Estimation of Methane Emission from Landfill sites at National Level

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Estimation of Methane Emission from Landfill Sites at National Level

Objectives:

- Assessment of quantity and composition of municipal solid waste
- Estimation of methane emission from landfill sites on national basis

Salient Features of Landfill Sites of India

- Proper segregation of waste is not carried out
- Uncontrolled disposal of municipal solid waste on specified/unspecified land is practised in most of the cities
- Sanitary landfills are not available
- Most of the corporation are not having proper records of quantity and composition of the waste reaching the landfill sites

First Order Decay Model and its Salient Features

- First order decay model has been used in the estimation
- Carbon in the waste decays to methane following first order decay reaction
- Methane emission is highest in first few years after deposition and gradually declines as the degradable carbon in the waste is used up
- Decomposable degradable organic carbon (DDOCm) is the key parameter in estimation

Basis of Estimation

- Municipal solid waste has been classified into two broad categories which are rapidly biodegradable and slowly biodegradable
- Rapidly biodegradable include fruits, vegetable, kitchen waste, etc.
- Slowly biodegradable includes paper, plastic, etc.
- NEERI data on quantity and composition have been used in estimation

Basic Equations used in Methane Estimation

$$DDOCm = W \times DOC \times DOC_f \times MCF \quad \text{.....(1)}$$

DDOCm = Amount of decomposable degradable organic carbon deposited, Gg

W = Mass of waste deposited, Gg

DOC = Degradable organic carbon in the year of deposition (fraction)

DOC_f = Fraction of DOC that can decompose

MCF = Methane correction factor (fraction)

$$DDOC_{ma_T} = DDOC_{md_T} + \left(DDOC_{ma_{T-1}} \times e^{-k}\right) \quad \text{..... (2)}$$

$$DDOC_{m_{decomp_T}} = DDOC_{ma_{T-1}} \times \left(1 - e^{-k}\right) \quad \text{..... (3)}$$

$DDOC_{ma_T} = DDOC_m$ accumulated in the solid waste disposal facility at the end of year T

$DDOC_{md_T} = DDOC_m$ disposed in the solid waste disposal facility in the year T

$DDOC_{ma_{T-1}} = DDOC_m$ accumulated in the solid waste disposal facility at the end of year (T-1)

$DDOC_{m\ decomp_T} = DDOC_m$ decomposed in year T

$$\text{Methane generated in year T} = DDOC_{m\ decomp_T} \times F \times 16/12 \quad \text{..... (4)}$$

F = Fraction of CH_4 by volume

16/12 = molecular weigh ratio, CH_4/C

$$\text{Methane emitted}_T = \left(\sum_{CH_4} generated - R_T\right) \times \left(1 - OX_T\right) \quad \text{..... (5)}$$

R_T = Methane recovered in year T, Gg

OX_T = Oxidation factor in year T (fraction)

T = Inventory year

Activity Data for Estimation of Methane Emission (2007)

- Degradable organic carbon (DOC) estimated from NEERI data = 0.11
- Methane correction factor for unmanaged, shallow disposal site (MCF) = 0.4
- Fraction of degradable organic carbon that decomposes (DOCf) = 0.5
- Rate contant = 0.17 $(yr)^{-1}$
- Fraction of methane by volume = 0.5
- Oxidation factor = 0
- Methane recovery = 0

CH_4 emitted from landfill sites in India

Year	2007
Urban population	352765402
MSW generated (Gg)	70818
Quantity of waste reaching the landfill site (Gg)	49572
DDOCm disposed (Gg)	1082.46
DDOCm accumulated (Gg)	5843
DDOCm decomposed (Gg)	906.77
Methane emitted (Gg)	604.51

Measures for Improvement

- Individual corporation should keep up to date records of MSW reaching landfill site
- Regular monitoring of quantity of waste reaching the landfill site
- Monitoring of composition of the waste from time to time
- Methane monitoring at the landfill site
- Need for construction of sanitary landfill
- Some corporations have initiated improvement measures in the light of legislation for MSW

Thank You