iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VIII **Month of publication:** August 2021

DOI: https://doi.org/10.22214/ijraset.2021.37315

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

Soil Stabilization Using Plastic Chips, Granules & Sugarcane Bagasse Ash Mixture

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Abstract: ***Soil is mainly the foundation of structure, that actually supports the structure from its beneath and hold it for a life long time and spread the load uniformly. If the stability of a soil would not be proportionate enough to hold or to support the structure then the chances of the breakdown of the structure might occur in the true form of its settlement and development of cracks. So, the soil stabilization will help in enhancing the shear strength of the soil as well as it enhancing the shrinkage and swelling properties of soil. It will also help in increasing the load bearing capacity of our soil in support of foundations and pavements. Soil stabilization can also be done by using the various admixtures such as lime, fly ash, cment etc. but in present day, these admixtures happen to be more expansive to be use as soil stabilizing mixture. So this problem is demanding an alternative solution in making the soil stabilizing process cheap and economic by using wastes as a stabilizer.This research work present the use of excess waste generated in our present and make it hazardeous. India generates nearly around 2600-2700 tons of plastic wastes everyday which is seriously one of the major problems not too for the India but also for the whole world. The harmful gases being generated by the various plastics such as furnace, dioxin, mercury e.t.c. into the open atmosphere and have a threat to our vegetation, humans life and animals as well. In the past recent years, the researchers from the various fields have attempt their best to solved the ecological problems occurred by plastic. But our major motive of this project is to properly analyse the potential capabilities of using plastic types as a stabilizer as well as sugarcane bagasse and its ashes. Bagasse ash as we all know, spread generally over the farms and dumped in ponds which causes severe environmental problems and also many researchers stated that ashes being dumped in the open workplace exposure can cause chronic lung infections. So there is seriously a major concern to reuse the sugarcane bagasse ash. This new techniques of soil stabilization could be essentially meet the various challenges in terms environmental concern. Plastic wastes being converted into chips will be used as a reinforcement in stabilizing the soil. So recommendation of using plastic waste and bagasse ash as a soil stabilizer will reduce the problem of disposing wastes and also helps to reduce the environmental problems.***

Keywords: Soil stabilization, Soil, Plastic waste, Plastic waste granules, Sugarcane bagasse ash, CBR, UCS, DST, Enviromental concern.

I. INTRODUCTION

In India, during the modern time period of soil stabilization, which has begun in the early 1970s. with an actual deficiency of aggregates and petroleum compounds, It has become requisite for the engineers to overlook the matter to improve the soil other than thinking of substituting the poor quality soils at the construction or building constructing sites. The Soil stabilization used to adopted in early times but due to the shortage of methods and moreover due to the unavailability of proper techniques and accurate methods, soil stabilization has lost its favour. In recent times, with the rapidly increase in the demand for modern infrastructure, fuels and some of the raw materials, the soil stabilization then started coming back into its existence. But, with the presence of betterment of research, varieties of specified materials as well as equipments, these all emerge as the cost effective method for the improvement of weak soils. Here, in this specfied work, the soil stabilization, that has been performed with the help of the randomly accumulated plastic wastes being converted into chips and a granule like shapes by the help of plastic machine cutter and sugarcane bagasse ash to the improvement of the shear strength parameters, compactive effort and to endure the bearing strength of the poor soil.So, soil stabilization can be applicable on the highway embankments, earthen bunds, soil under footing, retaining walls, as well as layers of subgrade soil. Soil stabilization using some fibres was the first explained by the researcher Heni Vedal in 1996, which has include in his study about the introduction of the materials which is tensile in nature to be added into the soil mass to improve the strength behaviour and its properties like stability, bearing capacity and deformation. Technically, we aware that the tensile strength of the soil mass is almost negligible whereas, soil has higher compressive strength comparatively to it, it is limited by the shear resistance of the soil.

II. LITERATUERE REVIEW

Ken C. Onyelowe, studied the "Cement stabilized lateritic soil with the admixture sugarcane bagasse ash". In this study, he has collected the soil from the depth of below 1.6m so to avoid the top soil. Then the sampled soil was being stabilized and prepared using 4% & 6% cement with respect to the weight of the soil and mixing the different variations of bagasse percentage, ranging from 2%,4%,6%,8%,10% with respect to the weight of dry soil mass. In this study, OMC, CBR & MDD test were conducted on the prepared mix. of soil sample with the cement as well as bagasse ash as an admixures. Afterwards, the result concluded of optimum moisture content(OMC), California bearing ratio(CBR), Maximum dry density(MDD) that too for the 4% & 6% cement content with the varies percentage of 2% weight of bagasse ash and so on . The study find out that, there is a fall in the values of (MDD)maximum dry density whereas there is a increase in the maximum dry density with the increase in MDD but with the increase in the content of bagasse ash at 6% of cement content.And the optimum moisture content values rapidly increase with the increasing amount of bagasse ash content. In CBR test also, there observed a great improvement in the values of CBR with the addition of bagasse ash in comparison to the naturally driven soil.

Kiran R.G, Kiran L has studied "The analysis of strength characterstic of black cotton soil by using bagasse ash & additive as stabilizer". In this study, the black cotton soil has been taken from the Harihara,dist.Davanagere, Karnataka. Since there is a huge availability of this type of soil which is cohesive in nature, highly clayey and high amount of shrinkage and swelling properties. So, to stabilize this type of soil which the agricultural waste is prove to a biggest challenge. So the researcher has decided to stabilize this black cotton soil sample with the different concentration of sugarcane bagasse ash such as (4%,8%&12%). Then the strength parameter like UCS, CBR were determined by test performed in laboratory. And through this study, it has observed that the blend results of these test like CBR,UCS with the mixed proportion of bagasse ash with black cotton soil gave the change in density of soil mass, CBR as well as UCS values. The density has got increased from 15.15KN/m3 to 16.5KN/m3 by the addition of 8% bagasse ash with the 8% of cement. After that, CBR values got also increased from 2.12 to 5.12 by the addition of mixture of 4% bagasse ash with the 8% of cement. We have found the huge increase in the values of CBR after the addition of adequate amount of cement and bagasse ash. Therefore , it proves to be suitable for the sub grade layer of the soil. Now the value of UCS test has also increased as we have prepared the sample by adding equal proportion with 8% of bagasse ash and 8% of cement by dry weight of soil. Through this study, it has observed the UCS value has also increased from 84.93KN/m2 to 174.9KN/m2. Therefore this study clarified that with the addition of sugarcane bagasse ash with any stabilizer material as an admixture in a adequate proportion, results into the betterment of the strength properties even of the weak soil.

III.EXPERIMENTAL INVESTIGATION

A. Methodology

The experimental work consist of the following technical steps:

1) Collection and the characterisation of the soil sample for the laboratory investigation
2) Determining the specific gravity(S.G) of soil
3) Determining the index properties of soil also known as Atterbergs limit
a) Test the liquid limit by casagrande's apparatus
b) Plastic limit as well as Plasticity Index of Soil
4) Particles size distribution, done by the sieve analysis
5) Perform the tests by mixing various proportions of soil with plastic chips and similarly with soil and sugarcane bagasse ash respectively.
6) Continue the test until it find the optimum proportion
7) Determining maximum dry density (MDD) and correspondingly Optimum moisture content(OMC) of the soil specimen, by the standard proctor test or modified standard proctor test
8) Determining the shear strength of soil by:
a) Unconfined Compression strength test
b) California bearing ratio test (CBR)
9) These tests will be carried out on individual percentage of the blends. By acquiring the results of all the prepared blends, then the final comparison out of the most suitable additive mixture will bring out respectively.
10) All the mentioned results performed are concluded by IS2720

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

IV. RESULT AND DISCUSSION

A. *Specific Gravity*

1) *Soil sample-I*

TABLE 1
Specific Gravity Values Of Soil Sample I

Pycnometer number	1	2	3
Temperature in °C	28	28	28
Weight of empty bottle(W_1) in gram	470	449.54	480.05
Weight of empty bottle + Dry soil(W_2) in gram	970	949.54	980.23
Weight of empty bottle+ Dry soil+ water(W_3) in gram	1345	1319	1397
Weight of empty bottle+ water(W_4) in gram	1022	1011	1080
Specific Gravity G = $\frac{w2-w1}{(W4-w1)-(w3-w2)}$	2.81	2.58	2.72
Average specific gravity	2.68		

2) *Soil Sample-II*

Table 2. Specific Gravity Values Of Soil Sample II

Pycnometer number	1	2	3
Temperature in °C	28	28	28
Weight of empty bottle(W_1) in gram	450	445	475
Weight of empty bottle + Dry soil(W_2) in gram	949.5	944.71	974.87
Weight of empty bottle+ Dry soil+ water(W_3) in gram	1322	1318	1397
Weight of empty bottle+ water(W_4) in gram	1015	1010	1080
Specific Gravity G = $\frac{w2-w1}{(W4-w1)-(w3-w2)}$	2.67	2.6	2.73
Average specific gravity	2.66		

B. *Index Properties*

1) *Liquid Limit Test*

a) *Soil sample-I*

Table 3: Liquid Limit Test Values Of Sample I

Sample No.	1	2	3	4
Number of Blows	30	18	22	26
Mass of empty container	11	12	13	13.5
Mass of cont. + moist soil in gram	21	22	23	23.5
Mass of cont. + Dry soil in gram	18.3	19.6	20.5	20.9
Mass of soil solids in gram	7.3	7.6	7.5	7.4
Mass of water (Mw/Ms)	2.7	2.4	2.5	2.6
Water content in %	36.98	31.57	33.33	35.51

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

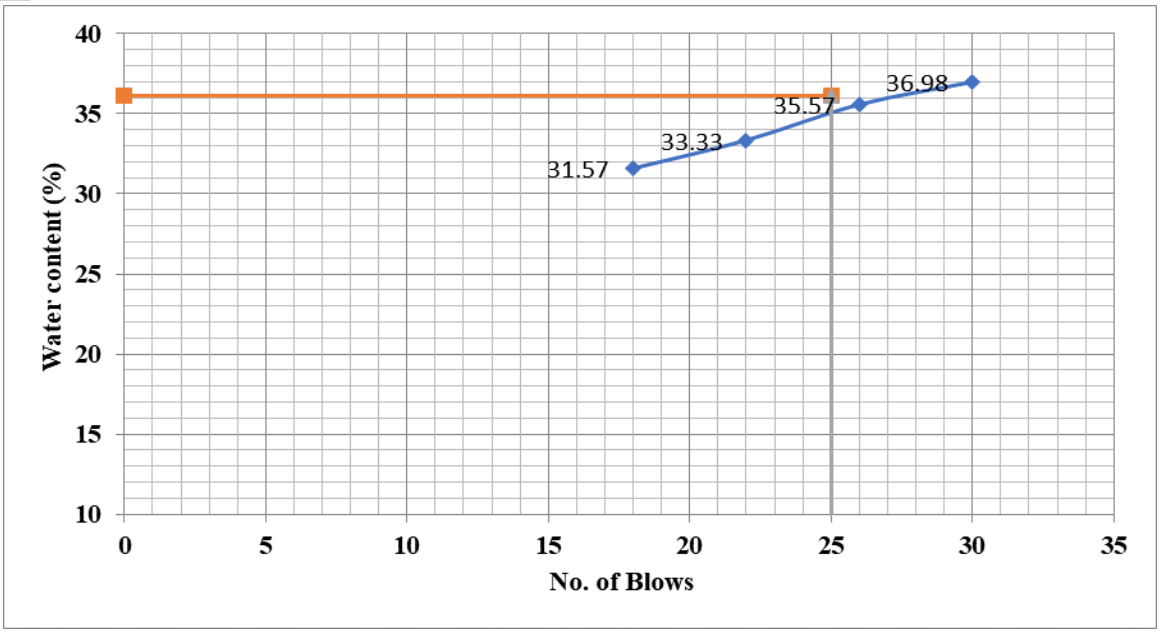

Fig.11: Liquid Limit graph of Soil Sample I

Therefore, from the graph, Water content= 36.13%

b) Soil sample-II

TABLE 4
Liquid Limit Test Values Of Soil Sample II

Sample No.	1	2	3	4
Number of Blows	27	30	32	25
Mass of empty can	12.5	11.5	13	13.5
Mass of can+ moist soil in gram	22.5	21.5	23	23.5
Mass of can+ Dry soil in gram	18.9	18.1	19.8	20
Mass of soil solids in gram	6.4	6.6	6.8	6.5
Mass of water (Mw/Ms)	3.6	3.4	3.2	3.5
Water content in %	56.25	51.5	47.05	53.38

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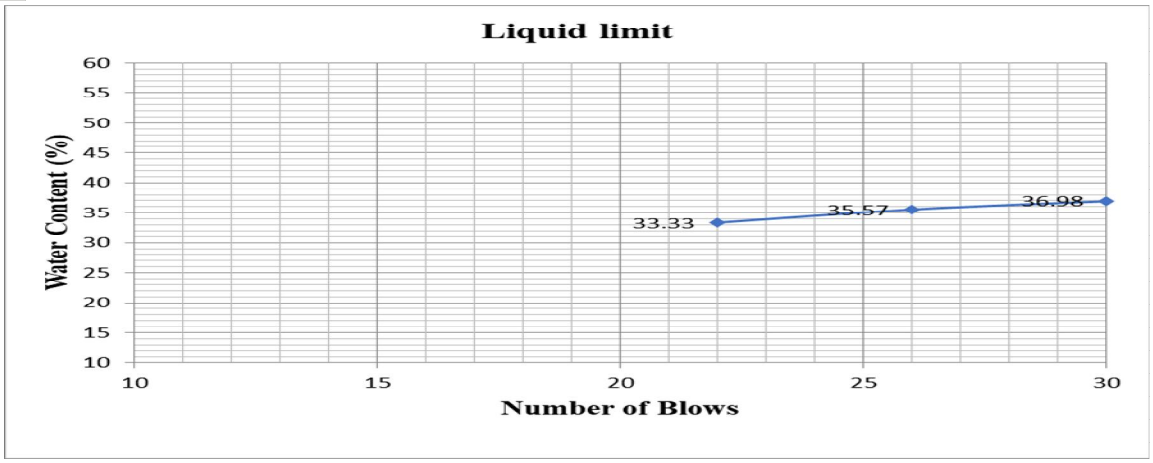

Fig.12: Liquid Limit Graph of Soil Sample II

C. Discussion

1) Interpretation from Unconfined Compression Test:

a) Soil Sample-I: UCS value has increased from 1.657kg/cm^2 to 1.89kg/cm^2 at 5.5% of plastic chips and granules mixed with soil sample. Therefore, net increase in percentage 14.06%. UCS value has increased from 1.657kg/cm^2 to 1.91kg/cm^2 at 8% of sugarcane bagasse ash and mix, mixed with soil sample. Therefore, net increase in percentage 15.26%.

b) Soil Sample-II: UCS value has increased from 1.07kg/cm^2 to 1.22kg/cm^2 at 5.5% of plastic chips and granules. Therefore, net increase in 14.01%. UCS value has increased from 1.07kg/cm^2 to 1.2kg/cm^2 at 8% of sugarcane bagasse mix, mixed with soil sample. Therefore, net increase in 12%.

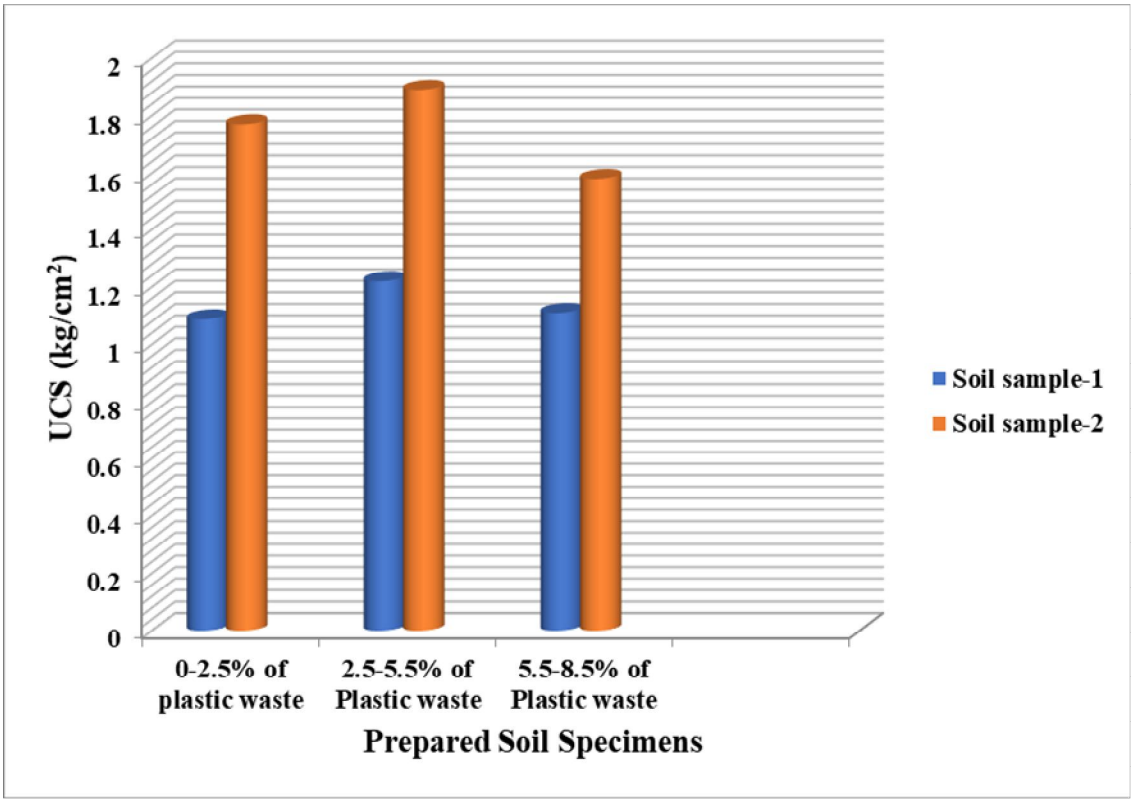

Fig.1: UCS result comparison of Soil sample-I and Soil sample-II mixed with plastic waste chips and Granules

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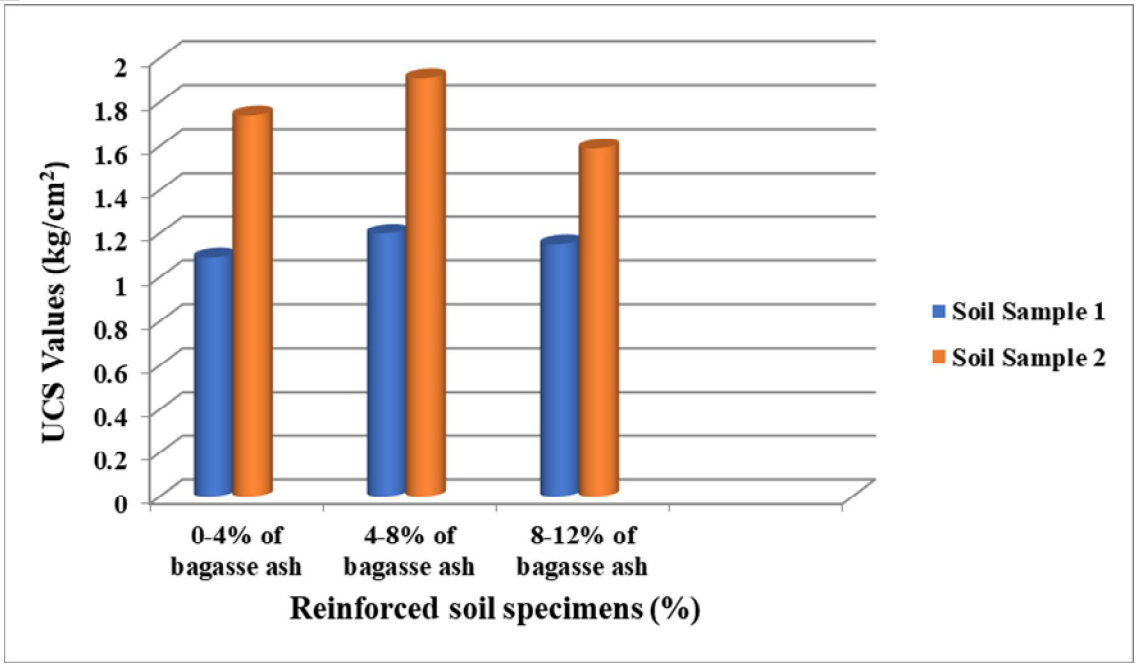

Fig.2: UCS result comparison of Soil sample-I and Soil sample-II mixed with bagasse ash mix.

2) *Interpretation from CBR Test Results*

a) *Soil Sample-I:* The CBR value has increased from 2.03 g/mm^2 to 2.78 at 5.5% of plastic chips an granules mixed with soil sample at 2.5mm penetration. And 4.26 to 4.68 g/mm^2 at 5mm penetration. The CBR value has increased from 2.03 to 2.54 g/mm^2 at 8% of bagasse as and mix, mixed with soil sample at 2.5mm penetration. And 4.26 to 4.45 g/mm^2 at 5mm penetration.

b) *Soil Sample-II:* The CBR value has increased from 2.033 g/mm^2 to 2.65 at 5.5% of plastic chips an granules mixed with soil sample at 2.5mm penetration. And 4.29 to 4.82 g/mm^2 at 5mm penetration. The CBR value has increased from 2.03 to 2.43 g/mm^2 at 8% of bagasse as and mix, mixed with soil sample at 2.5mm penetration. And 4.29 to 4.74 g/mm^2 at 5mm penetration.

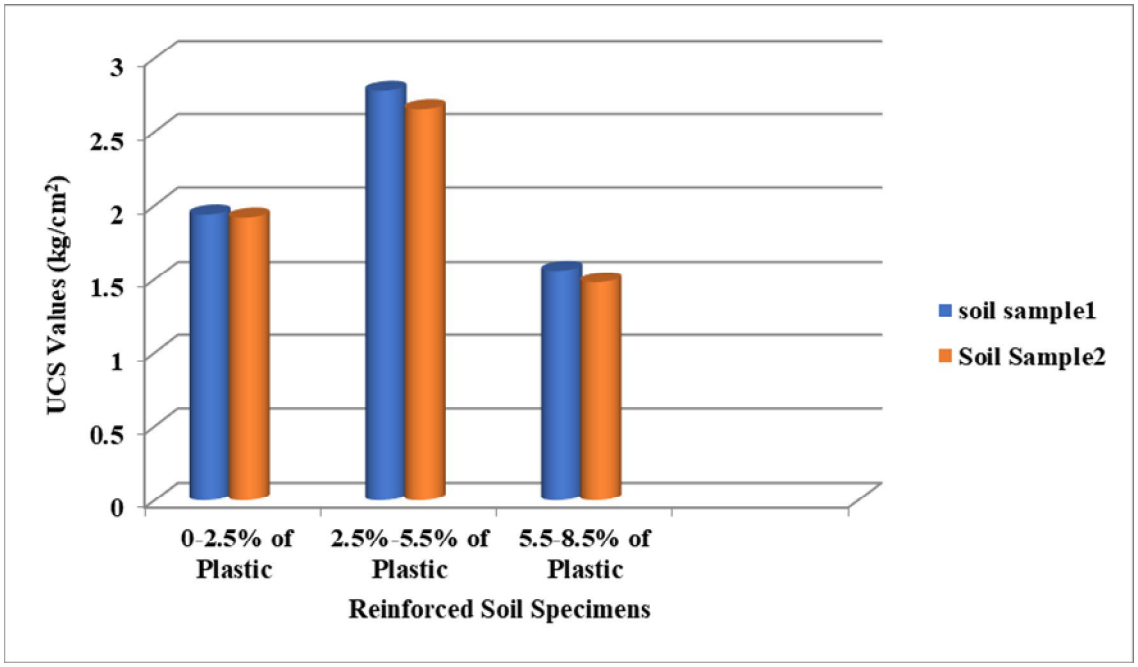

Fig.3: CBR result comparison of Soil sample-I and Soil sample-II mixed with plastic chips and granules @2.5mm penetration.

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Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

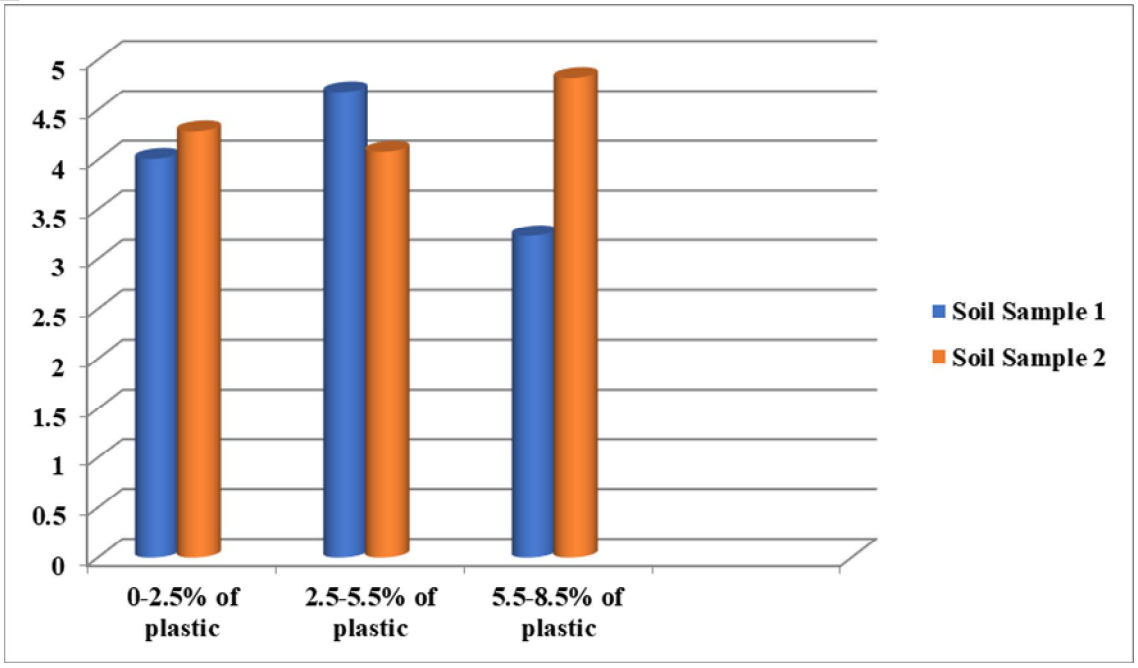

Fig.4: CBR result comparison of Soil sample-I and Soil sample-II mixed with plastic chips and granules @5mm penetration

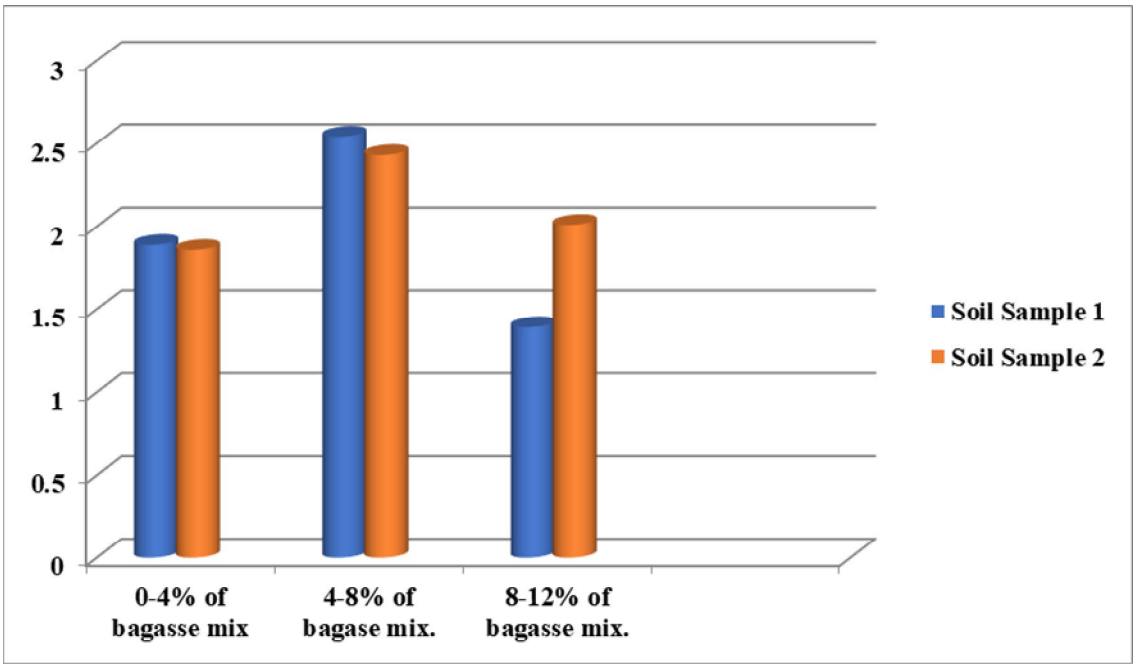

Fig.5: CBR result comparison of Soil sample-I and Soil sample-II mixed with sugarcane bagasse and mix. @2.5mm penetration.

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Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

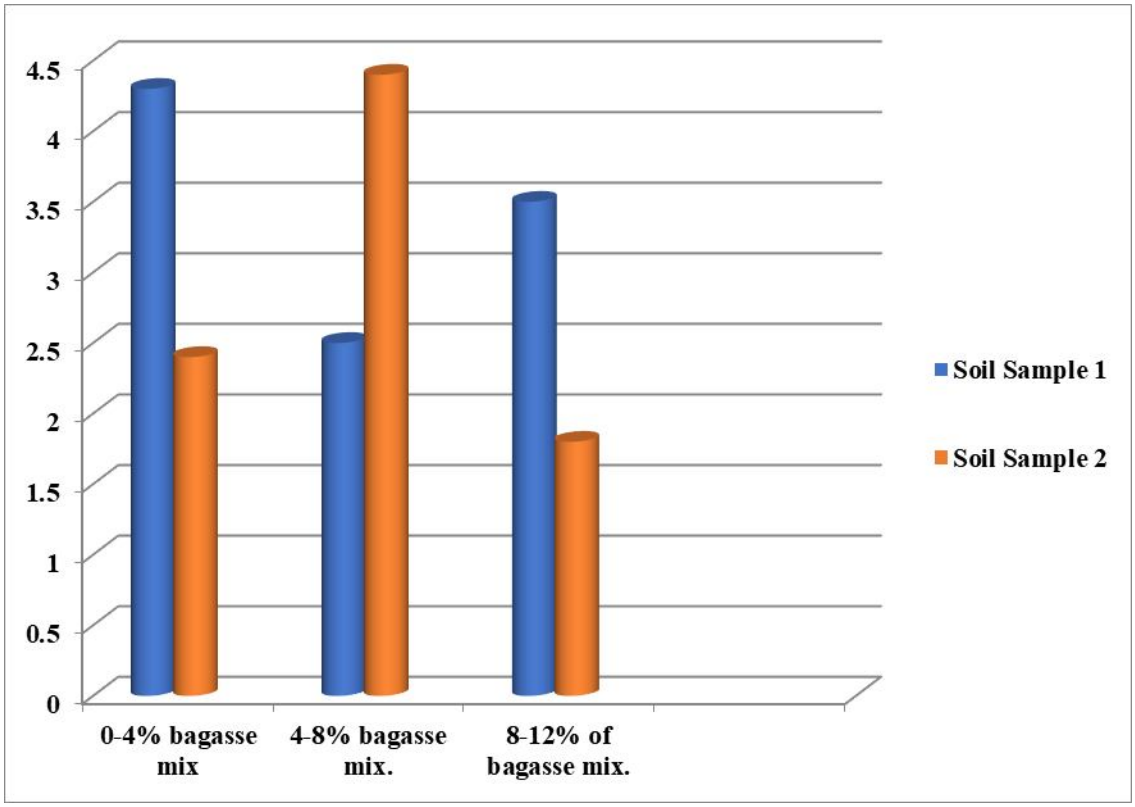

Fig.5: CBR result comparison of Soil sample-I and Soil sample-II mixed with sugarcane bagasse and mix. @5mm penetration.

V. CONCLUSIONS

A. Conclusion Drawn

It is proved by the experimental values, that waste such as plastic and sugarcane bagasse proved to be beneficial in stabilizing the soil by increasing its UCS and CBR value at a certain optimum percentages of mix.

Overall, the weak soil can be stabilize economically by reinforcing these wastes as stabilizer.

The maximum dry density will increase after the replacement of waste such as plastic granules and sugarcane bagasse ash mixture upto a certain percentage replacement of waste , after which decrease in value of MDD has observed. The reason is that bagasse ash has less specific gravity and similarly plastic content will settle down the rate if add maximum in mixture.

The optimum moisture content will decrease as we keep on replacing the soil with its percentage weight of plastic chips granules and bagasse ash.

The shortage of wastage will be observed as well as stabilizing the soil will be done at a certain ratio by weight.

As per the standard proctor test result, it is observed that over all consolidation with respect to time will be lesser as compared to unreinforced weak soil.

CBR value has increased after reinforcing the soil with plastic and bagasse ash. Hence it proved that the prepared reinforced soil can be used as sub grade soil base.

VI. FUTURE SCOPE

One can use the waste plastic bottle directly under the foundation. And test whether the soil will increase in its shear strength value or not. Conduct Direct shear test, MDD, OMC test on the prepared soil sample.

Stabilize the soil with plastic chips as well as plastic waste powder conversion into the soil. And performed all the required test and check the changes occurred in atterbergs limit of the soil.

In the future research, different formation of sugarcane bagasse can be used in the soil for enchancing the strength of soil.

Wooden chips and its pulp bagasse mixture can directly be mixed witht the soil sample.

All the previously added material can be tested in different proportion with respect to the weight of the soil.

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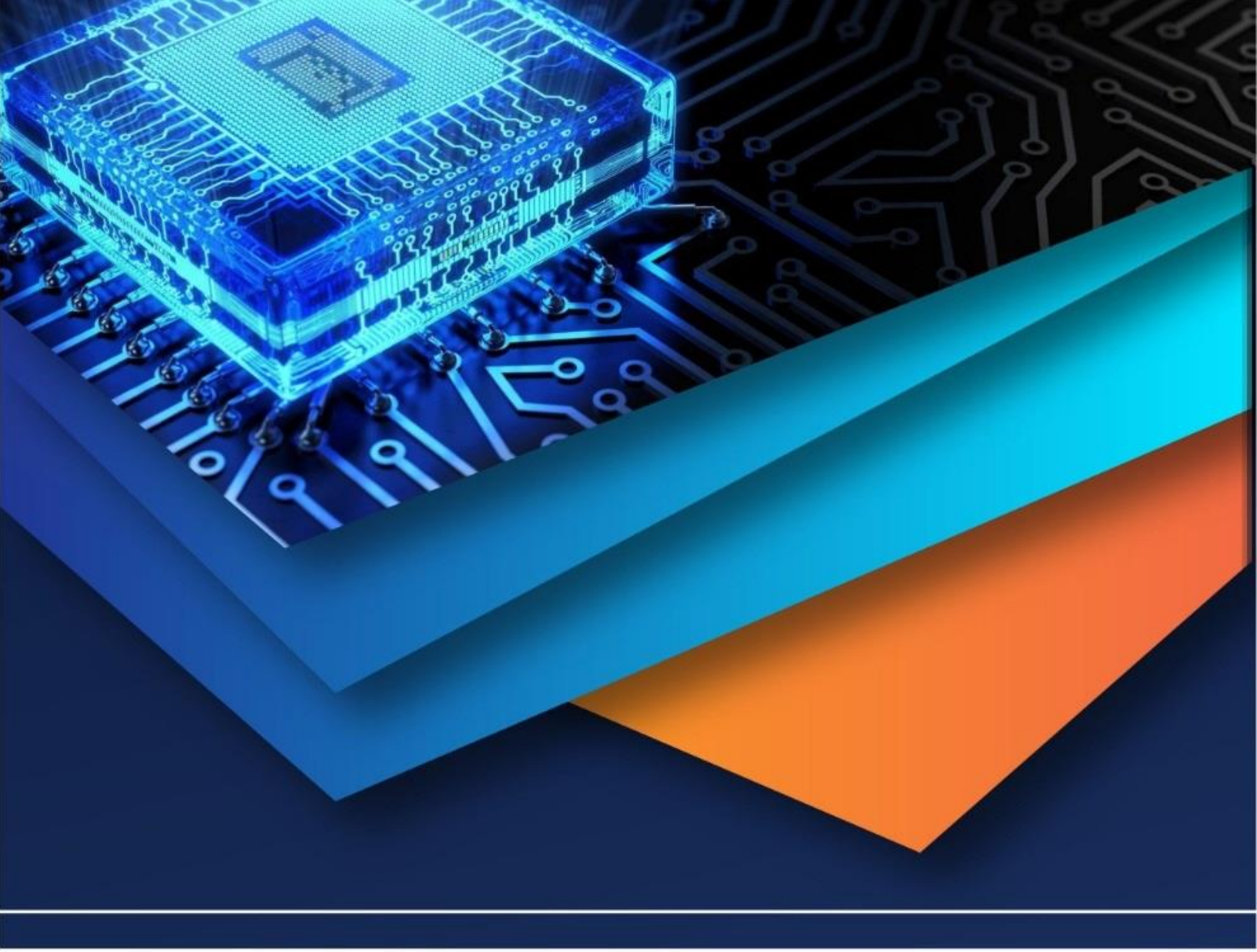

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