

# Test pumping

## Method to determine the landfill gas potential

Measurements with respect to the amount of CH<sub>4</sub> and flow in the landfill can be made by a test pumping period. This is done by installing gas wells which one by one is connected to a pump creating a sub pressure in the local area of the landfill. The gas withdrawn is analysed once a day by using a portable gas analysis instrument and the flow is read out on the inline flow meter. The daily work takes about ten minutes and is done by the personnel at the site. The result is daily reported to Biogas Systems for support. The process is run for a week at each gas well which gives an overview of the whole area. After the gas wells have been examined, one of them is designated for a longer test period. During the longer period the gas formation sustainability is examined. Afterwards, when all measuring results are compiled, a coarse estimation can be made which gives a picture of how much energy can be produced from the landfill gas.



*Test pump box*

## Prerequisites

For planning the test pumping project a CAD file is required which shows the landfill area, the topography, water/gas wells situation, everything installed as electric cables, leachate system and it is also beneficial if areas of known waste is drawn in the file like ashes, household, asbestos etc. The file should also depict if any capping has been done. In conjunction with investigating the landfill gas potential it is also of highly interest to collect data of the fractions of waste being disposed during the years at the landfill, i.e. household, industrial, inert, hazardous etc.

For installing the gas wells in the landfill an ordinary excavator with a driver is needed. As we don't establish the gas wells by drilling the excavator is equipped with a special made tool kit which easy allow us to make the installation. The gas wells are pushed down to the bottom without breaking the membrane underneath, if such exists. If the landfill is covered with a membrane, it can be repaired after the gas well installation.

To run the test pumping equipment power supply is needed on site, i.e. 230V/10 A, single phase. If the test is made during winter time a radiator inside the insulated test box starts automatically so the interior is kept warm.

## Result

When the test period is finished the results are presented in a report were also recommendations are written of how to proceed with the plans of installing a gas collecting system. Available amounts of gas can differ in a wide range from one landfill to another and therefore it is wise to make a test before installing a gas system. Affecting factors of gas formation is type of waste, age of waste, extension and height of the landfill, capping, access of water and if there has been any fire where most of the waste was burnt



*Gas well head*

# Test pumping



## Investigation of Landfill Gas Potential by Test Pumping According to Biogas Systems' Concept

In a landfill, there are ongoing biodegradation processes, both aerobic where organic materials decompose under the influence of oxygen, and anaerobic when organic matter decomposes in an environment free from oxygen. During the latter process a biogas is produced, landfill gas. This mainly consists of methane (CH<sub>4</sub>), carbon dioxide (CO<sub>2</sub>) and nitrogen (N<sub>2</sub>). Methane is a more hostile greenhouse gas than carbon dioxide. This can for instance be seen in areas where methane is present as there are no trees. Methane is also an important source for greenhouse impact. Landfills are sources of such emissions. To prevent the harmful methane to migrate into the atmosphere, landfill gas can be collected in a gas collection system and destroyed, or even better, used for energy production. When collecting landfill gas, one seeks to obtain as high yield as possible in terms of methane content and flow. Normal methane content of landfill gas is about 45% vol which can be said to be a guideline for adjustment of gas wells.

## Background

When organic material decomposes in an oxygen-free environment, the greenhouse gas methane is formed. With its GWP<sup>2</sup> of 21, methane has a significant impact on the environment. Methane will be continuously formed in the landfills around the world for many years to come, even after disposal is finished. The process that occurs in landfills is partly of psychrophilic nature, which means that the microbial activity is slow and at lower temperatures compared with the mesophilic process which also occurs but at a higher temperature. The latter process is often used to operate digesters so as the thermophilic processes where the temperature is even higher.

From the 1980s onwards, a number of landfill sites installed facilities for destroying/extracting the energy-rich methane gas which has led to reduced leakage to the atmosphere.

From a chemistry-physics perspective, water present in the landfill is crucial for the reactions to occur. The microbial flora activity occurs in the liquid film surrounding the organic material consisting of large, complex molecules.

At the sounding of the water levels directly in gas wells, it is possible to determine the levels. If the free water<sup>1</sup> is high in the wells, this means that generally only a short gas filter length is available and thus degasses a smaller volume than in a gas well without free water.

## Object

A test pumping report often serves as a basis for decisions on investment in landfill gas project and presents a picture of the possible gas extraction from the examined landfill.

## Methane levels

Normally the methane content in land fill gas ranges 45-50 %vol which also is a value to aim at while regulating the withdrawal from the gas wells. When combustion of methane in a gas engine is made the content should be at least 45 %vol. This is also applicable to gas boilers.

## Flow rates

The volumetric flow from each gas well along with the methane content is crucial for the energy flow from the landfill. The larger volumes taken from the landfill, the smaller amounts of methane content in the gas. If the methane content is lower than the combustible limit, then the volumetric flow is reduced.

Biogas Systems facilities for gas collecting systems are built upon a theory of optimising gas pipes with respect to flow and pressure drop. This enable higher flow rates at the same amount transported gas which leads to the fact that condensate and particles in the pipes easier follows the gas flow to the water trap where water is separated from the gas. This also prevents water from contaminate instruments and pumping equipment in the gas station.

## Energy

Methane is a high energy containing gas which can usefully be incinerated in a boiler or via a gas motor converted to electricity and heat. Recently, even gas turbines have become one of the applications suitable for landfill gas. Turbines are also suitable for both electricity and heat production.

<sup>1</sup> Free water is the water which is wholly or partially filling the voids and cracks as well as coarse pores and that by force of gravity moves down toward the groundwater. The opposite is bounded water which by adsorption is detained at the particle surfaces in the soil.

<sup>2</sup> GWP (global warming potential) is the factor which is used to estimate the global warming in relation to carbon dioxide. The value 21 means that an emission of 1 kg of methane has the same effect on the climate as 21 kg of carbon dioxide over a 100-year period.