

9-1 Solid waste container sizes

Given: High school population = 881; 30 class rooms; 0.11 kg/cap.d plus 3.6 kg/room;
density = 120 kg/m^3 ; Wednesday & Friday pickup; containers: 1.5, 2.3, 3.0, 4.6
m

Solution:

a. Daily solid waste generation

$$(30 \text{ rooms})(3.6 \text{ kg/room}) = 108.0 \text{ kg/d}$$

$$(881 \text{ students})(0.11 \text{ kg/student}) = 96.91 \text{ kg/d}$$

$$\text{Total} = 108.0 + 96.91 = 204.91 \text{ kg/d}$$

b. Daily volume

$$V = \frac{204.91 \text{ kg/d}}{120 \text{ kg/m}^3} = 1.71 \text{ m}^3/\text{d}$$

c. Collection schedule

Wednesday pickup includes Friday, Monday and Tuesday

Friday pickup includes Wednesday and Thursday

Therefore,

$$\text{Total Volume} = (3 \text{ d})(1.71 \text{ m}^3/\text{d}) = 5.12 \text{ m}^3$$

d. Number and size of containers

Many combinations possible:

$$\text{One of } 1.5 \text{ m}^3 \text{ and one of } 4.6 \text{ m}^3 = 6.10 \text{ m}^3 \quad \text{okay}$$

$$\text{One of } 2.3 \text{ m}^3 \text{ and one of } 3.0 \text{ m}^3 = 5.30 \text{ m}^3 \quad \text{okay}$$

$$\text{Two of } 3.0 \text{ m}^3 = 6.0 \text{ m}^3 \quad \text{okay}$$

9-6 Density of Davis, CA MSW

Given: Table 9-3 with paper, cardboard, plastics, glass, and tin cans removed

Solution:

a. Tabular computation showing fractions removed

Component	Mass (kg)	Volume (m ³)
Total	45.4	0.429
Paper	-19.6	-0.240
Cardboard	-2.98	-0.0297
Plastics	-0.82	-0.013
Glass	-3.4	-0.018
Tin cans	-2.36	-0.0268
NEW TOTAL	16.27	0.1015

$$\text{New Density} = \frac{16.27\text{kg}}{0.1015\text{m}^3} = 160.29\text{kg/m}^3$$

11-7

a. Calculate mean time per collection stop

(3 cans/wk = 1.5 can per collection for twice a week pickup)

$$t_p = 18.00 \text{ s} + (12.60 \text{ s/can})(1.5 \text{ can}) + 0$$

$$t_p = 36.90 \text{ s/stop or } 0.615 \text{ min or } 0.0103 \text{ h}$$

b. Number of pickup locations per crew (Eqn. 9-3). The average haul speed(s) is determined from Figure 9-6: 48.0 km/h

$$N_p = \frac{\frac{8.0}{2} - \frac{2(24)}{48} - (2)\frac{20}{60} - \frac{7.5}{60} - \frac{0.5}{2}}{0.0103} = \frac{1.9583}{0.0103} = 190 \text{ pickups per load}$$

c. Volume per pickup

$$\text{Waste generation rate} = (1.17 \text{ kg/cap d})(4 \text{ people}) = 4.68 \text{ kg/d}$$

For twice a week pickup assume 4 days between pickups

$$(4.68 \text{ kg/d})(4 \text{ d}) = 18.72 \text{ kg}$$

$$V_p = \frac{18.72\text{kg}}{144.7\text{kg/m}^3} = 0.1294\text{m}^3$$

d. Compute compaction ratio

$$r = \frac{475\text{kg/m}^3}{144.7\text{kg/m}^3} = 3.2827$$

e. Volume of truck (note numerator of N_p is same as bracket of Eqn. 9-1)

$$V_t = \frac{0.1294}{(3.2827)(0.0103)}(1.9583) = 7.49\text{m}^3$$

Since the smallest volume truck is 9.0 m³, Volume of truck = 9.0 m³

f. Number of trucks

The number of trucks required is a function of the population that must be served. An assumption must be made about the number of work days, i.e. pickup days per week. I have assumed 5 days/wk.

$$\frac{44000\text{people}}{4\text{people/residence}} = 11000\text{stops}$$

$$11,000 \text{ stops} \times 2 \text{ pickups/wk} = 22,000 \text{ stops/wk}$$

$$\frac{22000\text{stops/week}}{5\text{days/week}} = 4400\text{stops/d}$$

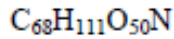
$$\frac{4400\text{stops/d}}{(190\text{stops/load})(2\text{loads/d})} = 11.57 \text{ or } 12 \text{ trucks}$$

Theoretical production of CH₄

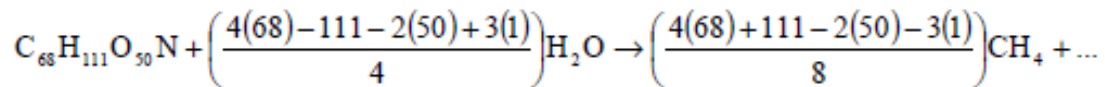
Given: 20.3 kg of rapidly decomposing MSW, density of methane = 0.7167 kg/m³ at STP

Solution:

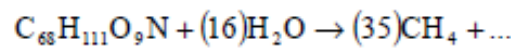
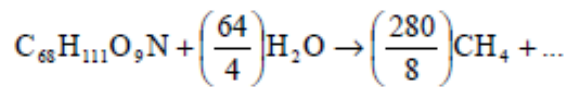
a. From the text –the chemical formula for rapidly decomposing MSW is



b. From the reaction equation (9-8)



OR



c. Calculate GMW of reactant and product

$$C_{68}H_{111}O_9N = 1741$$

$$35 CH_4 = 560$$

d. Ratio of GMW times mass of waste

$$\frac{560}{1741}(20.3\text{kg}) = 6.53\text{kg}$$

e. Estimate volume of gas at STP

$$\frac{6.53\text{kg}}{0.7167\text{ kg/m}^3} = 9.11 \text{ m}^3 \text{ of CH}_4$$