STATUS REPORT

ON

COMMERCIAL UTILIZATION

OF MARBLE SLURRY IN RAJASTHAN

Prepared by

MSME-Development Institute
Govt. of India, Ministry of Micro, Small & Medium Enterprises
22Godown Industrial Estate
JAIPUR – 302006 (Raj.)
Phone: 0141-2212098, 2213099, 2215847, 2210553
e-mail: dcdi-jaipur@dcmsme.gov.in
website: www.msmedijaipur.gov.in
1. INTRODUCTION

Rajasthan is known as mineral majestic State as it produces more than 50 types of mineral and rocks. The State is endowed with vast deposits of natural rocks known as “stones” in local parlance and a few important ones amongst them are Granite, Marble, Sandstone, Limestone, Slate and Quartzite. Perhaps, nowhere in the world social, economic and cultural fabric of the society is found to be so intimately ingrained with stone and stone based products as it is in Rajasthan State of India. The stone industries have not only provided occupation to large number of people but has also ignited the poetic expression of people of this State which is so vividly found expressed in varied colours and carving in various stone built monuments of the State.

The galaxy of the stone found in Rajasthan and its vide applicability has inspired many at home and outside. Marble – generally a white based elegant looking stone, geologically a thermally metamorphosed rocks belonging mainly to Precambrian rock formations of Rajasthan, spread over in 16 belts in 15 districts of the State is much sought after stone. The world famous Taj Mahal and Victoria Memorial are built of Marble produced from the Mines of Makrana (Rajasthan). Ten types of marble on the basis of colour variation have been identified which are Plain white, Panther white, white veined Plain Black, Black Zebra, Brown, Green, Pink Adanga, Pink and Grey (IS:1130-1969).

The ever increasing popularity of the marbles of Rajasthan, growing demand for finished and unfinished products, discovery of new marble deposits and growing private and public supports have led to a significant growth in Marble Industry of this State. As a result, number of marble quarries as well as marble processing units have significantly gone up mainly during last one decade. However, whereas there is significant growth in production of finished and unfinished marble products, there is also simultaneous rise in waste generation as well; thereby causing concern towards the deteriorating environmental quality. A wide spread need is being felt to make this industry environmentally sustainable.
2. **MARBLE INDUSTRY IN RAJASTHAN**

Marble Industry is now one of the most important industries in Rajasthan employing over 1 million people. The importance of the marble industry in Rajasthan can be illustrated by the following table:

<table>
<thead>
<tr>
<th>Availability</th>
<th>In districts of Nagaur, Udaipur, Banswara, Jaipur, Sirohi, Bhilwara, Ajmer, Bundi, Pali, Dungarpur, Chittorgarh, Jaisalmer and Sikar, Rajsamand, Alwar.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour &amp; Pattern</td>
<td>Snow white, Creamish white, White with grayish/ black bands and Wavy patterns, pink, pink bluish bands, green, yellow, black, multi-colour etc.</td>
</tr>
<tr>
<td>Number of mining leases</td>
<td>About 3660</td>
</tr>
<tr>
<td>Quarry Production in 2007-08</td>
<td>13684 million Tons</td>
</tr>
<tr>
<td>Geological Reserve</td>
<td>1144 million Tons</td>
</tr>
<tr>
<td>Slabs Processing Capacity</td>
<td>1000 million sq.ft.p.a.</td>
</tr>
<tr>
<td>Tile Processing Capacity</td>
<td>300 million sq.ft.p.a.</td>
</tr>
<tr>
<td>Export varieties</td>
<td>Snow white – very fine grained, green and pink. Indian green is highly priced and is the most desired marble in demand the world over.</td>
</tr>
<tr>
<td>Exports in 2009-10</td>
<td>Rs.1889 million</td>
</tr>
</tbody>
</table>

**Production Scenario**

**Quarrying Production:**

Rajasthan produces over 95% of the marble produced in India. The production figures of marble for the past few years are as given below:
### Production of Marble in Rajasthan during 2001 to 2007-08

<table>
<thead>
<tr>
<th>Year</th>
<th>Production (in tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001-02</td>
<td>6318</td>
</tr>
<tr>
<td>2002-03</td>
<td>7511</td>
</tr>
<tr>
<td>2003-04</td>
<td>8460</td>
</tr>
<tr>
<td>2004-05</td>
<td>9608</td>
</tr>
<tr>
<td>2005-06</td>
<td>1094</td>
</tr>
<tr>
<td>2006-07</td>
<td>12243</td>
</tr>
<tr>
<td>2007-08</td>
<td>13684</td>
</tr>
</tbody>
</table>

In the field of dimensional and decorative stones such as marble, granite, kotah stone (flaggy limestone), sandstone and slate, the State occupies a unique position by way of contributing more than 30% of the total value of minor minerals produced in the country. The stone industry employs about 4,00,000 people in Rajasthan alone.

About 3600 marble quarries are operational in Rajasthan. Most of the quarries in Rajasthan are not mechanized and the quarrying is done using traditional technologies. Only about 350 quarries are fully mechanized using wiresaw/ chainsaw technology.

**Processing Unit Production:**

There are over 1200 marble processing (gangsaw) units and 400 Automatic Tiling Plants (Block cutters) have been established in the State.

### Marble Processing Plants in Rajasthan

<table>
<thead>
<tr>
<th>Name of District</th>
<th>No. of Gangsaws</th>
<th>No. of Tiling Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Blades</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Up to 40</td>
<td>41-59</td>
</tr>
<tr>
<td></td>
<td>60-80</td>
<td>Above 80</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No. of Close Unit</td>
<td>No. of Tiling Block Cutters</td>
</tr>
<tr>
<td>1. Alwar</td>
<td>2 - 18 - 20</td>
<td>3</td>
</tr>
<tr>
<td>2. Abu Road</td>
<td>- - 16 - 16</td>
<td>3</td>
</tr>
<tr>
<td>3. Banswara</td>
<td>5 - 8 - 13</td>
<td>-</td>
</tr>
<tr>
<td>4. Chittorgarh</td>
<td>4 - 85 - 89</td>
<td>-</td>
</tr>
<tr>
<td>5. Dungapur</td>
<td>- - 5 - 5</td>
<td>-</td>
</tr>
</tbody>
</table>
3. MARBLE WASTE

Types of Waste generated

- Waste generated during Quarrying
- Waste generated during Processing

Various types of waste generated during Quarrying of marble are as follows:

a) Overburden
b) Side burden
c) Inter burden
d) Ungraded material
e) Undersize material

Percentage of Waste Generated

This dimensional stone industry has an extremely high percentage of waste generation. Solid marble waste, powder and slurry are the major sources of environmental degradation in the areas where marble quarries and marble processing units are located.

The marble waste generation varies widely from 30% by weight (in mechanized mines using wire saw cutting methods for extraction of marble blocks) to 65% by weight (at mines where manual mining is resorted to and the rocks are fractured).

Waste during quarrying by mechanized processes can be estimated at 30% to 40% of the production. The Conventional quarrying techniques of blasting leads to a waste percentage of 60% to 70% and lead to uncontrolled stripping of vegetation cover and subsequent soil erosion. Dust generated
during quarrying can also blanket surrounding areas leading to vegetation die-off and adversely affecting the fertility and quality of top soil.

However, since most of the quarries in India are ill equipped as far as mechanization is concerned, the percentage of marble waste, as generated during quarrying of marble blocks can be estimated at 60%. This waste includes odd blocks of various sizes and shapes, unwanted blocks and rock fragments produced during trimming and shaping of mined out blocks before dispatch to processing units.

**Quantum of quarrying waste produced with respect to method of production**

<table>
<thead>
<tr>
<th>Stage of Marble Industry</th>
<th>Type of marble waste</th>
<th>Nature of Marble Waste</th>
<th>With Mechanised mines &amp; Processing units using gan saw cutting machines</th>
<th>With mechanized mines using blasting</th>
<th>With semi mechanized mines using blasting</th>
<th>Weighted Average Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mining &amp; trimming upto the stage of dispatch to processing units</td>
<td>Mine waste</td>
<td>Odd shaped &amp; sized blocks &amp; fragments of various sizes (mine slurry not recoverable)</td>
<td>30%</td>
<td>55%</td>
<td>65%</td>
<td>50%</td>
</tr>
</tbody>
</table>

**Quality of waste generated**

- Marble Waste mainly comprises of the ‘Khandas’ (small irregular shaped pieces of marble) which chemical composition is essentially the same as that of Marble.

- Marble is recrystallised limestone and its main constituent is calcium carbonate (CaCO$_3$), Magnesium Carbonate (MgCO$_3$), lime (CaO) and MgO.

- Chemically the main impurities may be in the form of Silica (SiO$_2$), as free quartz or silicates; iron oxides as hematite (Fe$_2$O$_3$), Limonite; Manganese Oxide (MnO$_2$); Alumina (Al$_2$O$_3$) in the form of Aluminium Silicate; and Sulphur as FeS$_2$. 


• Minor impurities include quartz, chert, flint, hematite, limonite, graphite, mica, etc.

Quarrying waste Disposal practices

• The waste generated during the quarrying operations is mainly in the form of rock fragments (called “Khandas” in the common parlance).

• The Khandas generated by the quarries are usually dumped in empty pits in the forest area; thereby creating huge mounds of waste. There is absolutely no method of systematic disposal of waste in the quarrying areas.

• The waste & overburden is dumped on forestland. Roads, riverbeds, pasture lands & agricultural fields leading to widespread environmental degradation.

• There is no segregation of the overburden from the Khandas, thereby causing a loss of fertile top soil.

• The quarry operations express their inability in proper segregation and disposal of waste due to the small sizes of the quarries. Most of the quarries in the Rajsamand area are of 1 hectare size or less. The mines in Makrana area are one tenth of a hectare in size. Hence, no proper planning of the sites is realistically possible.

• However, a couple of quarry operators have properly segregated the quarrying waste and have performed plantation activities on the mounds.

• There is a severe health hazard to workers on account of dust and water pollution.

Indiscriminate quarrying of marble is being carried out and a lot of processing units are established resulting in tremendous increase in generation of stone waste in the form of mine waste, cutting waste and polish waste.
Various types of waste are generated during processing of marble are as follows:

a) Dressing Waste  
b) Cutting waste  
c) Polishing waste  

**Percentage of Waste Generated**

The slurry generated during *processing* can be estimated at about 10% of the total stone quarried (20% to 25% of the block as received from the quarries), and during polishing as 5% to 7%.

**Quantum of processing waste produced with respect to method of production**

<table>
<thead>
<tr>
<th>Stage of marble Industry</th>
<th>Type of marble waste</th>
<th>Nature of Marble Waste</th>
<th>With Mechanised Mines &amp; Processing units using Gangsaw Cutting Machines</th>
<th>With mechanised mines using blasing</th>
<th>With semi mechanised mines using blasting</th>
<th>Weighed Average Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Processing (Sawing of Blocks into slabs and Truing their Edges by Cutting)</td>
<td>Processing waste</td>
<td>Marble sludge &amp; slurry comprising of small fragment &amp; powder mixed with water.</td>
<td>10%</td>
<td>15%</td>
<td>18%</td>
<td>15%</td>
</tr>
<tr>
<td>2. Grinding &amp; Polishing</td>
<td>Polishing Waste</td>
<td>Marble Slurry comprising of fines of marble mixed with grinding &amp; polishing material in water.</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Quality of waste generated**

- Marble Slurry is a suspension of marble fines in water, generated during processing, polishing, etc.
• The chemical composition is 28 – 35% CaO, 10 – 114%, MgO, 1 – 2.5% R2O3, 15 -20% Acid insoluble and 35 – 40% Loss on ignition with traces of Titanium Oxide and Lead.

Chemical analysis of marble slurry waste from Gangsaw/ Circular Saw/ Block cutter Processing units installed at various places.

<table>
<thead>
<tr>
<th>Chemical Analysis</th>
<th>Jaipur</th>
<th>Ajmer</th>
<th>Chittorgarh</th>
<th>Udaipur</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO%</td>
<td>32.80</td>
<td>26.15</td>
<td>38.60</td>
<td>28.55</td>
</tr>
<tr>
<td>MgO%</td>
<td>10.80</td>
<td>14.18</td>
<td>6.90</td>
<td>14.75</td>
</tr>
<tr>
<td>R2O3%</td>
<td>2.65</td>
<td>2.65</td>
<td>0.85</td>
<td>1.05</td>
</tr>
<tr>
<td>Acid Insolubles %</td>
<td>14.38</td>
<td>23.55</td>
<td>16.80</td>
<td>17.49</td>
</tr>
<tr>
<td>Loss on Ignition %</td>
<td>39.35</td>
<td>33.50</td>
<td>36.75</td>
<td>37.70</td>
</tr>
<tr>
<td>Total</td>
<td>99.98</td>
<td>100.3</td>
<td>99.90</td>
<td>99.54</td>
</tr>
</tbody>
</table>

Chemical analysis of marble slurry waste from Saw/ Block cutter Polishing units installed at various places.

<table>
<thead>
<tr>
<th>Chemical Analysis</th>
<th>Chittorgarh</th>
<th>Udaipur</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO%</td>
<td>25.75</td>
<td>25.20</td>
</tr>
<tr>
<td>MgO%</td>
<td>12.80</td>
<td>15.20</td>
</tr>
<tr>
<td>R2O3%</td>
<td>12.45</td>
<td>2.78</td>
</tr>
<tr>
<td>Acid Insolubles %</td>
<td>16.15</td>
<td>14.42</td>
</tr>
<tr>
<td>Loss on Ignition %</td>
<td>35.74</td>
<td>33.57</td>
</tr>
<tr>
<td>Tio2 %</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>Pb %</td>
<td>6.96</td>
<td>8.82</td>
</tr>
<tr>
<td>Total</td>
<td>99.88</td>
<td>100.02</td>
</tr>
</tbody>
</table>

Processing Waste Disposal practices

• The wet slurry generated by the processing industries is generally diverted to a sedimentation tank. In almost90% of the industries, the settled slurry is pumped out in to adjacent agricultural lands and left to dry there.
• Some of the industries pump the slurry on to tankers and transport the slurry presumably for dumping in disposal sites earmarked by the government. However, most of them dump the slurry in vacant forest areas or on the road side.

• Some of the industries do employ a mud dehydration plant for recycling of water. The filtration plants installed employ flocculation agents for quick separation of water and slurry. They help in preservation of water to a great extent. However, they were found to be ineffective in reducing the volume of the waste to a large extent.

• There is no proper arrangement for collection of waste material in most of the processing units of marble.

• Except at few large processing units, segregation of waste is practically non-existent. The processing industry in Rajasthan mostly does not employ filter presses.

• In most of the cases there is contamination of polishing waste with the cutting waste (produced at circular raw and / or gangsaw).

• Large amount of marble slurry is discharged as a waste either to a vacant land or to a surface water source located in the vicinity of the units.

• Although land is identified or demarcated for dumping the waste by RIICO in the major industrial clusters, the polluting industries are not willing to pay the cost for transportation of the waste to the dumping site. Hence, they mostly buy a vacant plot adjacent to their plants and pump on the slurry to that vacant land.

• The transportation of slurry (if at all takes place) to dumping sites takes place in open tractor trolleys, which drip throughout the route.

• The transporters are paid a fixed amount per trip for transportation to the dumping site. The tractor drivers dump the slurry enroute to the dumping sites at any vacant land so as to reduce the distance and thereby cover more number of trips per day.
• There is not much awareness in the processing unit operators and local population about the utilisation of this valuable natural resource.

• The local associations in Udaipur and Chittorgarh are making serious efforts towards ensuring proper disposal of the slurry. The Udaipur Marble Association has tested a filter press for reduction of marble slurry volume produced by a company from Ahmedabad, but are not satisfied with its performance.

• There is no law to prevent the industries for dumping the waste in this haphazard manner. Slurry is not even identified as a hazardous waste by the Rajasthan Pollution Control Board.

• There is a lack of law enforcement in order to ensure dumping the waste at the dumping sites.

• The factories are spread out over a distance of about 20 kms on both sides of the national highway and roads in the Rajsamand and Udaipur belt. Hence, their distance from the dumping sites is considerably high. Moreover, the cost of transportation of slurry is differential for the nearer and the farther industries; thereby effecting their respective competitive cost. (In Chittor, where the industries have developed in a cluster, the problem is not so acute, since they have the same distance from the dumping sites and are willing to bear the fixed cost associated with the transportation of the slurry).

There is a general lack of seriousness towards effective disposal of the sludge and slurry to the identified/ specified site of disposal; for reasons like expenditure involved in handling the stone waste, remoteness of locations of the site of disposal, time and efforts involved in handling the waste material etc.
Quantum of Waste Generated

The estimated quantum of marble waste generated in Rajasthan during 1988-89 to 1996-97 has been put forward in the following table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Marble Production (As Blocks or Khandas)</th>
<th>Mine Waste</th>
<th>Processing Waste</th>
<th>Polishing Waste</th>
<th>Total Waste</th>
<th>Mined out Reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988-89</td>
<td>1093.60</td>
<td>1822.67</td>
<td>546.80</td>
<td>182.27</td>
<td>2551.73</td>
<td>3645.33</td>
</tr>
<tr>
<td>1989-90</td>
<td>1140.59</td>
<td>1900.98</td>
<td>570.30</td>
<td>190.10</td>
<td>2661.38</td>
<td>3801.97</td>
</tr>
<tr>
<td>1990-91</td>
<td>1442.72</td>
<td>2404.53</td>
<td>721.36</td>
<td>240.45</td>
<td>3366.35</td>
<td>4809.07</td>
</tr>
<tr>
<td>1991-92</td>
<td>1739.65</td>
<td>2899.42</td>
<td>869.83</td>
<td>289.94</td>
<td>4059.18</td>
<td>5798.83</td>
</tr>
<tr>
<td>1992-93</td>
<td>2050.26</td>
<td>3417.10</td>
<td>1025.13</td>
<td>341.71</td>
<td>4783.94</td>
<td>6834.20</td>
</tr>
<tr>
<td>1993-94</td>
<td>1875.40</td>
<td>3125.67</td>
<td>937.70</td>
<td>312.57</td>
<td>4375.93</td>
<td>6251.33</td>
</tr>
<tr>
<td>1994-95</td>
<td>2324.24</td>
<td>3873.73</td>
<td>1162.12</td>
<td>387.37</td>
<td>5423.23</td>
<td>7747.47</td>
</tr>
<tr>
<td>1995-96</td>
<td>3024.76</td>
<td>5041.27</td>
<td>1512.38</td>
<td>504.13</td>
<td>7057.77</td>
<td>10082.53</td>
</tr>
<tr>
<td>1996-97</td>
<td>3326.41</td>
<td>5544.02</td>
<td>1663.21</td>
<td>554.40</td>
<td>7761.62</td>
<td>11088.03</td>
</tr>
<tr>
<td>1997-98</td>
<td>3441.00</td>
<td>5735.00</td>
<td>1720.50</td>
<td>573.50</td>
<td>8029.00</td>
<td>11470.00</td>
</tr>
<tr>
<td>Total</td>
<td>21458.63</td>
<td>35764.38</td>
<td>10729.32</td>
<td>3576.44</td>
<td>50070.14</td>
<td>71528.77</td>
</tr>
</tbody>
</table>
4. ENVIRONMENTAL IMPACT

ENVIRONMENTAL IMPACT – AN EVALUATION

Environmental damage due to Slurry

The marble slurry generated during the processing of marble causes the following environmental damage:

- The porosity and permeability of the top soil is reduced tremendously and in due course of time it results in water logging problems at the surface and thereby not allowed the water to percolate down. When & where it has happened the ground water level had adversely been affected and it has gone down to deeper levels.

- The fine marble dust reduces the fertility of the soil by increasing its alkalinity.

- The waste thus dumped dries out and the fine marble dust suspends in the air and is slowly spread out through winds to the nearby area. It settles down on crops and vegetation, thus severely threatening the ecology of the marble clusters.

- When dumped along the catchment area of natural rain water, it results in contamination of overground water reservoirs and also causes drainage problem.

- It causes contamination of underground water resources.

- It cause respiratory ailments in the nearby residential areas.

- It has become a safety hazards on the highways along which it is dumped, due to its slippery nature when wet.

- It also has an adverse effect on the landscape beauty of the area.

The hazardous dumping practices in Rajasthan thus pose a severe threat on the environment, eco-system and the health of the people and has achieved mammoth proportions.

Environmental damage due to Quarrying & Trimming Waste

The Cutting waste produced during trimming of edges of the slabs, broken pieces, unsawable blocks, irregular and odd shaped blocks are lying scattered here and there in the mine area as well as in processing units.

The quarrying waste is just piled in the forest area by the miners, creating huge mounds of stone waste, thereby destroying the natural vegetation and ecology of the area.
The quarrying waste is even being dumped on seasonal river beds, thereby threatening the porosity of the aquifer zones. Quantum Of Marble Waste Generated

5. EXISTING MEASURES & INITIATIVES

In order to contain the damages to the Environment there are already many existing measures initiated by the Govt. of India and by the Govt. of Rajasthan. The following are the major relevant acts enacted by the Govt. of India.

- National Mineral Policy 1993 also contain provision for minimizing the adverse impact on Environment.

The Govt. of Rajasthan has also come out with modifications in Rajasthan Mines and Mineral Concession Rules 1986 (RS-MMCR) by incorporating provisions for management of the mineral waste.

There are number of enforcement agencies of the central and state Govt. for the enforcement of policies and legislation pertaining to the environmental safeguards. Besides there are number of NGOs such as Uparjal Paryavaran Samiti, Paryavaran Manch, Association of Geoenvironmentalists (AGE) are active in the field of Environmental Studies and conservation.

Shortcomings

There is no dearth of policies and initiatives in the field of environmental protection in the domain of mineral and mineral based industries. However, there are several shortcomings which hinder the execution and implementation of the above existing measures:

- Marble Slurry is not specified as a “Hazardous Waste” under the Hazardous Waste (management handling) Rules.
- The amendment on proper dumping within the quarry is not practicable as the sizes of the Quarries has been made smaller as per modified RMMCR.
- There is a lack of coordination among the various state and central govt. agencies.
• The stakeholders are their role has not been properly defined. There is no proper coordination and cooperation between the official of the enforcement Agencies and Entrepreneurs on the issue of the management of the Slurry.

6. **NEEDED INITIATIVES**

There is foremost need for reduction of the waste generation percentage at the processing and quarrying stage itself. The concept that the waste are not waste but possible resource need to be developed and technological effort be made towards Total Resource Utilisation (TRU).

It has been observed from the waste production scenario that mechanization lead to reduction in the waste as such following measures may substantially reduce the waste generation:

• Increased mechanization of the quarries.

• Systematic and scientific investigation of the quarry lease through core drilling, ultrasound scanning before opening the face of the mine.

• Training of the staff in Waste reduction Measures.

Introduction of Filter Presses at processing plants may lead to a substantial reduction in the water content of slurry, thereby reducing the volume of the slurry produced substantially.

All effort may be done to utilize the marble waste for various purposes. Some feasible uses are being given here below:

**Feasible Uses of Marble Waste**

It is essential to explore possible alternatives to arrive at *technically sound and financially viable technologies* to utilize marble slurry / powder / waste and also work out a framework for long term waste management in RIICO Industrial Areas.

**The areas where the utilization of marble waste and marble slurry needs to be explored as a substitute for conventional raw materials are as follows:**

1. **As a filler material for roads and embankments**

As marble dust is an inert material it can be mixed with certain types of soils for the preparation / raising of embankments etc. which will result in the saving of valuable soil. Central Road Research Institute (CRRI), New Delhi has carried out preliminary research on the utilization of marble dust in road sector.

• Unconfined Compressive Strength (UCS) have been performed to determine the strength of the mixes with soils and it has been observed that,
- In silty soil, there is 12 percent increase in UCS with 10% marble dust

- There is a 20% increase in UCS with 30% marble dust

- There is no improvement in clayey soil

- In concrete mixes there is a 15% increase in compressive strength when sand is mixed with 35% marble dust. There is an improvement in the density of the concrete as well. Preliminary tests show that marble dust can be easily mixed with silty and sandy soils and compaction of the mix would result in better strength of base layers over which water bound Macadem can be laid.

The preliminary results have been very encouraging and hence pilot level studies on this aspect need to be conducted.

2. For manufacture of bricks

Marble slurry is chemically dolomitic in nature and consists of very fine particles. Considering the phusico-chemical properties, it may be used as a fine aggregate in manufacturing bricks by using cement or lime as a binder. Central Brick Research Institute (CRRI), Roorkee has conducted research on this aspect. The results are very encouraging and the physical properties of the bricks produced by this process exceed those of normal bricks.

- The marble slurry-lime bricks were made in laboratory using, slurry, sand and hydrated lime, cured in a steam at normal pressure. It attained a strength of 50 – 60 kg / cm². (Since this process requires steam curing it may not be economically feasible).

- Marble slurry-cement bricks were made using slurry, sand and Portland cement in different proportions and moulded by vibro-compaction technique; cured in steam at normal pressure. It attained a compressive strength in the range of 80 to 120 kg / cm². Wet curing yields bricks with a compressive strength of 100 kg / cm².

The bricks thus produced have a perfect geometry, facilitating thin joints, resulting into high masonry strength to unit strength ratio and low mortar consumption.

A pilot plant level study of this possibility needs to be conducted.

3. Manufacture of Portland Cement

Cement grade limestone is the main raw material along with clay and other corrective materials for the manufacture of Portland cement. Analysis of marble waste shows that it satisfies the chemical composition requirements of cement grade limestone
to a great extent. As a part replacement of limestone, either marble waste and or a combination of along with limestone and or lime can be used.

4. Manufacture of Ceramic Tiles

A possibility of utilizing marble slurry as a raw material for production of Ceramic Wall tiles needs to be evaluated on a pilot plant level. A leading ceramic producer in the country has undertaken laboratory scale studies on this matter, which were reported to be highly successful.

5. Manufacture of Thermoset Resin Composites

The Macromolecular Research Centre at Jabalpur has conducted a short term programme with a view to explore the possibility of converting marble slurry into Resin Composites. The preliminary results have demonstrated the technical feasibility of such an option. However, a pilot plant level study need to be conducted.

6. Manufacture of lime

Limestone is the main raw material for the production of Lime. Limestone can be replaced by marble waste.

7. Manufacture of Activated Calcium Carbonate

Limestone or combination of marble waste and marble dust (from slurry) can be used on the production of activated or precipitated calcium carbonate.

8. Hollow Blocks and Wall Tiles

Marble slurry waste and other clay products can be used in the production of Hollow prefabricated blocks for buildings if used in the right proportion.

9. Manufacture of Ground Calcium Carbonate

Detailed feasibility analysis and pilot studies are needed to be conducted about the above.

Other Possible Uses of Marble Slurry / Marble Waste

Broadly speaking, marble slurry and marble waste, due to the high percentage of limestone in it can be used as a substitute for lime stone in most of its industrial and other applications. It can have predominantly one or more materials like calcite, dolomite or serpentine.

There is a possibility of the use of marble slurry in many more industries; mainly as a substitute for limestone in the following:
1. In production of synthetic agglomerated marble

2. In manufacture of glass

3. In chemical manufacture
   a) Lime manufacture
   b) Plastics manufacture
   c) As dilutents and carriers of pesticides
   d) In many other chemical processes as a substitute of limestone

4. Chemical and Industrial uses
   a) In iron and steel metallurgy as a substitute for limestone (as flux in the refining of metals, etc.)
   b) In non-ferrous metallurgy in the manufacture of magnesium and magnesia, uranium, alumina, nickel, tungsten, floatation of gold & silver.

5. As a neutralising agent and filler for paints, rubber etc.

6. As a concrete aggregate

7. As a railroad ballast

8. In the construction of dam spillways, docks, piers, and breakwaters in the form of irregular shaped fragments of sizes ranging from 25 – 30 cms.

9. As an Asphalt filler

10. As an insulation material in the rick wool insulation bats and pellets

11. As a mineral filler for putty and caulking compounds based on linseed oil or plastic.

12. As a mineral feed supplement for domestic animals

13. In waste water treatment

14. For de-sulfurising stack gases from utility and industrial plants that operate coal burning boilers.
15. In the treatment of Sewage sludge to quell obnoxious fumes

16. In filter beds as a screened mineral aggregate

The marble waste and marble slurry can be used as a substitute for limestone in various industrial applications. A table depicting the composition of marble waste, so as to be feasible as a raw-material input for the industries has been placed as Appendix-III.

The table clearly depicts that marble has to be treated before it can be substituted for limestone. This increases the cost of production and may not always be economically viable.

**Stakeholders Role & Responsibility**

The last but not the least important is the development of a Participatory Approach in the management of waste generation and conservation and protection of the environment. This can be achieved only if all the stakeholders are properly identified and tutored through a well co-ordinated workshop regarding their role and responsibility in the containment of waste generation and protection of the environment.
PROJECT PROFILE ON “MARBLE POWDER BRICKS”

PRODUCT CODE : 0 0 0 0 0 0 0 0 0

QUALITY STANDARD : The Bureau of Indian Standard has not published any I.S. Specification on this product. However, size of this product will be 9” x 4½” x 3” as per the consumers requirements.

PRODUCTION CAPACITY :

i) Qty : 42,00,000 pieces.

ii) Value: Rs.1,05,00,000/-

MONTH AND YEAR : August, 2011.

PREPARED BY :

MSME-DEVELOPMENT INSTITUTE
GOVERNMENT OF INDIA,
MINISTRY OF MICRO, SMALL AND MEDIUM ENTERPRISES
22 GODOWN, INDUSTRIAL ESTATE,
JAIPUR – 302006 (RAJASTHAN)
Phone : (0141)2212098, 2213099
Telefax : (0141) 2210553
E-mail : dcdi-jaipur@dcmsme.gov.in
Web-Site: www.msmedijaipur.gov.in
INTRODUCTION:

The ever increasing tempo of building activity makes stringent demand on building materials. For building of all types – Single, multistoried or high – rise for residences, schools, hospitals, commercial complexes offices and industries. This is obviously giving rise to the demand of building materials both in the rural as well as in urban areas and consequently the material like stone blocks, clay bricks are becoming more and more expensive. Any new method aimed at optimum use of resources and time resulting in economy in construction would be a welcome addition and Marble powder sand brick masonry is one such useful development in the building industry. Now the method has been developed for making building bricks by using Marble Waste/Thermal Power ash which pollutes the environments. This product is new and rapidly gain the popularity due to their very good properties in masonry construction, namely durability, strength, structural stability, low plaster cost, smooth surface as well as attractive appearance.

MARKET POTENTIAL:

Marble sand bricks is a new invention in the field of bricks manufacturing and is a best substitute for the ordinary building bricks. Marble sand bricks are used in all types of building construction work. This is cheaper and stronger in comparison to ordinary building bricks. This also has so many other advantages such as accurate dimension, less construction cost, consuming less mortar while plastering the surface or need not to be plastered even, pollution control etc.

Field investigations revealed that due to urbanization and increasing building construction activities the demand for this item is increasing fast. The basic raw-material i.e. Marble powder, Cement and River sand are easily available at cheaper rate. Therefore, there is good scope for setting up SSI units manufacturing marble Sand Bricks in the State of Rajasthan.

BASIS AND PRESUMPTION:

(1) This report is worked out on 75% efficiency utilization of its manufacturing building capacity and taken 300 days in a year on single shift basis of 6 hours per shift basis.

(2) Time period for achieving full/ envisages capacity with three years after production.

(3) Arrangement for labour wages has been considered as per minimum labour wages basis as per rule of Labour Department of Rajasthan State.
(4) Interest rate for fixed capital has been calculated @ 12% and for working capital @ 12% per annum.

(5) Margin Money/ State Subsidies has been calculated as per given by the Government of Rajasthan i.e. 20%.

(6) Pay back period of the project after one year from its production and repayment of fixed capital with three years.

(7) The cost of land has been calculated as per the Industrial Development & Investment Corporation of the State.

IMPLEMENTATION SCHEDULE:

Every project requires some specific time for its commercial product on and various schedules for its completion are as under :-

(1) Selection of Product:- First of all entrepreneurs should select his product for manufacturing within 15 to 30 days.

(2) After selection to obtain the registration from the Directorate of Industries and it will take about one to two weeks.

(3) After E.M. Part-I Registration then prepare Project Report self, through Industrial Consultant or through Govt. Departments like MSME-DI, RAJCON etc. within one week after collecting the quotations from machine suppliers and raw material suppliers, and then apply to financial organization like Rajasthan State Financial Corporation and Nationalised Banks. This financial exercise will take 3 to 5 months (approximately.

(4) After taking or sanction the loan from the above organization then construction of factory building is very important step and it will take another 6 to 8 months time and lesser too. In the meanwhile order should be placed to the machine manufacturer as well as raw materials suppliers.

(5) After that machine should be installed within a month time for production. Trial production should be over within one or two weeks time and finally commercial production in above mentioned period for its marketing.

In between machine installation labour should be recruited for manufacturing the product and contact to work for its end product and make the sweet & commercial relation with concerned person those are related with whole process for further smooth and profit oriented this product.
TECHNICAL ASPECTS:

Production Details and Process of Manufacture:

The bricks are made with marble powder 83%, river sand 10% and cement 7%. The sand and cement are mixed with the help of mixing machine, where the marble powder is also added. After thorough mixing, the material is fed to the hopper of brick moulding machine with the help of a belt Conveyer, where the mixture is shaped to bricks. These bricks are tough enough to be stacked. The bricks are then subjected to 7 – 10 days natural curing, where water is sprayed at intervals. The ratio of mixture can be varied as per requirement.

FINANCIAL ASPECTS:

1. Fixed Capital

   Land & Building

   Land 1500 Sq.M. @ Rs.250/- per Sq.M.
   Value in (Rs.) 3,75,000.00

   BUILT AREA

   Office, Stores, Work shed etc. 300 Sq.M.
   @ 1,500/- per Sq.M.
   ___________
   4,50,000.00
   8,25,000.00

MACHINERY & EQUIPMENT:

   a) Brickman Marble Powder
      Brick making machine with
      Conveyer & Mixer.
      1 No. 15,00,000.00

   b) Cost of tools/ other fixtures. - 1,00,000.00

   c) Cost of Office Equipments / furniture etc. - 1,00,000.00

   d) Electrification and installation charges
      @ 10% of cost of Machinery
      & Equipments.
      1,70,000.00

Total cost of Machinery & Equipments 18,70,000.00
3) PRE-OPERATIVE EXPENSES:

TOTAL FIXED CAPITAL 1 + 2 + 3

1) Land & Building 8,25,000.00
2) Machinery & Equipment 18,70,000.00
3) Pre-operative Expenses 1,00,000.00

27,95,000.00

WORKING CAPITAL PER MONTH:

i) Personnel:

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Designation</th>
<th>No.</th>
<th>Salary (Rs.)</th>
<th>Total (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Manager</td>
<td>1</td>
<td>10,000/-</td>
<td>10,000/-</td>
</tr>
<tr>
<td>2.</td>
<td>Supervisor</td>
<td>1</td>
<td>5,000/-</td>
<td>5,000/-</td>
</tr>
<tr>
<td>3.</td>
<td>Clerk cum Typist</td>
<td>1</td>
<td>4,000/-</td>
<td>4,000/-</td>
</tr>
<tr>
<td>4.</td>
<td>Accountant</td>
<td>1</td>
<td>4,500/-</td>
<td>4,500/-</td>
</tr>
<tr>
<td>5.</td>
<td>Peon</td>
<td>1</td>
<td>3,500/-</td>
<td>3,500/-</td>
</tr>
<tr>
<td>6.</td>
<td>Watchman</td>
<td>1</td>
<td>3,500/-</td>
<td>3,500/-</td>
</tr>
<tr>
<td>7.</td>
<td>Skilled Workers</td>
<td>3</td>
<td>3,000/-</td>
<td>9,000/-</td>
</tr>
<tr>
<td>8.</td>
<td>Semi Skilled Workers</td>
<td>5</td>
<td>2,800/-</td>
<td>14,000/-</td>
</tr>
<tr>
<td>9.</td>
<td>Unskilled Workers</td>
<td>8</td>
<td>2,500/-</td>
<td>20,000/-</td>
</tr>
</tbody>
</table>

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Total Salaries 73,000/-
ii) RAW MATERIALS (PER MONTH):

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Indigenous/Imported</th>
<th>Qty.</th>
<th>Rate</th>
<th>Total (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement</td>
<td>Indigenous</td>
<td>1500 Bags</td>
<td>Rs.250/-</td>
<td>3,75,000/-</td>
</tr>
<tr>
<td>Sand</td>
<td>-do-</td>
<td>5000 Cu.ft.</td>
<td>Rs.4/- per Cu.ft.</td>
<td>20,000/-</td>
</tr>
<tr>
<td>Marble Powder</td>
<td>-do-</td>
<td>40,000 Cu.ft.</td>
<td>Available free of cost.</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>3,95,000/-</td>
</tr>
</tbody>
</table>

iii) UTILITIES (PER MONTH):

- Power 15000 units @ Rs.6.00 per unit 90,000/-
- Water 1,000/-

---------
91,000/-
---------

iv) OTHER CONTINGENT EXPENDITURES (PER MONTH):

- i) Postage and Stationery, Telephone etc. 1,000/-
- ii) Consumable items 1,000/-
- iii) Repair & Maintenance 1,000/-
- iv) Transport Charges of Marble Powder and Sand 50,000/-
- v) Advertisement & Publicity 1,000/-
- vi) Insurance and Taxes 1,000/-

---------
55,000/-
---------
v) **TOTAL RECURRING EXPENDITURE (PER MONTH) :**

i) Salaries & Wages 73,500/-

ii) Raw Materials 3,95,000/-

iii) Utilities 91,000/-

iv) Other Contingent Expenses 55,000/-

-------------

6,14,500/-

-------------

vi) **Total Working Capital for 3 months** 18,43,500/-

F) **TOTAL CAPITL INVESTMENT :**

i) Fixed Capital 27,95,000/-

ii) Working Capital 18,43,500/-

-----------------

46,38,500/-

--------------------

G) **MACHINERY CAPACITY UTILISATION :** 75%

H) **FINANCIAL ANALYSIS**

1. **Cost of Production (Per Year) :**

- Total Recurring Cost per year = 73,74,000/-
- Depreciation on Building @ 5% = 41,250/-
- Depreciation on Machinery & Equipment @ 10% = 1,60,000/-
- Depreciation on Office Equipment @ 20% = 20,000/-
- Interest on Total Investment @ 12% = 5,56,620/-

-------------

81,51,870/-

Say : **81,52,000/-**
2. **Turn Over (Per Year):**

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty.</th>
<th>Rate</th>
<th>Value (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marble Powder</td>
<td>42,00,000 Nos.</td>
<td>Rs.2.50</td>
<td>1,05,00,000/-</td>
</tr>
<tr>
<td>- bricks.</td>
<td></td>
<td></td>
<td>Per brick.</td>
</tr>
</tbody>
</table>

3. **Net Profit (Per Year):**

\[
\text{Net Profit} = \text{Turn Over} - \text{Cost of Production}
\]

\[
= 1,05,00,000 - 23,48,000/-
\]

\[
\text{Net Profit} = 23,48,000/-
\]

4. **Net Profit Ratio:**

\[
\text{Net Profit per year x 100} = 23,48,000 \times 100 = 22.36\%
\]

\[
\text{Turn Over per year} = 1,05,00,000
\]

5. **Rate of Return**

\[
\text{Net Profit per year x 100} = 23,48,000 \times 100 = 50.61\%
\]

\[
\text{Total Investment} = 46,38,500
\]

6. **Break Even Point (% of Total Production Envisaged)**

i) **Fixed Cost:**

a) Depreciation on Machinery & Office Equipment @ 10% 1,80,000/-

b) Depreciation on Building @ 5% 41,250/-

c) Interest on Total Investment 5,56,620/-

d) 40% of Salaries & Wages 3,52,800/-

e) 40% of Other Contingent 2,64,000/-

f) 40% of Utilities 4,36,800/-

\[
\text{Total Fixed Cost} = 18,31,470/-
\]
ii) Net profit Per Year (As at Sl.No.11) = 23,48,000/

B.E.P. = \frac{F.C. \times 100}{F.C. + \text{Profit}}

= \frac{18,31,470 \times 100}{18,31,470 + 23,48,000} = 45.36\%

H) Additional information, if any. - NIL

I) ADDRESSES OF MACHINERY & EQUIPMENT SUPPLIERS:

Works

(1) M/s Cheema Engineering Works (P) Ltd.,
    Sugar Factory Road, Bazpur,
    Nainital (U.P.) – 262401
    Office: Flat No.14, Naveen Market,
    (Shikahak Park), Kanpur.

(2) M/s Cheema Boilers Ltd.,
    S.C.O. 66, Phase-3, B-11, Mohali (Chandigarh)-160057.

(3) M/s Kirti Enviotech Engg.,
    1355, Gokulpura, North Ayad,
    University Road, Udaipur – 313001.

Raw Material : Locally available in Huge quantity.

NOTE : The prices of Plant & Machinery, Raw-materials, Staff & Labour and other expenditure is to be changes as per market during the time of project implementation.

……
PROJECT PROFILE ON MARBLE SLURRY WASTE
HOLLOW BLOCK / SOLID BLOCK

The ever increasing tempo of building activities makes stringent demand on building materials. For building of all types – Single, multistoried or high – rise for residences, schools, hospitals, commercial complexes offices and industries. This is obviously giving rise to the demand of building materials both in the rural as well as in urban areas and consequently the material like stone blocks, clay bricks are becoming more and more expensive. Any new method aimed at optimum use of resources and time resulting in economy in construction would be a welcome addition. Marble powder sand brick masonry is one such useful development in the building industry. Now the method has been developed for making building bricks, Hollow Block and Solid Block by using Marble Waste which pollutes the environment.

MARKET POTENTIAL :

Field investigations revealed that due to urbanization and increasing building construction activities the demand for this item is increasing fast. The basic raw-material i.e. Marble powder, Cement and River Sand are easily available at cheaper rate. Therefore, there is good scope for setting up marble slurry waste Hollow Block/ Solid Block unit in Rajasthan because huge quantity of Marble Powder Waste is available.

<table>
<thead>
<tr>
<th>Cost of Project</th>
<th>Amount (Rs. in lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Land</td>
<td>1.00</td>
</tr>
<tr>
<td>(B) Building</td>
<td>3.75</td>
</tr>
<tr>
<td>(C) Plant &amp; Machinery</td>
<td>2.20</td>
</tr>
<tr>
<td>(D) Furniture &amp; Fixtures</td>
<td>0.00</td>
</tr>
<tr>
<td>(E) Pre-operative Expenses</td>
<td>0.10</td>
</tr>
<tr>
<td>(F) Working Capital</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3.20</td>
</tr>
</tbody>
</table>

(A) Land

The land provision has been taken in the reserve area of marble slurry two biga on the concessional rates/ free for which case has already been moved to State Government by Collector, Rajsamand.

While provision for land purchase has been taken @ 0.50 per biga.

2 biga x 0.50 1.0
### Building:

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Particulars</th>
<th>Size</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Shade for working in Block/brick roof of Manglora Kalu and store partition with GI Sheets.</td>
<td>15’ x 20’</td>
<td>2,00,000.00</td>
</tr>
<tr>
<td>02</td>
<td>Tube Well</td>
<td>41/2’ boring</td>
<td>1,00,000.00</td>
</tr>
<tr>
<td>03</td>
<td>Water Tank</td>
<td>30’ x 20’</td>
<td>25,000.00</td>
</tr>
<tr>
<td>04</td>
<td>Factory Gate &amp; Boundary fencing</td>
<td>--</td>
<td>50,000.00</td>
</tr>
</tbody>
</table>

**Total:** 3,75,000.00

### Plant & Machinery

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Particulars</th>
<th>Supplier</th>
<th>Amount (Rs. in lac.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Semi automatic hollow block/moulding machine type GMS – 2m with 2 HP motor.</td>
<td>The machine design is as per our requirement from State of Maharashtra / Gujrat as enquired.</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>Value of mould forma hollow block size 400mm x 200mm x 100mm</td>
<td>-do-</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>Value of mould forma bricks size 228mm x 108mm x 70mm.</td>
<td>-do-</td>
<td>0.25</td>
</tr>
<tr>
<td>4</td>
<td>Mixture Machine for mixing with 3 HP Motor.</td>
<td>From local market</td>
<td>0.50</td>
</tr>
<tr>
<td>5</td>
<td>Wooden plank / iron plate 200 Nos.@ Rs.25/-</td>
<td>-do-</td>
<td>0.20</td>
</tr>
<tr>
<td>6</td>
<td>Electrical Starter Panel bard cable &amp; power connection etc.</td>
<td>-do-</td>
<td>0.30</td>
</tr>
</tbody>
</table>

**Total:** 2.00
Add 10% for taxes transportation and contingency 0.20

Grand Total 2.20

Recurring Expenses:

No. of working days 300
No. of Shift One

Installed Capacity Type GMS – 2m

(1) Per minute vibration 6000
(2) Per hour operations 60
(3) Per hour hollow block production 100-120
(4) Per hour brick production (8x60) 480
(5) Vibrator motor HP two

Efficiency:

1\textsuperscript{st} Year 65%
2\textsuperscript{nd} Year 70%
3\textsuperscript{rd} Year 75%

Production : Installed Capacity (I) hollow block – 800 per day in 8 hours shift

<table>
<thead>
<tr>
<th>Per Year</th>
<th>2,40,000 blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1\textsuperscript{st} Year</td>
<td>65% 1,56,000 “</td>
</tr>
<tr>
<td>2\textsuperscript{nd} Year</td>
<td>70% 1,68,000 “</td>
</tr>
<tr>
<td>3\textsuperscript{rd} Year</td>
<td>75% 1,80,000 “</td>
</tr>
</tbody>
</table>

Production capacity (ii) Bricks : 480 x 8 = 3840 per day in 8 hour shift.

1\textsuperscript{st} year 65% say 2500 x 300 = 7,50,000 per year

1. **Raw material (Per month):**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Qty.</th>
<th>Rate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement</td>
<td>440 Bags</td>
<td>250/-</td>
<td>1,10,000.00</td>
</tr>
<tr>
<td>Sand</td>
<td>32 MT</td>
<td>1,000/-</td>
<td>32,000.00</td>
</tr>
<tr>
<td>Marble Slurry Waste</td>
<td>272 MT</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>1,42,000.00</strong></td>
</tr>
</tbody>
</table>
2. **Utility per month:**

Power consumed \( x \) per day working hour \( x \) days \( x \) rate per unit

\[
\text{Power} \ 5 \text{ HP} \times 0.746 \times 8 \times 30 \times 3.00 = 5,371.00
\]

(ii) Water from own tube well

3. **Salary & Wages Per month:**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Particulars</th>
<th>No.</th>
<th>Salary p.m.</th>
<th>Total (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Supervisor-cum-Manager</td>
<td>1</td>
<td>10,000/-</td>
<td>10,000/-</td>
</tr>
<tr>
<td>2.</td>
<td>Chowkidar</td>
<td>1</td>
<td>3,000/-</td>
<td>3,000/-</td>
</tr>
<tr>
<td>3.</td>
<td>Main Operator</td>
<td>1</td>
<td>4,000/-</td>
<td>4,000/-</td>
</tr>
<tr>
<td>4.</td>
<td>Unskilled Labour</td>
<td>7</td>
<td>3,000/-</td>
<td>21,000/-</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>38,000/-</strong></td>
</tr>
</tbody>
</table>

4. **Administrative Expenses Per Month:**

   i) Postage & Stationery - 2,000/-
   ii) Travelling - 5,000/-
   iii) Telephone - 2,000/-
   iv) Insurance - 2,000/-
   v) Legal & miscellaneous - 2,000/-

   **Total per month** - 13,000/-

5. **Total Capital Investment**

   Fixed Cost = 6,95,000/-
   Recurring Cost for 3 months = 5,94,900/-

   **Total** = 12,89,900/-

6. **Depreciation**

   (i) On Building 1 lacs @ 5.0% = 3.75 lacs Say 0.1875 lacs

   (ii) On Plant 1 lacs @ 10% 10% = 2.20 lacs 0.22 lacs

   **Total** 0.4075 lacs
7. **Total Cost of Production**

<table>
<thead>
<tr>
<th>Description</th>
<th>Rs. in lacs</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Raw material</td>
<td>17.040</td>
</tr>
<tr>
<td>(2) Utility</td>
<td>0.636</td>
</tr>
<tr>
<td>(3) Salary &amp; Wages</td>
<td>4.56</td>
</tr>
<tr>
<td>(4) Administrative Expenses</td>
<td>1.56</td>
</tr>
<tr>
<td>(5) Interest</td>
<td>1.55</td>
</tr>
<tr>
<td>(6) Depreciation</td>
<td>0.4075</td>
</tr>
</tbody>
</table>

   **Total** 25.7535

8. **Sales Realisation**:

   7,50,000 Hollow Bricks @ Rs.4/-  = 30,00,000/-

9. **Net Profit**

   Sales – Cost of Production  = 30.00 – 25.7535 = 4.2465 lacs.

10. **Percentage Profit on Total Capital Investment**  = 32.92%

11. **Percentage Profit on Sales**  = 14.55%

12. **Fixed Cost for BEP**

   1. 40% Total (Utility + Salary & Wages + Administrative Expenses)  = 2.7024 lacs

   2. Interest  = 1.55 lacs

   3. Depreciation  = 0.4075 lacs

   **Fixed Cost for BEP**

   

   **B.E.P.**  = \[
   \frac{\text{Fixed Cost} \times 100}{\text{Fixed Cost} + \text{Profit}}
   \]

   = \[
   \frac{4.6599 \times 100}{(4.6599 + 4.2465)}
   \]

   = 52.32%

   ……………………………..