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Document reference number and title:
A6.4-MEP009-A03. Draft Methodological tool: Emissions from solid waste disposal sites (version 01.0)

Item	Section no. (as indicated in the document)	Paragraph/Table/Figure no. (as indicated in the document)	Comment (including justification for change)	Proposed change (including proposed text)
1	5.3.2.3. Ex-post monitoring	Paragraph 43 / Equation 5	Currently, the oxidation factor OXy is determined as a weighted average based solely on the surface area of each zone of the solid waste disposal site (SWDS). However, methane oxidation in the cover layers mainly depends on the diffusive flux through the cover material, which is governed by the effective thickness, composition, and porosity of the layer. Using only the surface area as the weighting variable does not adequately reflect the actual oxidation potential when there are significant differences in the type or thickness of the cover between zones. Incorporating the vertical dimension associated with diffusion would allow a more accurate representation of the physical oxidation process of methane and improve methodological consistency.	**Clarification on the influence of cover thickness and diffusion in the determination of OXy** Methane oxidation occurs primarily as a result of the diffusive flux through the cover layer, which depends on the concentration gradient and the effective thickness (x) of the oxidizing material. Therefore, the oxidation factor (OXy)should reflect not only the surface area of each zone, but also the vertical length of the diffusive pathway. In sites where there are significant differences in the thickness, composition, or management type of the cover layers across zones, it is recommended to apply a weighted average based on the product of the covered area and the effective thickness of each layer, as expressed in the following equation: $$OX_y = \sum_{i=1}^{n}\sum_{k=1}^{m} X_{i,k} \times \frac{(Covered\ area_{i,k} \times x_{i,k})}{\sum_{i=1}^{n}\sum_{k=1}^{m}(Covered\ area_{i,k} \times x_{i,k})}$$ where i denotes the site zone, k the type of cover within zone i, xi,k the effective thickness (m) of the cover layer, and Covered areai,k the covered area. This modification more accurately represents the physical diffusion and oxidation processes controlling methane fluxes and aligns with the principles of Fick's law of diffusion. In the absence of specific data on cover thickness, the area-weighted approach may be maintained as a conservative default.

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2	5.3.2.3. Ex-post monitoring	Paragraph 43 / Equation 5	In landfill sites equipped with active biogas capture and flaring or utilization systems, the methane concentration gradient within the landfill body is significantly reduced, thereby decreasing the diffusive flux towards the surface. This phenomenon directly affects the magnitude of surface oxidation, as a lower gradient results in less CH4 reaching the cover layer and consequently a lower oxidized fraction (OX). The current methodology does not differentiate between sites with biogas flaring systems and those without, which could lead to an overestimation of oxidation in landfills with high gas capture efficiency. Introducing a correction factor associated with the degree of gas capture and flaring would allow for a more accurate representation of real operating conditions and an adjustment of default OX values according to the diffusive gradient intensity.	**Adjustment of the oxidation factor according to biogas capture and flaring** In sites where a biogas capture and flaring or utilization system is implemented, the reduction in the methane concentration gradient within the landfill body leads to a decrease in the diffusive flux towards the surface. This phenomenon can be qualitatively expressed according to Fick's law, where the flux (J) is proportional to the concentration gradient (ΔC) and inversely proportional to the thickness of the cover layer (x): $$J = -D \times \frac{\Delta C}{x}$$ When the gas capture system extracts a significant fraction of the gas, the value of ΔC decreases, thus reducing both the surface flux and the oxidation potential. To account for this condition, a biogas flaring adjustment factor ($\Phi flare$) may be applied, modifying the calculation of the oxidation factor as follows: $$OX_{adjusted,i} = OX_i \times \Phi_{flare}$$ where $\Phi flare$ represents the reduction fraction of the diffusive gradient attributable to the efficiency of the gas capture and destruction system. This factor may range between 0.7 and 0.95, depending on the capture rate and the documented performance of the system. In the absence of verifiable operational data on gas capture or flaring, a value of $\Phi flare$=1.0 should be applied as a conservative default. Information regarding the system's operation and methane destruction efficiency shall be included in the project monitoring report.

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3	5.3.2.3. Ex-post monitoring	Table 4. Values of *OXi*, to be applied based on the measurements of *Jout*	The uncertainty ranges associated with the oxidation factors (OX_i) in Table 4 are wide, and no procedure is specified to reduce them when empirical data or local monitoring are available. This may limit the representativeness of the estimates, particularly for sites with advanced characterization. According to the IPCC (2019) Guidelines, Volume 1, Chapter 3, Tier 2 or higher methodologies allow the reduction of parameter uncertainty through the use of site-specific data and statistical error propagation (eg, by quadrature sum or Monte Carlo simulation). Including this possibility within the methodology would encourage continuous improvement of accuracy and consistency of the results.	**Procedure for the reduction of uncertainties associated with OX_i** The uncertainty ranges indicated in Table 4 shall be considered as initial conservative values, applicable in the absence of site-specific information. When project participants have direct measurements or empirical evidence on the performance of the cover layer, reduced uncertainty values may be applied in accordance with the quality assurance and control (QA/QC) principles and error propagation methods established in the IPCC (2019) Guidelines, Volume 1, Chapter 3. Valid evidence may include the following: - Methane flux measurement campaigns using the Flux Box Method or soil gas profiles. - Characterization of the oxidation factor (OX) through field monitoring or laboratory assays. - Determination of degradable organic carbon (DOC and DOC_f) through representative sampling. - Monitoring of biogas pressure, composition, or temperature through continuous and verified data series. When records equivalent to six months of consecutive measurements with verified QA/QC are available, uncertainties may be reduced in accordance with the accuracy levels of Tier 2 or higher methodologies described in the IPCC (2019) Guidelines.

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4	Appendix 1. Measurements of methane flux leaving the surface of the landfill using flux box technique	4. Estimating the average flux of each zone	The Flux Box Method described in Appendix 1 allows measuring the surface methane flux at landfill sites. However, the methodology does not include the possibility of integrating satellite or aerial measurements to complement and validate the results obtained in the field. The correlation between both methods enables the estimation of methane fluxes without requiring the Flux Box method to be applied multiple times, reduces the uncertainty associated with oxidation factors (OX_i), and strengthens the transparency of reported results. This integration is aligned with the recommendations of the Global Methane Assessment (UNEP, 2021) and emerging combined verification practices (top-down/bottom-up).	**Integración de mediciones in situ y observación satelital** Results obtained using the Flux Box Method may be complemented and correlated with satellite or aerial observations that detect CH4 concentrations above the landfill site. A sufficient measurement period shall be required to achieve a statistically significant correlation of at least 95%. This correlation will improve the spatial and temporal representativeness of the estimates, help identify high-emission zones, and reduce the uncertainty associated with oxidation factors (OX_i). The comparison between both methods shall be carried out over coincident observation periods and under controlled meteorological conditions (wind speed, temperature, and atmospheric stability). The results of this correlation shall be documented in the monitoring report, including metadata, data sources, and quality criteria of the satellite observations used.
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