Ready to use Cement Plaster- Environment Friendly & Zero Waste Mining
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Abstract:
This paper deals with the Environment friendly and Zero waste mining concept by utilizing mining waste from of China Clay and Silica Sand Opencast mines and use it as the building construction product- the ready to use cement plaster. Innovativeness in processing the waste and making them a product shall is the goal in this paper. In this research, we have used waste silica sand which is making commercial and land environment issues and degrading land. The study was done to make it as product and utilize in the field of construction. The waste Silica sand was sieved and appropriate mixture were made by mixing cement and additives to make it ready to use cement plaster. The experimental results obtained were analysed and compared with the standards for reliability of performance before put in practice. After discussion on the results obtained from above tests, it is concluded that replacement of river sand from the plaster by waste silica sand is possible and it will be more profitable with high coverage and less use of water in curing will be required.

Keywords: Mining, Environment, Land, Mineral Processing, Waste Management, Ready to use, Cement Plaster, sand, river mining, Building Construction.

I. INTRODUCTION
Land is an important resource as it supports majority of the human activities. With the increase in the human population and human activities its demand will be on hike. The importance of land in an over populated country like India is better emphasised as the availability of useful per capita land is 0.1 ha and it would continue to decrease with the increase in population. Zero waste mining will lead to utilization of waste beneficially and will be environment friendly. For this we need to upgrade in technology and processing. Innovativeness in processing the waste and making them a product shall be the goal in this thesis. In this research, we have used waste silica sand which is making commercial and land environment issues and degrading land. The study was done to make it as product and utilize in the field of construction. The Silica sand was sieved and appropriate mixture were made by mixing cement and additives to make it ready to use cement plaster. The experimental results obtained were analysed and compared with the standards for reliability of performance before put in practice. After discussion on the results obtained from above tests, it is concluded that replacement of river sand from the plaster by waste silica sand is possible and it will be more profitable with high coverage and less use of water in curing will be required.

II. MATERIAL USED
China Clay Mines is an existing mining lease having are of around 113.31 hectares to excavate mineral China clay, Silica sand and Red ochre, and the proposed production is RED OCHRE-4,00,000 TPA, CHINA CLAY-4,00,000 TPA, SILICA SAND-10,00,000 TPA which is to be used as additive material for tiles industry, ceramic industry, cement industry and other industry. The mining will be done by open-cast with mechanized method.

NEED OF THE STUDY
The mining of China clay, Silica sand and Red ochre mineral to fulfils requirement of tiles and ceramic industry and cement plants as basic mineral for manufacturing of cements and red ochre is used as the additive minerals for making cement and which is basis requirement for developing infrastructures, road, building within Nations. This mining project will definitely reduce the cost of cement production in the area by supplying the mineral at low transit cost and the required volume of the demand.

Table.1. Location of the Project and Particular of the Mining Lease

<table>
<thead>
<tr>
<th>PARTICULARS</th>
<th>DETAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME OF THE MINE</td>
<td>China Clay, Silica sand Mines</td>
</tr>
<tr>
<td>AREA</td>
<td>Around 125 hectares</td>
</tr>
<tr>
<td>MINE VILLAGE</td>
<td>Banesti</td>
</tr>
<tr>
<td>TEHSIL</td>
<td>Chittorgar</td>
</tr>
<tr>
<td>DISTRICT</td>
<td>Chittorgar</td>
</tr>
<tr>
<td>STATE</td>
<td>RAJASTHAN</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>(N) 24° 46' 07&quot; to 24° 47' 06&quot;</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>(E) 74° 34' 33&quot; to 74° 35' 06&quot;</td>
</tr>
</tbody>
</table>

http://ijesc.org/
WASTE GENERATIONS
There is huge amount of China clay, Red Ochre and Silica Sand production due to high demand and following is the flow chart of the process from mines.

![Flowchart of Raw Material from Mines to Processing Plant](image)

**Figure.1. Flowchart of Raw Material from Mines to Processing Plant**

**Figure.2. China Clay, Silica sand open stock yards**

**WASTE PRODUCED**
For example, 10,000 MT/monthly, material is processed from plants only 30% is recovery
So KAOLIN Produced = 3000MT/monthly
Waste Produced = 7000 MT/monthly
So to handle such a big amount of material it is very important to have proper arrangement and management of waste or otherwise it will create Environmental issues as discussed above.

**MATERIAL REQUIREMENTS**

*Sand produced during China Clay Process:*-
- Due to the low recovery (30% only) generation of sand is high which consumes lot of space and become difficult to handle as it is an unutilised mineral. For handling the same the costing is involved fuel and manpower and most importantly land is required for dumping the same.
- The commercial or agriculture land will become for no use after dumping and by the time it will start affecting surrounding environment.

*Production of Pure Silica:*-
- Chemical analysis report of this sand shows that it contains 92% of silica. For converting it into pure silica having good market in glass industry, have to invest more than 2.5 cores. Recovery will be 56 to 60% only and again it is difficult to handle balance 40%.
- "Instead of considering it as a waste let us consider it as a by-product and convert it into value added products by using innovative ideas and technological inputs."
**Fine aggregate:**

- When the aggregate is sieved through 4.75mm sieve, the aggregate passed through it called as fine aggregate. Natural sand is generally used as fine aggregate, silt and clay are also come under this category. The soft deposit consisting of sand, silt and clay is termed as loam. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent. The fine aggregate were so choose that they will fulfil the requirement of IS specifications.

**Cement (43 grade OPC Cement)**

- A cement is a binder substance used in construction fields to sets, hardens and adheres to other materials, binding them together and giving them strength when they are bind together. Cement is rarely used solely, but is used to bind sand and gravel together.

**Additives**

- A substance added to something in small quantities to improve the binding and preserving long term strength of the product. The additives plays very vital role as the agent but it is significant that proper research shall be done for which additive can be used as the agent in ready mix plaster, so that in results it shall not show any adverse effects.

**Sieves**

- A sieve is a device for separating wanted elements from unwanted material or for characterizing and categorising the particle size distribution of a sample, typically using a woven screen such as a mesh or net or metal.
- The sand is sieve in different mm/mesh so that proper particle size distribution maintained in the product according the IS specifications.

**Cement and Sand Mixer**

- A concrete and sand mixer is a device that homogeneously combines cement, aggregate such as sand or gravel, and water to form concrete and mix them appropriately as required.

- In making silica sand ready to use plaster the Diesel mixer is used so that proper mixing of cement and sand can take place in the according to the appropriate specifications.

**III. PRODUCTION OF READY MIX PLASTER**

Checking to be done on following parameters:-

a. Cement Sand Ratio

b. Clay and Silt Content

c. Sieve Analysis as per IS specifications

Testing of Workability, smoothness, coverage and finishing will be done at the time of plaster.

**Equipment used while production and manufacturing of ready mix plaster as per the IS Specifications:-**

a. Seven meshes- 4.75mm, 2.36mm, 1.18mm, 600 micron, 300 microns, 150 microns and 300 mesh.

b. Hot Plate

c. China Dishes

**INDIAN STANDARD’S**

**IS 1542:1992 Sand for Plaster- Specifications**

**Scope**- This standard covers the requirements of naturally occurring sands, crushed stone sands and crushed gravel sands used in mortars for internal wall and ceiling plastering, and external plastering using mixes of lime, cement, composite lime-cement, activated lime pozzolana mixture (ALMP) or gypsum with or without admixtures and sand.

**Quality of Sand:**

The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain clay, silt and dust more than a specified amount mentioned below.

**Table 2. Indian Standard IS: 2386**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particular</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Clay, silt and dust {determined in accordance with IS 2386 (Part 2):1963}</td>
<td>Not more than 5 percent by weight</td>
</tr>
<tr>
<td>b.</td>
<td>Organic impurities {determined in accordance with IS 2386 (part 2): 1963}</td>
<td>Colour of liquid below that indicated by comparison with the standard solution specified in 6.2.2 of IS 2336 (part 2):1963</td>
</tr>
</tbody>
</table>

**Grading of Sand:**

The particle size grading of sand for plaster work for internal as well as external walls and ceiling as analysed by the method described in IS 2386(Part1): 1973 shall be as specified in Table. Where the grading falls outside the limits of the grading zones of sieves other than 150, 300 and 600 micron IS Sieve by a total amount not exceeding 5 percent, it shall be regarded as falling within the grading.
Table 3. Grading of Sand for Internal Wall or External Wall or Ceiling Plaster (As per IS 1542: 1992)

<table>
<thead>
<tr>
<th>IS Sieve Designation (See IS 460:1985)</th>
<th>Percentage Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>95-100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>95-100</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>90-100</td>
</tr>
<tr>
<td>600 micron</td>
<td>80-100</td>
</tr>
<tr>
<td>300 micron</td>
<td>20-65</td>
</tr>
<tr>
<td>150 micron</td>
<td>0-15</td>
</tr>
</tbody>
</table>

IV. RESULTS AND DISCUSSIONS

Sampling and Testing: Sampling: The method of sampling shall be in accordance with IS 2430: 1986. The amount of material required for each test shall be as specified in relevant parts of IS 2386 and as per the requirements of mentioned earlier (1. Quality of Sand).

Testing:

Table 4. Gradation Test – Sieve Analysis

<table>
<thead>
<tr>
<th>Particles below 53 micron (+ 300 #)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>S.No.</th>
<th>% passing from Sieve Size (mm) (IS:1542:1992)</th>
<th>Specifications as per IS:383-1970</th>
<th>Silica sand results obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>10</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>4.75</td>
<td>90-100</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>2.36</td>
<td>85-100</td>
<td>99</td>
</tr>
<tr>
<td>4</td>
<td>1.18</td>
<td>75-100</td>
<td>86</td>
</tr>
<tr>
<td>5</td>
<td>0.600</td>
<td>60-79</td>
<td>61</td>
</tr>
<tr>
<td>6</td>
<td>0.300</td>
<td>12-40</td>
<td>24</td>
</tr>
<tr>
<td>7</td>
<td>0.150</td>
<td>0-10</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 5. Silt and Clay Content IS: 1542-1992

<table>
<thead>
<tr>
<th>No.</th>
<th>Specifications as per IS: 1542-1992 (%)</th>
<th>Silica sand results obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>3.0 (max)</td>
<td>2.62</td>
</tr>
</tbody>
</table>

Table 6. Soundness with Na2SO4 (%) IS:2385 (Part-V) 1963

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Specifications as per IS:2386-1963</th>
<th>Silica sand results obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>15.0 (max)</td>
<td>7.50</td>
</tr>
</tbody>
</table>
Table 7. Compressive Strength of Cement Mortar Cubes (Ready Mix Plaster)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Age of Sample</th>
<th>Compressive Strength (N/mm²) Average</th>
<th>Cement Sand Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>28 Days</td>
<td>7.68</td>
<td>1:6</td>
</tr>
<tr>
<td>2.</td>
<td>07 Days</td>
<td>3.76</td>
<td>1:4</td>
</tr>
</tbody>
</table>

Workability, Smoothness, Finish and Coverage

- Take plastering trial with 50 kg of ready mix plaster once in while on a normal wall and get by physical appearance same can be envisaged.

Figure 3. Waste material stock for experiments

Figure 4. Readymade plaster coverage and smoothness trial
Test Results: - Ready Made Cement Plaster- Product from waste of washed China Clay (Silica sand)

Table 8. Comparison of Plastering

<table>
<thead>
<tr>
<th>S.No</th>
<th>Particulars</th>
<th>Silica sand based ready to use plaster</th>
<th>Normal Plaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Coverage</td>
<td>21.0 sq feet</td>
<td>16-17 sq feet</td>
</tr>
<tr>
<td>2.</td>
<td>Plastering rate</td>
<td>100 sq feet/ 5 hours</td>
<td>100 sq feet/ 8 hours</td>
</tr>
<tr>
<td>3.</td>
<td>Thickness</td>
<td>12mm</td>
<td>12mm</td>
</tr>
<tr>
<td>4.</td>
<td>Workability</td>
<td>Good</td>
<td>No so good</td>
</tr>
<tr>
<td>5.</td>
<td>Smoothness</td>
<td>Smooth</td>
<td>Not Smooth</td>
</tr>
<tr>
<td>6.</td>
<td>Cost</td>
<td>Rs.12/Sq. feet</td>
<td>Rs.20/Sq. feet</td>
</tr>
<tr>
<td>7.</td>
<td>Requirement of Putty &amp; Paint</td>
<td>Less</td>
<td>More</td>
</tr>
</tbody>
</table>

V. DISCUSSION OF TEST RESULTS

- We can make this product with **very low investment** by mixing the above processed sand with cement in the ratio 1:5 with the addition of polymer and can be packed in 50 / 40 kg bags. This product gives the following advantages to the customer:
  - About 25% saving in the construction cost
  - Better coverage, smoothness, finish, workability etc.
  - Less labour
  - Absolutely no wastage
  - Need to add water only for one time after 24 hours of plastering instead of normal practise of 7 days.
  - Less requirement of Putty and Paint
  - Easy to Handle and much more.
  - Time saving directly impact on the cost parameters

Usage Method

- Clean the surface to be plastered and make it wet accordingly.
- For Concrete and smooth surface do hawking (make the surface rough)
- Open the silica sand plaster bag, mix it with water (normally 8.0 to 9.5 litres of water is required per 50 kg)
- Allow 5.0 min time for reactions and dissolution of polymer additives.
- After proper mixing you can use the silica sand plaster for plastering.
- After 24 hours of plastering do sprinkling and continue the same only for two more days.
- Use the plaster within 60 Min.

ECONOMICAL AND ENVIRONMENTAL ANALYSIS

**Benefits of Recycling silica sand waste**

- Recycling of mining wastes has actually environmental, economical and technical benefits. It is beneficial for the mines owner also that his waste will be utilised. It is economically beneficial as the product which was been thrown as waste and same was diminishing environment not been a new, innovative and ready to use product in the field of Building constructions.
- Environmental Benefits
  - Waste material creates environment problem by using waste and making it continue practice will helpful for the country growth and life of our natural minerals will also grow and the same time it will give boost in the field of construction industry.
  - Zero waste mining will lead to utilization of waste and will be environment friendly for this we need to upgrade in technology and processing.

**Economical Benefits**

- In this thesis, while comparing with normal or conventional way of plastering and ready to mix plaster we have directly getting benefits in the form of coverage, finishing, zero waste, time saving which indeed getting us direct economic benefits.

NOTE-

- The comparison directly shows that this ready to use cement plaster will reduce the cost of plastering and time saving. Even it will make the work of plastering faster, less labour and lot of saving.

VI. CONCLUSION OF THE STUDY

In this thesis, waste management and utilization of the waste silica sand for the production of ready to use cement plaster has been studied and the following conclusion are made:

1. In normal cement plaster river sand is used and it is mixed with cement and water manually with the ration of 1:5 or 1:6 according to the usage and we have to sieve river sand so that wastage shall be removed and that result into 30% wastage which is in total is loss to the industry.
2. Silica sand ready to use cement plaster can replace river sand and manual mixing of plaster in this we just have to add appropriate water in 50 kg to make it ready to use cement plaster.
3. Silica sand based plaster is much beneficial compare to our traditional cement plaster in the coverage as well as the strength.
4. This silica sand can replace river sand and used in construction of residential apartments and flats, which is economical with compare to normal sand.
5. Utilization of this waste silica sand will also be very environment friendly and beneficial for our rivers which are facing illegal river mining issues.

**Future Scope of work**
1. We are trying to utilize the some coarser material for the purpose of mortar so the research is going as per the Indian Standards
2. Working the same silica sand with white cement to make new innovative product for Building construction industry.

**VII. REFERENCES**


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