

CH₄ Emission from Korean Landfills: Application of Tier 1

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Research Necessities for GHG inventories in Korea

- Generation Rate of GHG in Korea :
11th highest in the world
 - ✓ Collection of reliable emission data of GHG
 - Necessity for developing **reliable estimation methods** of GHG from various emission sources
- CH₄ emission from Landfill
 - ✓ Difficulty in estimating CH₄ emission correctly because of temporal variation of landfill conditions



Recent Works regarding CH₄ Emission from Landfill in Korea

- Estimation of Korean specific emission factor and key parameters for Tier 1
- Modification of Tier 2 method to reflect the Korean Landfill situations
 - ✓ Estimation of methane generation constant for Korean Landfill MSW (Municipal Solid Wastes)



Questions to be answered

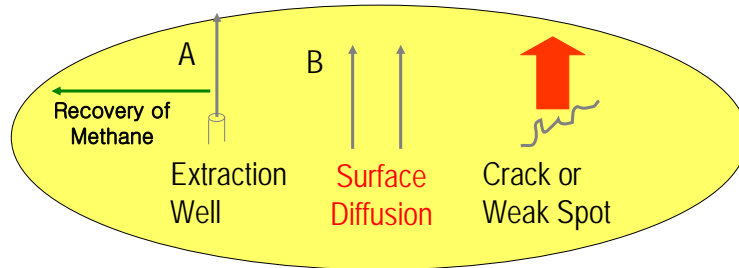
- Are the emission results accurate?
- What is the accuracy level to be used as national emission data?



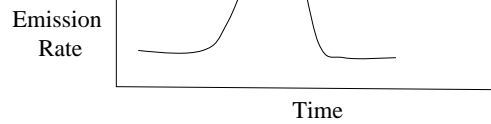
What does make it difficult to estimate the emission rate of CH₄ from landfill?



Emission from Landfill : Extraction well + Surface



Emission rate of CH₄ from landfill with respect to time

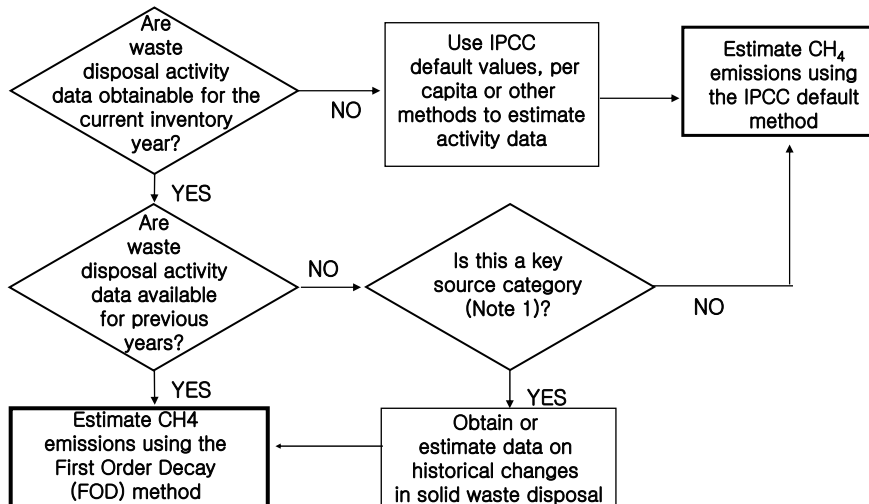


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Decision Tree



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Default Method : Tier 1

■ Assumption

- ✓ MSW landfilled in a year would be converted completely into CH₄ which would be emitted from the landfill in the same year

■ Limitation to application

- ✓ Only applicable for landfills demonstrating constant quality and quantity of MSW with respect to time



Estimation Equation for Tier 1

$$\text{CH}_4 = (\text{MSW}_T \times \text{MSW}_F \times L_0 - R) \times (1 - \text{OX})$$

MSW_T = Total MSW generated (Gg/yr)

MSW_F = Fraction of MSW disposed at Landfills

L₀ = Methane generation potential (Gg CH₄/Gg waste)

$L_0 = \text{MCF} \times \text{DOC} \times \text{DOC}_F \times F \times 16/12$

MCF = Methane Correction Factor (fraction)

DOC = Degradable organic carbon (fraction)

DOC_F = Fraction DOC dissimilated

F = Fraction by volume of CH₄ in landfill gas

R = Recovered CH₄ (Gg/year)

OX = Oxidation factor (fraction)

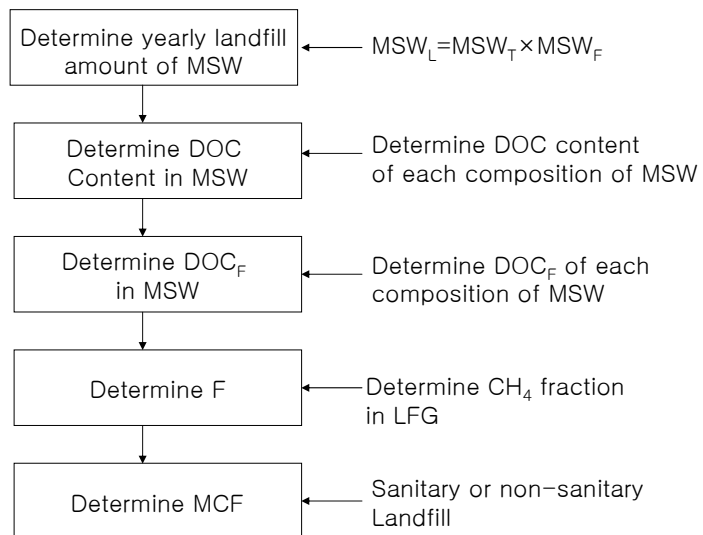


<Key Parameters of Tier 1>

- (1) Landfilled amount of MSW : MSW_L
- (2) DOC
- (3) DOC_F
- (4) MCF
- (5) R
- (6) OX



Flow diagram for
estimation of L_0



Properness of Key Parameters used in the Tier 1 calculations

- **MSW_L (Landfilled amount in a specific year)**
 - ✓ Using yearly reports of National Generation and Treatment Statistics of solid wastes reported by the MOE of Korea
- **DOC (Degradable Organic Carbon)**
 - ✓ Development of Korean specific DOC estimation equation

$$\text{DOC(\%)} = 0.114 \times \text{FW} + 0.320 \times \text{PA} + 0.366 \times \text{WO} + 0.571 \times \text{RU} \\ + 0.061 \times \text{SL} + 0.114 \times \text{AN} + 0.285 \times \text{OT}$$



- **DOC_F (Fraction DOC Dissimilated)**
 - ✓ Default value suggested by IPCC : 0.5~0.6
 - Using the average value : 0.55
 - ✓ Comparison with other results
 - EPA : 0.584
 - Metropolitan landfill in Korea : 0.596
- **MCF (Methane Correction Factor)**
 - ✓ IPCC suggested default values
 - Sanitary landfill : 1.0
 - Non-sanitary landfill : 0.4~0.8
 - ✓ Using 1.0
 - Most landfills recently constructed in Korea are sanitary landfills



▪ **R (Recovery Ratio of Methane)**

- ✓ Difficulty in estimating the recovery ratio
- ✓ Using 13% which was reported by a previous study
- ✓ Necessity to estimate the accurate R
 - Extensive research would be required

▪ **OX (Oxidation Factor)**

- ✓ IPCC default value
 - Sanitary : 0.1
 - Non-sanitary : 0.0
- ✓ Using 0.1



Generation and Emission of CH₄ from Korean landfills (1990~2000)

Year	DOC(%)	L ₀ (ton CH ₄ / ton waste)	Generation rate of CH ₄ (ton/yr)	Emission rate of CH ₄ (ton/yr)	TCE
1990	12.70	0.04657	1,427,269	1,117,450	6,399,940
1991	13.26	0.04862	1,598,714	1,251,679	7,168,710
1992	11.40	0.04180	1,328,532	1,040,146	5,957,202
1993	9.65	0.03538	1,473,674	1,153,782	6,608,025
1994	9.58	0.03513	978,054	765,747	4,385,641
1995	9.05	0.03318	754,556	590,764	3,383,465
1996	9.15	0.03355	855,382	669,703	3,835,574
1997	8.22	0.03014	814,805	637,934	3,653,622
1998	9.13	0.03348	744,693	583,041	3,339,236
1999	10.10	0.03703	711,649	557,170	3,191,067
2000	9.16	0.03359	622,927	487,752	2,793,489



Conclusions

- Key parameters for Tier 1 were estimated to accommodate the characteristics of MSW landfilled in Korea
 - ✓ Korean Specific Emission Factor is determined for Tier 1
 - Need to estimate DOC_F and R
- According to the Tier 1, the emission rate of CH_4 from Korean landfills in 2000 was 2,793,489 TCE, which represented more than 70% in total GHG emission from waste sectors



- Modified FOD (Tier 2) method is under development in order to reflect the landfill conditions in Korea
 - ✓ Within 2~3 years, the emission of CH_4 from Korean landfills would be estimated by means of the Tier 2 method.

