MSW Landfill K-value Calculation

BEST MANAGEMENT PRACTICE

October 2014

Introduction

This document outlines the best management practices for Municipal Solid Waste (MSW) landfill site-specific k-value calculation. The specifications for k-value calculation as a function of landfill methane flows are recommended.

Legal Framework

Landfills in Alberta are regulated by Alberta Environment and Sustainable Resource Development (ESRD) by the Environmental Protection and Enhancement Act and the Waste Control Regulation. If there are any inconsistencies or conflicts between the information contained in this document and the Alberta Acts and Regulations pertaining to landfills, the latter takes precedence.

Landfills with no LFG collection or field test data will calculate k-value as a function of local precipitation as per the List of Emission Factors available at:

Definition

K-value calculation means the landfill-specific methane generation rate as a function of the landfill's measured methane flow rate, annual waste placement and waste characterization data, and the methane generating potential of the waste.

K-value calculation

The LFG generation data, annual waste data and the methane generating potential of the waste (Lo) can be input into the Scholl Canyon first order kinetic decay model, where the k-value can be back calculated for each year. Consistent site-specific k-values calculated over a period of several years would confirm the k-value determined for the site is appropriate and can be used, *inter alia*, to determine LFG generation for areas not containing LFG recovery and to quantify avoided CH4 from waste diversion offset project activities.

Determine LFG Generation:

Estimated LFG generation = LFG flow rate
+ LFG surface emissions
+ LFG subsurface migration
+ LFG (methane) oxidization
+ LFG storage

Measured LFG flow rate

LFG Collection and Control Systems

Installed LFG collection and control systems can be used at any MSW landfill site to determine the sustainable LFG flow rate. The larger the landfill area covered by the collection system, the higher degree of accuracy in calculation of the landfill's production flow rate.

LFG Test Wells

LFG test wells and subsurface gas monitoring can also be used at MSW landfill sites to determine the LFG production flow rate in specific waste areas/cells.

A subsurface field test program using test wells and test probes should use a proven method successfully demonstrated at similar MSW landfill sites and recognized by the Solid Waste Association of North America (SWANA).

LFG Surface Emissions

There is no proven method for reliable measurements of LFG surface emissions. LFG emitted to the atmosphere can be estimated through Surface Emission Monitoring (SEM). SEM's can be conducted to evaluate the landfill cover system integrity following completion of the final cover system, as well as identify fugitive emissions from LFG wells, condensate traps, below grade vaults, leachate risers and the overall effectiveness of the LFG collection system. As a minimum, annual visual cover system integrity inspections should be considered.

Subsurface LFG migration

The Alberta Standards for Landfills require all landfills to have a sub-surface landfill gas monitoring program. LFG monitoring wells/subsurface gas probes are typically installed around the landfill perimeter to ensure compliance at the property boundary. Although subsurface LFG migration is difficult to quantify, these gas probes will provide monitoring data to indicate whether migration is occurring. LFG migration is generally controlled by an engineered liner system, and is typically negligible.

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Waste characterization studies for the landfill should be conducted as recommended in the Alberta Environment Provincial Waste Characterization Framework (Alberta Environment, 2005).

LFG (methane) oxidized

Methane is removed by oxidation during the passage of LFG through the landfill cover system. Default values for methane oxidation rates should be used (IPCC, 2006).

Type of site	CH_4 Oxidation Rates (OX, %)	Developed Area (m^2)
Managed, unmanaged and uncategorized landfill (not covered with aerated material)	0	A
Managed covered with CH_4 oxidizing material (i.e. soil, compost)	10	B

For the case of different site types at different landfill areas an average methane oxidation rate can be calculated by:

$$OX_{average} = \frac{[(0\% * A) + (10\% * B)]}{(A + B)}$$

The use of an oxidation value higher than 10% should be clearly documented, referenced and supported by data relevant to the geographical context (IPCC, 2006).

LFG stored

Storage is very hard to monitor as it is dependent on various landfill site related factors, such as waste composition, ambient climate, settlement, biodegradation, leachate volume and flow and waste compaction.

It is recommended to consider storage equal to zero for landfills with an active LFG collection system. For landfills without an active LFG collection, the average value of the gas-filled porosity (GFP) of 0.2 (20%) should be applied (Spokas et al., 2006).

$$CH_{4stored} = GFP * F_{CH_4} * Vol_{LF} * \delta_{CH_4}$$

[t CH4/a]

With

GFP	Gas Filled Porosity (%)
F_{CH4}	Fraction of Methane in LFG (vol. %)
Vol_{LF}	Volume of Landfill (m^3)
δ_{CH4}	Density of Methane (0.0006785 t CH_4/m^3, at 1.013 bar and 15°C)

Changes in CH_4 stored over time due to the difference in pore space being available can be calculated as:

$$\Delta CH_4 stored_C = CH_4 stored_C - CH_4 stored_{C-1}$$

With

$CH_4 stored_C$	Methane Stored in Current Year (t CH4/a)
$CH_4 stored_{C-1}$	Methane Stored in Year preceding the Current Year (t CH4/a)

LFG Collection Efficiency:

It is important to evaluate the collection efficiency of a system. This is one means to assess surface, subsurface, storage and oxidation assumptions.

Annual Waste Data:

Annual waste tonnages for Residential, ICI, and C&D waste stream acceptance should be based on scaled waste acceptance data records and annual reports and reflect tonnages landfilled within the area of LFG collection system or test well coverage.

Methane Generation Potential:

Determine landfill specific L_o based on the formula outlined in the List of *Emission Factors* and data from waste characterization studies for the landfill conducted as recommended in the Alberta Environment Provincial Waste Characterization Framework (Alberta Environment, 2005). Adjustments in L_o should be considered when there are significant changes in waste stream composition.

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