Effect of Pond Ash Content on Engineering Properties of Fine Grained Soil

Bera, Ashis Kumar
Assistant professor
e-mail: ashis@ civil.becs.ac.in

Department of Civil Engineering, Bengal Engineering and Science University, Shibpur, Howrah

ABSTRACT

In the present investigation a series of laboratory tests has been performed to know the effect of pond ash content on engineering properties of fine-grained soil. From the experimental results it is found that with increase in percentage of pond ash (within the range of 0 to 55 %) in the fine grained soil, the liquid limit of the soil pond ash mixture decreases gradually. The values of plasticity index of soil pond ash mixture also decreases rapidly with increase in percentage of pond ash up to 20 %. The engineering properties such as maximum dry density, optimum moisture content, unconfined compression strength and California bearing ratio also changes significantly with addition of pond ash content in the fine grained soil.

1. INTRODUCTION

Suitable construction materials are not readily available in many places for traditional road constructions. Nowadays environmental and economic issues have stimulated interest in development of alternative construction materials that can fulfill design specifications. The utilization of pond ash, the by – product of thermal power plant can be used mixed with fine grained soil, in bulk quantity as a alternative construction materials for developing residential and industrial sites, construction of road etc. A number of researchers studied the different engineering properties of fly ash stabilized soil (Jongpradist et al. 2010; Solanki et al. 2009; Edil et al. 2006; Bin-Shafique et al. 2004; Trzebiatowski et al. 2004; Cokca, 2001; Nicholson & Kashyap, 1993; Ferguson 1993). This paper presents the laboratory study to highlight the effect of pond ash content on engineering properties of fine-grained soil pond ash mixture.

2. MATERIALS AND METHODS

In the present investigation fine-grained soil collected from Howrah, West Bengal, India and pond ash collected from ash pond of Kolaghat thermal power plant, used as a stabilizer to the soil. The physical properties of the fine-grained soil and pond ash are presented in the Table 1. As per unified soil classification system (USCS) pond ash can be designated as SM and fine-grained soil designated as MH. Before conducting the test on pond ash soil mixture, both the soil and pond ash (in desired percentage) has been mixed thoroughly in dried condition.

Table 1: Physical Properties of Pond Ash and Soil

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Values of Physical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>Pond Ash</td>
</tr>
<tr>
<td>Gravel size (%)</td>
<td>0.00</td>
</tr>
<tr>
<td>Sand size (%)</td>
<td>1.50</td>
</tr>
<tr>
<td>Silt size (%)</td>
<td>83.32</td>
</tr>
<tr>
<td>Clay size (%)</td>
<td>15.18</td>
</tr>
<tr>
<td>C_c</td>
<td>11.11</td>
</tr>
<tr>
<td>C_e</td>
<td>5.44</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>2.62</td>
</tr>
<tr>
<td>Liquid limit</td>
<td>57</td>
</tr>
<tr>
<td>Plastic limit</td>
<td>31</td>
</tr>
<tr>
<td>Permeability (cm/s)</td>
<td>$2.97 \times 10^8$</td>
</tr>
<tr>
<td>USCS Classification</td>
<td>MH</td>
</tr>
</tbody>
</table>

3. RESULTS AND DISCUSSIONS

Figures 1 and 2 show the liquid limit versus pond ash content and plasticity index versus pond ash content curves respectively. Figures 3 and 4 show the plots of maximum dry density versus pond ash content and optimum moisture content versus pond ash content curve respectively.
Effect of Pond Ash Content on Liquid Limit of Soil Pond Ash Mixture

Liquid limit (\(w_l\)) is the water content at which a soil is practically in a liquid state, but has infinitesimal resistance against flow. Fig.1 shows the liquid limit versus pond ash content curve. From the curve it is found that with increase in pond ash content in soil pond ash mixture, the liquid limit decreases. Nicholson & Kashyap (1993) also found the similar types of results in case of fly ash stabilization of tropical Hawaiian soils.

Effect of Pond Ash Content on Plasticity Index of Soil Pond Ash Mixture

Plasticity index, \(I_p\) is the range of moisture content over which a soil exhibits plasticity. The plasticity index and also liquid limit assist in soil identification and classification of fine-grained soil. Fig.2 presents the plasticity index versus pond ash content (\(\%\)) curve. From the curve it is found that with increase in pond ash content (\(\%\)), plasticity index decreases rapidly. Similar types of results have been obtained in case of fly ash stabilization of tropical Hawaiian soils (Nicholson & Kashyap, 1993).

Effect of Pond Ash Content on Maximum Dry Density and Optimum Moisture Content of Soil Pond Ash Mixture

The maximum dry density (MDD) and optimum moisture content (OMC) are the benchmark for determination of quality compaction for any earth work project. In the present investigation compaction test has been performed in accordance with ASTM D698. Figures 3-4 show the maximum dry density versus pond ash content curve and optimum moisture content versus pond ash content curve respectively. A decrease in MDD and increase in OMC with addition of pond ash content has been obtained from the Figures 3 - 4 respectively. Similar types of results have been obtained in case of fly ash stabilization of tropical Hawaiian soils (Nicholson & Kashyap, 1993).
Effect of Pond Ash Content on Unconfined Compression Strength (UCS) of Soil Pond Ash Mixture.

Figure 5 shows the plots of unconfined compression strength (UCS) versus pond ash content curve. From the Figure 5 it is found that with increase in pond ash content of fine grained soil pond ash mixture, the values of UCS decreases. It may be due to that with increase in pond ash contents, the fine-grained soil altered into more friable “less clayey” form as a result; there cohesive strength may decline.

![UCS Versus Pond Ash Content Curve](image1)

Effect of Pond Ash Content on California Bearing Ratio (CBR) value of Soil Pond Ash Mixture.

The California bearing ratio (CBR) of a soil is one of the important parameter in evaluating design criteria for use as a pavement construction materials. Figure 6 shows the plots of CBR value versus pond ash content curve for pond ash soil mixture. From the curve (Fig.6) it is found that with increase in pond ash content (%) in the pond ash soil mixture, the CBR value increases. Edil et al. (2006) also found the similar types of results in case of fly ash stabilizing soft fine-grained soil.

![CBR Versus Pond Ash Content Curve](image2)

4. CONCLUSIONS

Based on the experimental results presented and discussions made in the previous section the following conclusions may be drawn:

- The values of liquid limit decreases with increase in pond ash content (with in 0 to 55 %) and at the same time values of plasticity index also decreases rapidly with increase in pond ash content up to 0 – 20 %.
- In addition of pond ash content to the fine-grained soil the MDD and OMC also changes considerably. With increase in pond ash content in percentage in the fine-grained soil, MDD decreases where as OMC increases.
- The values of unconfined compression strength (UCS) and California bearing ration (CBR) of fine-grained soil changes considerably with addition of pond ash (%). The value of unconfined compression strength (UCS) decreases where as the unsoaked California bearing ratio (CBR) value of pond ash fine-grained soil mixture increases with addition of pond ash content.

REFERENCES


