SHUBHAM GUPTA
180749

MID SEM EXAM

		D_{pi}, mm.	x_i	$x_i \times 100$	$\frac{x_i}{D_{pi}}$	$\frac{x_i}{D_{pi}^2}$
1)	4/6	4.013	3.1		0.0077	0
	6/8	2.843	10.3	3.3	0.036	0.0116
	8/10	2.007	20	8.2	0.1	0.041
	10/14	1.407	18.6	11.2	0.132	0.08
	14/20	1.001	15.2	12.3	0.152	0.123
	20/28	0.711	12	13	0.169	0.183
	28/35	0.503	9.5	11.5	0.189	0.388
	35/48	0.356	6.5	13.5	0.183	0.38
	48/65	0.252	4.3	8.5	0.171	0.337
	-65		0.5		0.028	
	65/100	0.178		6.2	0	0.348
	100/150	0.126		4	0	0.317
	-150			0.3		0.054
					1.168	2.24

Rittinger law: $\frac{P}{\dot{m}} = k_R \left(\frac{1}{\bar{D}_{VSP}} - \frac{1}{\bar{D}_{VSF}} \right)$

2 inches = 50.8 mm = $\bar{D}_{VSF}$

$\frac{1}{\bar{D}_{VSP}} = \frac{1}{1.168\ mm} = 0.856$

$\frac{390\ kW/ton}{110\ ton/hr} = k_R \left(\frac{1}{0.856} - \frac{1}{50.8} \right)$

$\boxed{k_R = 3.087}$

now $\bar{D}_{VSP_2} = \frac{1}{2.24} = 0.446$

$P = 110 \times 3.087 \left(\frac{2.24}{} - \frac{1}{50.8} \right)$

$P = 751\ kW$ Total Power = 751 + 10 = 761 kW

2) $P = K_b m' \left(\frac{1}{\sqrt{D_{P_1}}} - \frac{1}{\sqrt{D_{P_f}}} \right)$

for 1st core, $P_1 = 5\ hp$

$D_{P_1} = 88\mu m = 88 \times 10^{-6}\ m$

$D_{P_f} = 500\mu m = 500 \times 10^{-6}\ m$

for 2nd core, $P_2 = ?$

$D_{P_1} = 125\mu m = 125 \times 10^{-6}\ m$

$D_{P_f} = 500\mu m = 500 \times 10^{-6}\ m$

also $m_2' = 1.5 m_1'$

$$\frac{P_1}{P_2} = \frac{K_b m_1' \left(\frac{1}{\sqrt{88 \times 10^{-6}}} - \frac{1}{\sqrt{500 \times 10^{-6}}} \right)}{K_b 1.5 m_1' \left(\frac{1}{\sqrt{125 \times 10^{-6}}} - \frac{1}{\sqrt{500 \times 10^{-6}}} \right)}$$

$$\frac{5}{P_2} = \frac{1.38}{1.5}$$

$$\boxed{P_2 = 5.43\ hp}$$

The motor is insufficient to operate the grinder

3)

	D_i mm	x_{if}	x_{ip}	$\frac{x_{if}}{D_i}$	$\frac{x_{ip}}{D_i}$	N_{ss}
6/8	2.845	0.14		0.049	0	1
8/10	2.007	0.21		0.105	0	1
10/14	1.407	0.23		0.163	0	1
14/20	1.001	0.19	0.1	0.19	0.1	1
20/28	0.711	0.12	0.23	0.169	0.323	1
28/35	0.503	0.07	0.28	0.14	0.56	1
35/48	0.356	0.04	0.15	0.112	0.42	1
48/65	0.252		0.1	0	0.4	1
65/100	0.178		0.07	0	0.4	1
100/150	0.126		0.04	0	0.32	1
150/200	0.089		0.03	0	0.34	1
				0.928	2.863	

$S_p = 2.65$

surface area of feed $= \frac{6}{S_p}(9.28)$

$= 21.01 \text{ cm}^2/\text{g}$

surface area of prod $= \frac{6}{S_p}(28.63)$

$= 64.82 \text{ cm}^2/\text{g}$

new surface created $= 64.82 - 21.01$

$= 43.81 \text{ cm}^2/\text{g}$

new surface for feed $= 43.81 \times \frac{9000}{3600} \times 1000$

$= 109525 \text{ cm}^2$

work done $= \frac{109525}{17.51 \times 76.2 \times 100} = 0.82 \text{ hp}$

efficiency of grinder = 10%.

input power = $\frac{0.82}{0.1}$ = 8.2 H.P.

annual power cost = $\frac{8.2 \times 24 \times 300}{1.341} \times 3$

= Rs 1,32,080.5

maintenance = 0.5 × annual power cost

= Rs 66,040.25

purchase cost = Rs 2,40,000

life = 8 yrs

annual depreciation = 30,000

total annual cost = 1,32,080.5
+ 66,040.25
+ 30,000
= 2,28,120.75 Rs

Ore processed per year = 9 × 24 × 300
= 64800 tonnes

processing cost per tonne = $\frac{2,28,120.75}{64800}$

= Rs 3.52

4) $P_v = \frac{\beta_s g}{k_b}\left(1 - e^{-k_b H}\right)$

$\beta_s = 600\ kg/m^3 \qquad g = 10\ m/s^2$

$k_b = \frac{4k'\mu'}{D} \qquad k' = \frac{1 - \mu_i \alpha_i}{1 + \mu_i \alpha_i}$

$H = 18\ m$

$\mu_i = 0.577$

$\alpha_i = 35°$

$k' = \frac{1 - \mu_i 35°}{1 + \mu_i 35°} = 0.221$

$k' = 0.4$

$k_b = \frac{4 \times 0.4 \times 0.577}{5} = 0.1846$

$P_v = \frac{600 \times 10}{0.1846}\left(1 - e^{-0.1846 \times 18}\right)$

$P_v = 32432.43\left(1 - 0.036\right)$

$= 31264.86\ Pa$

$P_L = P_v k' = 31264.86 \times 0.4 = 12505.94\ Pa$