Monitoring of Contaminated Sites I

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Resistivity-IP Monitoring at Landfills in Southern Sweden

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DCIP (DC resistivity and time-domain induced polarisation) short term monitoring surveys were carried out at a number of landfills in southern Sweden. Resistivity results from these experiments have been presented earlier by Dahlin et al. (2011) and Loke et al. (2014), where details concerning experimental setup and test sites can be found. Now analyses of the IP part of the monitoring data are presented.

We use the 4-D inversion method by Kim et al. (2009) that carries out a simultaneous inversion of the different time-lapse data sets. The data misfit and model roughness vectors can be weighted if the L1-norm inversion method is used (Loke et al., 2003). The complex resistivity method (Kemna et al., 2000) is used to calculate the apparent resistivity and I.P. values in the data misfit vector. The finite-element method is used so that 2-D or 3-D models with topography and arbitrary resistivity and IP structures can be modelled. The time-lapse inversion implementation by Loke et al. (2014) is modified to use a two-step inversion algorithm. In each iteration, the resistivity model is first optimised. In the second step the resistivity model is fixed and the chargeability model is optimised.

Tests were carried out with synthetic models to ensure that the inversion algorithm showed the expected changes in the model resistivity and I.P. Then results from a field survey at the Filborna landfill monitoring site were inverted. An inversion of the resistivity data mapped the flow of water from a rainfall event up to the water table at depth of about 5 m. The results show a low resistivity permeable zone shown in the 3rd to 5th layers through which rainwater flowed from the surface to the water table in the 6th layer. The I.P. model section shows some anomalies of up to about 10 mV/V in the top layer that might be due to variations in the clay and organic compost content in the topmost cover material. The cause of the I.P. variations in the deeper layer is uncertain, they could be due to metallic waste or artefacts due to noise as there is poorer data coverage and resolution at depth. Significant changes in the resistivity due to the rainwater infiltration relative to the initial data set are evident. In contrast, the I.P. sections show relatively small variations of generally of less than 1 mV/V. This is expected as the materials are initially moist and the addition of more water would not significantly change their I.P. characteristics.

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