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

BUILDING PARTNERSHIPS FOR ENERGY SECURITY

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Training Presentation 6
Introduction to Landfill Gas Plant Operation

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November, 2014
Tbilisi, Kutaisi, Georgia
LANDFILL GAS PLANT OPERATION

General operation:

• Gas Well System
• Gas Collection Pipe Lines
• Gas Analysis
• Tuning of Gas Wells
• Condensate Drains
• Leachate Removal System
• Blower and Flare system
• Gas engine, CHP, gas upgrading or other similar
– GAS WELL SYSTEM –
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Gas well system:

– 42 vertically drilled gas wells
– Depth ranging from 6 m – 20 m
– Equipped with perforated pipes and aggregate surrounding it as filter
– Equipped with a well head with telescopic effect to cater for movement of the landfill
– Equipped with a measuring string
– Wells are spaced 40 metres apart
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Gas Well
Well Head and Measuring String

- **Monitoring Cap**
  - For monitoring and inspection of the gas well

- **Flow Control Ball Valve**
  - For regulating landfill gas flow of each individual well

- **Measuring Ball Valve**
  - Measuring of landfill gas concentration
  - Measuring of landfill gas flow rate of each well

- **On/Off Ball Valve**
  - For opening and closing each individual well
– GAS COLLECTION

PIPE LINES -
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Suction Line
Suction Line and Condensate:

- From the gas wells, the well heads are connected to a network of pipes, called the Suction Line.
- There are 7 lines in total, spread over Advance Cell and finally connected to the main pipe which is connected to the blower system.
- The suction line comprises pipes of different sizes. This is calculated to cater for pressure and volume of gas within the pipeline.
- Landfill gas is wet in nature due to water vapour present in them.
- These water vapour in the gas becomes condensate when temperature becomes cold.
Suction Line and Condensate

- It is essential that the landfill gas pipe networks (suction line) are maintained at a 2% downward gradient.
- Due to expansion and contraction of the HDPE material, the pipe will not maintain at its original position.
- Any low point along the pipe networks will allow condensate to accumulate in that area.
- This will cause blockage in within the pipes thus affecting the flow of landfill gas.
- In the case of low point along the pipe networks, a holding post shall be installed and used to eliminate the low point.
Suction Line

Use of Holding Post to lift gas pipe to achieve min. 2% of downward gradient.

- Main Collection Pipe leading towards Pumping & Regulating Unit with Flare

Correct Diagram:

Wrong Diagram:

Low Point
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– CONDENSATE DRAINS –
Plant Operation – Condensate Drains

• There are 8 numbers of Condensate Drains.

• Condensate drains are used to drain off condensate formed in the suction line. They are installed at the lowest point of a particular pipe line.

• The condensate drains are designed to allow liquid to drain off, but maintain that atmospheric air will not be sucked into the pipe line.

• Draining of the condensate is a daily routine and must be carried out in order to ensure the pipelines are free of condensate.
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Condensate Drain

During Operation (collection of condensate)

ON

OFF

OFF

Condensate Drain
Condensate Drain

During Discharging (Release of condensate)

- Operation

![Diagram of condensate drainage system]
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Suction Line and Holding Posts

Suction Line and Holding Posts
SESSION 8

– GAS ANALYSIS –
Gas Analysis:

• Gas analysis is essential in the operating of a LFG plant.
• Gas from each well is sampled separately to show the performance of the particular well.
• Gas analysis is carried out with the use of a Landfill Gas Analyzer, LFG20 or similar (LFGA).
• The LFGA is an expensive and sensitive equipment. Therefore, care must be exercised when the equipment is in used.
• The LFGA is a handheld unit, comes with a built in rechargeable battery, landfill gas analyzer for CH4, CO2 and O2, and an internal pump.
• A sampling tube and a hydrophobic filter are required.
Operating the LFGA

• Inspect the hydrophobic filter. If it is chocked or filled with water, replace with a new one.

• This hydrophobic filter is important as it minimizes water vapor from entering the instrument.

• Always make sure that a hydrophobic filter is attached before use.
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Operating the LFGA

With Hydrophobic Filter

Without Hydrophobic Filter
Gas Sampling with the LFG 20

Well Head with Measuring String
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– TUNING OF GAS WELLS –
Plant Operation – Tuning of Gas Wells

• The tuning of gas wells is an important part of the operation of the LFG plant.

• It involves measurement of gas flow rate in each gas well, and adjusting the valve to the desired gas flow rate.

• This is to establish the optimum gas flow rate in each gas well.

• The gas composition data obtained from the Gas Analysis are used to determined the desired gas flow rate.

• Flow rate of the gas is measured using a Flowmeter, TESTO 416 or similar (PFM).

• The PFM is an expensive and sensitive equipment. Therefore, care must be exercised when the equipment is in used.
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Portable Flowmeter (PFM)
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Operating the PFM

The “dot”
Tuning of Gas Wells

- When the flow rate is obtained using the flowmeter, this reading is compared to the recorded data previously.
- If the readings are the same, then maintain as it is.
- If they are different, then tune the flow by adjusting the Flow Control Valve on the well head with measuring string, by turning the valve wider or narrower. Measure the flow rate again with the flowmeter to achieve the desired flow rate.
- If it is decided to increase/decrease the flow rate, then this shall be recorded, and the Flow Control Valve is adjusted accordingly to the desired flow rate.
Tuning of Gas Wells – Factors

- Increase and Decrease of flow rates are adjusted at 10m³/hr per change. Each change can take place once the gas composition stabilises over 3-5 days.

- With experience, you will know when to adjust.

Objective:

- TO FIND THE EQUILIBRIUM OF THE SUCTION RATE AND THE GAS PRODUCTION RATE
- SUCTION FLOW RATE = GAS PRODUCTION RATE
Tuning of Gas Wells

Flow Control Valve
Tuning of Gas Wells - Factors

- Based on the gas analysis, the monitoring of the gas composition from each well is possible.
- Factors for tuning the flowrate:
  - When CH4 % is **constant**, the flow rate can be increased.
  - When CH4 % is **decreasing**, the flow rate can be decreased.
  - When O2 % is **present**, or increasing, flow rate has to be decreased.
Tuning of Gas Wells – Example (Well A)

<table>
<thead>
<tr>
<th>Date</th>
<th>Flow rate (m³/hr)</th>
<th>CH4 (%)</th>
<th>CO2 (%)</th>
<th>O2 (%)</th>
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<tbody>
<tr>
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<td>55</td>
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- Increase of flow rate is possible
Tuning of Gas Wells – Example (Well B)

<table>
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<tr>
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<th>CH4 (%)</th>
<th>CO2 (%)</th>
<th>O2 (%)</th>
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<td>12/12/14</td>
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<td>54</td>
<td>45</td>
<td>2</td>
</tr>
</tbody>
</table>

- Flow rate is required to be decreased in the last reading.
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– LEACHATE REMOVAL SYSTEM –
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Leachate Removal System

- AP3 AutoPumps®
- Pump Cycle Counter
- Air Compressor, Air Dryer and Compressed air tank
- Moving of AP Pumps among the wells
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AP3 AutoPump® & Pump Cycle Counter
AP3 AutoPump®

- AutoPumps are air-powered positive displacement pumps that require no surface timer-based controllers, bubblers or sensors in the well to operate.
- The pump is activated by an internal float in response to the natural well recharge. Because the AutoPumps fill by gravity and discharge by air displacement, no emulsification is created during its operation.
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Fill Cycle

Discharge Cycle
AP3 AutoPump® - Fill Cycle

- The fluid pushes the inlet check-valve open and fluid enters the pump.
- As the fluid level rises, air is expelled through the exhaust air valve and the internal float rises to the top of its stroke.
- In this upper position, the float triggers a lever assembly, which closes the air exhaust valve and opens the air inlet allowing air to enter and pressurize the pump.
**AP3 AutoPump® - Discharge Cycle**

- With the air inlet open, air pressure builds up within the pump body. This causes the fluid inlet check-valve to close and forces the fluid to be displaced up and out of the fluid outlet.
- As the fluid level falls, the float moves downward to the bottom of its stroke.
- In this lower position, the float triggers the lever assembly to close the air supply and open the air exhaust valve. And a new cycle begins.
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– BLOWER AND FLARE OPERATION, GAS ENGINE, CHP, UPGRADING OR OTHER SIMILAR
Any Questions?

Thank you