Leachate recirculation by vertical wells : moisture content assessment by geophysical technique

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Research questions

Landfill waste moisture is widely recognised to be a key precondition for optimal biodegradation and methanogenesis reactions to occur, accelerating the stabilisation of the waste matrix. Leachate recirculation is one way of providing such moisture. Performances of leachate recirculation systems can be assessed by measuring moisture distribution in waste mass. As measurement by probes or waste samples doesn't give satisfying results, the Environment Energy and Waste Research Centre of Vivendi Environment studied the possibility of using geophysical measurement methods. The main objective of this study is to validate these methods to assess waste moisture in a landfill. A first experiment was carried out on a first ONYX site where several methods were tested (electrical sounding, electrical 2D imaging, electromagnetic Slingram mapping and radar profiling) to see if they could be applied to a landfill. A second experiment was performed on a second ONYX site during leachate injection trials. Electrical 2D imaging was set up around the injection well before and at different stages of leachate injection.

Results

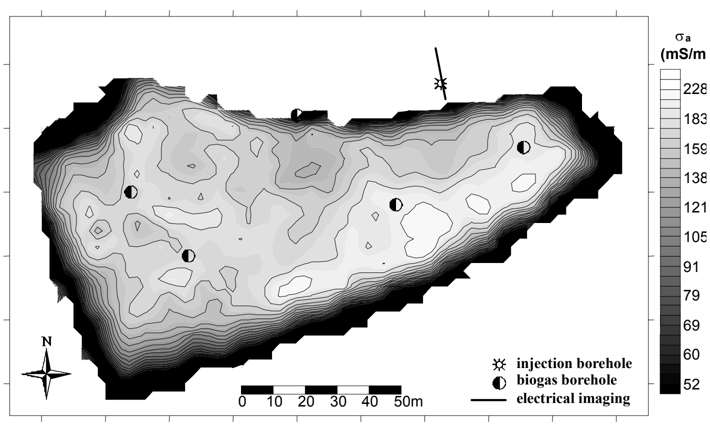

Figure 1 : Electromagnetic slingram map

Only electrical and electromagnetic methods highlighted significant conductivity variations. Electromagnetic slingram mapping (Fig 1) showed an average resistivity of 5 Ω.m (conductivity of 200mS/m) for the upper layer. The cell's border is well underlined by a strong conductivity gradient. Conductivity variations observed in the waste cell could correspond to an heterogeneity in the waste nature or in waste moisture content. Other trials conducted with a 2D electrical imaging tend to confirm this second hypothesis. Indeed, measurement carried out along a slope (Fig 2) showed localised rise of conductivity which corresponded to visible water seepage.

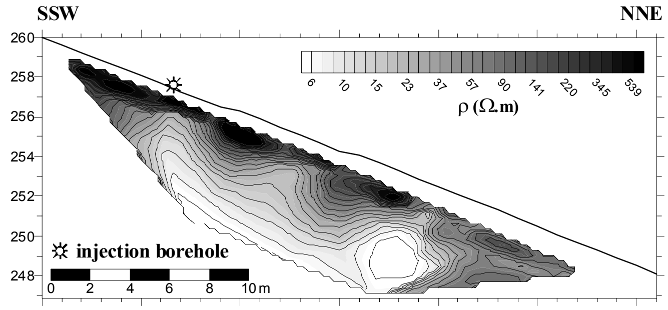

Figure 2 : Electrical 2D imaging on a slope

Each picture of figure 3 represents resistivity variations which occurred during injection trials (difference between resistivity during injection compared to resistivity before injection) . The injection well is located in the middle of the length of the picture and injects at a depth of between 4 and 6m. Figure 3 allowed us to follow the diffusion of leachate in the waste mass and to assess the influence zone of the injection well, estimated at 3,6m for a depth range of 3,5 to 5m. This result is based on an estimation of geophysical measurement error of –1,14%.

Negative variations observed mean that leachate injection tends progressively to increase conductivity. This can be explained first by the relatively cold temperature of the injected leachate (15°C) compared to presumed waste temperature. Indeed, resistivity increases by 2% when temperature decreases by 1°C. Secondly, the low conductivity of the injected leachate (3,46mS/cm) probably due to dilution by rainfall in the storage pond can contrast with the conductivity of the leachate trapped in the cell.

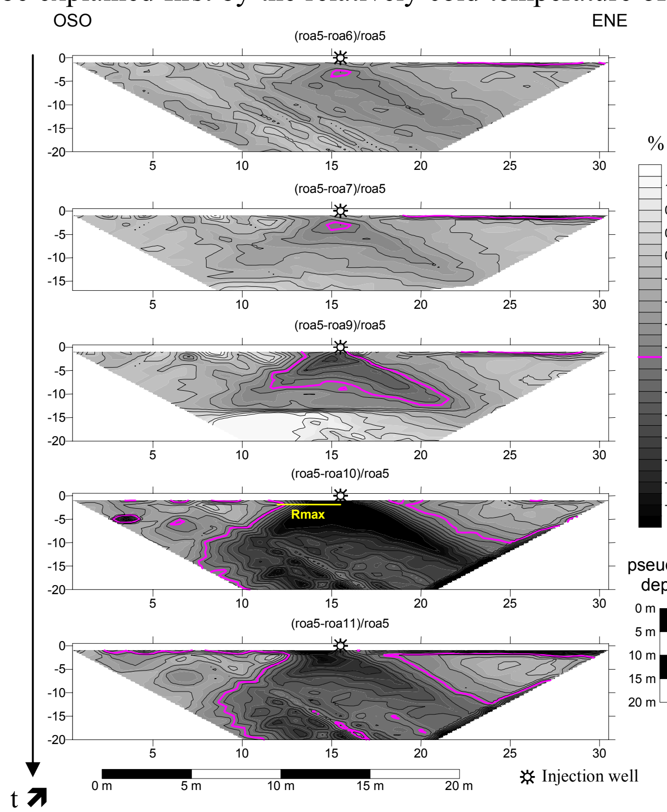

Figure 3 : Resistivity variations versus time during injection trials

Conclusions and prospects

Electrical methods allowed us to see leachate diffusion in the landfill. These qualitative observations will be quantified in order to validate the method. Particularly reduction of the acquisition time is hoped to give better results and correlation between resistivity and moisture is a laboratory and modelling study which will be done through a PhD thesis sponsored by CREED.

Reference list

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