2.4 Monitoring facilities & Passive containment system

Overview of Landfill Gas Monitoring

Passive containment system

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In general, monitoring of gases that emanate from landfills falls into the following five categories (Agency for Toxic Substances and Disease Registry, 2001):

- Soil gas monitoring
- Near surface gas monitoring
- Emissions monitoring
- Ambient air monitoring
- Indoor air monitoring

Table 1 presents a brief overview of each type of monitoring. For each type of monitoring activities, there are many gas sampling approaches and monitoring techniques, and unfortunately not all of them can be covered in this report. Some monitoring methods can be used to more than one monitoring activity. However, all the monitoring techniques can be classified from the following four aspects:

- Location of monitors (Subsurface, Surface, and Enclosed Space)
- Portable / Stationary sampling equipment
  - Portable monitors: Usually hand-held instrument that can be easily carried around a landfill, which can be used to find the source of methane leaks.
  - Stationary monitors: are installed at a fixed location, to monitor gas during a time period. Usually can get higher quality data than portable monitors.
- Grab sampling / Continuous monitoring
  - Grab sampling: A one-time measurement at specific location and time.
  - Continuous monitoring: Monitoring during a duration of time, through which we can see the changes over a time period.
- Analysis of samples in the laboratory / analysis in the field
  - In the lab: expensive but more accurate.
  - In the field: more convevient.

Different monitoring methods should be selected for different landfills, considering site conditions, monitoring concerns, financial costs, regulatory requirements and other factors.

Table 1. Types of gas monitoring methods (source: ATSDR, 2001)

Type of Monitoring	Description of Monitoring	Typical Perimeters Reported
Soil Gas	Soil gas monitoring measures the concentrations of chemicals in the vapor space of soils. Measurements of soil gas levels are taken at depth with the use of probes or wells.	Most landfills are required by federal law to report levels of methane around the landfill perimeter. Oxygen, carbon dioxide, and nitrogen are frequently reported. Sometimes H_2S and other specific NMOCs, such as vinyl chloride, might be reported if federal or state regulators suspect a significant problem. Pore pressure, in inches of water, is also frequently reported from permanent soil gas probes.
Near Surface Gases	Measures the concentrations of gases at a point no higher than 4 inches above the ground surface.	Methane is the most common gas monitored but VOCs and H_2S are sometimes reported.
Emissions	Emissions monitoring measures the rate at which chemicals are released from a particular source, such as landfill surfaces, flares, or stacks.	Landfill studies have measured emission rates for various pollutants, such as methane and NMOCs, from landfill surfaces and combustion by-products of flares and other treatment units.
Ambient Air	Ambient air monitoring measures levels of pollution in outdoor ambient air, or the air that people breathe.	Ambient air monitoring can be conducted for a wide range of pollutants. Near landfills, air monitoring is most commonly conducted for EPA's criteria pollutants and NMOCs.
Indoor Air	Indoor air monitoring measures levels of contamination in indoor air spaces.	Indoor air monitoring for methane is required at structures on many landfill properties. Methane monitoring at off-site locations and NMOC monitoring is usually only performed to address site specific concerns. Oxygen levels in confined spaces, such as buried utilities, are measured to determine if carbon dioxide and/or methane gases have replaced sustainable oxygen.

Passive containment system

How is landfill gas collected?

Landfill gas can be collected by either a passive or an active collection system. A typical collection system, either passive or active, is composed of a series of gas collection wells placed throughout the landfill. The number and spacing of the wells depend on landfill-specific characteristics, such as waste volume, density, depth, and area. Most collection systems are designed with a degree of redundancy to ensure continued operation and protect against system failure. Redundancy in a system may include extra gas collection wells in case one well fails. The system-specific components for passive and active gas collection systems are discussed below.

Passive Gas Collection Systems.

Passive gas collection systems (Figure 2.1) use existing variations in landfill pressure and gas concentrations to vent landfill gas into the atmosphere or a control system. Passive collection systems can be installed during active operation of a landfill or after closure.

Passive systems use collection wells, also referred to as extraction wells, to collect landfill gas. The collection wells are typically constructed of perforated or slotted plastic and are installed vertically throughout the landfill to depths ranging from 50% to 90% of the waste thickness. If groundwater is encountered within the waste, wells end at the groundwater table. Vertical wells are typically installed after the landfill, or a portion of a landfill, has been closed.

A passive collection system may also include horizontal wells located below the ground surface to serve as conduits for gas movement within the landfill. Horizontal wells may be appropriate for landfills that need to recover gas promptly (e.g, landfills with subsurface gas migration problems), for deep landfills, or for active landfills. Sometimes, the collection wells vent directly to the atmosphere. Often, the collection wells convey the gas to treatment or control systems (e.g., flares).

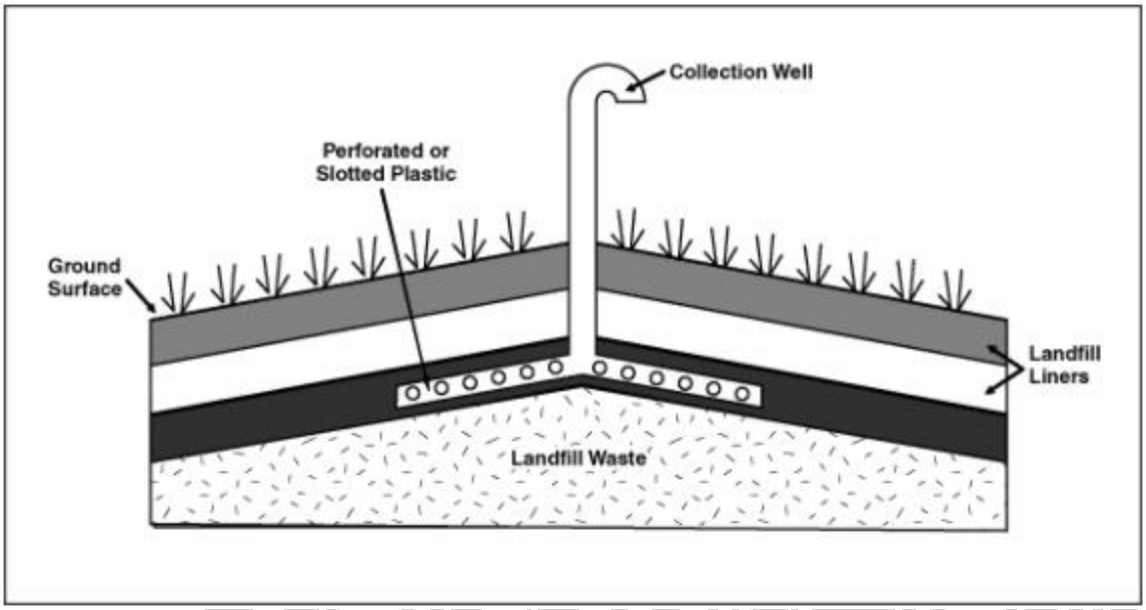

Figure 2.1 Passive gas collection systems

The efficiency of a passive collection system partly depends on how well the gas is contained within the landfill. Gas containment can be controlled and altered by the landfill collection system design. Gas can be contained by using liners on the top, sides, and bottom of the landfill. An impermeable liner (e. g., clay or geosynthetic membranes) will trap landfill gas and can be used to create preferred gas migration pathways. For example, installing an impermeable barrier at the top of a landfill will limit uncontrolled venting to the atmosphere by causing the gas to vent through collection wells rather than the cover.

The efficiency of a passive collection system also depends on environmental conditions, which may or may not be controlled by the system design. When the pressure in the landfill is inadequate to push the gas to the venting device or control device, passive systems fail to remove landfill gas effectively. High barometric pressure, sometimes results in outside air entering the landfill through passive vents that are not routing gas to control devices. For these reasons, passive collection systems are not considered reliable enough for use in areas with a high risk of gas migration, especially where methane can collect to explosive levels in buildings and confined spaces.