Application Note

Landfill gas detection monitoring



A landfill is an area that has been specifically dug out to contain waste and rubbish.

Also known as a tip or a dump, a landfill allows the natural process of decomposition to occur and is actually the oldest form of waste treatment undertaken by humans. In fact, historically landfills were known as middens and their effectiveness at aiding the biological break down of organic materials means this method is still the most common form of organised waste disposal globally today.

Landfill sites can vary considerably. Some include internal waste disposal sites or areas used for waste management where inorganic materials can be sorted and stored before being sent on to other areas for recycling or processing.

Types of landfill

There are two key types of landfill and the majority of landfills are publicly funded (although some are commercial businesses).

- Hazardous material landfill
- Non hazardous material landfill

The waste industry is heavily regulated in many regions, due to the considerable ecological and environmental impact that landfills can have. For example, they can affect local water ways, cause soil contamination and adversely affect local flora and fauna.

Gas hazards encountered in landfill applications

The gases produced by landfills are the result of various chemical reactions and microbial actions. The idea of a landfill is to assist and accelerate the natural process of aerobic (in the presence of Oxygen) decomposition and the rate at which decomposition occurs is dependent on various factors including the size of the landfill area itself and also the waste composition. Due to the complexity of chemical reactions taking place throughout the various stages of decomposition, numerous bacterial, fungal and insect-based ecosystems co-exist in landfills.

Decomposition of organic material produces a number of flammable, toxic and Oxygen gas hazards in various concentrations, depending on what stage of decomposition the material is in and what the original waste consists of.

Typically the gases produced in landfill sites include (from highest concentration to lowest):

- **Methane** (CH_4): 45-60%
- **Carbon Dioxide** (CO_2): 40-60%
- **Nitrogen** (N_2): 2-5%
- **Oxygen** (O_2): 0.1-1%
- **Hydrogen Sulphide** (H_2S): 0.1-1%
- **Ammonia** (NH_3): 0.1-1%
- **Hydrogen** (H_2): 1.1-0.2%
- **Carbon Monoxide** (CO): 0.1-0.2%

Landfills also contain trace concentrations of the following gases:

- **Benzene** (C_6H_6)
- **Toulene** (C_7H_8)
- **Chloroform** ($CHCl_3$)
- **Vinyl Chloride** (C_2H_3Cl)

The chemical reactions of decomposition cause the degrading material to heat up and as gases build up, pressure increases, which results in gases being vented into the surrounding atmosphere. Due to the many variables at landfill sites (site geometry and nature of material etc), the actual concentrations of gasses being produced fluctuates.

Landfill gas is often piped off at the site to gensets where it is used to produce electricity.

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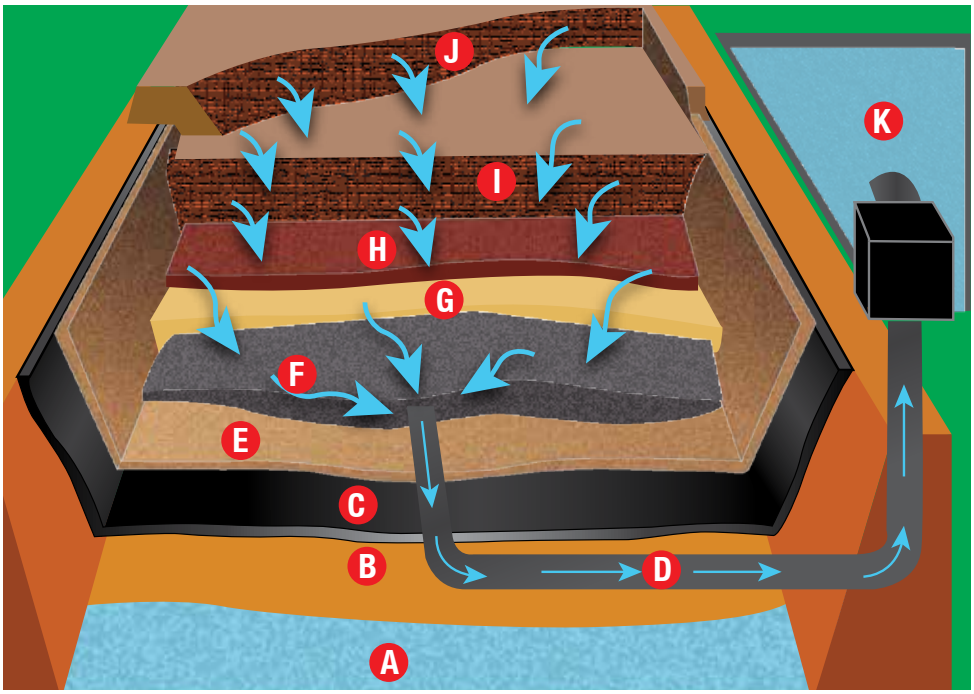

The stucture of a solid waste landfill

A. Ground water

B. Compact clay

C. Plastic liner

D. Leachate collection pipe

E. Geotextile mat

F. Gravel

G. Drainage layer

H. Soil layer

I. Old cells

J. New cells

K. Leachate pond

Testing and regulatory compliance

Due to the potential detrimental effects of landfills, various levels of testing and analysis is required to ensure the site stays within legal contamination limits. Please check with country specific regulations for further details. Typical required monitoring and analytics reporting includes:

- **Borehole analysis:** Where a small, deep section of the soil is removed and analysed for contaminants that have originated in the landfill
- **Surface emission monitoring:** Analysis of contaminants emitted from the landfill itself

This creates the need for robust gas detection to protect the site, its assets and personnel and also the surrounding environment including any nearby urban settlements.

Portable gas detection is essential in landfill applications to detect flammable, toxic - including low-level Volatile Organic Compounds (VOCs) - and Oxygen depletion (O_2 is often displaced by other gases), risks that are being produced by waste breakdown. Primary hazards are H_2S, CO_2 and explosion risks from CH_4 build up, but a flexible 4, 5, or 6-gas monitoring solution that also permits the detection of VOCs, provides optimum protection and the adaptability to deal with the numerous gases that could be encountered.

Applications requiring monitoring

Personnel should be protected continuously with a robust portable multi-gas detector and particular care should be taken when operators are working in the following applications:

Working near leachate pools and perimeter boreholes: H_2S can be released to the surface in these locations and due to the extreme toxic nature of H_2S, which is considered lethal after less than a minute in 30ppm or higher concentrations, low-level detection is essential.

Working near landfill gas pipework: Joints and seals in pipework can allow landfill gas to leak out, putting operators at risk from both H_2S and CO_2.

Surface emissions monitoring: It's essential to use a %LEL portable gas detector when monitoring surface emissions – especially when non-ATEX analytical devices are being used to carry out the analytical work. Build-ups of CH_4 can be ignited by equipment that is not ATEX certified or Intrinsically Safe (IS).

Waste handling: Waste handlers will be moving degrading material, causing a risk of H_2S and CO_2 gas pockets being released as they are working, creating the need for portable gas detection.

Working under weighbridges: When waste is brought on site by lorries, the weighbridge determines the weight of the load. When maintenance is being done on the weighbridge, there is a risk of gas exposure, creating the need for portable gas detection.

Analysis within landfill sites requires specialist analytical devices that are designed specifically for landfill monitoring. These applications include:

- Borehole monitoring
- Perimeter monitoring
- Surface emissions monitoring

The addition of portable gas detection in these applications is worth considering, as it can help to enhance on-site safety and deliver additional protection to personnel.

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Portable gas detection

GasAlertMicro 5 Series

Compact and lightweight, GasAlertMicro 5 Series instruments are available in diffusion or pumped formats. These portable gas detectors simultaneously monitor and display up to five atmospheric hazards. Model variants include the GasAlertMicro 5 PID model for the low level detection of VOCs and GasAlertMicro 5 IR for CO_2 monitoring.

PHD6™

Simultaneous monitoring of up to six gas hazards with 18 sensor choices, including PID for the low-level detection of CO_2 and CH_4. PHD6™ features an integrated blackbox data recorder and event logger that records all atmospheric hazards experienced during operation. (Compatible with the IQ6™ Multi-Gas Docking Station).

Automatic test and data logging

Due to the hazards in landfill applications, device safety is essential. Regular device testing ensures that portable fleets are able to do the job intended – detect gas and protect personnel. Our range of automatic test stations simplifies device testing and provides considerable savings over manual methods. The addition of automatic data logging capabilities also helps to reduce fleet management activities, delivering considerable savings over product life.

MicroDock II

The MicroDock II is an easy, cost-effective way to bump-test, calibrate and charge a device as well as manage records. Fully compatible with the complete BW Technologies by Honeywell product range, its accompanying Fleet Manager II software allows the user to download information faster than ever from the MicroDock II. Additional functionality is delivered by MicroDock II's accompanying Fleet Manger II software, allowing the automatic creation of accurate and user-friendly reports and graphs as well as email reminders to calibrate devices and the generation of calibration certificates. These aspects help to dramatically simplify fleet management activities.

IQ6™ Docking Station

A fully automated bump test, calibration and datalogging station for use with the PHD6™ range of portable gas detectors. Connects to a PC via USB port or Ethernet (optional).

Servicing and device support

Honeywell Gas Detection's approved partner networks are able to offer a range of third party servicing options, to ensure the maximised uptime of portable gas detection fleets. These services include calibration, expert guidance on preventative maintenance regimes and application support to ensure optimal plant and worker safety.

Please contact your local distributor for more information on services available.

Honeywell Gas Detection

Honeywell is able to provide gas detection solutions to meet the requirements of all applications and industries. Contact Honeywell Analytics or BW Technologies by Honeywell in the following ways.

Fixed Gas Detection

Honeywell Analytics
Experts in Gas Detection

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Portable Gas Detection

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