INVESTIGATION OF WATER FLOW IN A BIOREACTOR LANDFILL USING GEOELECTRICAL IMAGINING TECHNIQUES; TWO FULL-SCALE FLOW EXPERIMENTS AND A TRACER TEST

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This abstract describes field investigations of water recirculation at a bioreactor landfill using geoelectrical imagining technique (i.e., resistivity). The use of geoelectrical imagining techniques is an established practice for environmental investigations and monitoring of various landfill processes, and in recent years also internal processes in landfills have been emphasised (e.g., Guerin et al, 2004; Rosqvist et al., 2005; Rosqvist et al., 2007). In the study, the electrical resistivity technique was evaluated and the increase in moisture content as a result of the start of leachate recirculation was investigated

The bioreactor concept was developed to reduce and control the environmental impact of landfills and to utilise the energy potential of the waste, and in recent years the interest for bioreactor landfill techniques have been at a high level. The main principle of the bioreactor concept is to enhance waste biodegradation by recirculation of leachate in the waste mass, and consequently, the potential long-term risks will be reduced, and post operation costs will be decreased. Moreover, the enhanced waste biodegradation leads to an increase of biogas production for energy utilisation.

Spatial distribution of moisture content is recognised to be of great importance to the biodegradation and methane production in a bioreactor. The overall objective of the experiments was therefore to investigate the spatial distribution of water flow within a bioreactor landfill with leachate recirculation.

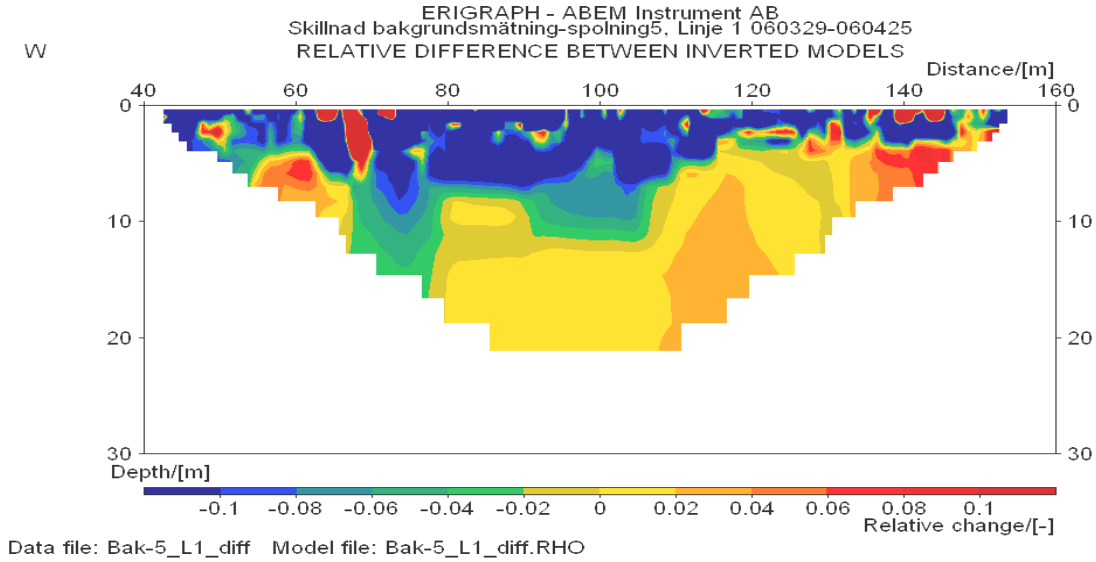
The field campaigns were carried out at a bioreactor landfill at the Filborna landfill site, Helsingborg, Sweden. The bioreactor landfill was 120 by 60 meter, with a depth of approximately 16 meter. Horizontal pipes for leachate recirculation were placed in trenches together with gas collection pipes. At the bottom of the bioreactor landfill, a leachate collection system was installed and in the interior horizontal pipes for gas collection was installed.

2-D resistivity surveys were performed in 2003 and 2006, in which three parallel lines each 160 m long, were measured perpendicular to the leachate distribution pipes. The electrode distance was 2 m and multiple current source gradient array was used. A number of resistivity surveys were carried out with the cable layout in fixed positions.

The main objective with the experiments was to investigate the temporal and spatial distribution of recirculated leachate in a bioreactor landfill at field scale. The experiment could successfully detect the distribution of recirculated leachate through the waste mass by comparing interpretations of resistivity measurements at different time steps (i.e., relative differences or time lapse inversion) in 2-D resistivity sections. The results presented in the resistivity sections indicated the moisture movement to be both horizontal and vertical. The results suggest the leachate flow to occur as a slow matrix flux combined with rapid vertical flow, which is in accordance with previous investigations on water flux through waste mass.

With the aim of mapping spatial and temporal moisture migration through the bioreactor landfill, a full-scale tracer test was performed using Lithium Bromide (LiBr) as a water tracer. During the tracer experiment geo-electrical measurements was performed simultaneously. Results showing moisture migration through the bioreactor landfill, during leachate flushing and during a tracer test, are presented. The results of the combination of a tracer test and resistivity measurements clearly suggest this technique to have potential for detecting and quantifying subsurface moisture movement in landfills. Further research is however required for optimisation of the approach and a more comprehensive understanding of the results. It is suggested that future experiments combining resistivity measurements with tracer tests should facilitate for water sampling in order to detect the migration of the tracer pulse.

It was concluded that Geo-electrical techniques provide an interesting technique for landfill process monitoring and it is therefore suggested that the techniques should be developed in order to achieve a better understanding of leachate and biogas migration in bioreactor landfills as well as in conventional MSW landfills. For future R&D, it is suggested that moisture migration through the waste mass should be investigated and clarified.



Figur 1. The results of the resistivity measurements shown as time lapse inversion during irrigation experiment

References

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