Geoelectrical monitoring in landfill bioreactor to study waste mass biodegradation behavior

Jouen Thomas[1], Moreau Sylvain[1], Clément Rémi[1], Simon Loisel[2], Mazéas Laurent[1]

(1) Irstea, Hydrosystems and Bioprocesses research unit, technological research team "Physical measurements for porous media", Antony, France
(2) SAS Les Champs Jouault, Cuves, France

keywords: Waste biodegradation, Electrical resistivity, Induced polarization, in situ monitoring

Landfilling is still one of the most used waste treatments in France and all over the world. For a long time, the industrials operators act to increase the performances of the waste mass biodegradation and the concept of engineering under control is no longer debatable in European countries. Bioreactor concepts using leachate recirculation to reach optimal humidity or aeration process to change the microbial metabolism are applied to propose an active management process of municipal solid waste landfills. One of the key points is the measurement tools to follow the evolution of the waste mass impacted by the industrial strategy proposed. Even if the leachate and the biogas analyses are necessary, they are associated with a global trend of the medium studied and they couldn't highlight the evolution of the different zones, from the top to the bottom for example, which composed a waste cell.

At the beginning, geophysical methods were mainly implemented to localise old landfills or leachate plumes using the difference of electrical conductivity from natural soils surrounding those sites or the leachate. Among the technics available, the Electrical Resistivity Tomography (ERT) rapidly began a robust method to investigate the landfill sites. Electrical resistivity variations recorded during leachate recirculation on bioreactors landfills are now widely known to study the volume of waste mass impacted by leachate diffusion. Waste temperature is also a physical parameter that this method can analyse to detect zones where exothermic reactions are suspected when air is injected in aeration process.

In situ experimentations and laboratory test have demonstrated that ERT data could be affected by waste decomposition or by the effect of biogas production (Moreau et al., 2012). The long term observations using ERT monitoring allow questioning the relevance of this method to discuss on waste stability during the post-closure. According to those assumptions, a research program was elaborated with the landfill operator SAS Les champs Jouault to follow the evolution of electrical resistivity and Induced polarization datasets during the biodegradation process highlighted by the biogas production and the settlement observed. Moreover, the Distributed Temperature Sensing method using optical fibers cables allows taking into account the temperature evolution to avoid its impact on the electrical resistivity variations observed.

Four years of data collected in landfill site are analysed using different mathematical methods to calculate the average evolution of resistivity and chargeability. The whole volume of sensitivity studied with the ERT method is interpreted like specific zones localized below leachate reinjection device or between two, where the biodegradation evolution could be different. Results from Time Domain Induced Polarization technic are promising to monitor the waste mass behaviour during the landfill post exploitation period.