STABALIZATION OF SUBGRADE SOIL USING SUGARCANE BAGASSE ASH (SCBA)

Chandra Pachori[1], Ajeet Saxena[2]

[1]*Student, Dept. of Civil Engineering, Radharaman Engineering College (REC), Bhopal M.P, India*
[2]*Professor, Dept. of Civil Engineering, Radharaman Engineering College (REC), Bhopal M.P, India*

Abstract - Soil is basic and an important element in Civil Engineering field. Stability of every structure depends on the type and characteristics of foundation which in turn depends on the type of soil. Because of its shrinkage and swelling properties, many problems irrupt if sweeping soil, Natural soil is to be used in foundation. There are numerous strategies to make normal soil stable for different developments. Normal soil is agreeable for street work, contrasted with different kinds of soil. There are two approaches to improve the nature of subgrade soil - "Substitution of soil" or "Soil adjustment". Soil adjustment should be possible synthetically or mechanically. Synthetic adjustment is done by including distinctive chemicals in reasonable extent, while Mechanical adjustment is accomplished by expansion of admixtures which enhances the properties of soil. This study has been supported by different types of literatures and a series of laboratory experiments. However, the findings of the research are limited to soil sample considered in this research which is expansive clay. The results are also specific to the type of additives used and test procedures that have been adopted in the experimental work. Therefore, findings should be considered indicative rather than definitive for filed applications.

Key Words: Soil, waste, ash, subgrade, stability, swelling.

1. INTRODUCTION

Sugarcane Bagasse Ash (SCBA) is the organic waste obtained from the burning of bagasse in Sugar mills. The side-effect or deposit of processing sugarcane is bagasse (the fiber of the stick) in which the leftover juice and the dampness from the extraction procedure remain. The sugar processing plants introduce an issue of taking care of the tremendous heft of this material. Sugarcane bagasse cinder demonstrates the nearness of undefined silica, which means that pozolonic properties, capable in holding the dirt grains together for better shear quality. The utilization of Sugarcane bagasse slag as settling material for normal soil can be checked under different tests, for example, grain measure circulation, fluid farthest point, plastic cutoff, Plasticity file, Specific gravity, OMC, MDD, Swelling weight and California bearing proportion (CBR) for drenched and unsoaked conditions. In present study use of sugarcane bagasse ash are used as admixtures for Mechanical stabilization of soil subgrade. Sugarcane Bagasse Ash (SCBA) help to improve important properties like plasticity, swelling and CBR by addition of these admixtures upto 30%. Admixtures used in powder form, mixed with soil in various ratios to modify the properties and to study the change in soil properties.

Today, world faces a serious problem of disposal of large quantities of agricultural and industrial waste like Sugarcane bagasse ash etc. The disposal of these wastes without proper attention creates hazardous impact on environmental health. So Sugarcane bagasse ash is used in this project because these waste materials are also low cost.

2. Literature Survey:

Debarati Jana, S. Yamini & Pavan Kumar N. (2018) Soil is very important in civil engineering construction. The poor engineering property of local soil provides difficulties for construction and therefore its need to improve their engineering properties. These include soil replacement, preloading, and chemical stabilization. Soils are may classify different types (sandy, silty, loamy, and peaty, clay, chalky) in this present study, we considered sandy red soil; and by using sugarcane fibres, lime admixture to improve the strength of soil. This study was oriented towards improving the strength of soil by using locally available agricultural fibres to reduce the construction cost. The strengthening agent like Sugarcane fibres (SCF) is added in the soil. The addition of sugarcane fibres with lime, increases specific gravity consistently from 2.34 to 2.42, liquid limit consistently from 28.80 to 29.02, plastic limit value has increased from 22.5 to 28.83, the CBR test consistently from 3.34 % to 5.68%.Further research could be carried out on the investigation on the Strength of the Soil under different admixtures such as we can even strengthen the soil by adding different admixtures like fly ash, marble dust, egg shell, quarry dust.

Er. Manish Kumar Suman, Er. Sumit Shringi & Dr. Biswajit Acharya (2018) This study analyses the use of lime and sugar cane bagasse ash (SCBA) as chemical stabilizers in compacted soil blocks. The blocks were tested for flexure and compression in a dry and a saturated state. The tests were performed at 7, 14 and 28 days of age in order to evaluate the effects of the addition of lime and SCBA on the mechanical properties of the compacted soil blocks. The results indicate that blocks manufactured with 10% of lime in combination with 10% of SCBA showed better performance than those containing only lime. It was also concluded that the combination of SCBA and lime as a replacement for cement in the stabilization of compacted soil blocks seems to be a promising alternative when considering issues of energy consumption and pollution. The results showed that sugarcane Bagasse ash improved the geotechnical properties of the soil samples. Sugarcane bagasse ash was therefore found as an effective stabilizer for sub grade soils. With increase percentage of bagasse ash, moisture content of soil samples decreases while dry density increases. Increasing percentage of bagasse ash increase the specific gravity of soil samples and decreases the water content. Liquid limit continuously decreases with increasing percentage of bagasse ash.

Sudipta Adhikary & Koyel Jana (2016) Rice Husk Ash may be a pozzolanic material that might be doubtless utilized in Soil stabilization, although it's moderately created and freely accessible. Once Rice-Husk is burnt below controlled temperature, ash is created associate degree concerning terrorist organization 25% of Rice Husk's weight. The progress of the Geo-Technical properties of the fine grain soil with fluctuated rates of RHA was through with the encourage of shifted institutionalize research centre tests. The testing program led on mother soil tests by blended with minor rates of rice-husk materials, it's implanted Atterberg limits, "California Bearing Ratio(CBR)", "Unconfined Compressive Strength (U.C.S)" , and "Standard Proctor check ".It was discovered that a general diminishing inside the most dry thickness (MDD) and increment in ideal wetness content (OMC) is appeared with increment of the odds (%) of RHA content and there was conjointly a noteworthy change appeared in CBR and UCS esteems with the ascent in percentages(%) of RHA.

3. Experimental Setup:

Natural Soil

The Natural soil sample is used in this project were taken from Radharaman Institute of Technology & Science **(RITS), Bhopal (M.P**) from depth of 2.5 m from ground level. It contains deleterious substances and of various sizes. The soil was air dried and pulverized manually. The color of this natural soil is grey and black.

Figure No. 1: Natural Soil Sample

Sugarcane Bagasse Ash

Sugarcane bagasse ash is taken from Sugar (Mill) Gadarwara, Narsinghpur (M.P) which is utilized in this project. The burning of sugarcane produces pulp ash that may be stuff. Presently in sugar factories pulp is burnt as a fuel thus on run their boilers. This ash is mostly meet farms and dump in ash pool that causes environmental issues conjointly analysis states that geographic point exposure to dusts from the process of ash will cause the chronic respiratory organ condition pneumonic pathology, additional specifically noted as alveolitis. Thus, there's nice want for its employ, conjointly it's found that pulp ash is high in silicon oxide and is found to possess pozzolanic property thus it may be used as substitute to construction material.

Particles Size Analysis of SCBA

The particle size dispersions of the Bagasse fiery debris were resolved utilizing the (AFS) details. 100g every one of the dried fiery remains was taken and presented unto an arrangement of sifters masterminded in diving request of fineness and shaken for 15 minutes which is the prescribed shaking time to accomplish finish characterization. The weight held on each sifter was taken and communicated as rates of the aggregate example weight. From the weight held, the grain fineness number (AFS) was figured.

Figure No. 3: Sugarcane Bagasse Ash Sample

The Grain size analysis on natural soil and the soil-additive mixture were conducted according to I.S. 2720 (Part IV):1975.

Table -1: Grain Size Distribution of N sample

S. N.	Sieve No.	Wt Retained in (gm)	% age Wt Retained	Cumulative retained (%) (V)	% of finer (100-V)
1	10 mm	91	9.1	9.1	90.9
2	6.8 mm	58	5.8	14.9	85.1
3	4.75 mm	37	3.7	18.6	81.4
4	2.36 mm	71	7.1	25.7	74.3
5	0.85 mm	177	17.7	43.4	56.6
6	0.425 mm	349	34.9	78.3	21.7
7	0.150 mm	186	18.6	96.9	3.1
8	0.075 mm	16	1.6	98.5	1.5
9	pan	15	1.5	100	0

Plastic Limit of N Sample:

Table No. 2: Plastic Limit of N Sample

S. N.	Particular	Trial-1	Trial-2	Trial-3
1	Container No.	22	23	24
2	Wt of container + Wet Soil (gm)	33.57	57.75	51.67
3	Wt of container + dry Soil (gm)	30.52	54.53	45.16
4	Loss of Moisture (gm)	3.05	3.22	6.51
5	Wt of container (gm)	15.12	38.36	18.34
6	Wt of dry Soil (gm)	15.54	16.17	18.82
7	Moisture Content (%age)	18.8	17.91	18.17
8	Average Plastic limit (% age)	17.8		

From the result shown in Table 3 the values of Plastic Limit are 17.8%.
Plasticity Index = Liquid Limit – Plastic Limit

= 27 - 17.8
= 9.2 %

Liquid Limit of N sample:

Table -3: Liquid Limit of N sample:

S. No.	Particular	Trial -1	Trial -2	Trial -3	Trial -4	Trial -5
1	No of Blows	17	22	27	30	34
2	Container No.	12	13	14	15	16
3	Wt of container + Wet Soil (gm)	67.55	56.42	34.72	38.72	45.54
4	Wt of container + dry Soil (gm)	56.84	48.34	31.31	34.51	40.15
5	Loss of Moisture (gm)	10.71	8.08	3.41	4.21	5.3
6	Wt of container(gm)	28.28	17.48	18.25	18.17	18.25
7	Wt of dry Soil (gm)	38.56	30.86	13.06	16.34	21.9
8	Moisture Content (%)	27.77	26.18	26.11	25.76	24.2

Specific Gravity:

Table No. 4: Specific Gravity of N sample

Observation	Sample
Empty wt. of bottle(W_1)	644
Bottle wt.+ Dry Soil wt.(W_2)	844
Bottle wt.+ Soil wt.+ Water wt.(W_3)	1626
Bottle wt.+ Water wt.(M_4)	1502
Specific gravity(G)	2.64

From the result shown in Table No. 4 the values of Specific Gravity are **2.64.**

The results obtained by laboratory test performed to determine various engineering properties are presented and detailed discussion regarding the results is elaborated which is shown by Table No. 5:

Table No. 5: Summary for Index Properties of N Sample

S.N.	Parameters	Value
1	Grain Size Distribution	
	Gravel (%)	18.60
	Coarse Sand (%)	7.10
	Medium Sand (%)	52.60
	Fine Sand (%)	20.2
	Silt and Clay (%)	1.5
2	IS Soil Classification	CL
3	AASHTO Classification	A-6
4	Liquid Limit (%)	27
5	Plastic Limit (%)	17.8
6	Plasticity Index (%)	9.2
7	Specific Gravity	2.64

California Bearing Ratio for N Sample
(A) California Bearing Ratio for Unsoaked N Sample

CBR test conduct on N (Natural Soil Sample) and optimum percentage of CBR value is found out which is shown by Table No.6 and Its graphical representation are shown by Figure No.6

Table No.6: Unsoaked CBR Test for N Sample

S.N.	Plunger Penetration	Dial Reading	Applied Load (Kg/cm^2)	CBR (%)
1	0	0	0	
2	0.5	11	27.21	
3	1	20	49.47	
4	1.5	26	64.31	
5	2	33	81.63	
6	2.5	39	97.82	7.14
7	3	43	106.36	
8	3.5	48	118.73	
9	4	52	128.63	

10	4.5	55	136.05	
11	5	58	143.47	6.97
12	5.5	62	153.36	
13	6	65	160.78	
14	6.5	68	168.2	
15	7	71	175.63	
16	7.5	74	183.05	
17	8	77	190.47	
18	8.5	80	197.89	
19	9	82	202.84	
20	9.5	84	207.78	
21	10	86	212.73	
22	10.5	88	217.68	
23	11	90	222.62	
24	11.5	92	227.57	
25	12	94	232.52	
26	12.5	95	234.99	

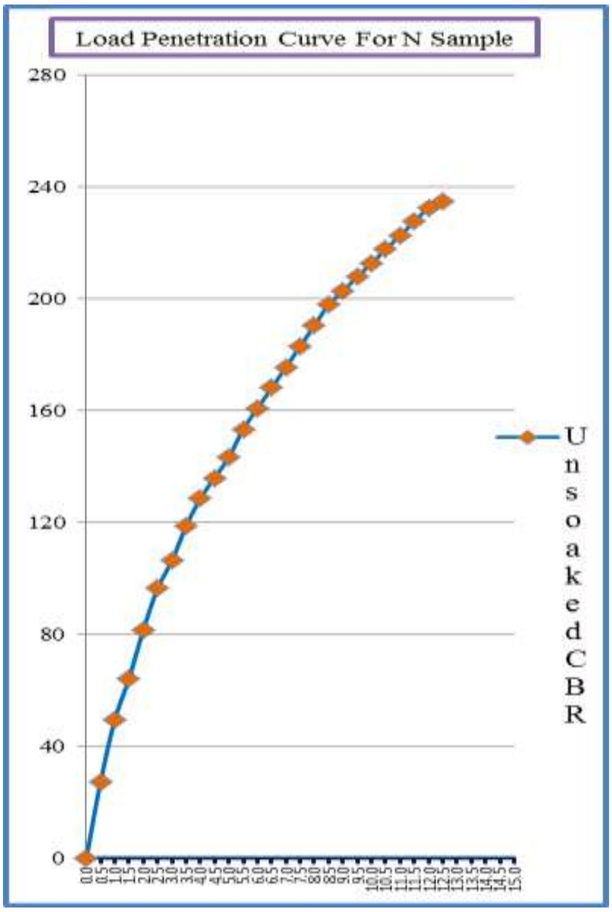

Figure No.5: Unsoakesd CBR of N Sample

- Unsoaked CBR Value for N Sample= **7.14 %**

(B) California Bearing Ratio for Soaked N Sample

CBR test conduct on N (Natural Soil Sample) for 96 Hours and optimum percentage of CBR value is found out which is shown by Table No.7 and Its graphical representation are shown by Figure No.7.

S.N.	Plunger Penetration	Dial Reading	Applied Load (Kg/ cm^2)	CBR (%)
1	0	0	0	
2	0.5	6	14.84	
3	1	10	24.74	
4	1.5	14	34.63	
5	2	18	44.52	
6	2.5	21	57.95	4.23
7	3	25	61.84	
8	3.5	28	69.26	
9	4	31	76.68	
10	4.5	33	81.63	
11	5	35	84.46	4.11
12	5.5	38	94	
13	6	40	98.94	
14	6.5	42	103.89	
15	7	44	108.84	
16	7.5	45	111.31	
17	8	47	116.26	
18	8.5	49	121.21	
19	9	50	123.68	
20	9.5	52	128.63	
21	10	53	131.1	
22	10.5	55	136.05	
23	11	57	141	
24	11.5	58	143.47	
25	12	60	148.42	
26	12.5	61	150.89	

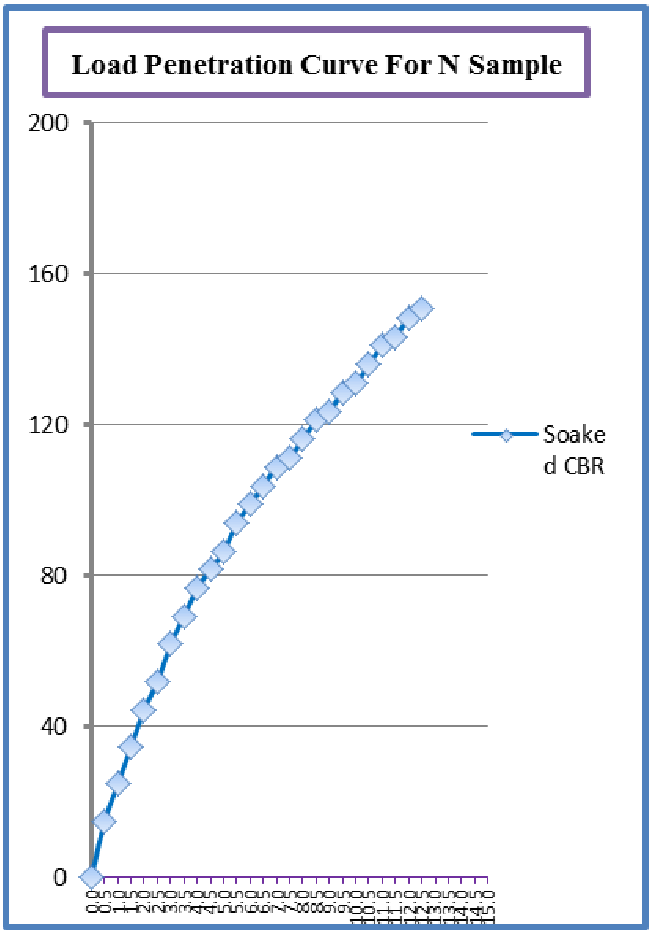

Figure No.6: Soaked CBR of N Sample

- Soaked CBR Value for N Sample = **4.23 %**

Swelling Pressure Ratio N Sample

Swelling pressure = Dial gage reading × 0.01
= 211× 0.01
= 2.11 %

3. CONCLUSIONS

In this research Sugarcane Bagasse Ash (SCBA) is used as mix to Natural Soil (CL) with varying their percentages are used and to evaluate its properties like Grain Size Distribution, LL, PL, PI, OMC, MDD, CBR and Swelling Pressure. Based on the investigation, following conclusions are drawn:

- In Grain Size Distribution, major a part of the soil belong to sand, it's been discovered that increasing share of SCBA decreases the gravel content and will increase the silt and clay content in soil mixture. Investigation conjointly shows that everyone soil mixture belongs to **CL** category per IS classification and **A-6** category below AASHTO classification.
- The results of Liquid Limit tests on natural soil goes on decreasing from **27 to 17%,** when SCBA Sample is mixed from 0 to 20% and increases from **17% to 22%** when SCBA Sample is mixed from 20 to 30% and further the value for 100% SCBA, the sample shows non plastic behavior same as for RHA.
- Plastic Limit tests of natural soil goes on decreasing from **17.80% to 10.80%**, when SCBA Sample is mixed from 0 to 20%, is increases from **10.80 to 14.40%** when SCBA Sample is mixed from 20% to 30%.
- Plasticity Index of natural soil decreases from **9.20% to 6.20%**, when SCBA Sample is mixed from 0 to 20 % and is increases from **6.20 to 7.60%** when SCBA Sample is increased mixed 20% to 30%.
- Specific Gravity of natural soil decreases from **2.64 to 2.39** with increase in percentage of SCBA from 0 to 30% and **1.89** for 100% SCBA.
- The results of Optimum Moisture Content of natural soil increases from **12.28 to 24.12%** and for 100% SCBA, value of Optimum Moisture Content is **47.21%** and Maximum Dry Density decreases from **1.87 g/cc to 1.46 g/cc** from 0 to 30% of SCBA and the value are **0.97 g/cc** for 100% SCBA. .
- The results of Unsoaked CBR of natural soil increases from **7.14 to 17.46%** when SCBA sample is mixed from 0 to 20% with natural soil and decreases from **17.46 to 12.23%** when SCBA Sample is mixed from 20% to 30% with natural soil and for 100% SCBA sample is **8.54%** and the Soaked CBR of soil increases from **4.23 to 9.13%** when SCBA sample is mixed from 0 to 20% and decreases from **9.13 to 5.89%** when SCBA Sample is mixed from 20% to 30% and for 100% SCBA sample is **5.44%.** In Soaked and Unsoaked CBR test on soil sample it has been observed that 20% SCBA mix withj Natural Soil sample gives maximum value of CBR in both conditions.
- The results of Swelling Pressure of natural soil decreases from **2.11 to 0.68** when SCBA sample is mixed from 0 to 20% and increases from **0.68 to 1.32** when SCBA Sample is mixed from 20% to 30% and for 100% SCBA is **1.97.**

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