Pre - Feasibility Report on Chalk

Process Technology Developed

by

INDEXTB

in association with
INDIAN BUREAU OF MINES
Government of India

INDEXTB
Industrial Extension Bureau
(A Govt. of Gujarat Organisation)
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REORT OF INVESTIGATION
NO. IBM/AJM/RI ....... 280

PRE-FEASIBILITY REPORT ON CHALK SAMPLE FROM
GUJARAT

(For Industrial Extension Bureau, Gujarat)

By

M.S.RAO, A.T.SUTAONE, S.C.TALUJA, P.N.DEO &
K.S.RAJU

INTRODUCTION

Indian Bureau of Mines (IBM), Govt. of India, Ministry of Steel & Mines and
Industrial Extension Bureau (inDEXTb), a Government of Gujarat organisation, had signed
the Memorandum of Undertaking (MOU) for conducting the laboratory scale and Pilot scale
beneficiation studies on chalk, clay and silica sand samples. After completion of laboratory
scale and pilot scale studies, the techno economical feasibility report was also to be prepared
on these three minerals separately.

IBM had conducted the laboratory scale investigation on two chalk samples (IBM RI
No. 1240 and 1250) from Adityana Mines, Porbandar dist., Gujarat and one pilot scale
beneficiation studies on chalk sample No. II (IBM RI No. 1250) vide IBM RI No. 1316.
The pilot scale beneficaiton studies were conducted with the following three routes and
each route comprises of the following unit operations:

Route No. I :

Circuit : Scrubbing, classification and multi-stage Hydrocyclone.

Route No. II :

Circuit : Scrubbing, classification and flotation with two cleanings.

Route No. III :

Circuit : Scrubbing, classification and Wet High Intensity Magnetic
Separation (WHIMS).
The salient results of these three routes are as follows:

### SCRUBBING FOLLOWED BY CLASSIFICATION

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Wt%</th>
<th>ASSAY %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CaO</td>
</tr>
<tr>
<td>+12 mm (Trommel oversize)</td>
<td>2.7</td>
<td>46.26</td>
</tr>
<tr>
<td>CL U/F</td>
<td>19.3</td>
<td>43.61</td>
</tr>
<tr>
<td>CL. O/F</td>
<td>78.0</td>
<td>47.34</td>
</tr>
<tr>
<td>Head (Calc)</td>
<td>100.0</td>
<td>46.59</td>
</tr>
</tbody>
</table>

**ROUTE No. I : Feed Classifier Overflow with three sage Hydrocycloning**

<table>
<thead>
<tr>
<th>Product</th>
<th>Wt %</th>
<th>Overall Wt %</th>
<th>ASSAY %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CaO</td>
<td>SiO2</td>
</tr>
<tr>
<td>Cy. O/F</td>
<td>50.0</td>
<td>39.0</td>
<td>49.62</td>
</tr>
<tr>
<td>Cy. U/F</td>
<td>50.0</td>
<td>39.0</td>
<td>45.06</td>
</tr>
<tr>
<td>Head (Calc)</td>
<td>100.0</td>
<td>78.0</td>
<td>47.34</td>
</tr>
</tbody>
</table>

**ROUTE No. II : WHIMS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Wt %</th>
<th>Overall Wt %</th>
<th>ASSAY %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CaO</td>
<td>SiO2</td>
</tr>
<tr>
<td>Mag</td>
<td>9.9</td>
<td>7.7</td>
<td>45.84</td>
</tr>
<tr>
<td>Non-Mag</td>
<td>90.1</td>
<td>70.3</td>
<td>47.68</td>
</tr>
<tr>
<td>Head (Calc)</td>
<td>100.0</td>
<td>78.0</td>
<td>47.50</td>
</tr>
</tbody>
</table>

**ROUTE No. III : FLOTATION WITH TWO CLEANINGS**

<table>
<thead>
<tr>
<th>Step</th>
<th>Product</th>
<th>Wt %</th>
<th>ASSAY %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>CaO</td>
</tr>
<tr>
<td>1.</td>
<td>IIInd Cl. Conc.</td>
<td>43.1</td>
<td>33.6</td>
</tr>
<tr>
<td>2.</td>
<td>IIInd Cl. Tail.</td>
<td>8.6</td>
<td>6.7</td>
</tr>
<tr>
<td>3.</td>
<td>1st Cl. Tail</td>
<td>14.1</td>
<td>11.0</td>
</tr>
<tr>
<td>4.</td>
<td>Rougher Tail</td>
<td>34.2</td>
<td>26.7</td>
</tr>
<tr>
<td>Head (Calc)</td>
<td>100.0</td>
<td>78.0</td>
<td>47.16</td>
</tr>
<tr>
<td>Composite (1+2)</td>
<td>51.7</td>
<td>40.3</td>
<td>51.63</td>
</tr>
</tbody>
</table>

**1st Cl. Conc.**
PLANT DESIGN CRITERIA:

Plant Capacity - 100 TPD
Working shifts - 2
Working hours - 8
Plant Availability - 75%
Actual No. of working hours - 15 x 0.75 = 12

Design – TPH = 100
= 8.33 say 9.0
12

Process = No comminution is involved.

PROCESS ROUTE AND UNIT OPERATIONS:

1.0 Scrubbing → Classification → Hydrocycloning (3 stage) → Thickening → Filtration → Drying.

2.0 Scrubbing → Classification → Flotation with two cleanings → Thickening → Filtration → Drying.

**Scrubber**

: Locally made, fitted with trommel

1550 mm φ x 3000 mm L

**Trommel**

: 900 mm φ x 1200 mm L

**Weigh Feeder & Conveyor Belt**

**Spiral Classifier :**

<table>
<thead>
<tr>
<th>P.D.</th>
<th>-</th>
<th>20% solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesh of separation</td>
<td>-</td>
<td>325 mesh</td>
</tr>
<tr>
<td>Slope</td>
<td>-</td>
<td>3”</td>
</tr>
<tr>
<td>Feed TPD</td>
<td>-</td>
<td>100</td>
</tr>
</tbody>
</table>

1.57 TPD overflow/sq.ft. pool area (Table)

Total area required = 100
= 64 sq.ft.
1.57

60” classifier at 20% solids with 3” slope having sand raking capacity of 140 tonnes
Hydrocyclone – KREB

Feed - 7.01 TPH
Water - 30.83 M³/hr
Pulp - 37.84
% Solids - 18.5

Pulp Vol. = \frac{30.83 + \frac{7.01}{2}}{34.34} M³/hr

Sp. Gr. of pulp = \frac{W_t}{V} = \frac{37.84}{34.34} = 1.1

% Solids by Wt. = \frac{\% \text{ solids} \times \text{Sp. Gr. of pulp}}{\text{Sp. Gr. of Solids}} = \frac{18.5 \times 1.1}{2.0}

Cyclone overflow required 100% -325 mesh with minimum SiO₂

Thickener

Unit area = \frac{0.166 M²/tons/24²}{39}

Area required = 39 \times 0.166 = 6.47 M²

Thickener Area = \pi r² = 6.47

3.14 R² = 6.47

R² = 6.47

R = 1.44

D = 2.88 \text{ say } 2.9

Ht = 1.5 \times 2.9 = 4.35

Thickener size = 2.9 \phi \times 4.35 M

Thickener U/F = 40\% \text{ solids}
1. **Rougher Flotation**:

Lab flotation time = 5'

In plant retention time = 12.5'

Cu ft/min per ton of solids at Sp. Gr. of 2.7 = 3.02 (17% solids)

Total Cu ft/min to be handled = 2.82 x 7.01
= 19.77 cu ft/min

Retention time = 12.5'

Total volume = 19.77 x 12.5
= 247.12 Cu ft

Effective volume = 247.12

= 0.85
= 290.72 cu ft

Denver DR 50 cells required = 290.72

= 50 or say 6 cells

H.P. = 0.12 x 50 = 6

2. **1st Cleaner Flotation**:

Lab flotation time = 5'

In plant retention time = 12.5'

Cu ft/min per ton of solids at Sp. Gr. of 2.7 = 3.02 (16% solids)

Total Cu ft/min to be handled = 3.02 x 4.61
= 13.92

Total volume = 13.92 x 12.5
= 174 Cu ft

Effective volume = 174

= 217.5 Cu ft

0.8

Denver DR 50 Cells required = 217.5

= 4.35 or say 5 Cells

50 required

HP = 0.12 x 50 = 6
3. **11\textsuperscript{nd} Cleaner Flotation:**

Lab flotation time = 2' 

In plant retention time = 5' 

Cu ft/min per ton of solids = 3.24

Total Cu ft/min to be handled = $3.24 \times 3.62$

= 11.73 cu ft/min

Total volume = 11.73 x 5

= 58.65 Cu ft

Effective volume $= \frac{58.65}{0.8} = 73.31$ Cu ft

Denver DR 15 Cells required $= \frac{73.31}{15} = 4.88$ or say 5 Cells required

Rougher flotation volume $= 32.83 + \frac{7.01}{2.7}$

= 32.83 + 2.6

= 35.43 M$^3$

= 0.59 M$^3$/Min

= 20.81 Cu ft/min

= 260.12

= $\frac{260.12}{0.85}$

= 306.02
CONDITIONERS:

1. **Rougher flotation**

   Cu ft/min of pulp = 19.77

   Conditioning time = 5'

   Volume (cu ft) = 19.77 x 5
   = 98.85 cu ft

   Effective volume = _______ 0.85
   = 116.29 cu ft
   = __________ 35.28
   = 3.3 Cu M

   Volume = \( \frac{\pi D^2}{4} \)  \( H = \frac{\pi D^2}{4} \) (1.5 D)

   \( H = 2.1 \ M \)

   Volume = \( \frac{1.5 D^3 \pi}{4} \)

   3.3 = 1.177 \( D^3 \)

   \( D^3 = \frac{3.3}{1.177} = 2.80 \)

   \( D = 1.4 \) Meters

   = 1.4 M x 2.1 M

   Or 116.29 x 28.32 = 3,293.33 or say 4,000 litres
2. **1st Cleaner Flotation:**

Cu ft/min of pulp = 13.92
Conditioning time = 5'  
Volume (cu ft) = 13.92 x 5
= 69.6 cu ft
= 69.6
= 0.85
= 81.88 cu ft
= 81.88
= 35.28
= 2.32 Cu M

\[
1.177 \, D^3 = 2.32
\]
\[
D^3 = \frac{2.32}{1.177} = 1.97
\]

or D = 1.2 M  
H = 1.87 M

Volume 81.88 x 28.32 = 2,318.84 or say 2,400 litres

3. **11th Cleaner Flotation:**

Cu ft/min of pulp = 11.73
Conditioning time = 5'  
Total Volume (cu ft) = 11.73 x 5'
= 58.69 cu ft
= 58.69
= 0.85
69 cu ft

\[
\begin{align*}
69 &= \frac{\text{cu ft}}{35.28} \\
   &= 1.95 \text{ Cu M}
\end{align*}
\]

\[
\begin{align*}
1.95 &= 1.177 D^3 \\
D^3 &= 1.66 \\
D &= 1.2 \text{ M} \\
H &= 1.8 \text{ M}
\end{align*}
\]

Or Volume = 69 x 28.32 = 1954.08 or say 2,000 litres

SAND PUMPS (DENVER VERTICAL CENTRIFUGAL)

Pump No. 1

Rougher float

\[
\begin{align*}
4.61 \times 3.02 &= 13.92 \text{ cu ft/min} \\
13.92 \times 28.32 &= \text{To convert to gal/min} \\
&= \frac{\text{gal/min}}{3.85} \\
&= 102.39 \text{ gal/min}
\end{align*}
\]

50 mm pump, 1520 rpm, 7.5 HP (50' head)

Pump No. 2

Rougher Tails

\[
\begin{align*}
2.4 \times 2.22 &= 5.33 \text{ cu ft} \\
5.33 \times 28.32 &= \text{To convert to gal/min} \\
&= \frac{\text{gal/min}}{3.85} \\
&= 39.2 \text{ gal/min}
\end{align*}
\]

40 mm pump, 1570 rpm, 5.0 HP (50' head)
Sand Pump 3

First Cl. Float

= 3.62 x 3.24
= 11.73 cu ft/min

= 11.73 x 28.32
= --------------- gal/min
= 3.85

= 86.28 gal/min
50 mm pump, 1520 rpm, 7.5 HP (50’ head)

Sand Pump 4

First Cl. Tails

= 0.99 x 2.22
= 2.19 cu ft/min

= 2.19 x 28.32
= --------------- gal/min
= 3.85

= 16.11 gal/min
25 mm pump, 1624 rpm, 2.0 HP (40’ head)

Sand Pump 5

Second Cleaner Conc.

= 3.02 x 3.5
= 10.57 cu ft/min

= 10.57 x 28.32
= --------------- gal/min
= 3.85

= 177.75 gal/min
50 mm pump, 1520 rpm, 7.5 HP (40’ head)

Sand Pump 6

Second Cleaner Tails

= 0.61 x 2.0
= 1.22 cu ft/min

= 1.22 x 28.32
= --------------- gal/min
= 3.85

= 8.97 gal/min
25 mm pump, 1620 rpm, 2.0 HP (40’ head)
**Sand Pump 7**

- Tailing pump
  - $4 \times 2.1$
  - $8.4$ cu ft/min
  - $8.4 \times 28.32$
  - $238$ gal/min
  - $3.85$
  - $617.8$ gal/min
- 40 mm pump, 1570 rpm, 5.0 HP (50' head)

**LIST OF EQUIPMENT FOR 100 TPD CHALK PROCESSING PLANT**

**Route No. 1: Scrubbing, Classification and Hydrocycloning:**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Equipment</th>
<th>Qty.</th>
<th>Make</th>
<th>Size</th>
<th>H.P.</th>
<th>Approx. price (Rs. in lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ore Bin</td>
<td>1</td>
<td>Local</td>
<td>$50 \text{ M}^3$</td>
<td>--</td>
<td>2.0</td>
</tr>
<tr>
<td>2.</td>
<td>Conveyor Belt</td>
<td>1</td>
<td>Local</td>
<td>--</td>
<td>5</td>
<td>6.0</td>
</tr>
<tr>
<td>3.</td>
<td>Weigh Feeder</td>
<td>1</td>
<td>Local</td>
<td>--</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>4.</td>
<td>Scrubber</td>
<td>1</td>
<td>Local</td>
<td>$1500 \times 3000$ mm</td>
<td>5</td>
<td>12.0</td>
</tr>
<tr>
<td>5.</td>
<td>Classifier</td>
<td>1</td>
<td>Local</td>
<td>$60''$ Simplex</td>
<td>5</td>
<td>10.0</td>
</tr>
<tr>
<td>6.</td>
<td>Hydrocyclone</td>
<td>3</td>
<td>Kreb/Mozley</td>
<td>$1500 \text{ mm}$</td>
<td>15</td>
<td>15.0</td>
</tr>
<tr>
<td>7.</td>
<td>Slurry pumps</td>
<td>5</td>
<td>Local</td>
<td>$-\times25$</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Thickener</td>
<td>1</td>
<td>Local</td>
<td>$2.9\phi \times 4.35$ x $15.0$</td>
<td>15</td>
<td>4.0</td>
</tr>
<tr>
<td>9.</td>
<td>Filters</td>
<td>-</td>
<td>Local</td>
<td>$-\times15$</td>
<td>15</td>
<td>15.0</td>
</tr>
<tr>
<td>10.</td>
<td>Dryer</td>
<td>-</td>
<td>Local</td>
<td>$-\times5$</td>
<td>5</td>
<td>20.0</td>
</tr>
<tr>
<td>11.</td>
<td>Misc</td>
<td>-</td>
<td>Local</td>
<td>$-\times10$</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL** | 92 | 100.0 |
## ROUTE NO. II: SCRUBBING, CLASSIFICATION & FLOTATION

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Equipment</th>
<th>Qty.</th>
<th>Make</th>
<th>Size</th>
<th>H.P.</th>
<th>Approx. Price (Rs. in lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ore Bin</td>
<td>1</td>
<td>Local</td>
<td>50 M³</td>
<td>--</td>
<td>2.0</td>
</tr>
<tr>
<td>2</td>
<td>Conveyor Belt</td>
<td>1</td>
<td>Local</td>
<td>--</td>
<td>5</td>
<td>6.0</td>
</tr>
<tr>
<td>3</td>
<td>Weigh Feeder</td>
<td>1</td>
<td>Local</td>
<td>--</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>4</td>
<td>Scrubber</td>
<td>1</td>
<td>Local</td>
<td>1500 x 3000 mm</td>
<td>5</td>
<td>12.0</td>
</tr>
<tr>
<td>5</td>
<td>Classifier</td>
<td>1</td>
<td>Local</td>
<td>1500 mm Simplex</td>
<td>5</td>
<td>10.0</td>
</tr>
<tr>
<td>6</td>
<td>Sand Pump</td>
<td>6</td>
<td>Local</td>
<td>50, 40 &amp; 25 mm</td>
<td>30</td>
<td>6.0</td>
</tr>
<tr>
<td>7</td>
<td>Rougher Flotation Cell</td>
<td>6</td>
<td>Triveni</td>
<td>DR 50</td>
<td>36</td>
<td>6.0</td>
</tr>
<tr>
<td>8</td>
<td>1st Cleaner Cell</td>
<td>5</td>
<td>Triveni</td>
<td>DR 50</td>
<td>30</td>
<td>5.0</td>
</tr>
<tr>
<td>9</td>
<td>2nd Cleaner Cell</td>
<td>5</td>
<td>Triveni</td>
<td>DR 15</td>
<td>15</td>
<td>3.0</td>
</tr>
<tr>
<td>10</td>
<td>Conditioners</td>
<td>3</td>
<td>Triveni</td>
<td>4000 lit</td>
<td>15</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3000 lit</td>
<td>15</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2500 lit</td>
<td>15</td>
<td>2.0</td>
</tr>
<tr>
<td>11</td>
<td>Thickener</td>
<td>1</td>
<td>Local</td>
<td>2.9 x 4.35 x 15.0</td>
<td>15</td>
<td>4.0</td>
</tr>
<tr>
<td>12</td>
<td>Filter</td>
<td>1</td>
<td>Local</td>
<td></td>
<td>15</td>
<td>15.0</td>
</tr>
<tr>
<td>13</td>
<td>Dryer</td>
<td>1</td>
<td>Local</td>
<td></td>
<td>5</td>
<td>20.0</td>
</tr>
<tr>
<td>14</td>
<td>Misc.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>208</td>
<td><strong>106.00</strong></td>
</tr>
</tbody>
</table>
CRITERIA FOR CALCULATION OF OPERATING COST:

<table>
<thead>
<tr>
<th></th>
<th>ROUTE NO. I</th>
<th>ROUTE NO. II</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Electric Power kwh/t requirement</td>
<td>92 x 0.746</td>
<td>208 x 0.746</td>
</tr>
<tr>
<td></td>
<td>0.85 x 9</td>
<td>0.85 x 9</td>
</tr>
<tr>
<td></td>
<td>8.97 or 9.00</td>
<td>Say 10.0 kwh/t ROM</td>
</tr>
<tr>
<td></td>
<td>Say 21 kwh/t ROM</td>
<td></td>
</tr>
<tr>
<td>b) Water M³</td>
<td>5.0 M³</td>
<td>8.0 M³</td>
</tr>
<tr>
<td>50% water recirculation</td>
<td>2.5 M³ say 3.0 M³</td>
<td>4.0 M³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.0 M³</td>
</tr>
</tbody>
</table>

FIXED OPERATING COST:

1. Total Labour Cost:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>STANDBY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PLANT MANAGER</td>
<td></td>
</tr>
<tr>
<td>PA to Manager</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Clerk</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peon</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shift Incharge</td>
<td></td>
</tr>
<tr>
<td>Clerk</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peon</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supervisor</td>
<td></td>
</tr>
<tr>
<td>Clerk</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peon</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mechanic</td>
<td></td>
</tr>
<tr>
<td>Clerk</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peon</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrician</td>
<td></td>
</tr>
<tr>
<td>Clerk</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peon</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Helper</td>
<td></td>
</tr>
<tr>
<td>Clerk</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peon</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operator</td>
<td></td>
</tr>
<tr>
<td>Clerk</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peon</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

SALARY PER MONTH:

<table>
<thead>
<tr>
<th></th>
<th>Salary per annum = 1.5 x 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Manager</td>
<td>12,000/-</td>
</tr>
<tr>
<td>Shift Incharge</td>
<td>24,000/-</td>
</tr>
<tr>
<td>Supervisor</td>
<td>12,000/-</td>
</tr>
<tr>
<td>Operator</td>
<td>25,000/-</td>
</tr>
<tr>
<td>Helper</td>
<td>15,000/-</td>
</tr>
<tr>
<td>Mechanic</td>
<td>12,000/-</td>
</tr>
<tr>
<td>Electrician</td>
<td>12,000/-</td>
</tr>
<tr>
<td>P.A</td>
<td>4,500/-</td>
</tr>
<tr>
<td>Clerk</td>
<td>7,000/-</td>
</tr>
<tr>
<td>Driver</td>
<td>3,000/-</td>
</tr>
<tr>
<td>Peon</td>
<td>5,000/-</td>
</tr>
</tbody>
</table>

Total Labour Cost: 18,00,000/- (100 x 300)

Say Rs. 75/-
ESTIMATION OF CAPITAL COST (ROUTE No. 1):

1. Total Capital cost
   Rs. in Lakhs 100.00

2. Installation cost including electrical, piping, engine etc. (0.5 x 100)
   Rs. in Lakhs 50.00

3. Plant building cost (0.2 x 100)
   Rs. in Lakhs 20.00

4. Contingencies (0.15 x 100)
   Rs. in Lakhs 15.00

5. Tailing Ponds (0.1 x 100)
   Rs. in Lakhs 10.00

TOTAL Say 195.00

TOTAL 200.00

Capital Investments

1. Total Capital cost
   Rs. in Lakhs 180.00

2. Working Capital
   a) Stores & Spares
   Rs. in Lakhs 10.00
   b) Cash in hand
   Rs. in Lakhs 10.00

TOTAL 200.00

A. Direct Operating Cost

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>HEAD</th>
<th>UNIT</th>
<th>RATE (Rs./Unit)</th>
<th>Qty.</th>
<th>COST Rs./t of ROM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Water</td>
<td>M3</td>
<td>5.0</td>
<td>3.0</td>
<td>15.0</td>
</tr>
<tr>
<td>2.</td>
<td>Power</td>
<td>Kwh</td>
<td>3.0</td>
<td>10.0</td>
<td>30.0</td>
</tr>
<tr>
<td>3.</td>
<td>Concentrate</td>
<td></td>
<td>5.0</td>
<td>1.0</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>handling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Royalty etc.</td>
<td></td>
<td>5.0</td>
<td>1.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

TOTAL 55.0
B. **Fixed Operating Cost : Per Tonne of ROM:**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>Rs. 75.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total labour cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Maintenance and spares: 2% 15% of</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depreciation : 10% capital cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Insurance etc. : 1%</td>
<td></td>
<td>Rs. 27.00</td>
</tr>
<tr>
<td>5</td>
<td>Extra (Misc.) : 2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Processing Cost Per Tonne of ROM:**

\[
A + B = \text{Rs. 55} + \text{Rs. 102} \\
= \text{Rs. 157} \text{ say Rs. 160}
\]

Production cost per tonne of conc. = \( \frac{160}{0.75} \)

(75% weight percent yield)

= Rs. 213 say Rs. 215

---

**ESTIMATION OF CAPITAL COST (ROUTE No. II)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Rs. in Lakhs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total Capital cost</td>
<td>106.00</td>
</tr>
<tr>
<td>2</td>
<td>Installation cost including electrical, piping, engine etc. (0.5 x 106)</td>
<td>53.00</td>
</tr>
<tr>
<td>3</td>
<td>Plant building cost (0.2 x 106)</td>
<td>21.00</td>
</tr>
<tr>
<td>4</td>
<td>Contingencies (0.15 x 106)</td>
<td>16.00</td>
</tr>
<tr>
<td>5</td>
<td>Tailing Ponds (0.1 x 106)</td>
<td>11.00</td>
</tr>
</tbody>
</table>

\[
\text{TOTAL} \quad \text{Say} \quad \text{207.00} \quad \text{210.00}
\]
Capital Investments

1. Total Capital cost  
   Rs. in Lakhs  
   210.00

2. Working Capital
   c) Stores & Spares (5%)  
      10.50
   d) Cash in hand (7.5%)  
      15.75
   TOTAL  
      236.25
      say 240.00

A. Direct Operating Cost

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>HEAD</th>
<th>UNIT</th>
<th>RATE (Rs./Unit)</th>
<th>Qty.</th>
<th>COST Rs./t of ROM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Water</td>
<td>M3</td>
<td>5.0</td>
<td>5</td>
<td>25.0</td>
</tr>
<tr>
<td>2.</td>
<td>Power</td>
<td>Kwh</td>
<td>3.0</td>
<td>21</td>
<td>63.0</td>
</tr>
<tr>
<td>3.</td>
<td>Concentrate handling</td>
<td>--</td>
<td>5.0</td>
<td>1.0</td>
<td>5.0</td>
</tr>
<tr>
<td>4.</td>
<td>Royalty etc</td>
<td></td>
<td>5.0</td>
<td>1.0</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>98.0</td>
</tr>
</tbody>
</table>

B. Fixed Operating Cost: Per Tonne of ROM:

1. Total labour cost  
   Rs. 75.0
2. Maintenance and spares : 2%  
   15% of capital
3. Depreciation : 10%  
   cost  
   Rs. 30.00
4. Insurance etc. : 1%  
   Extra (Misc.) : 2%  
   Rs. 105.00

Processing Cost Per Tonne of ROM:

A + B = Rs. 98 + Rs. 105 = Rs. 203 say Rs. 200/-

Production cost per tonne of conc. = 200
(75% weight percent yield)  
   = Rs. 384 say Rs. 390
WATER BALANCE:

ROUTE NO. 1

a) Water in:

1. Feed to Scrubber - 13.5 M³
2. Discharge end of Scrubber (Trommel) - 4.7 M³
3. Classifier feed - 16.9 M³
4. Cyclone feed (1st) - 2.0 M³
5. Cyclone feed (2nd) - 18.5 M³
6. Cyclone feed (3rd) - 16.0 M³

Total - 71.6 M³

b) Water in:

1. Screen O/S - 0.36 M³
2. Screen U/S - 3.91 M³
3. Cyclone O/F (1st) - 23.66 M³
4. Cyclone O/F (2nd) - 20.19 M³
5. Cyclone O/F (3rd) - 16.44 M³
6. Cyclone U/F - 7.04 M³

Total - 71.6 M³

Conveyor Belt:

400 mm Belt Width at 100 fpm belt speed has a capacity of about 42 TPH with 20 idlers. HP required = 5.0.

Rotary Drier:

1.61 M × 13 M. L/D = 8.

4 TPH of solids containing 25% moisture.
# 100 TPD CHALK PROCESSING PLANT
(Material Balance)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Products</th>
<th>Dry Wt. TPH</th>
<th>Water M³/hr</th>
<th>Pulp</th>
<th>P.D.</th>
<th>Wt %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Feed to scrubber</td>
<td>9.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100.00</td>
</tr>
<tr>
<td>2.</td>
<td>Water to scrubber + Trommel</td>
<td>9.00</td>
<td>18.20</td>
<td>27.20</td>
<td>33.10</td>
<td>100.00</td>
</tr>
<tr>
<td>3.</td>
<td>Trommel over size</td>
<td>0.25</td>
<td>0.10</td>
<td>0.37</td>
<td>67.60</td>
<td>2.70</td>
</tr>
<tr>
<td>4.</td>
<td>Trommel under size</td>
<td>8.75</td>
<td>18.10</td>
<td>26.85</td>
<td>32.60</td>
<td>97.30</td>
</tr>
<tr>
<td>5.</td>
<td>Feed to classifier</td>
<td>8.75</td>
<td>18.10</td>
<td>26.85</td>
<td>32.60</td>
<td>97.30</td>
</tr>
<tr>
<td>6.</td>
<td>Water to classifier</td>
<td>8.75</td>
<td>16.90</td>
<td>43.75</td>
<td>20.00</td>
<td>97.30</td>
</tr>
<tr>
<td>7.</td>
<td>Classifier underflow</td>
<td>1.74</td>
<td>4.17</td>
<td>5.91</td>
<td>29.20</td>
<td>19.30</td>
</tr>
<tr>
<td>8.</td>
<td>Classifier overflow</td>
<td>7.01</td>
<td>30.83</td>
<td>37.84</td>
<td>18.50</td>
<td>78.00</td>
</tr>
</tbody>
</table>

**A) MAGNETIC SEPARATION (WHIMS)**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Products</th>
<th>Dry Wt. TPH</th>
<th>Water M³/hr</th>
<th>Pulp</th>
<th>P.D.</th>
<th>Wt %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Feed to WHIMS</td>
<td>7.01</td>
<td>30.83</td>
<td>37.84</td>
<td>18.50</td>
<td>78.00</td>
</tr>
<tr>
<td>2.</td>
<td>Magnetic</td>
<td>0.09</td>
<td>0.23</td>
<td>0.32</td>
<td>28.10</td>
<td>1.00</td>
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<tr>
<td>3.</td>
<td>Non-magnetic</td>
<td>6.92</td>
<td>30.60</td>
<td>37.52</td>
<td>18.44</td>
<td>77.00</td>
</tr>
</tbody>
</table>

**B) HYDROCYCLONING**

1. **First Stage Cyclone**
   - Feed to Cyclone | 7.01 | 30.83 | 37.84 | 18.50 | 78.00 |
   - Water to Cyclone | 7.01 | 2.00 | 39.84 | 17.60 | 78.00 |
   - Cyclone underflow | 5.59 | 9.17 | 14.76 | 37.87 | 62.20 |
   - Cyclone overflow | 1.42 | 23.66 | 25.08 | 5.66 | 15.80 |

2. **Second Stage Cyclone**
   - Feed to cyclone | 5.59 | 9.17 | 14.76 | 37.87 | 62.20 |
   - Water to cyclone | 5.59 | 18.50 | 33.26 | 16.80 | 62.20 |
   - Cyclone underflow | 1.13 | 20.19 | 21.32 | 5.30 | 12.60 |
   - Cyclone overflow | 4.46 | 7.48 | 11.94 | 37.35 | 49.60 |

3. **Third Stage Cyclone**
   - Feed to cyclone | 4.46 | 7.48 | 11.94 | 37.35 | 49.60 |
   - Water to cyclone | 4.46 | 16.00 | 27.94 | 15.96 | 49.60 |
   - Cyclone underflow | 0.95 | 16.64 | 17.59 | 5.40 | 10.60 |
   - Cyclone overflow | 3.51 | 6.84 | 10.35 | 33.90 | 39.00 |

**C) FLOTATION**

- Feed, Classifier Overflow | 7.01 | 30.83 | 37.84 | 18.50 | 78.00 |
- Water to flotation cell | 7.01 | 2.00 | 39.84 | 17.60 | 78.00 |

**Rougher Flotation**

- Rougher float | 4.61 | 24.20 | 28.81 | 16.00 | 51.30 |
- Rougher tail | 2.40 | 8.63 | 11.03 | 21.70 | 26.70 |

**First Cleaning**

- Feed to Rougher float | 4.61 | 24.20 | 28.81 | 16.00 | 51.30 |
- First Cl. Float | 3.62 | 20.51 | 24.13 | 15.00 | 40.30 |
- First Cl. Tail | 0.99 | 3.69 | 4.68 | 21.10 | 11.00 |

**Second Cleaning**

- Feed to First Cl. Float | 3.62 | 20.51 | 24.13 | 15.00 | 40.30 |
- Second Cl. Float | 3.02 | 18.55 | 21.57 | 14.00 | 33.60 |
- Second Cl. Tail | 0.60 | 1.96 | 2.56 | 23.70 | 6.70 |