APPENDIX 1

Chapter 4

Calculations of Coal Requirement (For Section 4.1.1):

I) Since 87.33 pct Fe_2O_3 contain in JSW dust after beneficiation, that means 87.33 g Fe_2O_3 (W_{io}) present in 100 g JSW dust.

So, carbon requirement (W_C) [as per eq. (4.2)]: $(\frac{36}{160} \text{ x } 87.33) = 19.65$ g

and coal requirement (W_{coal}) [as per eq. (4.3)]: $(\frac{100}{62} \text{ x } 19.65) = 31.69$ g

Therefore, stoichiometric ratio as per eq. (4.4): $\frac{W_{io} x\ 0.7}{W_C} = \frac{87.33\ x\ 0.7}{19.65} = 3.11$

Similarly,

II) Since 90.69 pct Fe_2O_3 contain in JSW sludge after beneficiation, that means 90.69 g Fe_2O_3 (W_{io}) present in 100 g JSW sludge.

So, carbon requirement (W_C) [as per eq. (4.2)]: 20.41g

and coal requirement (W_{coal}) [as per eq. (4.3)]: 32.91 g

Therefore, stoichiometric ratio as per eq. (4.4): $\frac{90.69\ x\ 0.7}{20.41} = 3.11$

III) Since 85.77pct Fe_2O_3 contain in VIZAG sludge after beneficiation, that means 85.77 g Fe_2O_3 (W_{io}) present in 100 g VIZAG sludge.

So, carbon requirement (W_C) [as per eq. (4.2)]: $0.225W_{io} = W_C$ g of carbon =19.3g

and coal requirement (W_{coal}) [as per eq. (4.3)]: $(\frac{100}{F_C} \text{ x } W_C) = 31.13$ g

Therefore, stoichiometric ratio as per eq. (4.4): $\frac{85.77\ x\ 0.7}{19.3} = 3.11$

Calculations of Fraction of Reduction (For Section 4.4):

→Sample calculation for JSW Dust:

Fe_2O_3 contain in JSW Dust = 87.33 pct

fore = 0.6935, ρ_{ore} = 0.8733, f_{coal} = 0.2198, f_{VM} = 0.17, f_O = 0.3

eq. (4.14): $f = [\frac{4 \text{ x } \{f_{wl} - (f_{coal} \text{ x } f_{vm})\}}{7\ x\ (f_{ore}\ x\ \rho_{ore}\ x\ f_O)}]$ $= f = [\frac{4 \text{ x } \{f_{wl} - (0.2198 \text{ x } 0.17)\}}{7\ x\ (0.6935\ x\ 0.8733\ x\ 0.3)}]$ =

$[\frac{4 \text{ x } \{f_{wl} - (0.037366)\}}{7\ x\ (0.18169)}]$

Chapter 5

Calculations of Iron Yield for JSW Dust (Section 5.6.1):

F_2 = Fraction of iron oxide present in JSW dust composite= 0.6935

F_3 = Fraction of Fe present in iron oxide (JSW dust) = 0.8733

F_5 = Fraction of Fe present in TMT rod = 0.983

Heat No.	**F_1(Initial Sample) Table 5.2**	**F_6 Final Sample) Table 5.3**
1	98.7	97.8
2	98.6	98
3	98.5	98.5
4	98.9	94.1

Sample Calculation:

$$Iron\ yield\ (\%) = \frac{(W_5\ x\ F_6)\ x\ 100}{\{[(W_1 - W_2)\ x\ F_1] + (W_3\ x\ F_2\ x\ F_3\ x\ F_4) + (W_4\ x\ F_5)\}}$$

For Heat No. 1:

$$Iron\ yield\ (\%) = \frac{(2.036x0.978)x100}{\{[(1.986-0.028)x0.987]+\left(\frac{0.1045x0.6935x0.8733x112}{160}\right)+(0.223x0.983)\}}$$

$$= \frac{(1.991)x100}{\{1.933+0.044+0.219\}} = 199.1/2.196 = 90.66$$

For Heat No. 2:

$$Iron\ yield\ (\%) = \frac{(1.984x0.98)x100}{\{[(1.94-0.056)x0.986]+\left(\frac{0.2154x0.6935x0.8733x112}{160}\right)+(0.03x0.983)\}}$$

$$= \frac{(1.944)x100}{\{1.858+0.0913+0.0295\}} = 194.4/1.979 = 98.23$$

For Heat No. 3:

$$Iron\ yield\ (\%) = \frac{(1.965x0.985)x100}{\{[(1.696-0.087)x0.985]+\left(\frac{0.2993x0.6935x0.8733x112}{160}\right)+(0.344x0.983)\}}$$

$$= \frac{(1.936)x100}{\{1.585+0.1269+0.338\}} = 193.6/2.05 = 94.44$$

For Heat No. 4:

$$Iron\ yield\ (\%) = \frac{(2.0x0.941)x100}{\{[(1.38-0.062)x0.989]+\left(\frac{0.344x0.6935x0.8733x112}{160}\right)+(0.711x0.983)\}}$$

$$= \frac{(1.882)x100}{\{1.304+0.1458+0.699\}} = 188.2/2.149 = 87.58$$

Calculation of Iron yield for JSW Sludge (Section 5.6.2):

F_2 = Fraction of iron oxide present in JSW sludge composite= 0.7122

F_3 = Fraction of iron oxide (JSW sludge) = 0.9069

F_5 = Fraction of Fe present in TMT rod = 0.983

Heat No.	F_1(Initial Sample) Table 5.2	F_6 Final Sample) Table 5.3
5	98.3	0.971
6	99	0.978
7	98.5	0.978
8	98.7	0.965

Sample Calculation:

$$Iron\ yield\ (\%) = \frac{(W_5\ x\ F_6)\ x\ 100}{\{[(W_1 - W_2)\ x\ F_1] + (W_3\ x\ F_2\ x\ F_3\ x\ F_4) + (W_4\ x\ F_5)\}}$$

For Heat No. 5

$$Iron\ yield\ (\%) = \frac{(2.046x0.971)x100}{\{[(1.99 - 0.016)x0.983] + (0.105x0.7122x0.9069x112/160) + (0.130x0.983)\}}$$

$$= \frac{(1.987)x100}{\{1.94 + 0.047 + 0.128\}}$$

$$= \frac{(1.987)x100}{2.115} = 93.95\%$$

For Heat No. 6

$$Iron\ yield\ (\%) = \frac{(2.0x0.978)x100}{\{[(1.906 - 0.034)x0.99] + (0.216x0.7122x0.9069x112/160) + (0.125x0.983)\}}$$

$$= \frac{(1.956)x100}{\{1.853 + 0.098 + 0.123\}}$$

$$= \frac{(1.956)x100}{2.074} = 94.31\%$$

For Heat No. 7

$$Iron\ yield\ (\%) = \frac{(2.333x0.978)x100}{\{[(1.89 - 0.052)x0.985] + (0.333x0.7122x0.9069x112/160) + (0.420x0.983)\}}$$

$$= \frac{(2.282)x100}{\{1.810 + 0.151 + 0.413\}}$$

$$= \frac{(2.282)x100}{2.374} = 96.12\%$$

For Heat No. 8

$$Iron\ yield\ (\%) = \frac{(1.643x0.965)x100}{\{[(1.38 - 0.039)x0.987] + (0.344x0.7122x0.9069x112/160) + (0.256x0.983)\}}$$

$$= \frac{(1.585)x100}{\{1.324 + 0.156 + 0.252\}}$$

$$= \frac{(1.585)x100}{1.732} = 91.51\%$$

Calculations of Iron Yield for VIZAG Sludge **(Section 5.6.3):**

F_2 = Fraction of iron oxide present in VIZAG sludge composite= 0.7086

F_3 = Fraction of Fe present in iron oxide (VIZAG sludge) = 0.8577

Heat No.	**F_1(Initial Sample) Table 5.2**	**F_6 Final Sample) Table 5.3**
9	0.987	0.977
10	0.99	0.98
11	0.972	0.971
12	0.989	0.969

Sample Calculation:

$$Iron\ yield\ (\%) = \frac{(W_5\ x\ F_6)\ x\ 100}{\{[(W_1 - W_2)\ x\ F_1] + (W_3\ x\ F_2\ x\ F_3\ x\ F_4) + (W_4\ x\ F_5)\}}$$

For Heat No. ~~2~~ 9

$$Iron\ yield\ (\%) = \frac{(2.88x.977)x100}{\{[(2.452)x0.987] + (0.131x0.7086x0.8577\ x112/160) + (\ 0.510x\ 0.983)\}}$$

$$= \frac{(2.814)x100}{\{2.42\ +0.056+0.501\}} = \frac{(2.814)x100}{2.977} = 94.52\%$$

For Heat No. 10

$$Iron\ yield\ (\%) = \frac{(2.231x.98)x100}{\{[(2.358)x0.99] + (0.3225x0.7086x0.8577\ x112/160) + (\ 0.20x\ 0.983)\}}$$

$$= \frac{(2.186)x100}{\{2.334\ +0.137+0.197\}} = \frac{(2.186)x100}{2.668} = 81.93\%$$

For Heat No. 11

$$Iron\ yield\ (\%) = \frac{(2.608x0.971)x100}{\{[(1.832)x0.972] + (0.332x0.7086x0.8577\ x112/160) + (\ 0.664x\ 0.983)\}}$$

$$= \frac{(2.532)x100}{\{1.781\ +0.141+0.653\}} = \frac{(2.532)x100}{2.575} = 98.33\%$$

For Heat No. 12

$$Iron\ yield\ (\%) = \frac{(1.743x0.969)x100}{\{[(1.307)x0.989] + (0.342x0.7086x0.8577\ x112/160) + (\ 0.383x\ 0.983)\}}$$

$$= \frac{(1.689)x100}{\{1.293\ +0.145+0.376\}} = \frac{(1.689)x100}{1.814} = 93.11\%$$