APPENDIX R. EMISSIONS CALCULATIONS FOR MUNICIPAL SOLID WASTE LANDFILLS [NEW]

A megagram is also known as a metric ton and approximately equal to 1.1 U.S. short tons or 2,205 pounds.

EQUATION 1

In accordance with OAC 252:100-47-9(a)(1)(A), Equation 1 must be used if the actual year-to-year solid waste acceptance rate is known. The mass of nondegradable solid waste may be subtracted from the total mass of solid waste in a particular section of the landfill when calculating for the value for M_i if documentation of the nature and amount of such wastes is maintained.

$$M_{NMOC} = \sum_{i=1}^{n} 2kL_oM_i(e^{-kt_i})(C_{NMOC})(3.6 \times 10^{-9})$$

Where:

M_{NMOC} = Total NMOC emission rate from the landfill, megagrams per year.
k = Methane generation rate constant, year^{-1}.
L_o = Methane generation potential, cubic meters per megagram solid waste.
M_i = Mass of solid waste in the ith section, megagrams.
t_i = Age of the ith section, years.
C_{NMOC} = Concentration of NMOC, parts per million by volume as hexane.
3.6×10^{-9} = Conversion factor.

EQUATION 2

In accordance with 252:100-47-9(a)(1)(B), Equation 2 must be used if the actual year-to-year solid waste acceptance rate is unknown. The mass of nondegradable solid waste may be subtracted from the total mass of solid waste in a particular section of the landfill when calculating the value of R, if documentation of the nature and amount of such wastes is maintained.

$$M_{NMOC} = 2L_oR(e^{-kc} - e^{-kt})C_{NMOC}(3.6 \times 10^{-9})$$

Where:

M_{NMOC} = Mass emission rate of NMOC, megagrams per year.
L_o = Methane generation potential, cubic meters per megagram solid waste.
R = Average annual acceptance rate, megagrams per year.
k = Methane generation rate constant, year^{-1}.
t = Age of landfill, years.

C_{NMOC} = Concentration of NMOC, parts per million by volume as hexane.
c = Time since closure, years; for an active landfill c = 0 and $e^{-kc} = 1$.
3.6×10^{-9} = Conversion factor.

EQUATION 3

In accordance with 252:100-47-9(b), after installation and startup of a collection and control system in compliance with OAC 252:100-47, the owner or operator must calculate the NMOC emission rate for purposes of determining when the system can be capped, removed, or decommissioned as provided in 252:100-47-7(f) using Equation 3.

$$M_{NMOC} = 1.89 \times 10^{-3} Q_{LFG} C_{NMOC}$$

Where:

M_{NMOC} = Mass emission rate of NMOC, megagrams per year.
Q_{LFG} = Flow rate of landfill gas, cubic meters per minute.
C_{NMOC} = NMOC concentration, parts per million by volume as hexane.

EQUATION 4

In accordance with 252:100-47-9(e), Equation 4 must be used to calculate the control efficiency.

$$Control\ Efficiency = (NMOC_{in} - NMOC_{out})/(NMOC_{in})$$

Where:

$NMOC_{in}$ = Mass of NMOC entering control device.
$NMOC_{out}$ = Mass of NMOC exiting control device.

EQUATION 5

In accordance with 252:100-47-10(a)(1)(A), the maximum expected gas generation flow rate from the landfill for sites with unknown year-to-year solid waste acceptance rate must be calculated with Equation 5.

$$Q_M = 2L_o R(e^{-kc} - e^{-kt})$$

Where:

Q_M = Maximum expected gas generation flow rate, cubic meters per year.
L_o = Methane generation potential, cubic meters per megagram solid waste.
R = Average annual acceptance rate, megagrams per year.
k = Methane generation rate constant, year^{-1}.
t = Age of the landfill at equipment installation plus the time the owner or operator intends to use the gas mover equipment or active life of the landfill, whichever is less. If the equipment is installed after closure, t is the age of the landfill at installation, years.
c = Time since closure, years (for an active landfill c = 0 and e^{-kc} = 1).

EQUATION 6

In accordance with 252:100-47-10(a)(1)(B), the maximum expected gas generation flow rate from the landfill for sites with known year-to-year solid waste acceptance rate must be calculated with Equation 6.

$$Q_M = \sum_{i=1}^{n} 2kL_o M_i(e^{-kt_i})$$

Where:

Q_M = Maximum expected gas generation flow rate, cubic meters per year.
k = Methane generation rate constant, year^{-1}.
L_o = Methane generation potential, cubic meters per megagram solid waste.
M_i = Mass of solid waste in the i^{th} section, megagrams.
t_i = Age of the i^{th} section, years.

EQUATION 7

In accordance with 252:100-47-14(a)(3)(B)(i), the NMOC emissions from each landfill section proposed for exclusion from control must be computed using Equation 7.

$$Q_i = 2kL_oM_i(e^{-kt_i})(C_{NMOC})(3.6 \times 10^{-9})$$

Where:

Q_i = NMOC emission rate from the i^{th} section, megagrams per year.
k = Methane generation rate constant, $year^{-1}$.
L_o = Methane generation potential, cubic meters per megagram solid waste.
M_i = Mass of the degradable solid waste in the i^{th} section, megagram.
t_i = Age of the solid waste in the i^{th} section, years.
C_{NMOC} = Concentration of NMOC, parts per million by volume.
3.6×10^{-9} = Conversion factor.