

HW Problem 13:

2005

Solution

For each scenario (A, B, C): estimate the % reduction in waste landfilled (both volume and mass if incineration is used.

Assumptions:

Incinerator is closed for maintenance or repairs 7 % of the time.

5 % of the waste stream must be diverted, because it is bulky.

Determine the percentage of the waste stream that will become ash using the Tabular method (similar to how we estimated BTU). Ash data is given in Table 4-4, in the text.

Ash weight, after quenching with water, is increased 1.3 times.

Specific weight of ash in landfill: 2000 lb/cu-yd

Specific weight of landfilled bulky waste: 1000 lb/cu-yd

Waste composition, and MSW collected per capita given at bottom of page.

Assume the population is 95000 .

a) determine the ash percentage of each scenario's MSW. Which scenario results in the lowest percentage? Why?

Material	MSW % composition			Ash %	% Moisture	Percent Ash of MSW		
	Scen A	Scen B	Scen C			Scen A	Scen B	Scen C
Food waste	7.5	8.4	8.9	5.0	70	0.1	0.1	0.1
paper	34.7	38.8	37.7	6.0	6	2.0	2.2	2.1
cardboard	6.2	6.9	6.7	5.0	5	0.3	0.3	0.3
plastic	6.7	7.5	7.6	10.0	2	0.7	0.7	0.7
textile	2.1	2.3	2.5	2.5	10	0.0	0.1	0.1
Rubber	0.5	0.6	0.6	10.0	2	0.0	0.1	0.1
Leather	0.2	0.2	0.2	10.0	10	0.0	0.0	0.0
yard waste	19.1	9.6	10.2	4.5	60	0.3	0.2	0.2
wood	2.1	2.3	2.5	1.5	20	0.0	0.0	0.0
glass	8.5	9.5	9.1	98.9	2	8.2	9.2	8.8
steel cans	5.5	6.1	5.8	90.5	3	4.8	5.4	5.1
aluminum cans	0.6	0.7	0.6	90.5	2	0.5	0.6	0.5
Other metal	3.2	3.6	3.8	90.5	3	2.8	3.1	3.3
Dirt, ash, etc	3.1	3.5	3.7	68.0	8	1.9	2.2	2.3
Total	100.0	100.0	100.0			21.9	24.2	23.7

Percent ash of MSW calculated as "MSW % composition" x "ash %" x "(100-Moisture %) / 10000

b) determine the specific weight of landfilled MSW, for each scenario.
 Use the normal compaction factors given in Table 11-24.

Material	MSW % composition			CF Lse. SWVol in landfill, compacted				
	Scen A	Scen B	Scen C	5	6	7	8	9
Food waste	7.5	8.4	8.9	0.35	490	0.005	0.006	0.006
paper	34.7	38.8	37.7	0.2	150	0.046	0.052	0.050
cardboard	6.2	6.9	6.7	0.25	85	0.018	0.020	0.020
plastic	6.7	7.5	7.6	0.15	110	0.009	0.010	0.010
textile	2.1	2.3	2.5	0.18	110	0.003	0.004	0.004
Rubber	0.5	0.6	0.6	0.3	220	0.001	0.001	0.001
Leather	0.2	0.2	0.2	0.3	270	0.000	0.000	0.000
yard waste	19.1	9.6	10.2	0.25	170	0.028	0.014	0.015
wood	2.1	2.3	2.5	0.3	400	0.002	0.002	0.002
glass	8.5	9.5	9.1	0.6	330	0.015	0.017	0.016
steel cans	5.5	6.1	5.8	0.18	150	0.007	0.007	0.007
aluminum cans	0.6	0.7	0.6	0.18	270	0.000	0.000	0.000
Other metal	3.2	3.6	3.8	0.35	540	0.002	0.002	0.002
Dirt, ash, etc	3.1	3.5	3.7	0.85	810	0.003	0.004	0.004
Total	100	100	100			0.141	0.140	0.139

Column

5 Compaction factor: given, Table 11-24 (Normal Compaction)

6 Loose specific weight, given, Table 4-1 (lb/cu-yd)

7, 8, 9 "MSW % composition" x Compaction Factor / loose specific weight (cu-yd)

The landfilled specific weights are calculated as 100 lb / total volume

Scen A 710 lb/cu-yd

Scen B 714 lb/cu-yd

Scen C 720 lb/cu-yd

c) determine the mass and volume of MSW landfilled in one year, for the base condition (no incineration).

	as coll lb/p/d	People	Mass tons/yr	Landfill SW lb/cu-yd	volume cu-yd/yr
	1	2	3	4	5
Scen A	5.5	95000	95410	710	268637
Scen B	4.9	95000	85387	714	239158
Scen C	4.6	95000	80070	720	222532

Column

3 Mass of MSW per year = column 1 x column 2 x 365 / 2000

4 calculated in part b)

5 Volume of MSW (if landfilled) per year = 2000 x column 3 / column 4

d) determine the mass and volume of material landfilled in one year, if incineration is used.

Note: first estimate the amount of MSW sent to the landfill during the time the incinerator is closed. Second, estimate the amount of bulky waste sent to the landfill. Next, calculate the amount of ash produced from incinerated material, based on part a) and the stated assumptions. Finally, sum the amounts.

	Total Mass	Landfilled due to inc. downtime		Landfilled Bulky Materials		Ash and quench water		Total amount Landfilled	
	tons/yr	Mass tons/yr	Volume cuyd/yr	Mass tons/yr	Volume cuyd/yr	Mass tons/yr	Volume cuyd/yr	Mass tons/yr	Volume cuyd/yr
	2	3	4	5	6	7	8	9	10
Scen A	95410	6679	18805	4437	8873	23945	23945	35060	51623
Scen B	85387	5977	16741	3970	7941	23738	23738	33685	48420
Scen C	80070	5605	15577	3723	7447	21835	21835	31163	44859

column

- 2 From previous table
- 3 column 2 x diversion from incinerator due to downtime
- 4 column 3 x 2000 / landfilled specific weights
- 5 (column 2 - column 3) x diversion due to bulky wastes
- 6 column 5 x 2000 / bulky material specific weight
- 7 (column 2 - column 3 - column 5) x ash % x quench water factor
- 8 column 7 x 2000 / ash specific weight
- 9 Sum of columns 3, 5, and 7
- 10 Sum of columns 4, 6, and 8

e) determine the percent reduction (by mass and volume) of materials sent to the landfill when incineration is used, as compared to each scenario's base condition and to the scenario A base condition.

	Percent Reduction as compared to:			
	Scenario's base condition		Scenario A base condition	
	Mass	Vol.	Mass	Vol.
	2	3	4	5
Scen A	63	81	63	81
Scen B	61	80	65	82
Scen C	61	80	67	83

C 1