Category		Title
NFR:	5.A	Biological treatment of waste - Solid waste disposal on land
SNAP:	090401 090402 090403	
ISIC:		
Version	Guidebook 2016	

Coordinator
Carlo Trozzi

Contributing authors (including to earlier versions of this chapter)
Jeroen Kuenen, Katja Hjelgaard

Contents

1 Overview

This chapter treats emissions from solid waste disposal on land. This source, however, is only a minor source of air pollutant emissions; emissions of greenhouse gases (CH_4, CO_2 and N_2O) are the major pollutants. Small quantities of non-methane volatile organic compounds (NMVOCs), NO_x, NH_3 and CO may be emitted, but there are no estimates available on the emission factors for these pollutants. Also, particulate emissions from waste handling are generated; Tier 1 emission factors are available and Tier 3 emission factors can be calculated according to US EPA (2006).

2 Description of sources

2.1 Process description

Treatment and disposal of municipal, industrial and other solid waste mainly causes greenhouse gas emissions. Fugitive emissions from waste handling at municipal solid waste disposal sites include emissions from the loading of wastes onto storage piles, equipment traffic at the disposal sites, wind erosion of piles and ground areas and possibly the load out of waste e.g. for waste burning. US EPA (2006) provides emission factors for fugitive particle emissions generated from the handling and wind erosion of different outdoor storage piles, including municipal solid waste at landfills.

2.2 Techniques

No techniques are identified.

2.3 Emissions

Major emissions from waste disposal are emissions of greenhouse gases. Particulate matter (PM) emissions are also emitted from waste handling, methods for calculating these emissions are described in the following sections of this chapter. Small quantities of NMVOC, CO, NH_3 and NO_x may be released as well.

2.4 Controls

In many industrialised countries, waste management has changed much over the last decade. Waste minimisation and recycling/reuse policies have been introduced to reduce the amount of waste generated, and increasingly, alternative waste management practices to solid waste disposal on land have been implemented to reduce the environmental impacts of waste management. Also, landfill gas recovery has become more common as a measure to reduce CH_4 emissions from solid waste disposal sites (SWDS). More information with regard to this source can be found in the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (IPCC, 2006).

3 Methods

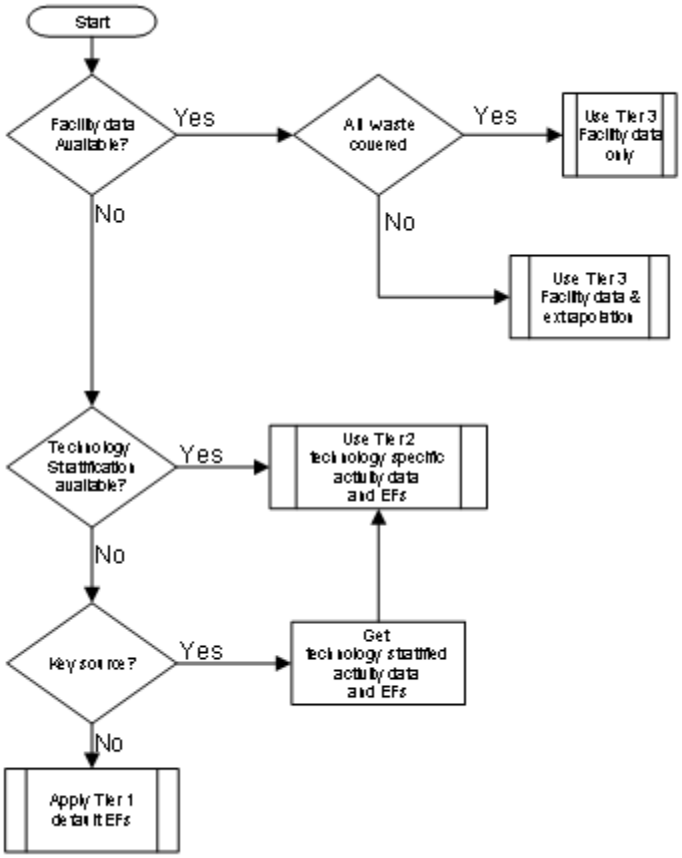
3.1 Choice of method

Figure 3-1 presents the recommended procedure to select the methods for estimating emissions from solid waste disposal on land. The basic concept is:

- if detailed information is available, use it;
- if the source category is a key category, a Tier 2 or better method must be applied and detailed input data must be collected. The decision tree directs the user in such cases to the Tier 2 method, since it is expected that it is more easy to obtain the necessary input data for this approach than to collect facility-level data needed for a Tier 3 estimate;
- the alternative of applying a Tier 3 method, using detailed process modelling, is not explicitly included in this decision tree. However, detailed modelling will always be done at facility level and results of such modelling could be seen as 'facility data' in the decision tree.

This chapter provides both a Tier 1 and a Tier 3 approach for estimating emissions from solid waste disposal on land.

Figure 3-1 Decision tree for source category 5.A Biological treatment of waste - Solid waste disposal on land



3.2 Tier 1 default approach

3.2.1 Algorithm

The Tier 1 approach for process emissions from solid waste disposal uses the general equation:

$$E_{pollutant} = AR_{production} \times EF_{pollutant} \qquad (1)$$

This equation is applied at the national level, using annual national total waste disposal.

The Tier 1 emission factors assume an averaged or typical technology and abatement implementation in the country and integrate all different sub-processes within this source category.

3.2.2 Default emission factors

Table 3-1 presents the Tier 1 default particulate emission factors for solid waste disposal on land. These emission factors are calculated using equation 2 and default data described in subsection 3.3 of this present chapter (US EPA, 2006). Small quantities of NMVOC and nitrate compounds are also emitted. For NMVOC, US Environmental Protection Agency (US EPA) evaluates that 98.7 % of the landfill gas is methane and 1.3 % are other VOCs such as perchlorethylene, pentane, butane, etc. (US EPA, 1990).

Table 3-1 Tier 1 emission factors for source category 5.A Biological treatment of waste - Solid waste disposal on land

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	5.A	Biological treatment of waste - Solid waste disposal on land			
Fuel	NA				
Not applicable	NO_x, SO_2, Pb, Cd, As, Cr, Cu, Ni, Se, Zn, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB, BC, HCH				
Not estimated	NH_3, Hg, CO				
			95% confidence interval		
Pollutant	**Value**	**Unit**	**Lower**	**Upper**	**Reference**
NMVOC	1.56	kg/Mg	0.5	3.0	UK Inventory (2004)*
TSP	0 463	g/Mg	0.006	2.21	US EPA (2006)
PM_{10}	0 219	g/Mg	0.003	1.05	US EPA (2006)
$PM_{2.5}$	0 033	g/Mg	0.0004	0.16	US EPA (2006)

Notes: *UK Inventory (2004) refers to 5.65 g NMVOC per m^3 landfill gas. According to US EPA (2006) chapter 2.4.4.1, the CH_4 generation potential can vary from 6 to 270 m^3 per Mg waste, the default emission factor has been calculated by using the default CH_4 generation potential of 138 m^3 per Mg waste and the default methane content of 50 % (IPCC, 2006, Vol. 5, Ch. 3.2.3).

Particulate uncertainty estimates are calculated as 'worst case' examples. The lower boundaries are calculated as wet fly ash (27 % moisture content (M)) at a wind speed of only 0.6 m/s (U). The upper boundaries are calculated as dry slag (3.6 % moisture content) at a wind speed of 6.7 m/s.

Information on estimation methods for greenhouse gas emissions is given in the 2006 IPCC Guidelines (IPCC, 2006).

3.2.3 Activity data

The statistics required include the annual amount of landfilled waste. This information is available from the national statistics agencies, environmental agencies, or may be obtained through direct contact with the landfill site operators.

3.3 Tier 2 technology-specific approach

Not available for this source.

3.4 Tier 3 emission modelling and use of facility data

Particle emissions from waste handling at municipal solid waste disposal sites were calculated by equation 2 (US EPA, 2006, chapter 13.2.4). This formula estimates emissions from any drop related operation:

$$E = k(0.0016)\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \quad (2)$$

E: emission factor (kg/Mg)
k: particle size multiplier; k (PM_{TSP}) = 0.74, k (PM_{10}) = 0.35 and k ($PM_{2.5}$) = 0.053
U: mean wind speed (m/s)
M: material moisture content (%)

If specific parameters are available, countries should use these to apply with the Tier 3 method. The following factors are standard assumptions and standard values; if no country specific information is available for U and/or M the Tier 1 emission factors should be used instead.

According to US EPA (2006) the wind speed varies from 0.6-6.7 m/s, the default average wind speed is set to:
U = 6.7 m/s
This upper range for equation 2 will be too high for many areas. If a country specific mean wind speed is available this should be applied.

According to US EPA (2006) table 13.2.4-1, the moisture content for municipal solid waste landfills can vary from 2.3 % (low end range for slag) to 29 % (high end range for fly ash). The average moisture content for miscellaneous fill materials is set to:
M = 11 %
If a country specific average moisture content is available this should be applied.

4 Data quality

No specific issues.

5 References

IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan. http://www.ipcc-nggip.iges.or.jp/public/2006gl/ (accessed 5 June 2013).

UK Inventory (2004). United Kingdom Air Pollutant Emission Inventory.

US EPA (1990). Air Emissions Species Manual, Volume 1: Volatile Organic Compounds Species profiles, second edition, EPA-4502-90-001a, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, January 1990.

US EPA (2006). AP42 Fifth Edition, Compilation of Air Pollutant Emissions Factors, Volume 1: Stationary Point and Area Sources. Available via: http://www.epa.gov/ttn/chief/ap42/index.html (accessed 5 June 2013).

6 Point of enquiry

Enquiries concerning this chapter should be directed to the relevant leader(s) of the Task Force on Emission Inventories and Projection's expert panel on combustion and industry. Please refer to the TFEIP website (www.tfeip-secretariat.org/) for the contact details of the current expert panel leaders.