SOFTWARE DEVELOPMENT OF A MULTIPLE-STEP WORFLOW FOR ASSESSING LANDFILL GAS SURFACE EMISSIONS FROM SAMPLING DESIGN TO GEOSTATISTICAL MODELING

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INERIS and ISSeP have been working together on methodological aspects related to the assessment and the cartography of diffusive landfill biogas fluxes since the year 2005, in collaboration with KIDOVA and Ephesia which provided expertise on geostatistics.

Over the last five years, different approaches were studied in order to obtain more reliable assessment of global and local landfill gas (LFG) surface emissions through landfill covers. These included using gas probes, as fast indirect emission measurement tool, and implementing different sampling design strategies.

The most significant improvement comes from the sampling strategy by using specific local sampling patterns to increase the sampling density in areas where LFG emissions are higher in order to better estimate their contribution to global fluxes.

Another area of improvement is the development of a new type of measurement, the Instantaneous Flux Measurement (IFM), which combines the rapidity of the Instantaneous Surface Monitoring (ISM) and the accuracy of surface flux measurements as performed by the static flux chamber with recirculation.

The correlation between IFM and surface flux measurement data collected at the same time in the same landfill area is generally rather good ($R^2 > 0.9$, depending on the surface), thanks to the use of a bell probe which is also less sensitive to wind velocity changes.

The designed sampling strategy involves 2 steps. In the first step, a LFG concentration emission survey is carried out in order to identify the areas where LFG emissions are present. In a second step, the data are completed by a combination of high density Instantaneous Flux Measurements, using a simple bell probe, and surface flux measurements, using a more precise static recirculation chamber. This sampling strategy has been implemented by ISSeP and INERIS and compared favorably with other strategies.

The studies carried out by ISSeP (Bietlot, 2013) and INERIS (Bour, 2013) also highlight the importance of the contribution of fluxes in the vicinity of wells and quantified it (Akerman, 2011). The identification of such very local and timely LFG flux sources must be performed in the most integrated media, i.e. the air just above the surface of the landfill, using simple concentration measurements, in order to avoid underestimating LFG emission fluxes. In this sense, the methane leaks in the surroundings of gas wells must necessarily be reduced in order to avoid masking weakly diffusive areas on the surface of the landfill.

A multiple-steps approach has been devised by ISSeP, INERIS and KIDOVA as a workflow to design sampling plans, to carry out data processing and to estimate local and global LFG emissions using statistical and geostatistical methods.

As part of the SoilRemediation® Suite developed by KIDOVA in the GOCAD-SKUA® geological modeling software of Paradigm to provide dedicated software tools to environmental engineers, a specific plugin, called SR Biogas, has been the purpose of a joint research project between KIDOVA and INERIS to implement this LFG-adapted workflow. The objective of this plugin is to help users to put into action the different steps of the approach, from sampling design to the estimation of local and global fluxes and associated uncertainty.

The paper will give details about the workflow that has been implemented in SR Biogas and will present a case study.

References

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