ASSESSMENT OF THE CONTRIBUTION OF LOW EMISSIVE AREAS TO THE TOTAL FLUX OF BIOGAS DIFFUSING THROUGH THE OVERALL COVER OF LANDFILLS IN WALLONIA

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In 1998, ISSeP (Institut Scientifique de Service Public) set up an ambitious monitoring network on sanitary landfills on behalf of the environmental authorities of Wallonia (Southern Belgium). The network includes now 12 municipal solid waste (MSW) and non-hazardous waste landfills located all around the Walloon territory.

The assessment of risks and nuisances related to gaseous emissions through the surface of MSW landfills in which a residual fraction organic compound was dumped is a common issue of environmental management and monitoring. In this context, ISSeP, in partnership with other experts (INERIS, EPHESIA CONSULT), constantly adapts its acquisition method of field measurements and applies (geo-)statistical tools to estimate diffusive biogas fluxes on Walloon landfills. For on-site flux measurements, an adapted apparatus is used consisting of a closed dynamic chamber system [1] connected to a multichannel non-destructive detector based on the infrared (IR) technology (Ecoprobe5®, RS Dynamics). The current methodology, applied for 4 years, has shown to be reliable for the estimation of methane, carbon dioxide and total petroleum surface landfill fluxes. Part of these methodological developments has already been presented at Sardinia 2009 [2]. However, regarding the methane parameter, it appeared that the lower detection limit of the Ecoprobe5®, experimentally established around 300 ppm, could be problematic for flux estimation in areas displaying emission rate below this detection limit (mainly rehabilitated ones). Therefore, the contribution of such low emissive areas to the estimation of the global landfill flux is still an open question. In order to solve this problem, ISSeP has acquired a new apparatus, the Inspectra® Laser detector, totally selective to methane (no false measurements due to the presence of hydrocarbons or other pollutants) with an extended measurement range from 1 ppm to 100% gas volume.

This paper presents the preliminary results of the comparison between Ecoprobe5® and Inspectra® Laser for the detection and quantification of methane fluxes on landfills.

Both apparatus were first compared on a series of lab tests performed on syngas and on biogas collected on a landfill, with the aim of establishing the intrinsic sensitivity threshold to methane of Ecoprobe5® and Inspectra® Laser and evaluating the correlation between the responses of both devices [3]. Figure 1 shows the responses of the IR and Laser detectors in the lower ranges of concentration of CH_4 contained in syngas samples, confirming that Ecoprobe5® is not reliable for the detection of lower CH_4 contents. Furthermore, for each test, methane concentrations measured by Ecoprobe5® were systematically lower than those obtained by mean of the laser detector.

Field measurements were then conducted on the Mont-Saint-Guibert landfill. The Inspectra® Laser and the Ecoprobe5® were simultaneously connected to the closed dynamic flux chamber equipped with two separate external recirculation systems. Again, Inspectra® Laser effectively showed higher sensitivity to methane concentrations lower than 300 ppm, thus leading to a decreasing number of zero values. In addition, the correlation between both devices is very good (Pearson correlation coefficient equal to 0.99) [4].

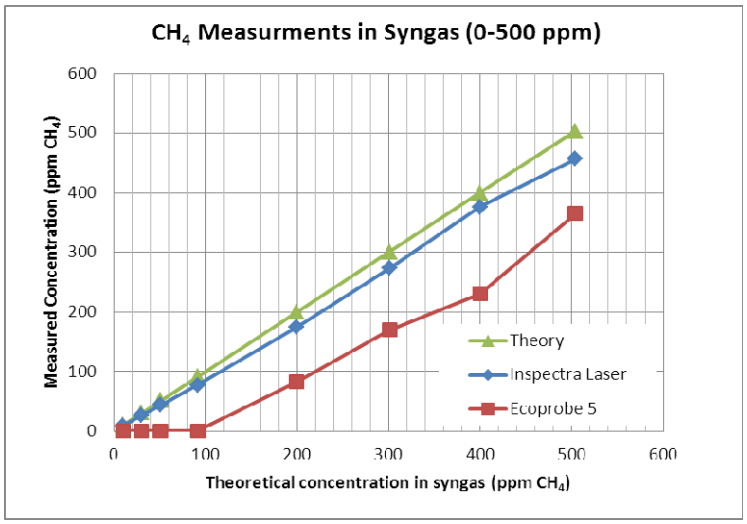

Figure 1 : Comparisation of Ecoprobe5® and Inspectra® Laser to methane (syngas)

The same data sets were finally used to produce flux maps and estimates of the global flux. This was achieved by a geostatistical treatment involving sequential Gaussian simulations [4]. The resulting maps are very similar (Figure 2), as well as the global flux estimates, indicating that the contribution of less emissive areas on the total global flux of methane on this landfill is not significant.

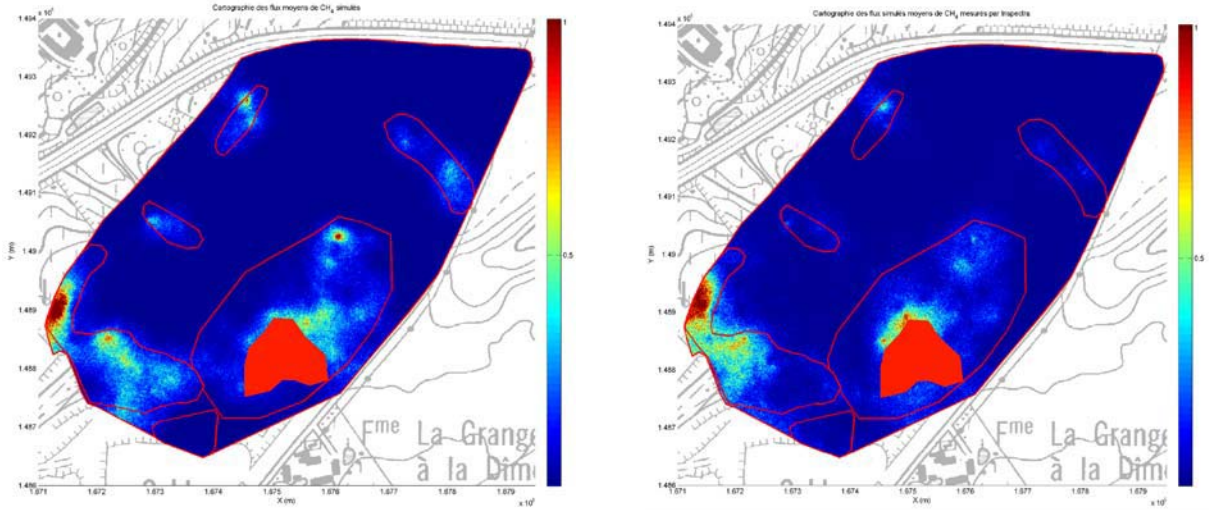

Figure 2 : Maps of methane flux measured with Ecoprobe5® (left) and Inspectra® Laser (right)

This state of thing led us to conclude that rather than focusing on the quantification of diffusive fluxes in areas with low emissivity and their impact on the estimated total flux, the areas of interest that must be investigated in priority are the annular of gas wells. Taking into account the contribution of such convective emissive zones certainly would lead to a more accurate quantification of the total flux of biogas. On the Mont-Saint-Guibert landfill in particular, more than 50% increase of the estimated total flux was observed after integration of the flux data collected at the annular of gas wells.

References

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