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Stabilization of Black Cotton Soil by using the Admixtures of Pond Ash and Lime

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Abstract*: we have done some experiments on black cotton soil to strengthen the soil. Black cotton soil is very expansive soil so it is not used under basements for any building works. So our experiment shows that how to use black cotton soil in building purposes. So that we have done researches on adding lime and pond ash to make useful of black cotton soil.Changes in various soil properties such as Liquid limit, Plastic Limit, Maximum Dry Density, Optimum Moisture Content were studied. Keywords– Black cotton soil, density, will lime, soil, and stabilization. So we have done the some mixed proportions of 10%, 15% and 20% of pond and lime. So we utilize the waste material which comes from the thermal power plant. By that we can decrease the rate of expenditure for the construction of roads Based upon the performance of the test such as standard proctor test and other to know the required amount of the material to stabilize the black cotton soil.

Keywords : Black Cotton Soil, Pond Ash, Lime,

I. INTRODUCTION

Soil is well important element in the nature it is useful in many ways all the basic amenities of life, which ever may be food, cloth, house and many other are depend upon soil without soil we cannot survive also. So the soil is the basic need. soil is formed by depletion of rocks with the help of water a lot of mechanical work in the formation of soil. Soil is also divided into different types and each has its own properties and they have different strength in it. in that types black cotton soil is widely available but it is not use full for the construction purpose larger amount of clay particles present in it. Black cotton soil eradicates the water flow while floods or any disaster may occur. The formation of soil structures is based up on the different factors. The engineering properties of the soil comprise physical properties, index properties, strength parameters, permeability characteristics, consolidation properties, modulus parameters etc.

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India has larger range of black cotton soil within it. It covers up to 20% of total land init the major areas like Andhra Pradesh, Gujarat and eastern parts are covered with it. Such kind of soils are highly expansive above the water table and under go the different changes with the combination the moisture content increasing the water content may also effect the different properties such as swelling index California bearing ratio and strength may changes. Swelling index and the shrinkage limit may affect the foundation of the buildings, roads. various researches such as K. Shyam chamberlin are worked upon the black cotton soil mixed with various percentage of pond ash and fly ash.

II. OBJECTIVE:

1) To improve the stability of soil.
2) To increase the usage of black cotton soil.
3) To determine the properties of black cotton soil by using admixtures.

2.1 Availability of black cotton soil:

In India 20% of soil is covered with the black cotton soil. The most of the area is presented in the western parts of India. States such as Maharashtra and Andhra Pradesh are covered with it. So most of the cities such as Mumbai, Madras, Amaravathi is covered with black cotton soil. So it is very dangerous when earth quakes may occur . It may affect the total city and the economy rate of India. In our project we have done some experiments upon black cotton soil they are mainly swelling and shrinkage limit.

III. COMPONENTS OF STABILIZATION

3.1 Soils

So we have done some experiments on black cotton soil to strengthen the soil. Black cotton soil is very expansive soil so it is not used under basements for any building works. So our experiment shows that how to use black cotton soil in building purposes. So that we have done researches on adding lime and pond ash to make useful of black cotton soil. Changes in various soil properties such as Liquid limit, Plastic Limit, Maximum Dry Density, Optimum Moisture Content were studied. Black cotton soil, density, lime , soil, and stabilization. So we have done the some mixed proportions of 10%, 15% and 20% of pond and lime. So we utilize the waste material which comes from the thermal power plant. By that we can decrease the rate of expenditure for the construction of roads.

3.2 Stabilizing materials

These are the materials which are waste and not much useful in human life

A) Lime
B) Pond ash

A) Lime

A white caustic alkaline substance consisting of calcium oxide, which is obtained by heating limestone and which combines with water with the production of much heat quicklime.

B) Pond ash

Pond ash is the substance which we get from the thermal power plants. The thermal power plant has two kind of waste materials are well known as pond ash and fly ash. Such kind of pond is to be known as surface impoundment which uses gravitational force to get settle down. These are the suspended materials from thermal power plant.

The ash is stored in the large pond to avoid the flying of the materials due to air the ash gets fly in air and cause the air pollution and gets passes through and make like snow like climate it may cause the damage to the people near the power plant.

IV. PROPERTIES

The properties of soil, not only the geo technical properties but also indicative of engineering properties are index properties. They are

4.1 Specific gravity

Specific gravity is also known as relative density, is the ratio of substance to the ratio of reference substance, equivalently, is the ratio of mass of the substance to the mass of reference substance for the same given sample.

4.2 Atterberg limit (IS CODE ASTM D4318)

(a) liquid limit: The water content at which the soil has smaller shear strength that flows to close a groove of standard width when jarred in a specific manner

(b)Plastic limit: It is also known as the lower plastic limit, is the water content at which a soil changes from plastic state to semi solid state

*(C)Plasticity limit***:** It is the measure of plasticity of black cotton soil. It is the ranges of water content where the soil is having sticky like nature. It also exhibits the plasticity index. It is the difference between liquid limit and the plastic limit.

V. EXPERIMENTAL SETUP

Casagrande method*:*

1. Take 350 grams of soil which is passed through the 425µ sieve and weigh the substance
2. Add some water through it until it gets some sticky nature
3. Keep it aside for the 24 hours weight the soil sample arrange the casagrande equipment
4. Using the spatulas mix it with the distilled water for the 10 min start the rotate the handle in such way that it complete two oscillations per seconds.
5. The first blow should be on the count of 50
6. With the help of the grooving tool cut the soil at the middle of the soil part and start the oscillations.
7. And start the oscillations at some point the divided soil will get joint and the joint should be in the range of 120mm
8. With the help of the spatulas take the soil sample which is at the joint and take the bowl and note the number and note the bowl weight with soil sample the taken soil samples should be filled in the bowl keep the bowl in the oven at 100ºc.
9. After 24 hours weigh the soil sample check the difference between the weight of the soil samples and calculate along with the formula

$$\frac{W1 - W2}{W2 - W0} * 100$$

PLASTIC LIMIT: Take the same in soil samples and weigh the soil sample 25gms mix with the distillated water until it gets plasticity enough without sticking to the figures mould it into the shape of the small ball and crack should not be appear on the top of the bowl.

Take a bowl note the number keep the ball in bowl take a glass plate take the remaining soil sample rub it into the form of stick up to the 15cm and it into the equal pieces pick the soil threads mould further and repeat the same thing and cut it into the pieces in the range of 3mm .

Keep it aside for the 24 hours weight the soil sample arrange the casagrande equipment

Swelling index:

Procedure:

1. Take the soil sample in separate glass cylinders.
2. Pour water in one cylinder and kerosene in the another cylinder fill up to the level of 100 ml.
3. To remove the air shakes the cylinder gently.
4. The sample should be kept undisturbed for 24 hours.
5. Next day calculate the swelling index with the help of the formula.

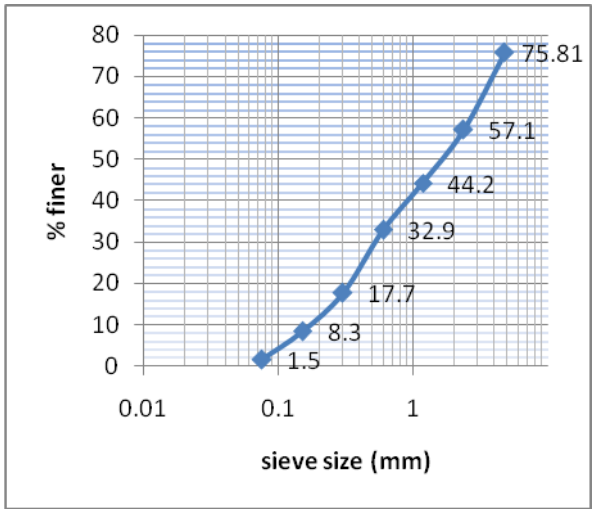
STANDARD PROCTOR TEST

1. Take soil sample of 20 kg and air dried soil later sieve it through the 20mm and retained in 475µ sieve.
2. Mix the soil retained on 4.75 mm sieve and that passing through 4.75 mm sieve
3. Later clean and dry the mould and the base plate and apply grease to it
4. Weight the base plates
5. Take 20 kgs so soil sample add 4% of water
6. Keep the soil in the air tight container for 24 hours
7. Take the soil in to into the mould and add the base t the mould.
8. Take the soil sample of 5 kgs by layers and compact it by giving 25 blows by using rammer
9. And later the second layer is added and make 25 blows to it and do the same for the third layers
10. Cut the excess above the soil projection
11. Take the soil sample for the water content from the middle and top and bottom to know the water content
12. And the process should be repeated by increasing water to know the water content.

VI. RESULTS AND DISCUSSION

SIEVE ANALYSIS

When we have taken the 930 gms of black cotton soil which is oven dried to determine the particle size of the soil. Arrange the sieves in the manner of 4.75,2.36,1.18,600 microns, 300 microns ,150 microns ,75 microns , pan pour the soil sample into the sieves and sieve the sieve with the help of the mechanical shaker for 15 to 20 mins and measure the weights retain on the each sieve present in it.

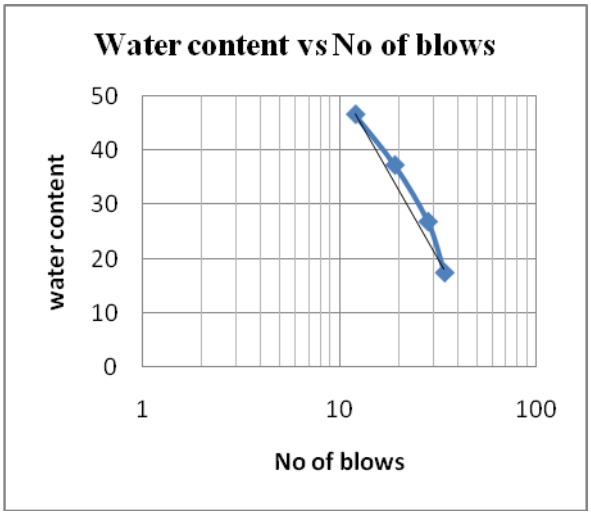


Casagrande method:

Table:

No of blows	34
Weight of the container (w0)	18.7
Weight of the container with wet soil (w1)	39.6
Weight of the container with dry soil (w2)	36.5
(w1-w2)	3.1
Weight of oven dry soil (w2-w0)	17.8
Water content w	$\frac{W1-W2}{W2-W0}*100$ $\frac{39.6-36.5}{36.5-18.5}*100$
Result	17.415

No of blows	Water content
34	17.415
28	26.82
19	37.24
12	46.57



PLASTIC LIMIT:

Weight of the container	26.1
Weight of the container with wet soil (w1)	32.29
Weight of the container after oven dry(w2)	31.20
(w1-w2)	1.09
(w2-w0)	5.1
$\frac{W1-W2}{W2-W0}*100$	21.37

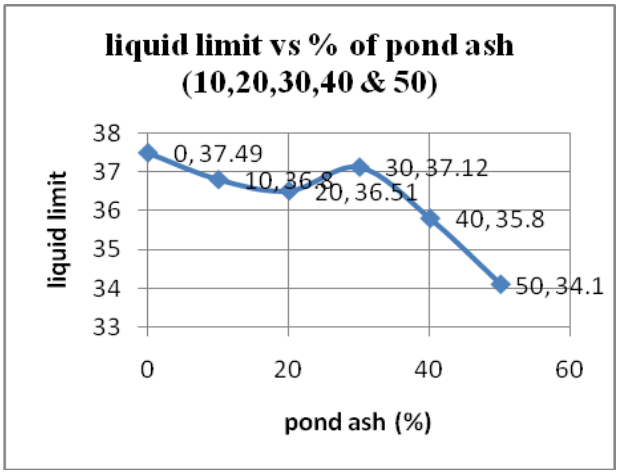
Plasticity index: It is a simple calculation which requires the determination of liquid limit and the plastic limit b using the casagrande method

Plasticity index = liquid limit (L.L) – plastic limit

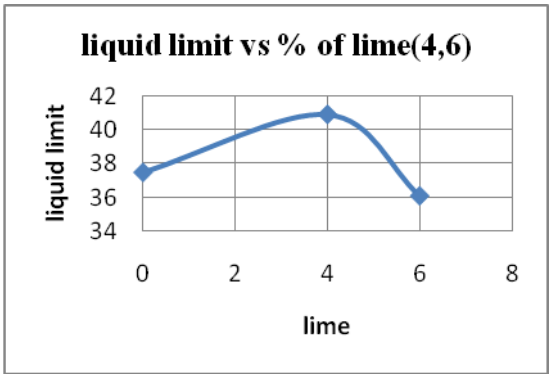
29.73-21.37 =8.36

REPORT: Plasticity index is reported to the nearest whole number by the result of it we can decide plastic or non-plastic may be found.

Test specimen	Liquid limit	Plastic limit	Plasticity limit
Black cotton soil	37.49	28.33	9.16
10% of pond ash	36.8	19.5	17.3
20% of pond ash	36.51	19.9	16.61
30% of pond ash	37.12	20.1	17.02
40%of pond ash	35.80	19.2	16.6
50% of pond ash	34.10	18.6	15.5

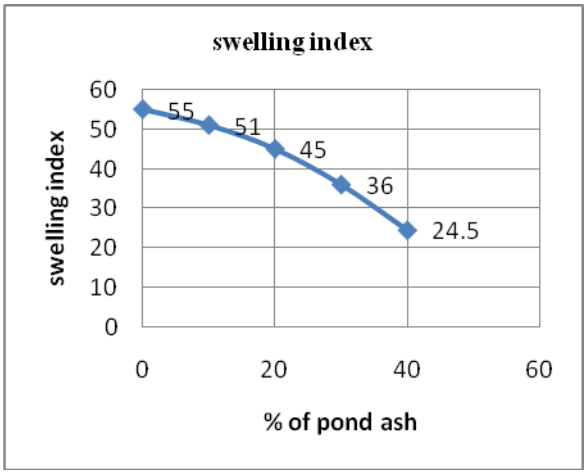


Test specimen	Liquid limit	Plastic limit	Plasticity limit
Black cotton soil	37.49	28.33	9.25
4% of lime	40.92%	-	--
6% of lime	36.1%	-	--



SWELLING INDEX TABLE:

Pond ash percentage	Swelling index	Degree of expansion
0% of pond ash	55%	Very high
10% of pond ash	51%	High
20% of pond ash	45%	High
30% of pond ash	36%	Moderate
40% of pond ash	24.80%	Moderate



RESULTS: From this experiment we absorb the curve which is gradually decreasing is shows that the pond ash adding is decreasing the swelling index.

STANDARD PROCTOR TEST TABLE:

Observations and calculations	Determination no		
	Trail 1	Trail 2	Trail 3
Empty mass of compaction mould (m1)	7.780	7.780	7.780
Mass of mould + compactor soil (m2)_	10.354	10.970	10.750
Mass of compactor soil (m= m2-m1)	4.018kg	4.634kg	4.416kg
Inner diameter of compaction mould (d)	152	152	152
Height of the compaction mould (h)	127	127	127
Volume of compaction mould (v)	2303	2303	2303
Bulk density (P)	1.744	2.01	1.917
Cup number (m3)	24	512	53
Mass of the empty cup + wet soil (m4)	130	58	88
Mass of the empty cup + dry soil	119	52	78
Water content %	8.4 %	10.38%	11.36%
Dry density (g/cm^3)	1.608	1.82	1.72

STANDARD PROCTOR TEST

BLACK COTTON SOIL + 10% OF POND ASH

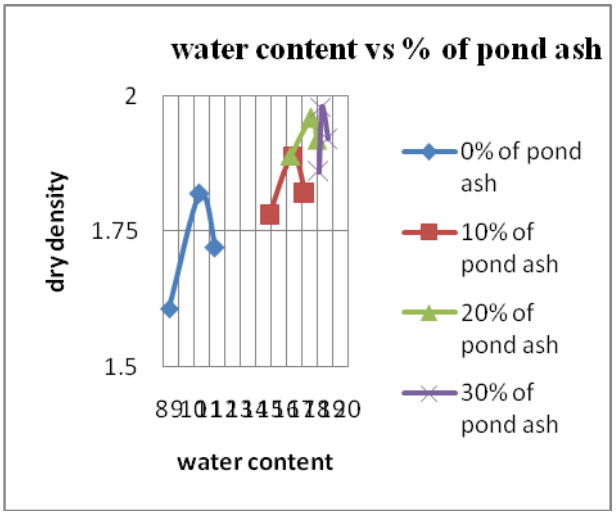
WATER CONTENT (%)	DRY DENSITY (gm/cc)
14.9	1.78
16.4	1.89
17.2	1.82

BLACK COTTON SOIL + 20% OF POND ASH

WATER CONTENT (%)	DRY DENSITY (gm/cc)
14.9	1.78
16.4	1.89
17.2	1.82

BLACK COTTON SOIL + 30% OF POND ASH

WATER CONTENT (%)	DRY DENSITY (gm/cc)
14.9	1.78
16.4	1.89
17.2	1.82

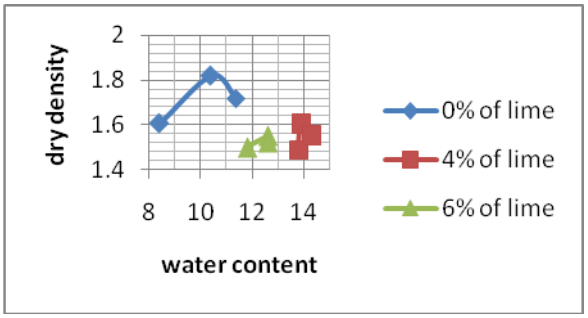


Black cotton soil + 4% of lime

WATER CONTENT (%)	DRY DENSITY (gm/cc)
13.8	1.49
13.9	1.60
14.3	1.55

Black cotton soil + 6% of lime

WATER CONTENT (%)	DRY DENSITY (gm/cc)
10.8	1.50
12.6	1.55
12.6	1.52



VII. CONCLUSION:

These are the following conclusions which are prepared from the performing of experiments

1. From the free swelling index, we observe that by adding pond ash the free swell value is gradually decreases.
2. Optimum moisture content and the dry density is increasing along with the percentage of pond ash.
3. Black cotton soil changes its behavior due to the addition of pond ash `where as pond ash is the non-plastic material and the black cotton soil is the plastic material the combination of both may result the perfect soil.
4. The shear strength of the black cotton soil gradually increased by adding the pond ash but from 30 % of pond ash is still gradually decreased.
5. It has been found that addition of % of lime the liquid limit value is gradually decreases.
6. It has been found that addition of % of lime the plastic limit value is gradually decreases.
7. These values are not prefered for the construction these are the values which are observed while performing experiments.

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