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EXPERIMENTAL ANALYSIS ON STABILIZATION OF BLACK COTTON SOIL USING BAGASSE ASH, LIME & QUARRY DUST

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Abstract - *Soil stabilization deals with physical, physio-chemical and chemical methods to ensure that the stabilized soil services its intended purpose as pavement component material. This recommended practice describes a method of stabilization of soils by utilizing Bagasse ash with lime & quarry dust to proved a base/ sub base course in the design of road pavement. Bagasse ash is a waste product available from burning of bagasse. The basic principles of soil stabilization include evaluating the properties of given soil and assessing the deficient property due to which the soil is considered weak. It also decides the appropriate method of supplementing the deficient property by the economical and effective methods of stabilization.*

Bagasse ash can be advantageously used not only in the pavement construction work, but provides an useful and economic avenue for disposal of bagasse ash. The research investigated the properties of black cotton soil when stabilized by lime, bagasse ash and combination of lime, ash and quarry dust. The experiment covered grading test, Plasticity index (Atterberg) and California bearing ratio (CBR).

Key Words: **Bagasse ash, lime, quarry dust, atterberg, CBR**

1. INTRODUCTION

Soil stabilization means the improvement of the stability or bearing capacity of the soil by the use of controlled compaction, proportioning and the addition of suitable admixture or stabilizers. Due to lack of suitable soil at many places it need for soil stabilization. The common soil stabilized methods are lime stabilization and cement stabilization, which many be replaced by bagasse ash for economy. This reduces its disposal volume. Stabilization is being used for a variety of engineering works, the most common application being in the construction of road and air field pavements.

Methods of stabilization may be grouped under two main types.

a. Modification or improvement of a soil property of the existing soil without any admixture.

b. Modification of the properties with the help of admixtures. Compaction and drainage are the examples of first type, which improve the inherent shear strength of soil. Examples of second type are, mechanical stabilization, stabilization with cement, lime, bitumen and chemical etc.

In the present study an attempt has been made to improve the properties of Black cotton soil subgrade by stabilization method using bagasse ash, lime & quarry dust. In this investigation laboratory studies were carried to know the effect of bagasse ash, lime & quarry dust when mixed separately and in combination with Black cotton soil by conducting various tests such as plastic limit and CBR tests.

1.1 Objectives

1. To determine optimum percentage of bagasse ash, lime & quarry dust by conducting tests such as liquid limit, plastic limit and plasticity index by varying the percentage of bagasse ash and lime.
2. To study the behavior of different soil using bagasse ash, lime & quarry dust.
3. To determine the optimum moisture content and maximum dry density by conducting the proctor compaction test.
4. To determine the CBR value of BC soil mixed with different percentages of bagasse ash and lime.
5. To reduce the cost of construction of the pavement over black cotton soil by soil stabilization technique with the help of soil stabilizing agent.
6. To utilize the waste materials available in the agro-industries.

1.2 Methodology

- To Determine the Liquid Limit, Plastic limit, Maximum Dry Density (M.D.D), Optimum Moisture Content (O.M.C) & C.B.R value of the Raw Soil.
- Sieve the soil by 20mm & 4.75mm (IS Sieve) to obtain the quantity of 5 kg.
- Mixed the soil by water up to (O.M.C).
- Take the quantity of Jute Fibre by Dry weight of the Soil by following percentage.
- Mix the Jute Fibre layer-by-layer into the soil.
- Test the Doped Soil in C.B.R apparatus to obtain the value of following percentage.

2. Materials used

1. BAGGASE ASH :- The burning of bagasse which a waste of sugarcane produces bagasse ash. Presently in sugar factories bagasse is burnt as a fuel so as to run their boilers. This bagasse ash is generally spread over farms and dump in ash pond which causes environmental problems also research states that Workplace exposure to dusts from the processing of bagasse can cause the chronic lung condition pulmonary fibrosis, more specifically referred to as bagassosis. So there is great need for its reuse, also it is found that bagasse ash is high in silica and is found to have pozollinic property so it can be used as substitute to construction material.

2. QUARRY DUST :- Crushed quarry dust was obtained from the local crusher plants. Quarry dust is a waste product produced during the crushing process which is used to extract stone. It is rock particles. When huge rocks brake in too small parts for the construction in quarries. It is like sand but mostly grey in colour.

3. Lime :-Lime production begins by extracting limestone from quarries and mines.Pure calcium oxide is fused with coke in order to render the highest yield in the manufacture of acetylene. The quality of the resultant carbide lime is a direct result of the excellent quality raw materials. Carbide lime is finer in particle size, and physically, having a very finely divided particlesize makes carbide lime better. A finer particle size means faster and more reactivity.

3. Engineering properties of soil

1. Permeability: It is defined as the property of the soil which allows the passage or seepage of water through its interconnecting voids.
2. Plasticity: It is defined as the property of soil which allows it to deform rapidly without any volume change and without elastic rebound.
3. Compaction: It is a artificial process by which soil particles are rearranged and packed together into a closer state of contact by mechanical means to increase its dry density and decrease its porosity.
4. Compressibility: The property of the soil to reduce in volume under pressure is called compressibility.
5. Shear Resistance: It is the resistance to deformation by continuous shear displacement of soil particles.

4. Experimental Investigation

Determination of liquid limit of soil: Moisture content of the soil which is expressed by the percentage of weight of oven dried soil in between plastic and liquid states of consistency.

Determination of plastic limit of soil: Moisture content of the soil which is expressed by the percentage of weight of oven dried soil in between plastic and semi solid states of consistency.

Plasticity index : Plasticity index of soil is the difference between its moisture content of liquid limit and plastic limit.

CBR test: California bearing ratio is the ratio of force per unit area required to penetrate in to a soil mass with a circular plunger of 50mm diameter at the rate of 1.25mm/min.

5. Composition Taken

S. No.	Bagasse Ash (%)	Lime (%)	Quarry dust (%)
1	0	4	0
2	0	5	0
3	0	6	0
4	4	0	0
5	5	0	0
6	6	0	0
7	1	4	1
8	2	3	1
9	3	2	1
10	4	1	1

6. Results

Observations & Calculations of Density Test:-

Weight of mould=4.120 kg Volume of mould =1000CC

Diameter of mould =10 cm Height of mould =12.8 cm

Weight of rammer =4.5 kg

DETERMINATION NO	1	2	3	4
Weight of Water Added, Ww (gm)	400 gm	550 gm	700 gm	850 gm
Weight Of Mould + Compacted Soil, (gm)	5.850	5.960	6.170	6.210
Weight of Compacted Soil, W (gm)	1.730	1.840	2.050	2.090
Bulk Density(gm/cc) = W/(Mould Volume)	1.73	1.84	2.05	2.09
Dry Density (gm/cc) = Bulk density/ (1+w).	1.67	1.77	1.81	1.79
Container No.	1	2	3	4
Wt. of container (gm) = W1	23.12	22.36	23.93	22.28
Wt. of container + wet soil (gm) = W2	35.05	42.99	39.35	42.44
Wt. of container + dry soil (gm) = W3	33.85	40.53	37.10	39.51
Moisture %	11.18	13.54	17.08	20.43

OMC=17.08%

M.D.D= 1.81 gm/cc.

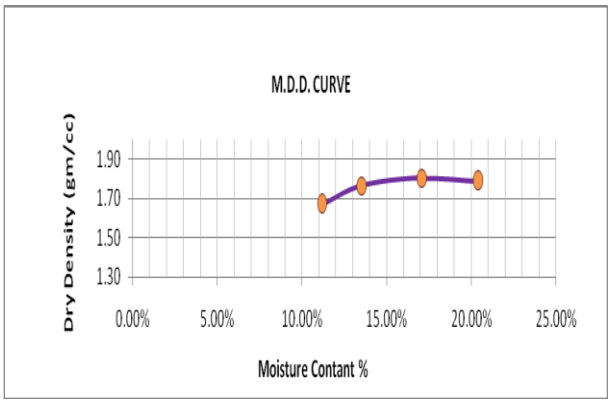
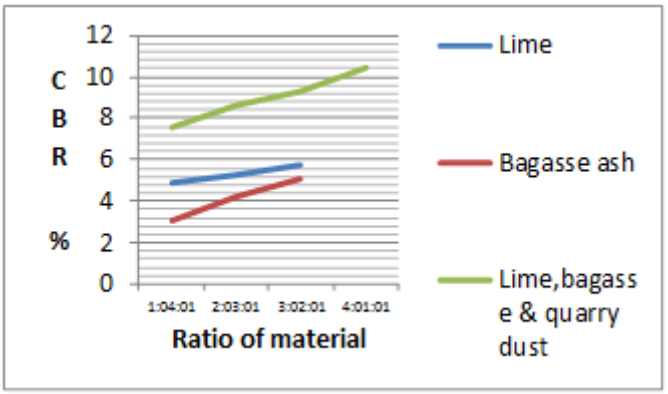


Fig -1: MDD



Atterberg Limits

Black Cotton Soil	LIME (%)		
	4	5	6
Liquid Limit (%)	44.56	42.32	41 .02
Plastic Limit (%)	27.80	25.82	23.24
Plasticity Index	16.76	16.5	17.78

Black Cotton Soil	Bagasse Ash		
	4 %	5 %	6 %
Liquid Limit (%)	67.02	63.91	58.07
Plastic Limit (%)	29.89	28.01	26.23
Plasticity Index	37.13	35.9	31.84

Black Cotton Soil	Lime, Bagasse Ash & Quarry Dust			
	1:4:1	2:3:1	3:2:1	4:1:1
Liquid Limit (%)	59.06	56.25	53.89	45.73
Plastic Limit (%)	36.00	33.29	32.86	29.11
Plasticity Index	23.06	22.96	21.03	16.62

CBR Test results

Black Cotton Soil	LIME		
	4 %	5 %	6 %
CBR (%)	4.93	5.27	5.76

Black Cotton Soil	BAGASSE ASH		
	4 %	5%	6 %
CBR (%)	3.029	4.18	5.089

Black Cotton Soil	LIME, BAGASSE ASH & QUARRY DUST			
	1:4:1	2:3:1	3:2:1	4:1:1
CBR (%)	7.59	8.63	9.27	10.41

7. CONCLUSIONS

- Soil stabilization method by applying waste product bagasse ash is successfully improve the existing poor and expansive sub grade soil.
- The plasticity index reduced with increased in content of bagasse ash and lime.
- The addition of lime and lime in combination with bagasse ash improved the CBR of the soil. The combination bagasse ash, lime & quarry dust can strongly improve the strength of the expansive soil.
- Bagasse ash is free of cost and available locally, hence it proved economical also.
- Bagasse ash effectively dries wet soils and provides an initial rapid strength gain, which is useful during construction in wet, unstable ground conditions.
- It can be seen that addition of bagasse ash, lime & quarry dust can be consider as an suitable and stabilizing agent.

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