ABEM

CASE STORY

Landfill Gas Detection

| Resistivity |

Landfill gas detection with resistivity

SUMMARY

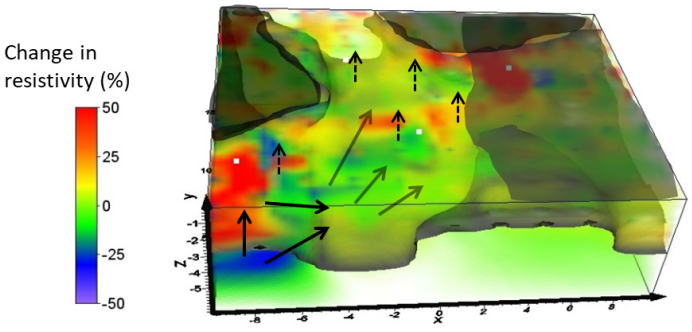
Landfills generate and contain gas, methane gas, which is both a heating resource and an environmental risk, when leaking into the atmosphere. Resistivity investigations can be used to map and monitor this gas and thus provide, for example, information on where best to locate gas extraction wells or carry out remediation work.

CHALLENGE

A municipal solid waste landfill can comprise about 40-60% methane gas. Whilst this gas is a resource that can be used for heating, it is also a greenhouse gas. With climate change high on the agenda for many countries and institutions, it is increasingly important to quantify and manage the leaking of landfill gas into the atmosphere, and/or to carefully collect the gas for use in heating systems thus reducing the level of emissions.

The distribution and movement of methane gas within a landfill site can be quite heterogenous, which can make the placement of gas wells somewhat difficult. A landfill area is often large and discrete, point-by-point, investigation techniques are time consuming and gain relatively limited information.

The 3D volume shows the percentage change in resistivity between five different measurement occasions. The arrows indicate a possible directions of gas movement.



CLIENT

The MaLaGa-project (Mapping Landfill Gas) has been a collaborative research project between universities, public and private sector mainly between 2012 and 2015, but which is still ongoing. The main participating organizations in the project are the Department of Engineering Geology, Lund University, and Tyréns AB. The MaLaGa-project's main aim was to develop techniques for monitoring and characterization of solid waste landfills, based on geophysical measurements.

SOLUTION

Resistivity methods have been used for several years for different landfill applications. When measuring the moisture movement (with low resistivity zones) in previous MaLaGa-projects, high resistivity anomalies were also observed and connected to gas movement. To further investigate this, a thorough investigation was set up at the Filborna landfill site, in Helsingborg, Sweden. Several parallel investigation lines were monitored using a remote-controlled ABEM LS system, with a 3D investigation design for both measurements and interpretation. Measurements were made several times a day, to provide near- continuous monitoring. To check the gas emissions at the surface, a laser measurement system was used and results compared to the resistivity investigations.

RESULTS

The MaLaGa-project showed that underground zones containing higher concentrations of gas were seen as relatively high resistivity zones. Further on, it was shown that zones with high gas content and migration of gas are signalled by high resistivity variation over time, due to the gas and water interaction in the soil pore system. So sub-surface landfill gas migration can be detected in the ground by measuring the relative change in resistivity over time.

RESULTS (CONT.)

- With continued analysis, the results from this research collaboration has shown that measurements for gas detection with resistivity can be used for:
- Optimizing the placement of gas extraction systems
- Testing the effect of gas wells, once in operation
- Identifying sensitive or dynamic areas of the landfill for gas movement
- Providing the basis for a conceptual picture of gas flow at a specific landfill
- Examining how the gas generation and flow around and out of the landfill are affected by changes in weather conditions.

MORE TO READ

More to read on the internal structure of landfills can be found here:
https://malagageophysics.com/index.html
https://malagageophysics.com/publications.html

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MaLaGa
WE MAKE LANDFILLS TRANSPARENT

PROJECT

Method: Resistivity
Solution: ABEM Terrameter LS
Measurement: Parallel profiles with measurement, and processing undertaken in 3D, and monitored remotely. The electrode configuration was pole-dipole with 100 m to the remote electrode. Measurements have also been made with gradient configurations.
Inversion & Visualization SW: Res2dInv and Res3dInv when several parallel lines were investigated.