards due to offsite migration of leachate
    (explosive gases and H2S in confined spaces)
Issues with Slope Stability

Indonesia - Leuwigajah dumpsite
21st Feb 2005. 150 fatalities
Philippines - Payatas dumpsite
10\textsuperscript{th} July 2000 - 230 fatalities
Leachate Collection Methods

- **Lining system** – containment is key!
  - **Gravity flow under-drains**
    - Installed (above liner) prior to waste placement
  - **Extraction via pumps in vertical wells**
    - Pneumatic or Electrical
  - **Combined Extraction**
    - LFG and Leachate
      - Vertical wells
      - Horizontal trenches
Leachate Collection
Landfill lining and leachate collection systems
Leachate Treatment Methods

- Often a combination of mechanical, chemical or biological technologies:
  - Lagoon Evaporation
  - Aeration
  - Sedimentation
  - Ammonia Stripping
  - SBR anaerobic treatment - Aerobic polishing
  - Reverse Osmosis
  - Leachate Evaporation
  - Reed Beds
  - Carbon Adsorption
  - Transfer to Public Pre Treatment Works
Aerobic Treatment
Extended Aeration
Reverse Osmosis
Sequential Batch Reactor (SBR)
Chemical Additives

pH Adjustment
Fenton Reagent
Volume reduction up to 97% - residual returned to Landfill
Leachate Re-Circulation

• **Control of leachate level within landfill by re-circulation**
  – Pumps and injection wells / trenches
  – Sprinkler systems

• **Promote biodegradation through recirculation of nutrients and distribution of moisture**
  – Improves LFG production
  – Lowers leachate treatment requirements
  – Additional air space created
  – Close monitoring required
Capping / Cover Systems

- Temporary / intermediate / final capping layer system
  - Minimize infiltration
  - Limit air intrusion
  - Composite systems
  - Daily Cover
  - HDPE / LDPE
  - Clayey Soils
Interim Cover
Surface Water Management

Goal is to minimize water entering waste mass, reducing the levels of leachate, and the amount for collection and treatment.

- Temporary drainage berms and channels to partition or segregate surface water from entering the active filling area.
- Channels on the side slopes drain to perimeter channels for storm water runoff.
Surface Water Management
Results: Improved LFG Recovery

• Removal of excess leachate from the landfill (in conjunction with proper maintenance of capping and surface water management systems):
  – Improved methane generation rates
  – Improved LFG collection efficiency
    • Allows extraction from a larger prism of waste
    • Increases radius of influence
  – Reduced Infiltration of precipitation
  – Reduced fugitive emission of LFG
  – Reduced air intrusion
  – Reduced environmental and operational impacts
Additional LFG-to-Energy
Lessons Learned at Several Landfills in Asia

- Improving leachate, capping, and surface water management practices has resulted in the following trends:
  - Increases in LFG recovery ranging from 30% to 100% in LFG
  - Additional revenue from power generation, gas export, renewable credits, and CER
- Operation practices can be improved with proper training and time for implementation
- More data collection is ongoing to determine the long-term results!
Thank you for your kind attention!

For additional information:

Bryce Lloyd

bryce.lloyd@owthk.com.hk

+(852) 2696-5740