HW Problem 2: **SOLUTION** **2004**

Dusseau's Folly currently has a drop-off program that diverts a number of materials from the Orlins landfill. The composition of material collected at the drop-off center is:

Material	%
Paper (newspaper)	45
Cardboard	13
Glass	19
Steel cans	9
Plastic (HDPE & PET)	11
Aluminum cans	3
Total	100

The amount of material collected at the Jahan Drop-off Center / year is 4770 tons. You estimate that 35 % of all households have food grinders, & grind 25 % of their food waste.

Mehta Consulting determines that the as collected composition of municipal solid waste in Dusseau's Folly is:

Material	% by weight (as collected)	Material	% by weight (as collected)
Food waste	7.5	yard waste	19.1
paper	34.7	wood	2.1
cardboard	6.2	Mics. Organ	0
plastic	6.7	glass	8.5
textile	2.1	steel cans	5.5
Rubber	0.5	aluminum cans	0.6
Leather	0.2	Other metal	3.2
		Dirt, ash, etc	3.1
		Total	100

a. Determine the weight % of Dusseau's Folly's municipal waste stream diverted at the Jahan Drop-off Center, as a percent of the amount of municipal solid waste currently collected

% of as collected wastestream diverted to Drop-off center =
amount collected at Drop-off center / amount sent to landfill

= 4770 / 95410

= 5%

b. Estimate the as generated composition of MSW. What is the total amount of MSW generated in Dusseau's Folly? What is the per person per day generation rate (lb)? What % is diverted to the Jahan Drop-off center?

Material	1	2	3	4	5	6
Food waste	7.5			8.22	8.22	7.8
paper	34.7	45	2.249774		36.94977	35.0
cardboard	6.2	13	0.649935		6.849935	6.5
plastic	6.7	11	0.549945		7.249945	6.9
textile	2.1				2.1	2.0
Rubber	0.5				0.5	0.5
Leather	0.2				0.2	0.2
yard waste	19.1				19.1	18.1
wood	2.1				2.1	2.0
Mics. Organ	0				0	0.0
glass	8.5	19	0.949904		9.449904	8.9
steel cans	5.5	9	0.449955		5.949955	5.6
aluminum cans	0.6	3	0.149985		0.749985	0.7
Other metal	3.2				3.2	3.0
Dirt, ash, etc	3.1				3.1	2.9
Total	100		4.999497		105.72	100.00

Calculations:

Column — Description

1 As collected MSW composition, also pounds out of 100 pounds as collected (given)

2 As collected composition at Drop-off center (given)

3 Pounds collected at Drop-off Center for every 100 pounds of MSW collected,
(0.01 x column 2 x lbs collected at drop-off center per 100 lbs MSW collected)

4 Pounds of food waste, as generated, for 100 MSW as collected,
column 1 FW / (1-HFG x FG)
where HFG = fraction of households with food grinders and
FG = fraction of FW that is ground, and FW = food waste

5 Pounds of as generated MSW for every 100 pounds of as collected MSW
FW: column 4
Stuff collected at Drop-off center: column 1 + column 3
Everything else: column 1

6 As generated MSW % composition, 100 x column 5 divided by sum(column 5)

The total amount of MSW generated is the amount sent to the landfill + the amount diverted to the drop-off center + the amount of food diverted to the sewer

95410 + 4770 + 686 = 100866 tons/year

where the food waste amount = ((column 4 - column 1)/100) x MSW sent to landfill

Per person / day as generated = est. total waste gen. in year / number of people / days in year

= 100866 x 2000/ 95,000 / 365

= 5.8 lbs/person/day

The percentage of the as generated MSW diverted to the Drop-off center is the amount diverted to Drop-off center divided by total amount of waste generated

100 x 4770 / 100866 = 4.7 %

c. Using the as generated composition determined in part b, estimate the as collected MSW composition if a curbside yard waste collect. program is implemented that collects 55 % of the as generated yard waste. What percent of the as generated MSW is diverted to composting and recycling?

Material	1	2	3	4	5
Food waste	7.8	7.09		7.09	8.4
paper	35.0		2.1	32.82	38.8
cardboard	6.5		0.614777	5.86	6.9
plastic	6.9		0.520196	6.34	7.5
textile	2.0			1.99	2.3
Rubber	0.5			0.47	0.6
Leather	0.2			0.19	0.2
yard waste	18.1	8.13		8.13	9.6
wood	2.0			1.99	2.3
Mics. Organ	0.0			0.00	0.0
glass	8.9		0.898521	8.04	9.5
steel cans	5.6		0.425615	5.20	6.1
aluminum cans	0.7		0.141872	0.57	0.7
Other metal	3.0			3.03	3.6
Dirt, ash, etc	2.9			2.93	3.5
Total	100.00		4.73	84.65	100.00

Calculations:

Column — Description

1 As generated MSW composition, also pounds out of 100 pounds as collected (from part b)

2 As collected Food Waste: column 1 x (1-HFG x FG)
where HFG = fraction of households with food grinders and
FG = fraction of FW that is ground
Yard waste not collected by yard waste collection program =
column 1 x (1 - fraction of YW generated collected by YW program)

3 Amount diverted to Drop-off center=
0.01 x column 2 in part b x (lbs collected at drop-off center/100 lbs MSW generated)

4 Pounds of as collected MSW out of 100 pounds of as generated MSW,
FW and yard waste: column 2; drop-off center materials: column 1 - column 3;
everything else: column 1

5 As collected MSW % composition, assuming food grinding, yardwaste diversion, and drop-off center diversion, column 4 / sum(column 4)

The % diverted to recycling and composting is 100 - Sum column 4 - (FW column 1 - FW column 2)
= 14.7 %

The total amount of MSW collected each year is the total amount generated x fraction collected
= 100866 x 0.846539 = 85387

Per person / day as collected = est. total waste collected in year / number of people / days in year
= 85387 x 2000/ 95,000 / 365
= 4.9 lbs/person/day

d. Using the as generated composition determined in part b, estimate the as collected MSW composition if a curbside yard waste collect. program is implemented that collects 55 % of the as generated yard waste and a curbside recycling program is implemented that diverts 10 % of the as generated MSW (including food that is ground and sent to the sewer).

Material	%
Paper (newspaper)	50
Cardboard	12
Glass	17.5
Steel cans	10
Plastic (HDPE & PET)	8
Aluminum cans	2.5
Total	100

Also, what percent of the as generated MSW is diverted to composting and recycling?

For part d, Assume the drop-off program no longer collects material.
For parts c and d, assume that food grinding occurs as described in part a.

Material	1	2	3	4	5	6
Food waste	7.77	7.09			7.09	8.9
paper	34.95		50	5.00	29.95	37.7
cardboard	6.48		12	1.20	5.28	6.7
plastic	6.86		8	0.80	6.06	7.6
textile	1.99				1.99	2.5
Rubber	0.47				0.47	0.6
Leather	0.19				0.19	0.2
yard waste	18.07	8.13			8.13	10.2
wood	1.99				1.99	2.5
Mics. Organ	0.00				0.00	0.0
glass	8.94		17.5	1.75	7.19	9.1
steel cans	5.63		10	1.00	4.63	5.8
aluminum cans	0.71		2.5	0.25	0.46	0.6
Other metal	3.03				3.03	3.8
Dirt, ash, etc	2.93				2.93	3.7
Total	100.00			10.00	79.38	100.00

Calculations:

Column — Description

1 As generated MSW composition, also pounds out of 100 pounds as collected (from part b)

2 As collected Food Waste: column 1 x (1-HFG x FG)
where HFG = fraction of households with food grinders and
FG = fraction of FW that is ground
Yard waste not collected by yard waste collection program =
column 1 x (1 - fraction of YW generated collected by YW program)

3 Composition of recycled material

4 Amount diverted to recycling is (lb recycled/100 lbs generated) x column 3 / 100

5 Pounds of as collected MSW out of 100 pounds of as generated MSW:
FW and yard waste: column 2; recycled materials: column 1 - column 4;
everything else: column 1

6 As collected MSW % composition, assuming food grinding, yardwaste diversion, and drop-off center diversion, column 5 / sum(column 5)

The % diverted to recycling and composting is 100 - Sum column 5 - (FW column 1 - FW column 2)
= 19.9 %

The total amount of MSW collected each year is the total amount generated x fraction collected
= 100866 x 0.79383 = 80070

Per person / day as collected = est. total waste collected in year / number of people / days in year
= 80070 x 2000/ 95,000 / 365
= 4.6 lbs/person/day