TRASFER STATIONS

Factors for designing of Transfer Stations :-

1. Type of transfer operation
2. Capacity requirement
3. Equipment and accessory requirement
4. Environmental Requirement

Type of trasfer :

1) Direct discharge
2) Storage Discharge
3) Combined direct and storage discharge

Self loading-compactor,

$$\text{operating Cost} = \frac{\$40}{60} = \$0.67/hr$$

$$\text{Operating cost} = (0.67/hr) / \frac{(600 \times 30)}{2240}$$

$$= \$0.0829 / ton \cdot min$$

Tractor semitrailer transport,

$$\text{operating cost} = \frac{\$60}{60} = \$1/hr$$

$$\text{operating cost} = \frac{1}{(105 \times 325)/2240}$$

$$= 0.066 / ton \cdot min$$

Fixed cost for

$$\$(3.25 + 0.4)/ton = \$3.65/ton$$

27.8	~~34.9~~ 35
5.94	7.48
41.52	52.25
0.57	0.71
0.11	0.14
3.52	4.43
79.46	100

2011-12

wet mass	Dry mass	C	H	O	N	S	Ash
100	57.4	25.34	3.87	23.83	0.63	0.13	3.61

~~% by wt~~

C	25.34	25.34
H	3.87	8.60 %
O	23.83	61.70 %
N	0.63	0.63 %
S	0.13	0.13 %
Ash	3.61	3.61
		100.01

$$\text{Btu per lb} = 145C + 610\left(H_2 - \frac{O_2}{8}\right) + 40S + 10N$$

$$\text{kJ per kg} = 337C + 1428(H - O/2) + 95S$$

2) $\sum_{j=1}^{3} x_{ij} < D_j \quad j = 1 \text{ to } 3$

The total amount of waste hauled from tranfer station must be equal to or less than total ~~amount~~ capacity of disposal sites.

$x_{ij} \geq 0$

The amount of waste hauled from transfer station must be equal to or greater than zero.

Processing Technique

Types of waste
- source seperated
- Comingled

Way of seperation of waste

- Manual: (Primarily for seperation at source)
- Manual and Mechanical:

(at separating facilities:

Material Recovery facility, (MRF)

Transfer Facility (TF)

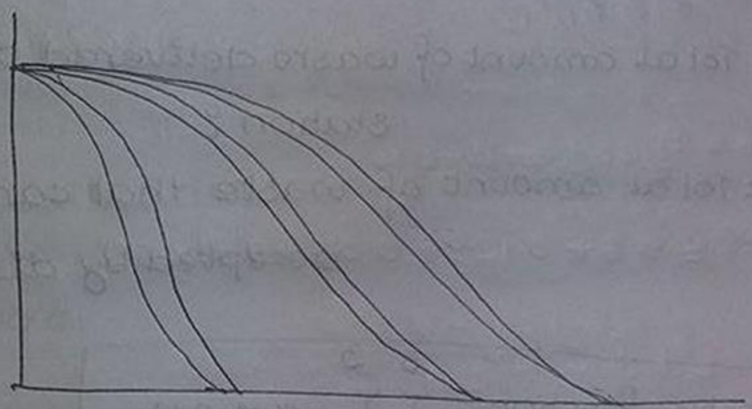
Material Recovery facility for source seperated sources:

1) Paper and cardboard from mixed paper and cardboard
2) aluminium from aluminium and tin cans
3) Plastics by class from comingled plastics
4)

MRF's for comingled waste

- All types of co-mingled materials
- Sophistication depends on number and types of components to be seperated

size reduction



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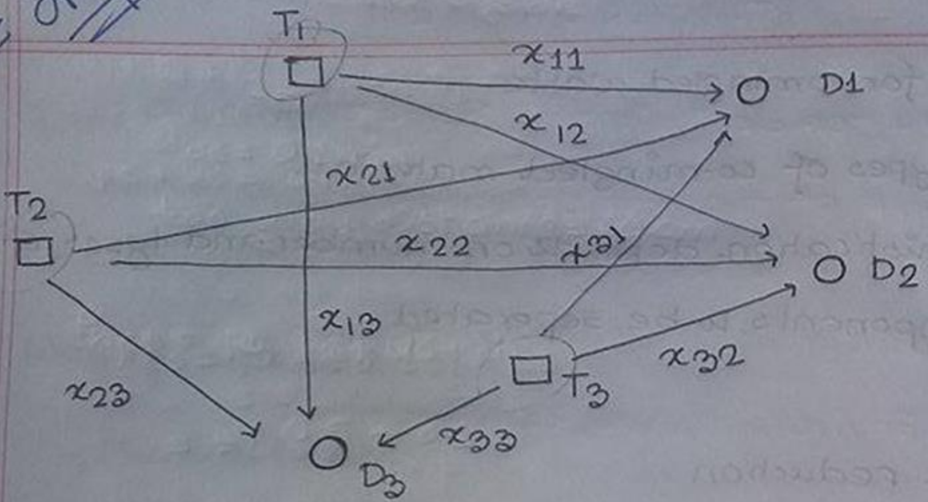


R_i = Total amount of waste delivered to transfer station i

D_j = Total amount of waste that can be accepted by disposal site j.

$$\text{Objective function} = \sum_{j=1}^{3} \sum_{i=1}^{3} x_{ij} c_{ij}$$

$$\sum_{j=1}^{3} x_{ij} = R_i \qquad i = 1 \text{ to } 3$$

1) The amount of waste hauled to disposal site must be equal to amount brought to transfer station — 1st constraint.

2013-14

2(b)

Raw produce

processed product = 12T

waste fed to cattle = 2.2T

waste disposed = 0.8T

Cans

stored for future use = 4T

damaged cans = (5-4)×0.05 = 0.05T

used to package product = 1×0.97 = 0.95T

Cartons

used for packaging product = (0.02 0.475T

damaged and recycled = 0.025T

Miscellaneous product

internal storage = 0.25×0.3 = 0.075

waste generated = 0.25×0.3 + 0.3×0.5×0.65

= 0.1725

recycled = 0.3×0.5×0.35

= 0.0525

waste produced

= 0.8 + 0.1725 =

0.9725T

Input = 20.8T

~~Output~~

stored 4 + 0.075

= 4.075

output = 15.~~2775~~ 7525

4.075 = 20.8 − 15.7525 −

Transfer station cost :

$$\text{Operating Cost} = \frac{0.40\ /m^3}{0.150/\text{tonne}}$$

$$= \boxed{\$2.67/\text{tonne}}$$

Unloading Cost,

$$\text{Operating Cost} = \frac{0.05}{0.15\text{tonne}/m^3}$$

$$= \$0.33/\text{tonne}$$

Fixed Cost for transfer and transport system :

$$\text{cost/tonne} = \$2.67 +$$

Static Container System

$t_1 + t_2 = 0.35 + 0.25$

$= 0.6h$

$$T_{scs} = \frac{(1-0.15)\,8 - 0.6}{N_d\,(2)}$$

$$N_d = \frac{}{}$$

$T_{scs} = 3.1$ hours/trip

$T_{scs} = P_{scs} + s + a + bx$

$\Rightarrow P_{scs} = 3.1 - [0.15 + 0.016 + 0.011 \times 50]$

$= 2.384$ hr/trip

$P_{scs} = C_t u_c + (N_p - 1) d_{bc}$

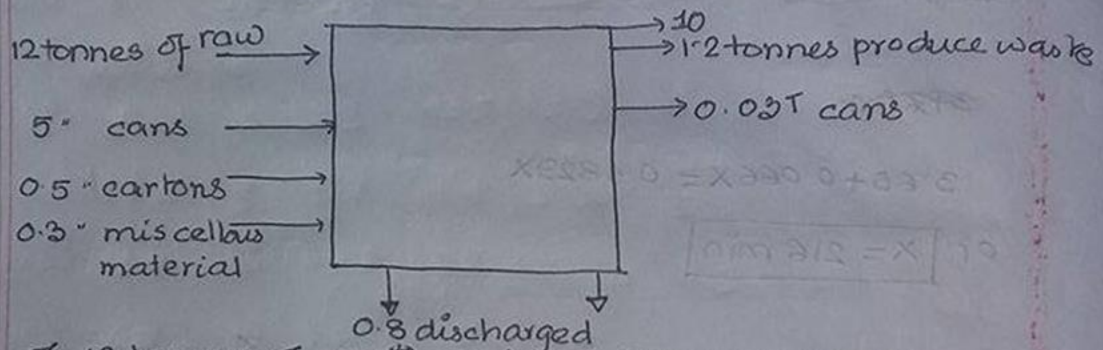
$2.384 = C_t \times 0.15 + (C_t/2 - 1) \times 0.15$

$C_t = 11$ containers/trip

$$C_t = \frac{V \times 02.5}{5 \times 0.70}$$

$V = 15.4 m^3$

$16 m^3$ or nearest standard size can be used.



// of 12 tonnes of raw produce, 10 becomes processed good, 1.2 tons end up as produce waste, which is used as feed to cattle and remainder to waste water plant

(ii) Four tons of cans are internally for future use (4)

remainder is used to package the packet

// About 3% of cans used as damaged

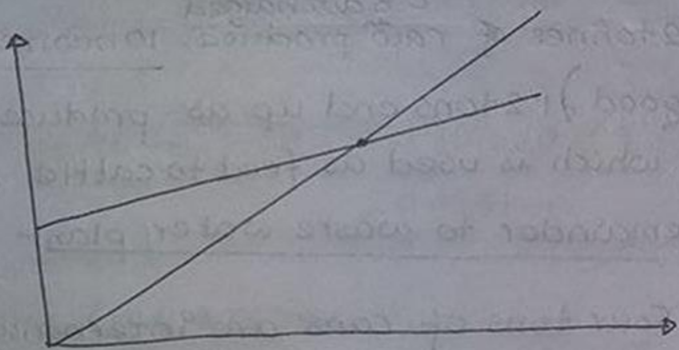
(5-4) tons × 0.3 = 0.03T

Used for production of packet

0.97 tons //

$$3.65 + 0.066X = 0.0829X$$

or $\boxed{X = 216 \text{ min}}$



Haul container System

$t_1 + t_2 = 0.75 \text{min}$

$d_{bc} = 0.1 \text{min}$

two way distance = 60km

$P_{hcs} = pc + uc + d_{bc}$

$= 0.5 + 0.1$

$= \boxed{0.6 \text{min}}$

$T_{hcs} = P_{hcs} + s + a + bx$

$= 0.6 + 0.129 + 0.016 + 0.11 \times 60$

$= 1.405 \text{ min}$

$$N_d = \frac{(1-0.15)\times 7 - 0.75}{1.405}$$

or, $N_d = 3.70$

$N_d = 3$

$$3 = \frac{(1-0.15)\times H - 0.75}{1.405}$$

$= 5.84 \approx 6 \text{ hour}$

$\frac{W-D}{W}$ = moistur content by wet weight

~~w(1+0.7)=9~~

$22 \times (1+0.6) =$

	wet	moisture %	dry wt	C	1.3	H		O	
Food waste	9	70	2.7	48	~~1.08~~	6.4	0.17	37.6	1.02
Paper	34	6	32	43.5	13.9	6	1.92	44	14.08
Cardboard	6	5	5.7	44	2.508	5.9	0.34	44.6	2.54
Plastics	7	2	6.86	60	4.12	7.2	0.5		
Textiles	2	10	1.8	55	1	6.6	0.12	22.8	1.56
Rubber	0.5	2	0.49	78	0.38	10	0.05	31.2	0.56
Leather	0.5	10	0.45	60	0.27	8	0.036	—	—
Yard waste	18.5	60	7.4	47.8	3.54	6	0.44	11.6	0.0522
wood	2	20	1.6	49.5	0.79	6	0.096	38	2.81
								42.7	0.68
	79.5	59	27.8				~~4.5~~ 3.66		23.3

	without water	with water	Molecular weight
C	27.8	27.8	12
H	3.66	5.94	2
O	23.3	41.52	16
N	0.57	0.57	14
S	0.11	0.11	32
		03.52	

0.

2~~28~~

v) Route should be laid in such a way that the last container to be collected on the route is located nearest to the disposal side.

vi) Wastes generated at traffic congested locations should be collected as early as possible in the day.

vii) Scattered pickup points that receive the same collection frequency, should, if possible, be serviced during one trip or on the same day.

viii) Sources at which extremely large quantities of wastes are generated should be serviced during first part of the day.

2012-13

~~operation cost for HCS~~ = $\frac{1875}{6 \times 225} \times 225$ = (kg) va.

$\frac{1875}{6m^3}$ / $1 m^3 \times$

Operational cost for HCS = $\frac{1875}{6 \times 225}$ = Tk. 1.388/kg

" " " SCS = $\frac{3000}{15 \times 325}$ = Tk. 0.615/kg

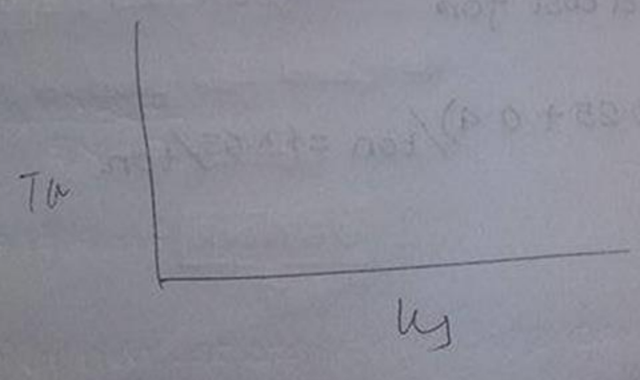
" " " Tractor semitrailor = $\frac{3500}{150 \times 80}$

= Tk. 0.292/kg

Fixedcost for operation of transfer station, $\frac{Tk. \ 30/m^3}{150 \ kg/m^3}$

= Tk 0.2/kg

F 4/



a. Stationary container system:

Operating cost = $20/h / 60$

$= 0.33/\text{min}$

Tonnes/load = $\dfrac{18 \times 325 \text{ kg/m}^3}{1000}$

= 5.85 tonnes

∴ Operating cost = $0.33 / 5.85$

$= \$0.0564/\text{tonne·min}$

ⓑ TTT.

Operating cost $\$25/60\text{min}$

$= 0.42/\text{min}$

tonnes/load = $\dfrac{120 \times 150}{100}$ = 18 tonne

$\dfrac{0.42}{18 \text{ tonne}} = \$0.023/\text{tonne·min}$

~~Material output = (10 +~~

(iii) Cartons,

The cartoons used for packing the canned product, except 3% that are damaged and subsequently seperated.

Damaged and recycled = 0.5 × 0.03
= 0.015

Cartons used in product = (0.5 − 0.015)
= 0.485 ton

(iv) 0.3 tons miscellaneous

✓ 25% → stored internally for future use
✓ 50% → becomes waste paper

[A. 35% is seperated for recycling
65% is discharged]

25% becomes mixture of solid waste

Amount stored = 0.25 × .3 ton = 0.075 ton

Paper seperated and recycled = 0.5 × 0.35 × 0.3 = 0.053

Mixed waste = [(0.3 − 0.075) − 0.053]
= 0.172 ton

No. of trips = no. of containers

2010 - 11

$t_1 + t_2 = \frac{15+20}{60} = 0.583 \text{ hr/trip}$

$P_C + U_C = 24 \text{ min.}$

$= 0.4 \text{ hr/trip}$

$P_{hcs} = 0.4 + 0.1$

$= 0.5 \text{ hr/trip}$

$T_{hcs} = 0.5 + \frac{8}{60} + 0.016 + 0.018 \times 31$

$= 1.207$

$= \frac{(8 - 1.25) - 0.583}{1.207}$

$= \boxed{5.1} \approx ⑤$

2011-12

3(b)

$t_1 + t_2 = \frac{15+25}{60} = 2/3$ ~~min~~ hour

$d_{bc} = 19/6$ hour

$P_{ncs} = (0.4 + 1/6)$ hr/trip

$= 0.567$ hr/trip

~~$P_{ncs} = 0.4$ hr/trip~~

$T_{ncs} =$ ~~0.44~~ $0.567 + 0.127 + 0.05 + 0.025 \times 40$

$= 1.744$ hr/trip

$$N_d = \frac{(1-0.15) \times 8 - 2/3}{1.744}$$

$= 3.52$ trips/day

Material stored

$= (4 + 0.075) = 4.075$

Material

Material output $= (10 + 0.97 + 0.485 + 1.2 +$

$0.03 + 0.015 + 0.53)$

Waste generation $= (0.8 +$

2011-12

2.ⓐ

$$T_{SCS} = \frac{(1-0.15)\times 8-(0.33+0.25)}{2}$$

$= 3.11 \text{ hr/trip}$

$T_{SCS} = P_{SCS} + S + a + bx$

$P_{SCS} = 3.11 - (0.1 + 0.034 + 0.018 \times 35 \times 2)$

$= 1.716 \text{ hr/trip}$

$P_{SCS} = C_t \times uc + (N_p - 1)\, dbc$

$= C_t \times 0.1 + (C_t/2 - 1) \times 0.1$

$C_t = 12.10$

≈ 12

$$12 = \frac{v \times 2.25}{4 \times 0.8}$$

$v = 17.1 m^3/\text{truck}$

Transfer and Transport

Determine break even time for a stationary container system and a seperate transfer and transport system for transporting wastes collected from a metropolitan area to a landfill disposal site. Assume following cost and system data are applicable:

1. Transportation costs:

   a. SCS using an $18 m^3$ compactor = \$20/h

   b. TTT " " with a capacity of $120 m^3$ = \$25/h

2. Other cost.

   Transfer station operating cost = \$0.40/m^3

   Extra cost for unloading for TTT = \$0.05/m^3

3. Density of waste in compactor = 325 kg/m^3

   Density of waste in transport units = 150 kg/m^3

N		S		Ash	
2.6	0.0702	0.4	0.0108	5	0.135
0.3	0.096	0.2	0.069	6	1.92
0.3	0.017	0.2	0.011	5	0.29
-	0	-	0	10	0.686
4.6	0.08	0.15	0.003	2.5	0.045
2	0.01	-	—	10	0.049
10	0.045	0.4	0.0018	10	0.045
3.4	0.25	0.3	0.02	4.5	0.33
0.2	0.00	0.1	0	1.5	0.02
	0.57		0.2078		3.52

without sulphur

2.32	2.32	
1.83	2.97	
1.46	0.91	
0.04	0.04	
003	0.003	0.1

75.94 = Total

$$t_1 + t_2 = \frac{15 + 20}{60}$$

$= 0.583$ ~~min~~ hr/trip

$$P_{hcs} = \frac{4 + 4 + 6}{60}$$

$= 0.233$ ~~min~~ hr/trip

$T_{hcs} = 0.004 + 0.015 \times 12 + 0.233 + 6/60$

$=$ ~~1.804 hr~~ 0.517 hr/trip

$$12 = \frac{(1-x) \times 8 - 0.583}{0.517}$$

~~1 − 0.85 = 1~~ $1 - x = 0.85$

or $\boxed{x = .15}$

∴ ~~cotte~~ management claims right.