LOCALISATION AND CHARACTERISATION OF UNDERGROUND FIRES IN LANDFILLS USING ELECTRICAL METHODS

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Characterisation of underground fires in landfills started in 2002 with the demand of landfills managers who have observed at certain places of their site, some evidence of the combustion activity inside the waste mass : high temperatures, vapours and cracks, unusual settlements at certain places of their site.
Given the potential risks represented by this type of fire, a specified study in collaboration with the French environment agency (ADEME) has been implemented. Different steps have been studied to localise the extent of the fire, to understand its formation process, try to foresee the directions of the evolution, and finally, select the correct field survey, without any sanitary risks for the landfill and the employees on the site.

The excavation of the area, by introducing some oxygen, presents the risk of starting or restarting an uncontrolled fire propagation inside mass. For this reason, a non destructive method was chosen. Geophysics seems to be well adapted to this situation, in particular the electrical methods (2-D electrical survey). Indeed, combustion modifies the electrical properties of waste (particularly the water content and the temperature).

At the beginning of the study, electromagnetic method was tested as well.

Following the study carried out in 2002, on a site in the North of France, observations wells were set up to monitor temperature in the waste. A new 2D electrical survey was realised to precise the location of fire.

The purpose of the 2-D electrical survey is to determine the resistivity distribution, using a large number of current and potential electrodes, connected to a cable along a profile on waste mass. After treatment, the data can be represented on a vertical section of the resistivity distribution.

A 2-D electrical survey was carried out with 18 profiles separated by 10 meters. The electrical array used is the dipole-dipole array. Each profile uses between 24 to 44 electrodes every 5 meters. They are centred on each anomaly.

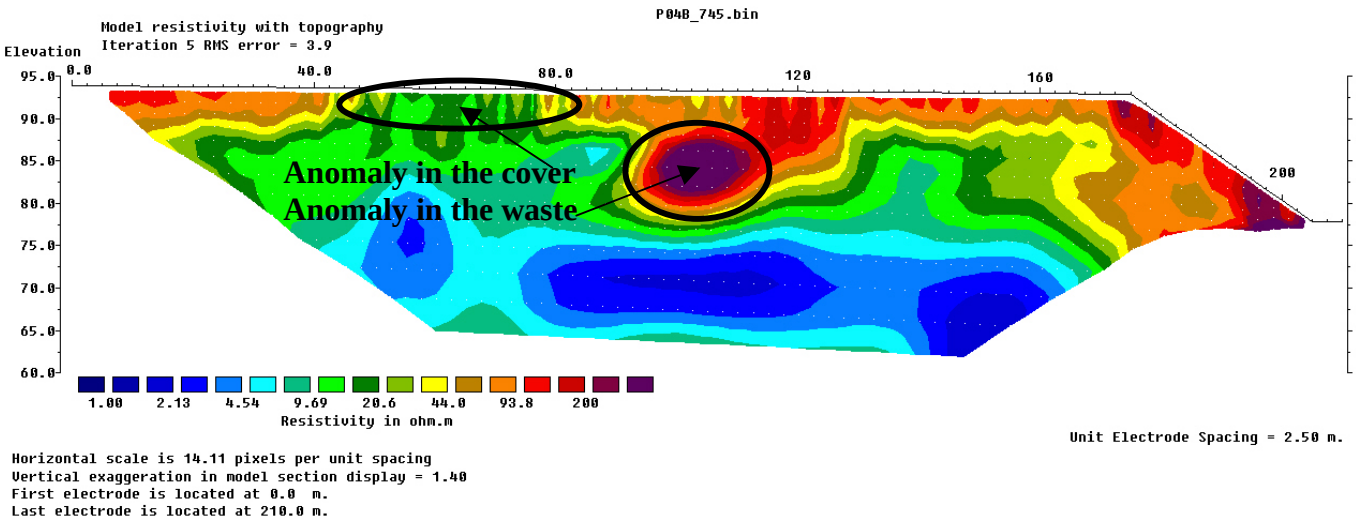
An increase of temperature implies an increase of resistivity, that’s why zones of high resistivity can be interpreted as zone of fire.
In addition, up of an area with fire occurrence, water evaporates and wets the cover. This behaviour can imply a decrease of resistivity in the cover.

A specific treatment computer program for 2-D electrical surveys (res2Dinv) was used for the interpretation of the measurements. The results first show the structure of the cell: basal, sides, intermediary dams, thickness of the cover. Besides, based on the correlation with the

observations of cracks, vapours, high temperatures at the surface, the extent of the underground fire was located : areas showing no combustion (low resistivities), areas with fire occurrence (high resistivities).

Into the waste :
Restitivity of waste is around 15 Ω.m at the top and decrease to 3 Ω.m at the bottom. The decrease of resistivity observed in the depth can be explained with the presence of wet waste in the bottom.
An anomaly is observed on some profiles with a resistivity around 200 Ω.m in the centre. The deep of this anomaly is around 15 to 20 meters.

Into the cover :
The thickness of cover measured during the drilling of observations wells, was used to fit with the electrical measurements. The thickness is around 4 to 5 meters in the prospected zone.
Resistivity of cover without anomaly is from 50 to 100 Ω.m
Anomaly of resistivity was observed in the cover where the resistivity can reach the same range as waste resistivity on part or all thickness of the cover.



SUGGESTED SESSION : **Topic 2.** Internal processes and physical characterisation of landfills.
REQUESTED DESTINATION: oral