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Sodium Bentonite soil Stabilized by Using the Agriculture Waste

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Abstract – *Bentonite soil is a problematic in nature and very low shear strength. When high swelling, high shrinkage and wet characteristics. This type of soil is damaging buildings, roads, and bridges every year in the world. So, the use of agriculture waste to improve the soil properties. The agricultural industries are generating large quantities of wastes. It is impact ore environment causes like water pollution, and air pollution. Rice husk ash and sugarcane bagasse ash from the mills. Rice husk ash contains good amount of amorphous silica which can be used as stabilizer. Sugarcane bagasse ash is rich in oxides of silica and aluminum. In this paper Rice husk ash are mixed different percentage (5%, 10%, 15%, 20%) in soil and Sugarcane bagasse ash are mixed in different percentage (5%, 10%, 15%, 20%) in soil and find MDD in both RHA and SCBA at 10% by Standard proctor test. And fixed 10% RHA and SCBA are treated with cement in different percentage (2.5%, 5%, 7.5%, 10%) and performed various tests like UCS test at curing periods (7,14, and 28) and CBR test. It is found that to increase shear strength and decrease compressibility of the soil*

Key Words: Bentonite Soil1, Rice husk ash2, Sugarcane bagasse ash3 and cement4.

1.INTRODUCTION

In India the bentonite soil is found in Gujarat and Rajasthan. The sodium bentonite soil found in the Kutch district of Gujarat is very for swelling properties [1]. The agriculture waste material is a big problem in the developing country like India. These agriculture wastes are used in the form of stabilizing agent is the modern approach. The bentonite soil used in the study is a very problematic in nature for the construction of various infrastructures like pavements, foundation etc. [2]. During Monsoon season bentonite soil absorb water swells and become soft and dry season they become shrinks and become harder when evaporation of water and all these types of variation are looking in the soil. So, used waste materials RHA, SCBA is to improve the properties of the Bentonite soil.[3]. The SCBA (Sugarcane Bagasse Ash) results solving the problem and proves to be a cheaper stabilizer and RHA (Rice Husk Ash) is a very good super pozzolanic properties can bind soil particles together and reduce water absorption to the soil and result gives to increase in durability and strength of the soil. And for the heavy loaded vehicles, foundations need special care of the construction work so, use of cement OPC 43grade. The cement is blended in different percentage with soil and waste materials (RHA and SCBA). So, checked the bear maximum load for the construction. The Cement is to improve the geotechnical properties such as plasticity, compaction and Unconfined Compressive Strength different.

2. Materials

2.1 Bentonite soil

Bentonite are naturally occurring consisting mostly of montmorillonite clay mineral. Sodium bentonites are generally for constructing landfill liners due its high swelling. And sodium bentonite soil is purchased from Pune and chemical properties are shown in table [11].

Table-1: Initial properties of bentonite.

Properties	Values
Liquid limit	371.64
Plastic limit (%)	40
Plasticity index	331
IS classification	CH
Shrinkage limit (%)	10
Specific gravity	2.75
% of clay	67
% of silt	17
% of sand	8
OMC (%)	31.6
MDD(g/cc)	1.48
UCS (KN/m^2)	100.8
Free Swell (ml/g)	18

2.2 Sugarcane Bagasse Ash (SCBA)

Sugarcane is used large industries and mills to make sugar by extract juice. Sugar is used as food product by every person and the waste produced creates a disposal problem. Many researchers are used of SCBA for the soil stabilization and binding the particles of the soil together by reducing the void ratio and increase the shear strength [4].

Table-2: Chemical Composition of Sugarcane Bagasse Ash

Compound	Value (%)
Silica (SiO_2)	70.20%
Aluminum (Al_2O_3)	1.93
Iron (Fe_2O_3)	2.09
Calcium (Cao)	12.20
Magnesium (MgO)	1.95
Potassium (K_2O)	3.05
Sodium (Nao)	-------

2.2 Rice Husk Ash (RHA)

Rice is the primary source of food and waste material dumped into the waste and chemical composition is below in the table [5].

Table -3: Chemical Composition of RHA

Compound	Value (%)
SiO_2	60.80
AlO_3	1.10
Fe_2O_3	2.79
CaO	5.23
MnO	0.38
K_2O	6.58
SO_3	0.52

2.3 Cement

Ordinary Portland Cement (OPC) stabilization is the common technique used to improve the properties of road-base and subbase materials [6].

Table -4: Chemical Composition of OPC Cement

Compound	Value (%)
SiO_2	20.27
Al_2O3	5.32
Fe_2O_3	3.56
Al_2O_3+ Fe_2O_3	8.88
CaO	60.41
MgO	2.46
SO_3	3.17
Loss on ignition	3.55

3. Objective

- To review the existing methods for strengthening the soils.
- To improve the geotechnical properties of bentonite soils.
- To solve the agricultural waste problem.
- To increase the life of the construction work.
- To monitor the effect of different combination of sugarcane bagasse ash and rice husk ash on the engineering properties of bentonite soil including compaction and unconfined compressive strength study.
- To monitor the laboratories test results from various combination of the stabilize
- After monitoring all these aspects coming to certain conclusion regarding the use of sugarcane bagasse ash, rice husk ash and cement to stabilized bentonite soil.

4. Experimental Work

4.1 Standard Proctor Test

This test was conducted on the soil to find out the maximum dry density (MDD) and optimum moisture content (OMC). According to specifications given by IS: 2720 (Part VII)-1980. This test was repeated by replacing some percentage of soil by sugarcane bagasse ash such as 5%, 10%, 15% and 20% of total weight. And also replacing some percentage of soil by rice husk ash such as 5%, 10%, 15% and 20% of total weight. After performed the proctor test and find the MDD and OMC of the agricultural waste (RHA and SCBA) on the different ratio and shown on the below table.

Table-5: Compare the MDD on the different ratio of RHA.

RHA (%)	MDD	OMC
5%	17.06	33.04
10%	17.12	27.27
15%	16.3	30.04
20%	17.09	26.96

In this table we are noticed at 10% of RHA have maximum dry density when RHA mixed in the soil.

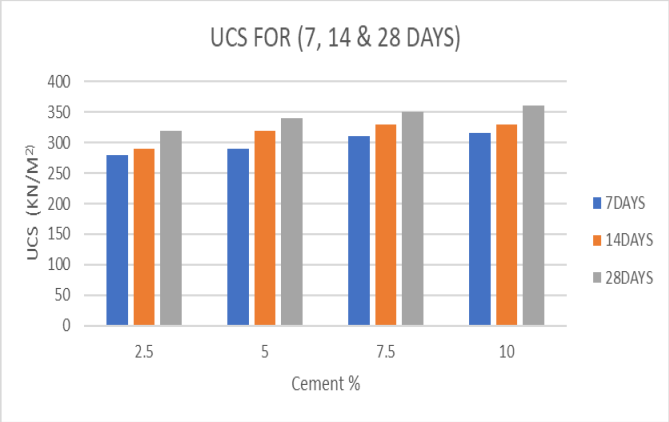
Table-6: Compare the MDD on the different ratio of SCBA.

SCBA (%)	MDD	OMC
5%	17.98	24.01
10%	18.13	24.1
15%	17.87	26.96
20%	17.06	33.03

In this table also noticed at 10% of SCBA have maximum dry density when SCBA mixed in the soil. And now other test performed we knowing that RHA and SCBA have give maximum dry density on 10%. So, fixed the ratio of RHA and SCBA and kept for curing periods 7, 14 and 28 days.

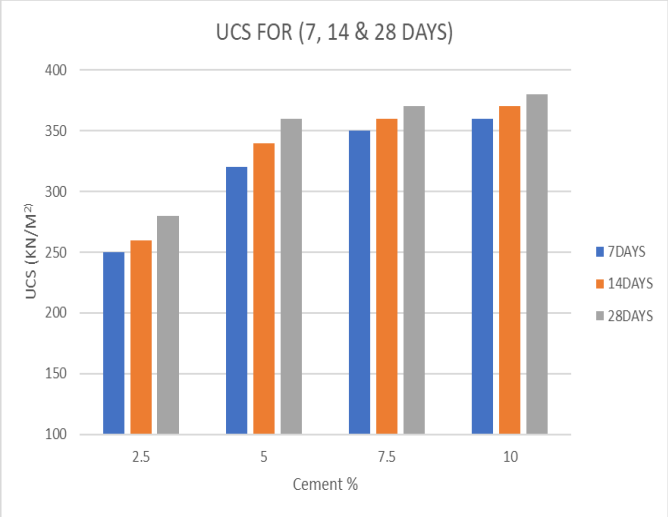
4.2 Unconfined Compressive Strength Test

The UCS test is to determine the shear strength, compressive strength of the soil sample is prepared as per the requirement. According to specifications given by IS: 2720 (Part 10)-1991. The quantity of agriculture waste (RHA and SCBA) is fixed at 10% makes sample were separately and added cement at varying percentage (2.5, 5, 7.5 and 10) % mixed with the soil at varying curing periods of 7, 14 and 28 days [9].



Graph-1: UCS test for RHA and cement.

In this graph, we can see that the cement at 10% added in the soil and RHA gives more strength for curing periods of 28 days.



Graph-2: UCS test of SCBA and cement.

In this graph, we can see that the cement at 10% added in the soil and RHA gives more strength for curing periods of 28 days.

4.3 California Bearing Ratio

California Bearing Ratio (CBR) is the penetration test for subgrade materials. It is used to determine the strength of the soil. The behavior of the load v/s penetration of the subgrade soil treated with agriculture waste (RHA and SCBA) at 10% and the quantity of cement mixed at 10%.

Table-7:CBR test of Sodium bentonite soil.

S. No	Penetration (mm)	Load (kg)
1	0.5	10.5
2	1	19
3	1.5	34
4	2	50
5	2.5	74
6	4.5	92
7	5	100
8	7.5	110
9	10	125
10	12.5	136

Table-8: CBR test of sodium bentonite soil + 10% RHA.

S. No	Penetration (mm)	Load (Kg)
1	0.5	12.6
2	1	25.26
3	1.5	33.32
4	2	39.05
5	2.5	65
6	4	93
7	5	102.12
8	7.5	109.56
9	10	121.45
10	12.5	139.12

Table-9: CBR test of sodium bentonite soil + 10% SCBA.

S. No	Penetration (mm)	Load (Kg)
1	0.5	11
2	1	24.32
3	1.5	31.56
4	2	39.63
5	2.5	62
6	4	94.05
7	5	106.23
8	7.5	110.23
9	10	123.45
10	12.5	140.32

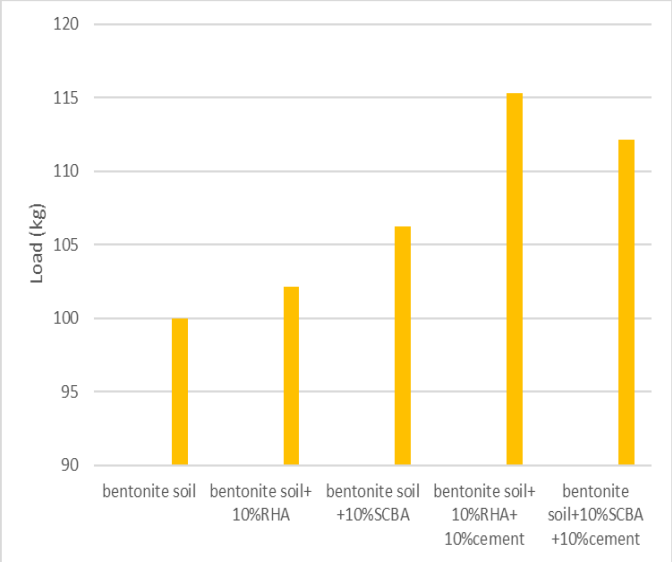
Table-10: CBR test of sodium bentonite soil + 10% RHA + 10% Cement.

S. No	Penetration (mm)	Load (Kg)
1	0.5	27.12
2	1	35.21
3	1.5	56.23
4	2	59.12
5	2.5	68.76
6	4	84.12
7	5	115.28
8	7.5	125.12
9	10	134.56
10	12.5	146.78

Table-11:CBR test of sodium bentonite soil + 10% SCBA + 10% Cement.

S. No	Penetration (mm)	Load (Kg)
1	0.5	22.56
2	1	36.78
3	1.5	49.19
4	2	59.45
5	2.5	70.12
6	4	78.12
7	5	112.12
8	7.5	123.53
9	10	139.16
10	12.5	145.56

COMPARE ALL THE CBR VALUE.



Graph-3: The CBR values are compare.

3. CONCLUSIONS

Sodium bentonite soil is problematic in nature and generally for constructions and due high swelling properties. So, reduced the problem and we can used agriculture waste. From this study following significant observation have been made. The effect of addition of RHA and SCBA.

The following are the conclusions drawn from this paper.

- The standard proctor compaction parameters i.e. varying percentage of (5, 10, 15 and 20) % RHA mixed in Sodium bentonite soil and we can see that at 10% RHA gives maximum dry density.

- The standard proctor compaction parameters i.e. varying percentage of (5, 10, 15 and 20) % SCBA mixed in Sodium bentonite soil and we can see that at 10% RHA gives maximum dry density.
- The UCS Test, we can see that the cement at 10% added in the soil and RHA gives more strength 360 KN/m^2 for curing periods of 28 days.
- The UCS Test, we can see that the cement at 10% added in the soil and SCBA gives more strength 380 KN/m^2 for curing periods of 28 days.
- The CBR value also increases with the increase in the cement. But the maximum CBR value is obtained for the addition of 10% RHA and 10% cement

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