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Effect of Sugarcane Industrial Solid Waste on B. C. Soil and Lateritic Soil

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ABSTRACT: The sugarcane industrial waste product is called grit, the lime is added in manufacturing of sugar to make color of the sugar white, to make the sugar white only some sio2 particles are required so the remaining components of lime which is added will be thrown out of factory and then it is used as base fill material for construction of buildings. About 2000 m3 of grit produced everyday and it will be sold out. It may cost about 600rs per 200m^3. so to make use in pavement construction as a sub-grade material some laboratory test has been conducted by varying percentage of grit mixed with deferent type of soil to check the geotechnical properties of soil as well as the strength properties of soil , from the addition of grit we got to know that as the percentage of grit increases the strength properties of soil goes on increase, but we have tested by adding only 5%,10%,15%,and 20% 0f grit and we have gotten the results in increasing order. Due to insufficient time we could not check the geotechnical properties of soil by adding more other different percentage of grit. However we are finding out the immediate effect on the geotechnical properties of soil so we had threat that further addition of grit may damage the soil so that one we have kept for future scope of work.

I. INTRODUCTION

There are many soils which are not capable of bearing the loads which are coming from the super structure. So it needs to strengthen the soil by adding different type of material. Many geo-technologists have done many researches to improve the strength properties of soil. However, in this study sugarcane industrial solid waste is used to check the strength properties of soil.When I conducted the laboratory tests after adding different percentage of solid waste it seemed to be very economical and effective. The soil which has been treated from solid waste can bear large amount of loads, but depending on loads coming from the super structure we need to decide the percentage of the solid waste to be add.

Many researchers have been proved that the black cotton soil is problematic soil since it is susceptible to shrink and swell when water is added to it. The water may be added by means of natural process (rain, water table etc.) or by artificial means (disposal of water from the industry and others). when black cotton soil comes in contact with water gains its size and leads to increase in the volume of the soil mass, as the water present in the soil mass gets off then it starts to regain its original size it leads to shrinkage cracks, finally it leads to failure of structure. so to avoid these problems many researchers did work to improve the soil properties however we decided to use sugar cane industrial solid waste, and this study let us to know that using the solid waste to improve strength properties of soil gives good results and it will be satisfactory .i have added only 0 % - 20 % of solid waste and it has been proved that the strength properties of the soil mass gets increased as the percentage of solid waste increases. I never tried to check the strength properties by adding beyond 20 % of solid waste because my aim was to study only immediate effect, and I thought that addition of grit beyond 20% may cause adverse effect on the soil mass, but I too don't know whether it harms or not, it will proved by future study of this research. The soil like red soil has enough strength and not capable of shrink and swell but sometimes even such type of soil cannot fulfill the needs where we need to construct huge structures and where we need to construct the pavement for more traffic volume. So, in such case we need to improve the strength properties of soil mass, for that purpose only we have selected this soil to improve the strength properties by adding grit. The same process undertakes as happened in black cotton soil when we add sugarcane industrial solid waste in this soil.

Sugar cane industry disposes solid wastes they are called press mud and grit. Grit is a sugarcane industrial waste which is byproduct after consuming the cao content from quick lime which is added to make the sugar white. The required amount of cao is taken and the remaining products will be disposed off. About 20 tonne of grit will be producing everyday and it will be disposed off, so to make use of it this material has been used in this study to test the effect on strength properties on lateritic soil and b.c soil mass.

II. MATERIALS AND METHODOLOGY

Many effluents and solid wastes are available to introduce in soil to make the soil strengthen, the effluents may be in the form of liquid 0r solid could be used for improving the geotechnical properties of the soil mass. The property of the material depends on where it brought from. Different location and the different condition of environment of soil mass has different engineering and geotechnical properties. So it's been proved that the reaction between soil mass and effluent changes a bit. So, in this the materials have been brought from the nearby area where the laboratory tests are to be conducted.

Materials Used:

1. Black cotton soil
2. Lateritic soil
3. Sugar cane industrial lime waste (grit)

Black Cotton Soil: The region about 3.5km from Bhalki,bidar district from where the sample were collected.the land was diggedupto 1m from the level surface of the ground by means of chisel and sample were collected. In this study many basic tests used to conduct and the results obtained have been tabulated in the table 3.1.

Lateritic soil: The region about 14 km from Bhalki,bidar district from where the sample were collected.the land was diggedupto 1m from the level surface of the ground by means of chisel and sample were collected. Results obtained are tabulated in the table 1.

Table 1: Basic Test Results Of Lateritic Soil And B.C Soil

Properties	Values Obtained For Lateritic Soil	Values Obtained For B.C Soil
Field Density	14.5 KN/m³	12.8 KN/m³
Specific Gravity	2.42	2.7
Optimum Moisture Content	11.6 %	23.5 %
Maximum Dry Density	1.78 g/cc	1.64 g/cc
Sieve Analysis	About 46.9 % Of Soil Is Passing Through The Sieve Of 600mm	About 52.8 % Of Soil Is Passing Through The Sieve Of 600mm
Plastic Limit	17.2%	37 %
Liquid Limit	35.8 %	66.4%
Plasticity Index	18.6 %	29.4%
Unconfined Compressive Strength	402.2 kpa	269.4kpa
California Bearing Ratio	8.42 %	2.59%
Classification Of Soil	MH	CH

Sugar Cane Industrial Solid Waste(Grit): The particals which has been disposed by sugar cane industry after being consumed the partially caoparticals from the lime is named as grit. The soild industrial effluent has been brought from the mahatma gandi sugar cane industry which has been located about 1km far from hunji(a) , Bhalki talluk and bidar district. The collected effluent will be added to balck cotton soil and red soil which we had colleted from the near by field of Bhalki to conduct the laboratory test to find out the engineering properties and strength properties of soil before conducting the laboratory test on mixed soil we needed to find out the effect of solid effluent on black cotton soil as well as red soil, however after being conducted the laboratory test it seemed more effective to use as subgrade material in pavement.

Table 2: Chemical And physical Properties of Sugarcane Industrial Solid Waste (Grit) :

Particulars	Values
Appearance	White in color
Odour	Odourless
Silica	67 %
Calcium Oxide	22%
Carbonic Acid	1.02%
Alkalies	0.9%

Fig. 1. Sugarcane Industrial Solid Waste(Grit).

To improve the engineering properties of soil as soon as we add solid effluent and water in the soil suddenly there will be agglomeration and flocculation process takes place this process results in increase in OMC at the same time decrease in the Dry Density of soil but this leads to increase in strength properties of soil.

Test Procedures: The laboratory experiments which are given below are the tests which are conducted to check the effect sugarcane industrial of solid waste on soil.

Specific gravity: IS code: 2720 (Part 4/sec-I) was referred to find out the specific gravity by density bottle method for both the soils. Equipment used are pycnometer with conical brass cup,weighing balance, sieve of size 4.75mm, thermometer, Glass rod and distilled water. $G = \frac{\sqrt{s}}{\sqrt{w}}$

Grain Size Analysis: IS code 2720 part 4 1985 procedure is used to get to know the % finer of soil mass, sieve analysis is done by mechanical means. The sizes of sieve between 4.75mm to 75micron are kept vertically in a increasing order and known weight of soil mass is dumped in 4.75mm sieve and the cap is placed on it. At the bottom pan is to b placed to know amount of % passing through the 75micron sieve. Next the sieve will be allowed to sake for about 10-15 min then each sieve is weighed and %finer can be found out.

Liquid Limit: At minimum moisture content soil gets to semi liquid ,meanwhile soil will be having low shearing resistance is termed as liquid limit. Weighing Balance, Casagrande Apparatus, sieve of size 425 micron and Spatula are the equipments which was used to carry this experiment.

Plastic limit: The moisture content at which crumbling of soil mass starts when the soil will be rolled upto 3mm thick thread is termed as plastic limit.

Compaction: Standard proctor test has been involved to know compaction properties of soil. mould which is in cylindrical shape and inside diameter will be 10.15 cm , collar 5cm minimum height, detachable base plate and 2.5 kg rammer falling from height of 31 cm. These are the equipment which involved to conduct standard proctor test.

The soil mass is compacted adding deferent water content to get to know the mud and omc, 25blows will be given to each layer and it will b compacted in 3 equal layers. the soil which is passing through 4.75mm is taken about 2.5kg ,then it will mixed with known quantity of water, by previous study we almost came to know the what will be the water content of soil which we need to study. Depending on that water will be added . After adding water water it will kept in the moist cloth upto 5-25 minutes for saturation after that it will compacted in 3 equal layers by giving 25 blows to each layer.after the soil mass is being compacted the colour will be removed and then subjected to weighing balance to know mass of soil and empty mould after weighing the specimen it will be unmoulded and the small amount of soil mass is collected in a container and it will kept in the ovum for 24 hours to know % of water. Different % of water will be added and the same procedure will be repeated. At the starting the bulk density will be increasing and when it reached to maximum starts to decrease.

Unconfined Compressive Strength Test(UCS):

Sample preparation: The mould whose diameter is 34mm and length 78mm is used for sample preparation of unconfined compressive strength. About 150gm of sample is taken which is passed from 475micron sieve and optimum moisture content which is obtained from standard proctor test will added and mixer will mixed thoroughly until lumbs gets vanish, finally the semi solid paste will poured in 3 equal layers in the mould and compaction is done by giving 25 blows each layer.After compaction that will be unmoulded and the specimen will be trimmed to make the uppersurface smooth. This manner the sample will be by adding different % of grit.

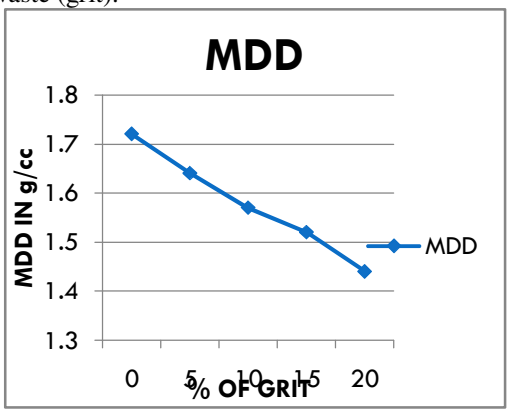
Test procedure: IS code 2720 10th part 1973 has been reffered to carry the ucs test. Loading will be done at a rate of 1.2mm/min strain. The sample is placed on the base plate of ucs equipment and the equipment is un adjusted in such a way that the upper plate will be just touched to top surface of the mould the initial readings will be noted and the loading will be started, the dial gauge reading will be noted down at every 0.5mm interval. Initially loading starts increasing as the specimen gets fail it starts to decrease and then taking reading will be stopped and stress and strain will be calculated.

III. RESULTS AND DISCUSSION

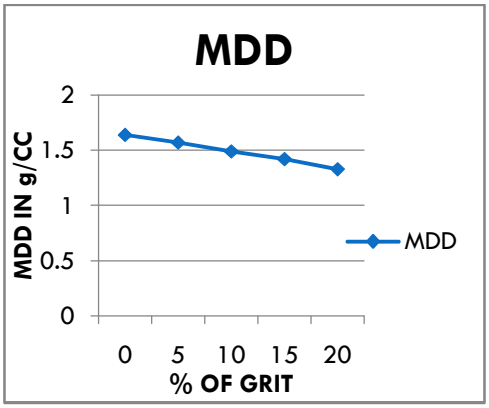
The results which we got from all the experiments have been described in this topic.

Compaction Properties:

Maximum Dry Density: The graph 1 and graph 2for lateritic soil and b.c soil respectively represented MDD verses % of Sugarcane Industry Solid Waste (grit) added.From the graph we can get to know that the MDD getting decreased with increasing in %of sugarcane industry solid waste (grit) due to undergoing reaction called agglomeration and flocculation which leads to change in texture of soil mass. These reaction undergoes only after addition of sugarcane industry solid waste (grit).

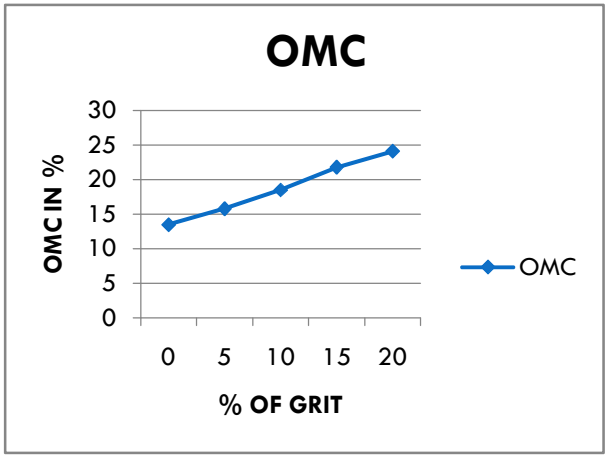


Graph 1 : Variation of MDD of Lateritic soil with increase in Grit Percentage.

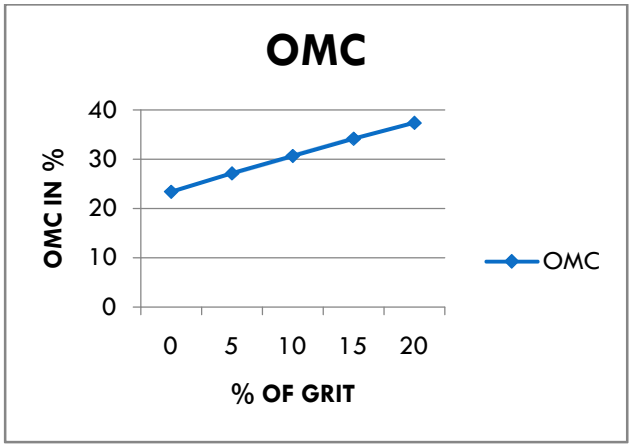


Graph 2 : Variation of MDD of B.C. Soil with respect to increase in grit percentage.

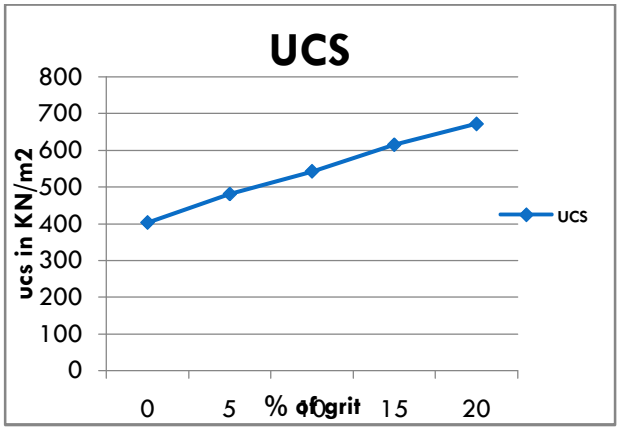
Optimum Moisture Content: The graph 1 and graph 2for Lateritic Soil And B.C soil respectively represents the OMC verses % of Sugarcane Industry Solid Waste (grit). Below graph shows that the increase in OMC happens when we increase the % of Sugarcane Industry Solid Waste (grit).



Graph 3 : Variation of OMC of lateritic soil with respect to increase in percentage if grit.

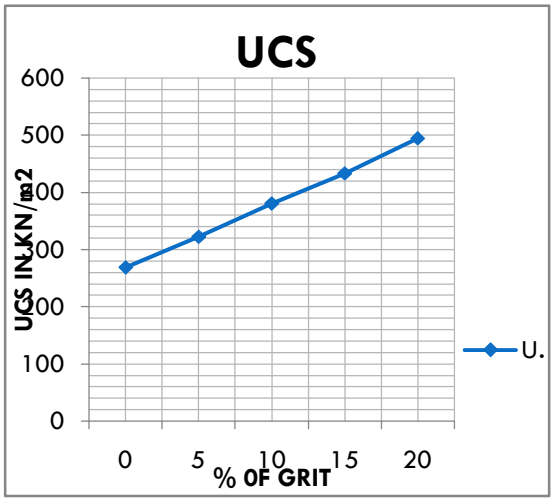


Graph 4 : Variation of OMC of B.C. soil with respect to grit content.



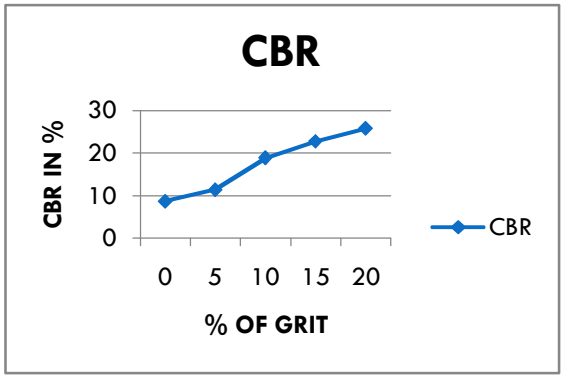
Graph 5 : Variation of UCS of Lateritic soil with respect to percentage of grit.

Unconfined Compressive Strength: The graph 3 and graph 4for lateritic soil and b.c soil respectively represents the UCS verses % of sugarcane industry solid waste (grit). Due to change in texture arrangement in soil mass due to addition of sugarcane industry solid waste (grit) results in tight arrangement of the soil particles this leads to strength gain. From the graph we can get to now that UCS going to increase as the % of sugarcane industry solid waste (grit) increases.

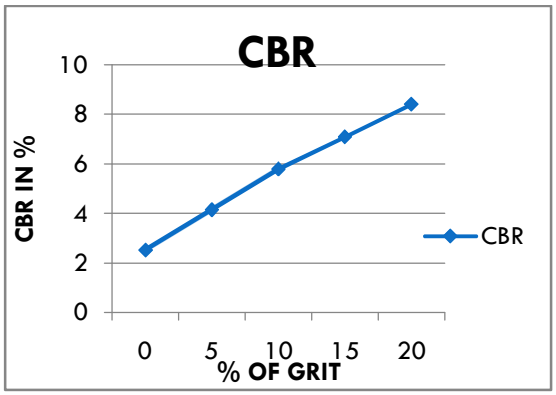


Graph 6: Variation of UCS of B.C. soil with respect to increase in % of grit.

California bearing ratio: The graph 7 and graph 8for Lateritic Soil And B.C soil respectively represents the cbr verses % of sugarcane industry solid waste (grit). The graph indicates that the CBR getting to increased with increase in % of sugarcane industry solid waste (grit).



Graph 7: Variation CBR of Lateritic Soil with respect to % of grit.



Graph 8: Variation of CBR of B.C. soil with respect to grit %.

CONCLUSION

1. Response of the soil mass studied is positive towards the addition of sugarcane industrial solid waste (grit) for Lateritic Soil and B.C Soil.
2. Gradually decreasing of MDD has been found by increasing the content of sugarcane industrial solid waste (grit), at the same time we have also got to know that OMC of the soil mass gets to increased as the % of sugarcane industrial solid waste (grit) increases for Lateritic Soil and B.C Soil.
3. CBR got increased due to increase in the solid waste. By this study we got to know that the CBR got increased about 2.71%,7.51%,3.88% and 3.04% for each 5%,10%,15% and 20% addition of sugarcane industrial solid waste (grit) respectively for Lateritic Soil.
4. From this study we also observed that, for lateritic soil about 17.14% of CBR has been increased after 20% of grit is being added , this results in the reduction of the thickness of the pavement that is for CBR of 25.82 % about 22mm thickness pavement can be constructed for traffic volume of 1500-4500.where as for pure Lateritic soil the CBR value is less that is 8.68 % this results in the higher thickness. Reduction in pavement thickness may lead to less construction cost.
5. CBR got increased due to increase in the solid waste. By this study we got to know that the CBR got increased about 1.63%,1.64%,1.3% and 1.32% for each 5%,10%,15% and 20% addition of sugarcane industrial solid waste (grit) respectively for B.C. Soil.
6. From this study we observed that, for B,C soil about 5.89% of CBR has been increased after 20% of grit is being added, this results in the reduction of the thickness of the pavement.

That is for CBR of 8.42 % about 28mm thickness pavement can be constructed for taffic volume of 45-150 .where as for pure B.C.soil the CBR value is less that is 2.59% this results in the higher thickness. Reduction in pavement thickness may lead to less construction cost.

7. The UCS for all soil gets to increased due to increase in % of sugarcane industrial solid waste (grit). This study shown that about 300% of UCS got increased when the soil is mixed with maximum of 20% of sugarcane industrial solid waste (grit) for Lateritic Soil And B.C Soil for Lateritic Soil And B.C Soil.

8. For Lateritic Soil And B.C Soil the cohesion property of soil getting to decreased ,meanwhile the angle of internal friction getting to increased as the % of sugarcane industrial solid waste (grit) increasing.

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