Utilization of Waste Silica Sand in Building Construction Industries
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Abstract:
This research deals in the utilization of the waste silica sand to be used in the Building Construction industries, in the concrete and in plaster of walls replacing natural sand. 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 was concluded that waste silica sand can be used in Building Construction Industries and it will play a very vital role in fulfilling demand of sand.

Keywords: Mining, Environment, Building Construction, Mineral Processing, reuse, waste, Concrete, silica sand, natural sand.

I. INTRODUCTION

The Huge amount of waste silica sand can be seen in the different mining lease of China Clay and Silica Sand in which high quality of silica sand is supplied to the Glass, Paper and Foundry Industries and low-grade silica sand is stacked in the dump yards which create a huge amount of the environmental and land degradation issues. There are many sandy clay washing units in the region which were washing clay or kaolin mineral from the silica sand and then the waste silica is stacked outside plants which create huge Environmental issues like Air Pollution and deteriorating Ambient Air Quality. The waste silica sand is used in the Construction Industries as the raw material but in this research, we have done the experimental research in the raw silica and try to find out by doing some sieving and industrial experiments how the waste silica sand can be used as the one of the significant product in the Building Industry.

Figure 1. Silica Sand Dump Yards In Region

SILICA SAND WASTE IN ONE MINING LEASE AREA
For example, 100,000 MT/monthly, material is processed from plants only 30% is recovery
So KAOLIN Produced = 30,000MT/monthly
Waste Produced = 70,000 MT/monthly

SILICA SAND PRESENCE IN STATE OF RAJASTHAN
About 332.46 million tonnes of Silica Sand resources has been assessed in the State. The important deposits of silica sand are Barodia (Bundi) having 1.16 million tonnes; Mudh, Gudha (Bikaner) with 3.0 million tonnes insulator, refractory and...
c. China Dishes
b. Hot Plate
a. Seven meshes- 4.75mm, 2.36mm, 1.18mm, 600 microns, 150 microns and 300 mesh.

II. MATERIAL USED

Waste Silica Sand:-
• Due to the high generation of waste silica sand that 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.

Product Development are Building Construction Industries

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 microns, 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>
<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>
<thead>
<tr>
<th>IS Sieve Designation (See IS :469:1985)</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>

III. 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 3. Gradation Test – Sieve Analysis
Particles below 53 micron (+ 300 #)

<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 4. 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 5. 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 6. 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>

Test Results:- Waste Silica Sand used with Cement for Trail as Building Construction Product
Table 7: Comparison with Conventional Method

<table>
<thead>
<tr>
<th>S.No</th>
<th>Particulars</th>
<th>Waste Silica sand with Cement</th>
<th>Normal sand with Cement</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>

IV. DISCUSSION OF TEST RESULTS

- Waste Silica Sand can be used as the vital material in the Building Construction Industries.
- 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.
- Better coverage, smoothness, finish, workability etc.
- Less labour
- Absolutely no wastage
- Less requirement of Putty and Paint
- Easy to Handle and much more.
- Time saving directly impact on the cost parameters

V. CONCLUSION OF THE STUDY

In this paper, we have worked on the utilization of the waste silica sand in the Building Construction Industries:
1. Waste Silica sand based plaster is much beneficial compare to our traditional cement
2. Waste Silica sand is used in the Concrete mixture and after sieving in appropriate way and addition of cement the plaster on the exterior and interior bricks and stones walls could be done.
3. 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 waste silica sand with epoxy and other chemical components to make putty and other Building Construction Industry products.

VI. REFERENCES

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