COMPACTION AND CBR CHARACTERISTICS OF LIME STABILISED POND ASH

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ABSTRACT: There is need for increasing the utilisation of coal ashes. Pond Ash being a non-plastic cohesionless material has potential to be used as an overlay. However, the “fly by air” nature of the pond ash is to be controlled by stabilisation. In view of this, efforts are made in this project to stabilise the pond ash with Lime in various substitution levels 2%, 5%, 10% and 20%. The effect of lime on compaction and CBR characteristics are observed systematically including the role of curing period. For the materials used in this research when pond ash was substituted by 20% of Lime and cured for 28 days, the CBR value was found to be 156%. This study brings out the promising performance of Lime stabilised Pond Ash as an overlay.

INTRODUCTION
Generation of electric power and construction of pavements are two key sectors of infrastructure development. While coal based thermal power generation is producing huge quantities of environmentally hazardous coal ashes that deserve utilisation, the construction of pavements on soft subgrades is requiring a mechanically stable overlays. Pond Ash being a mechanically stable material, has potential to be used as an overlay on soft subgrades, provided the “Fly by Air” nature is controlled. In view of this efforts are made in this research to stabilise the pond ash using lime which control the fly by air nature vis a vis increases the CBR value leading to economy.

REVIEW OF LITERATURE
Limited studies are carried out on the engineering behaviour of Pond Ash. A.K. Bera et.al. [1], Raju Sarkar [2], Raj Padam[3] have studied the compaction characteristics of Pond Ash. Amalendu Ghosh et.al. [4], Goutam Kumar Pothal and G. Venkatappa Rao [5] have studied the bearing capacity of geosynthetic reinforced pond ash. Kumar, R et.al. [6], Temel Yetimoglu et.al. [7] have studied the behavior of pond ash reinforced with randomly distributed fibers. Kolay, P.K. et.al. [8] have used pond ash as a stabiliser of Peaty soil.

Sudeep Kumar Chand et.al. [9] have attempted in-place stabilisation of pond ash deposit by hydrated lime columns and concluded that, this technique was effective in increasing the unconfined compressive strength and decreasing the permeability. In addition, the contamination potential of the ash leachates was reduced. Ambarish Ghosh et.al. [10] have attempted stabilization of pond ash using lime and phosphor-gypsum and found that, the content of stabilizers and the curing period are influential on the bearing ratio values.

STATEMENT OF THE PROJECT
The objective, necessity and scope of this project are as given below.

Objective
The primary objective of this project is to investigate the the effect of stabiliser content on compaction and CBR characteristics of Pond Ash stabilised with lime. The objective include studying effect of curing period on CBR value of the lime stabilised pond ash.

Necessity
The coal ashes generated by Thermal Power Plants in India is currently about 170 million metric tons per annum, which is projected to reach a level of 300 mmot by 2032. The ash ponds are occupying huge area of land and their maintenance has become costly. It is therefore appropriate to utilise the pond ash than to maintain the ash ponds. Use of pond ash as an overlay on soft sub-grade of pavements is one such potential application, provided the “fly by air” nature of pond ash is controlled by cementing methods of stabilisation. Lime is one such stabiliser. It is therefore necessary to investigate the effect of lime on compaction and CBR characteristics of the lime stabilised pond ash.

Scope
Scope of this project is limited to studying the mechanism at macroscopic level in terms of compaction and CBR characteristics. The tests are conducted using one type of pond ash and lime.

METHODOLOGY
The methodology include

- Collection and characterisation of Pond Ash
- Collection and characterisation of Lime
- Conducting compaction & CBR tests as per scheme of experiments
- Analysis of results and formulation of conclusions.

Characterisation of Pond Ash
The pond ash used in this project is collected from NTPC, Ramagundam, Andhra Pradesh during June, 2011 from near the delivery point. The engineering properties of the pond ash are as shown in table 1.
Table 1 Engineering characteristics of Pond Ash

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>1.97</td>
<td></td>
</tr>
<tr>
<td>Particle Size distribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravel Size particles</td>
<td>7.19</td>
<td>%</td>
</tr>
<tr>
<td>Sand Size particles</td>
<td>80.52</td>
<td>%</td>
</tr>
<tr>
<td>Silt size particles</td>
<td>12.29</td>
<td>%</td>
</tr>
<tr>
<td>Consistency</td>
<td>Non-Plastic</td>
<td></td>
</tr>
<tr>
<td>Coefficient of uniformity, Cu</td>
<td>4.65</td>
<td></td>
</tr>
<tr>
<td>Coefficient of curvature, Cc</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>IS Heavy Compaction test results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Dry Density</td>
<td>1.17</td>
<td>g/cc</td>
</tr>
<tr>
<td>Optimum Moisture content</td>
<td>28.90</td>
<td>%</td>
</tr>
<tr>
<td>Classification as per IS:1498-1970</td>
<td>SP</td>
<td></td>
</tr>
</tbody>
</table>

Characteristics of Lime
The lime of Suryacem brand is purchased from the local market. Its composition is as given in table 2.

Table 2 Composition of Lime

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>90</td>
<td>%</td>
</tr>
<tr>
<td>C₃A</td>
<td>3</td>
<td>%</td>
</tr>
<tr>
<td>Other ingredients</td>
<td>7</td>
<td>%</td>
</tr>
</tbody>
</table>

Compaction and CBR tests
The IS Heavy compaction test is performed on un-stabilised and lime stabilised pond ash. The sample for CBR test is prepared at OMC and the tests are conducted with a surcharge of 5kg. All the laboratory tests are performed strictly in accordance with the provisions of IS:2720. The moulding density of CBR samples is constantly monitored and the tests are repeated where ever discrepancy is noticed.

RESULTS AND OBSERVATIONS
The test results are presented in table 3. Based on the results, the following observations are made.

Effect of Lime on compaction characteristics
As it can be seen from fig.1, higher the lime content, higher is the MDD. This may be due to the fact that, the lime with better plasticity at OMC is facilitating rearrangement of pond ash particles in a better way.

Effect of Lime on OMC

Fig.2, shows that, as the lime content is increasing, the OMC is decreasing. This is different from the behaviour of soils wherein increase in fines causes an increase in gross specific surface and hence increase in OMC. This difference may be due to the fact that, the pond ash particles consist of cavities. Hence, a portion of OMC is consumed to fill these intraparticle cavities over and above the water present in the interparticle voids that facilitate compaction process. When lime is admixed, it may be sealing these cavities thereby conserving the entry of water in to the cavities and hence a decrease in OMC. The effectiveness of sealing may be increasing with the increase in lime content and thus a progressive decrease in OMC is observed.

Effect of Lime content on CBR value
As can be seen from fig.3, higher the substitution level of lime, higher is the CBR value at all periods of curing. This may be due to the fact that, higher lime content produces higher cementing agents which bind the particles effectively.

Effect of curing period on CBR value
As it can be seen from Fig.4, as the curing period is increasing, the percentage increase in CBR value is also increasing for every percentage of lime. The rate of increase is higher after 7 days of curing. This may be due to
Compaction and CBR characteristics of lime stabilised pond ash

Fig. 2 Effect of lime on OMC

![Graph showing the effect of lime on OMC](image)

Fig. 3 Effect of lime content on CBR value

![Graph showing the effect of lime content on CBR value](image)

the fact that, the minimum time required for completion of colloidal stage of reactions followed by pozzolanic stage reactions is generally 72 hours. Hence, production of cementing agents commences from 3 days onwards. This may be reason for the poor increase in CBR value up to first 4 days and from there on progressive increase has taken place due to development of cementing agents.

CONCLUSIONS
Based on the experimental results found during this project, the following conclusions are made

1. The CBR characteristics of Lime stabilised pond ash are improved phenomenally over un-stabilised pond ash.
2. Higher the lime content higher is the improvement in CBR value at all stages of curing.
3. Higher the curing period higher is the improvement in CBR value for all percentages of lime.
4. For the materials used in this research the CBR values recorded were in the range of 54% to 156%. The minimum was for 2% lime with 4 days of curing and the maximum was for 20% of lime with 28 days of curing.
5. Stabilisation of pond ash with lime not only control its fly by air nature but also improves the CBR value significantly. Hence, it can be used as an effective overlay on soft subgrade of pavements.

REFERENCE