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# SOIL STABILIZATION USING CORN HUSK FIBER AND STONE DUST

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**Abstract -** *Soil has been proved in many situations to be difficult to deal with while creating various structures like foundations, highways and piles, water barriers, and others. The current study employs a variety of admixtures to strengthen particular kinds of soil and improve its physical properties.*

*Cement and lime have been widely used to stabilize soil for many years. The goal of this study is to see if the fiber of corn husks (CHF) can be used as a stabilizing material when paired with stone dust (SD). The current research compares the effects of Corn Husk Fiber & Stone Dust upon the strength characteristics of silty soil.*

*A series of laboratory experiments were performed on silty soil samples with dose of Corn Husk Fiber & Stone Dust that varied from 1% to 4% and 10% to 50% by mass of dried soil. The experimental findings demonstrated a significant improvement in soil parameters, indicating that corn husk fiber when combined with stone dust is a highly promising addition for enhancing soil properties at optimum dose of 30% for Stone dust and 3% for corn husk fiber.*

***Key Words***: Soil Stabilization, Corn Husk Fiber, Stone Dust, OMC, MDD, CBR.

## 1.INTRODUCTION

India has a large population, and in recent years, roads and buildings have been built even on unstable ground. Due to the lack of accessible land, garbage disposal is another major issue. The need for adequate disposal methods or the dumping of waste has an effect on the ecosystem. Additionally, the need for terrestrial acquisition has grown because to population growth. The primary worry when it comes to the sustainable use of resources and waste materials has been industrial wastes. It is effective to employ these wastes to enhance the properties of numerous other materials. Utilizing industrial and agricultural waste improves the ground, stabilizes the soil, and lowers environmental pollution.

### 1.1 Stone Dust

Stone dust is an unused byproduct generated by crusher facilities. It has the potential to be employed as a soil stabilizer. The addition of stones in soils not only enhances the soil's conditions but also has an impact on cost. A series of experiments was carried out in the current research to investigate the functionality and durability of soil established from stone dust. It is a kind of material for construction that is generated by mining an adequate rock deposit and then crushing it down to the necessary size using crushers.

**Table 1: Properties of Stone Dust**

| Properties of Stone Dust | Experimental Values |
|---|---|
| Specific gravity(G) | 2.85 |
| Liquid limit (L.L) | 35% |
| D10 | 0.149 mm |
| D30 | 0.60 mm |
| D50 | 01.44 mm |
| D60 | 1.6 mm |
| Uniformity coefficient, Cu | 10.67 |
| Coefficient of curvature | 1.5 |
| Max dry unit weight | 21.3 kN/m3 |
| OMC | 12.09% |
| Coefficient of permeability | 8.5x10-5 |

### 1.2 Corn Husk Fibers

The Punjab local territory provided the corn husks, which were employed as a comprehensive material for investigating their impacts on the strength and compaction properties of a sample of soil. Below are listed the physical characteristics of corn husk fibres.

**Table 2: Properties of Corn Husk Fibers**

| | |
|---|---|
| Width | 6 mm |
| Thickness | 0.39 mm |
| Density | $3.1x10^{-1}$ gm/$mm^3$ |

## 2. LITERATURE REVIEW

Sabat, Akshaya & Bose, Bidula. (2013), it discusses the impact of two industrial by-products, fly ash and quarry dust, on various properties of expansive soil, including compaction characteristics, unconfined compressive strength, California bearing ratio (CBR), shear strength parameters, and swelling

pressure. It also examines how the molding water content influences the CBR of expansive soil stabilized with fly ash-quarry dust, and evaluates the cost-effectiveness of this stabilization method.

Dixit, Manish & Patil, Kailas. (2016), the current investigation focuses on assessing the potential use of stone dust in road and highway construction. The experimental program involves two main phases: initially, the properties of original expansive soils obtained from various locations are evaluated, along with the properties of stone dust collected from the same areas. Subsequently, the soil modification process entails incorporating stone dust into the original expansive soils, ranging from 0% to 60% in increments of 10% (i.e., 10%, 20%, 30%, 40%, 50%, and 60%). The study examines the impact of stone dust on key soil parameters such as liquid limit, plastic limit, plasticity index, dry density, optimum moisture content, and California bearing ratio (CBR) values.

Duong, Nga & Satomi, Tomoaki & Takahashi, Hiroshi. (2021), the aim of this study is to explore how the inclusion of corn husk fiber affects the properties of soil cemented with high water content. Specifically, at a cement content of 40 kg/m$^3$, the tensile and compressive strengths of cemented specimens increase significantly, ranging from 79% to 330% and from 26% to 119%, respectively, as the fiber content is increased from 3 to 15 kg/m$^3$. It's observed that the impact of fiber on tensile and compressive strength diminishes as the cement content increases. However, regardless of the cement level, higher fiber content leads to a reduction in the loss of post-peak stress.

## 3. OBJECTIVES OF STUDY

a) To find OMC and MDD for various soil mixes.

b) To determine optimum dose of Stone Dust by CBR test.

c) To find and compare the doses of stone dust and corn husk fiber for mixture by CBR test.

## 4. EXPERIMENTAL STUDIES

Corn husk fibre waste were gathered from local furniture enterprises in Ludhiana, Punjab. Stone dust was collected in the hamlet of Dada, near Hoshiarpur, Punjab. Stone dust was utilized as stabilizer and was blended in varied percentages and length in an optimal dosage of corn husk fiber to reinforce the soil. The geotechnical properties of soil under consideration are given in Table no. 3.

**Table 3: Properties of soil**

| S No. | Properties | Values |
|---|---|---|
| 1 | Relative density (G) | 2.65 |
| 2 | Grain size distribution | |
| | Percent Sand | 27.15 |
| | Percent Fines | 72 |
| 3 | Atterberg limits | |
| | LL | 38 |
| | PL | 32.5 |
| | Plasticity index $I_p$=LL-PL (%) | 6.5 |
| 4 | Compaction characteristics Standard Proctor Test | |
| | O.M.C | 11.5 |
| | M.D.D (gm/cm$^3$) | 1.8 |
| 5 | CBR (%) unsoaked | 3.20 |
| 6 | Differential free swell | 53 |

The following values of OMC and MDD of soil containing corn husk fiber have been found and given in Table no. 4.

**Table 4: OMC and MDD values of soil mix**

| | %age of CHF | OMC value without CHF | OMC with CHF of diff. length | MDD without CHF | MDD with CHF of diff. length |
|---|---|---|---|---|---|
| Sample | | 16.1 | 2cm<br>3cm<br>4cm | 1.82 | 2cm<br>3cm<br>4cm |
| | 1 | | 22<br>25<br>28 | | 1.72<br>1.69<br>1.66 |
| | 2 | | 26<br>29<br>30 | | 1.7<br>1.66<br>1.63 |
| | 3 | | 30<br>33<br>35 | | 1.68<br>1.64<br>1.59 |
| | 4 | | 33<br>36<br>38 | | 1.66<br>1.62<br>1.56 |

Unsoaked & soaked CBR values with various lengths of husk of corn fibers combined together have been found and given in Table 5 & 6.

**Table 5: Unsoaked CBR of soil mix**

| Soil sample | %age of CHF | Unsoaked CBR without CHF | Unsoaked value with CHF |
|---|---|---|---|
| | | 4.9 | 2cm 3cm 4cm |
| | 1 | | 5.7 6 6.3 |
| | 2 | | 6.4 6.9 7.2 |
| | 3 | | 6.7 7.8 8.1 |
| | 4 | | 7.6 7.4 6 |

**Table 6: Soaked CBR of soil mix**

| Soil sample | %age of CHF | CBR without CHF | CBR value with CHF |
|---|---|---|---|
| | | 3.9 | 2cm 3cm 4cm |
| | 1 | | 4 4.2 4.3 |
| | 2 | | 4.1 4.2 4.5 |
| | 3 | | 4.3 4.6 4.9 |
| | 4 | | 4.6 4.3 4.1 |

CBR (unsoaked & soaked) for various percentage of different length increased up to 3 % with 4 cm length and then it started decreases. Now we have determined CBR values with addition of stone dust from 10% to 50% and given in Table no. 7.

**Table 7: Shows CBR with Stone Dust**

| Soil sample | %age of stone dust | CBR without SD | CBR value with SD |
|---|---|---|---|
| | 10 | 3.9 | 4 |
| | 20 | | 4.1 |
| | 30 | | 4.22 |
| | 40 | | 4.05 |
| | 50 | | 4 |

Experiment results for optimum moisture content (OMC) and maximum dry density are obtained from standard proctor test and are shown in Table no. 8 & 9.

**Table 8: Shows OMC with Stone Dust**

| Soil sample | %age of stone dust | OMC without SD | OMC value with SD |
|---|---|---|---|
| | 10 | 11.5 | 11.3 |
| | 20 | | 11 |
| | 30 | | 10.8 |
| | 40 | | 10.7 |
| | 50 | | 10.7 |

**Table 9: Shows MDD with Stone Dust**

| Soil sample | %age of stone dust | MDD without SD | MDD value with SD |
|---|---|---|---|
| | 10 | 1.8 | 1.85 |
| | 20 | | 1.89 |
| | 30 | | 1.94 |
| | 40 | | 1.96 |
| | 50 | | 1.98 |

Table no. 7 give optimum dose of stone dust (SD) as 30%. It is further used to determine optimum dose of corn husk fiber (CHF) dose. Experiment results for this combination are given in Table no. 10 & 11.

**Table 10: Shows combine values of OMC, MDD.**

| Soil sample | %age of CH+30%SD | OMC (CH+SD) | MDD (CH+ SD) |
|---|---|---|---|
| | | 2cm 3cm 4cm | 2cm 3cm 4cm |
| | 1%+30% | 28 32 33 | 1.86 1.85 1.83 |
| | 2%+30% | 31 34 35 | 1.84 1.82 1.8 |
| | 3%+30% | 33 36 38 | 1.81 1.8 1.78 |
| | 4%+30% | 35 37 39 | 1.8 1.78 1.75 |

**Table 11: Shows CBR value for combined material**

| Soil sample | % of CHF+30%SD | CBR(CHF+SD ) |
|---|---|---|
| | | 2cm 3cm 4cm |
| | 1%+30% | 4.2 4.3 4.5 |
| | 2%+30% | 4.1 4.4 4.6 |
| | 3%+30% | 4.7 4.9 5.1 |
| | 4%+30% | 4.9 4.7 4.4 |

## 5. CONCLUSION

The stabilization of soil has attracted attention in order to minimize its negative influence on infrastructure components such as roads and buildings. A new idea for soil stabilization utilizing Corn Husk and stone dust has been addressed in this article. The sample preparation process and variations in basic geotechnical parameters of soil are investigated. Following implications can be drawn based on the collected results and discussion.

a) As the corn husk absorbs moisture, the OMC value of soil increases when adding varying percentages of corn husk to silty soil.
b) MDD of soil sample is decreased by adding different percentage of corn husk and stone dust due to low specific gravity of corn husk fiber.
c) The CBR value of soil with corn husk and stone dust increased firstly then it started decreasing due to loss of contact between soil particles. We achieved the maximum value of CBR as 5.1 with optimum dose of stone dust as 30% and corn husk fiber dose as 3% with 4 cm as fiber length

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