Prognosis of the Amount of Landfill gas

Prof. Dr. Werner Bidlingmaier & Dr.-Ing. Christian Springer

Projekt Orbit | Dr. W. Bidlingmaier
Bauhaus Universität Weimar | www.orbit-online.net

BUSWELL developed a formula for the composition of landfill gas. BOYLE added to this formula by nitrogen and sulphur.

$C_nH_aO_bN_cS_d + (4n - a - 2b - 3c + 2d) \cdot H_2O \rightarrow$

$1/8 \cdot (4n + a - 2b - 3c - 2d) \cdot CH_4 + 1/8 \cdot (4n - a + 2b + 3c + 2d) \cdot CO_2 + cNH_3 + dH_2S$

The physikal model for the total expected gas amount is:

$$G_e = 1{,}868 * C_0 * (0{,}014\theta + 0{,}28) * \eta_{DF} * \eta_{CE} * \eta_{MF} * [\frac{M}{24 * 365}]$$

with:

G_e :	gas amount which is produced in long periods [m³/h]
η_{DF}:	degradation factor
η_{CE}:	capture efficiency
η_{MF}:	Milieu factor
C_0:	organic carbon [kg]
θ:	Temperature [°C]

mathematical model – Gas amount over the time

$$G_t = G_e * (1 - 10^{-k * t})$$

with

G_t:	gas produced till time t [m³/Mg waste]
k:	degradation constant [1/a]
t:	time [a]

Gas prognosis model by Tabasaran:

In practise the gas potential can be calculated as theoretical generated amount approximately as described in the following:

precondition:

C_0: municipal waste with 170 to 220 carbon kg/Mg waste, depending from the composition of the waste
θ: Temperature in landfill between 25 and 35°C, valid for mesophilic conditions
k: elected 0,025 bis 0,05 equates to a degradation of 50-75% of the organic matter
M: dumped waste [Mg]
η_{DF} = 0,8
η_{CE} = 0,9
η_{MF} = 0,6

Time set off
Gas production starting phase 2 month till 1,5 years without any production

Law of ideal gases
Convert 1 kg organic carbon totally to CO_2 a gas volume of 1,868 m³ will be produced.

1. Gas production during filling the landfill

$$G_e = 1{,}868 * C_0 * (0{,}014\theta + 0{,}28) * \eta_{DF} * \eta_{CE} * \eta_{MF} * \left[\frac{M}{24*365}\right] * \left(1 - 10^{-k*t}\right)$$

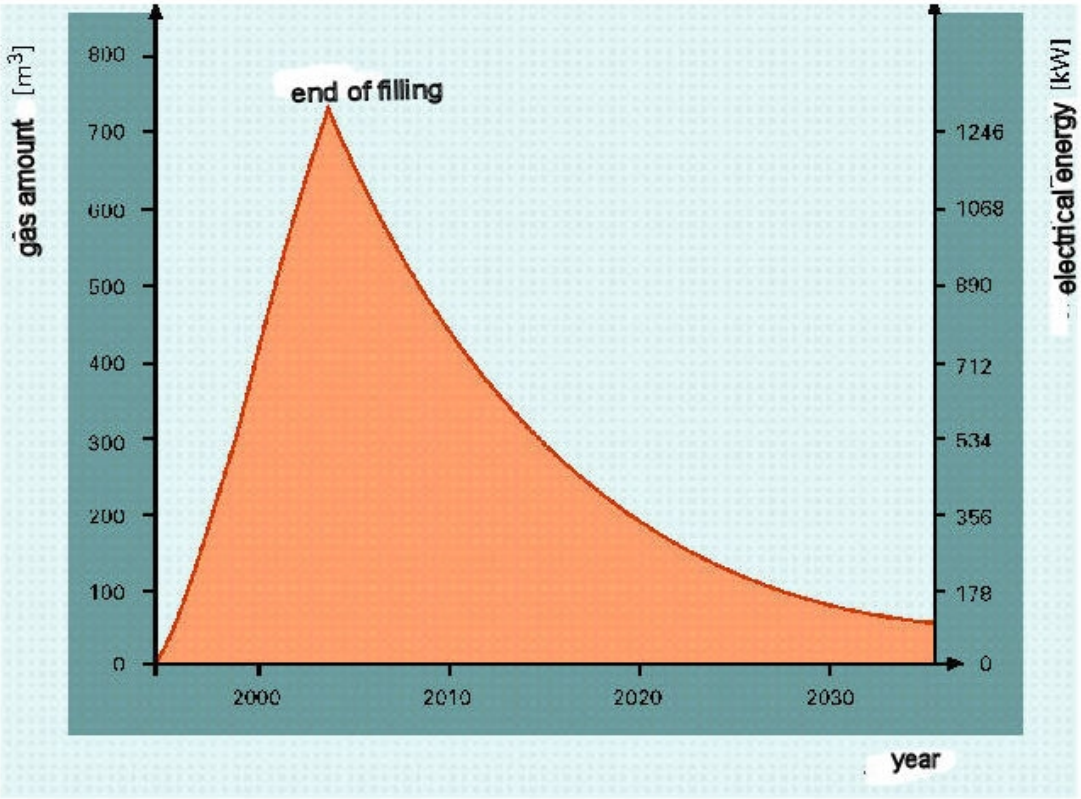
2. Gas production after filling the landfill

$$G_t = \frac{G_e * \left(1 - 10^{-k*t}\right)}{10^{-k*t_2}}$$

with:
t_1: years of operation of the filling time [a]
t_2: years of operation of the time after ending the filling [a]
$t_2 > t_1$

Literatur:
O. TABASARAN. Überlegungen zum Problem Deponiegas. *Müll und Abfall*, 8. Jhrg. (Heft 7), Seiten 204 – 210, 1976.

O. TABASARAN (Hrsg.). *Abfallwirtschaft Abfalltechnik*. Verlag Ernst & Sohn, Berlin, 1994.



Curve of gas production