# Chemical Stabilization of Clayey Soil Using Blend of Calcium Carbide Residue and Coconut Shell Ash

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## Abstract

Calcium rich and silica rich waste materials are abundantly available in many countries. These wastes ended in a waste dump there by polluting environment and endangering the lives of the people living within the vicinity. Calcium carbide residue CCR and coconut shell ash CSA are such wastes produce as result of industrial and agricultural activities. Utilizing these wastes for stabilization purposes may result in providing a product with adequate strength for construction purposes. In this research, CCR and CSA were employed in stabilizing CI , CSA was fixed at 20% in CI respectively using index properties tests and then CCR was varied ( i.e. 0.5, 1.0 and 1.5% ). Standard proctor test results showed general decrease in MDD values and increasein OMC values which may be obvious as the specific gravity of the additives is less than that of the soil. UCS results indicated a tremendous improvement in the strength of the soil with the improvement of up to 1.59 times the strength of the virgin soils at 7 days curing period and CBR results Showed Enhancement in the strength of the soil with the improvement of up to 2.1 times the strength of the virgin soils at 7 days curing period with combination of S+1.5%CCR+20%CSA respectively. Hence CCR and CSA can be employed for expansive soil stabilization subject to further researches.

**Keywords: Clay soil, Calcium carbide, Blackcottonsoil, Standard proctor, CBR Test, Unconfined strength test (UCS)**

## I. INTRODUCTION

There are various types of soils which show volume changes due to change in the moisture content. This causes major damage to property constructed on it. These soils contain minerals such as montmorillonite that are capable of absorbing water. When they absorb water their volume increases. One of the biggest necessities in the developing countries is to provide proper roadway network by conventional method. Hence it is necessary to go for suitable method of low cost road construction followed by a process of stage development of the roads, to meet the growing needs of road traffic.

Good quality of subgrade soil is preferable for durable road but not always available for highway construction. The highway engineers designing a road pavement face weak or unsuitable subgrade. In this situation improvement in the properties of the existing soil by addition of some other materials can be adopted which is otherwise known as “soilstabilization”. Soil Stabilization:

Soil stabilization means the improvement of the stability or bearing capacity of a poor soil by the use of compaction; proportioning and the addition of suitable stabilizers or admixtures. Soil stabilization includes chemical, mechanical, physico-chemical methods to make the soil stabilized. This process basically involve excavation of soil, this is an ideal technique for improving of soil in shallow depth, as in pavements. Stabilization method may be categorized as two main types: (a) improvement of soil properties of existing soil without using any type of admixture; and (b) improve the properties with the admixtures.

The commonly used admixtures for the stabilization of clayey soil have been reported in the literature are cement ,lime, flyash, rice husk ash, furnace slag or in the combination of more than one admixture. Fly ash, rice husk ash and furnace slag are added due to the abundance of pozzolanic materials($SiO_2$ and $Al_2O_3$)

## II. .MATERIALS

### A. Soil

Soil is taken from for this exploration work. The measure of soil is taken around 150 kg of locally accessible clayey soil (CI) was gathered and air dried in open ranges. The superfluous materials like rocks and vegetative matter were expel physically from soil. The irregularities are available in soil are additionally broken with the assistance of wooden sledge and after that sieved through 4.75 mm strainer to concentrate rock part. By then the earth illustration was oven dried for 24 hours at 100 °C before it was mixed with Calcium Carbide and Ground Granulated Blast Furnace Slag using it for trials. The properties of soil used are given below in table 1.

Table No. 1 Properties of soil:

| S.NO. | PROPERTIES | RESULTS |
|---|---|---|
| 1. | Liquid Limit | 47 % |
| 2. | Plastic Limit | 21.11 % |
| 3. | Plasticity Index | 25.89 % |
| 4. | Optimum Moisture Content | 17.5 % |
| 5. | Maximum Dry Density | 16.2 kN/$m^3$ |
| 6. | Specific Gravity | 2.67 |
| 7. | Indian Soil Classification | CI |
| 8. | California ratio test | 2.2 % |
| 9. | Unconfined compression strength | 240.05 kN/$m^2$ |

### B. Calcium Carbide Residue:

The Calcium Carbide Residue is used in this research was taken from Locally market.

Table No. 2Chemical composition of Calcium Carbide Residue

| S. No | Name of constituent | Percentage |
|---|---|---|
| 1 | $SiO_2$ | 6.49 |
| 2 | $Al_2O_3 + Fe_2O_3$ | 5.80 |
| 3 | Calcium Oxide (CaO) | 70.78 |
| 4 | Magnesium oxide (MgO) | 0.69 |
| 5 | $SO_3$ | 0.66 |

### C. Coconut shell Ash

The material Coconut shell ash was taken local market.

Table No. 3 chemical composition of Coconut shell ash

| S. No | Name of constituent | Percentage |
|---|---|---|
| 1 | $SiO_2$chemical composition of Coconut shell ash | 37.97 |
| 2 | $Al_2O_3 + Fe_2O_3$ | 39.60 |
| 3 | Calcium Oxide (CaO) | 4.98 |
| 4 | Magnesium oxide (MgO) | 1.89 |
| 5 | $SO_3$ | 0.71 |
| 6 | $Na_2O$ | 0.95 |
| 7 | $P_2O_5$ | 0.32 |

## III. SOIL PREPARE & EXPERIMENT

The soil take up in the proposed study was gathered from local area. Right off the bat the soil knots were broken with the assistance of a wooden hammer and after that air dried. At that point soil was gone through from sifter 4.75 mm and after that gathered in packs. The amount of soil required is then oven dried at 105˚C for 1 day.

### A. LABORATORY TESTS

**Various tests that were performed in the laboratory to attain the desired objectives**

1. Pycnometer test (Specific gravity).
2. Casagrande's test (Liquid limit).
3. Thread test (Plastic limit).
4. Modified proctor test (OMC and MDD)
5. CBR test.
6. UCS test

### B. MIX PROPORTIONS USED

In present work the ratio of Calcium Carbide Residue utilized was 1.0, 1.5 and 2.0% and Coconut hell Ash was 15, 20 and 25%.

Here, S=Soil, CSA = Coconut shell Ash & CCR= Calcium Carbide Residue.

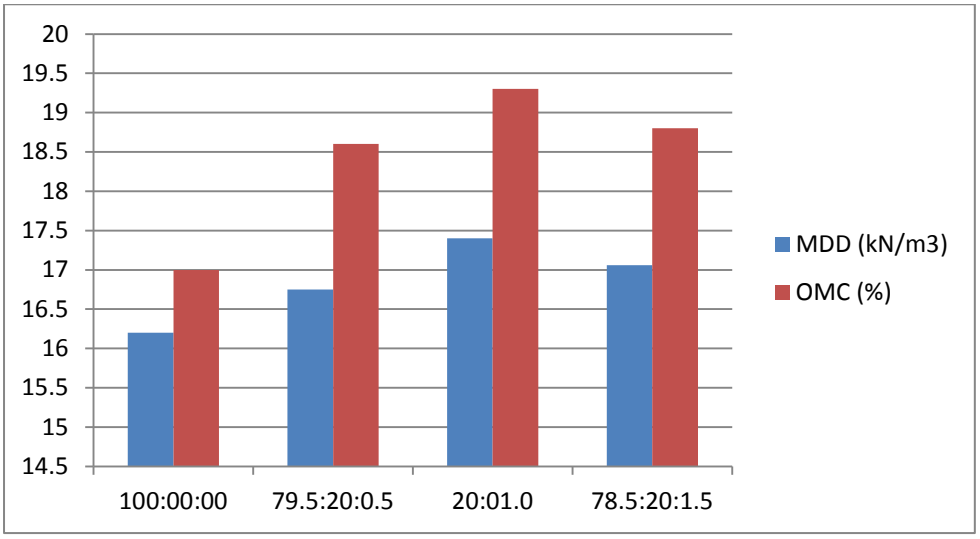
## IV. RESULTS AND DISCUSSION

### 1. STANDARD PROCTOR TEST:

Table No. 1 MDD and OMC for soil– CSA– Calcium Carbide mix

| S. No. | Proportion Soil : CSA: Calcium Carbide | MDD ($kN/m^3$) | OMC (%) |
|---|---|---|---|
| 1. | 100:0:0 | 16.20 | 17 |
| 2 | 79.5:20:0.5 | 16.75 | 18.6 |
| 3 | 79:20:1.0 | 17.40 | 19.3 |
| 4 | 78.5:20:1.5 | 17.06 | 18.8 |

Graph No. 1 Graphs representing the curves that are obtained from standard proctor test for soil – Coconut Shell Ash - Calcium Carbide mixture

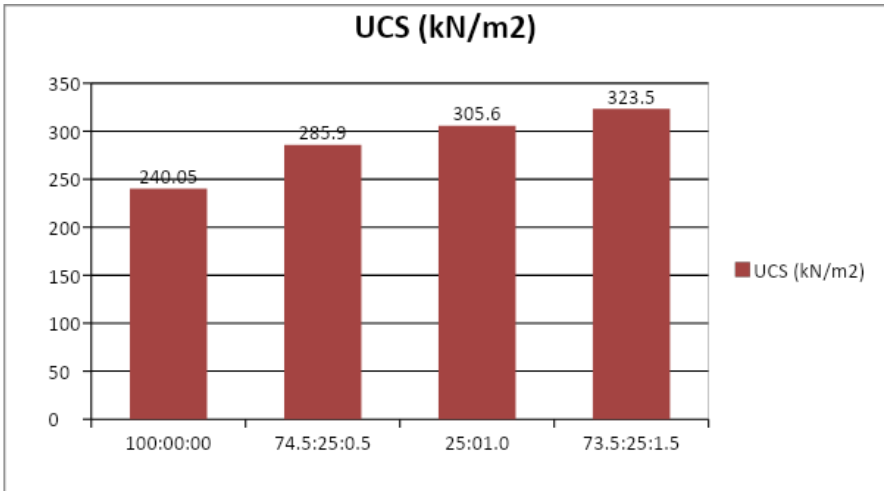



### A. Unconfined Compression Strength Test

Table No. 2 Results of UCS of Coconut shell Ash and Calcium carbide

| Clayey Soil :CSA: CC | Curing Period (Days) | UCS ($kN/m^2$) |
|---|---|---|
| 100 : 00 | 7 | 240.05 |
| 79.5:20:0.5 | 7 | 321.43 |
| 79:20:1.0 | 7 | 357.61 |
| 78.5:20:1.5 | 7 | 381.73 |

Graph No. 2 UCS Value of Clayey soil of Coconut shell Ash and calcium carbide




**B. California Bearing Ratio Tests**

Table No. 3 Results of CBR of Rice Husk Ash and Nylon Fibre Mix with Soil

| CS: CSA: CC | CBR (%) |
|---|---|
| 100:00:00 | 2.2 |
| 79.5:20:0.5 | 4.1 |
| 79:20:1.0 | 4.3 |
| 78.5:20:1.5 | 4.6 |

Graph No. 3 CBR Percentages of Clayey soil, Rice Husk Ash and Nylon Fibre