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KOTA STONE DUST USED FOR SOIL STABILIZATION WITH FLY ASH

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ABSTRACT

Black cotton soil is available in abundance and about 51.8 million hectares of the land area are covered with black cotton soil. It has to characteristic of swelling and shrinking when exposed to change and moisture content that is why possess challenge for civil engineer. The black cotton soil is tough when dry and loses its strength when in wet condition. In the construction of highway subgrade material placed a major role because its provides lateral support to the pavement, hence where there is majority of black cotton soil we are supported to alter the properties of the soil to give stability that enhances engineering properties that is why soil stabilization is the most suitable alternative for the construction of pavement. "Soil stabilization technique used to improve the engineering properties of the soil such as strength, stability and bearing capacity of the soil". Method of soil stabilization, it is related to compaction and use of admixture for altering the properties of the soil lime, cement and fly ash was used. Now it is observed that, kota stone dust are used for this purpose with fly ash, Fly ash is the produced from coal waste thermal power station as a waste and at present 82 thermal power plants in the country which produced about 175 million tonne of fly ash per annum. It is acidic in nature and particles consist of silica, alumina, oxides of iron, calcium, and magnesium and toxic heavy metals like lead, arsenic, cobalt, and copper. It posses serious problems leading to cancers or another diseases. On the other hand fly ash control shrink swell by cementing the soil grain together, it have cementing properties and it is also a good drying agent.

KEYWORDS: Soil Stabilization, Black Cotton Soil, Kota Stone Dust, Fly Ash, CBR

Black cotton soil are highly clayey soils, grayish to blackish in color found in several states in India. It is available in abundance and about 51.8 million hectares of the land area are covered with black cotton soil. The black cotton soil expands, swells, shrinks as it is its natural properties and it is also hard when it is dry but looses its toughness when it is wet. It shows cracks when it turn dry again black cotton soil is also fluctuating in nature and it change with the moisture in air in the nature. In several black cotton soil area suitable road aggregates are to be transported from distant places, thus increasing the cost of conventional types of pavement layers. Typical behavior of these soils under different climatic condition has made the construction and maintenance in black cotton soil areas are found to suffer from early failures. That is why in the construction of roads, canals, dams, bridges and other structure works some times damages take place. Specially use of black cotton soil due to its shrinkage quality it has damage the construction of roads under various climatic conditions. For examples pavement construction by black cotton soil are more prone to damage and specially in rainy season it is not stagnate and get easily damage. Like unevenness, ruts, waves and corrugations are formed almost after every monsoon season due to heavy traffic, in flexible pavements.

PROBLEM ADDRESSED

Water is the worst enemy of the pavement and due to capillary action water penetrates into pavement from top, side berms and from subgrade. To avoid it surfacing must be impervious side ferms paved and subgrade well treated.

As per various investigation it is observed that water has gat easy access into the pavement. It lower its bearing capacity resulting into depression and settlements. Water acts as lubricant in the base course layer making finding material loose which makes interlock unstable. In the top bituminous surfacing raveling, stripping and cracking develops due to stagnation of water.

Following are the main problems in the case of black cotton soils:

- It is very difficult to pulverize the soil as the dry lumps are different to brake due to high dry strength and the wet soil is too sticky and unmanageable.
- There is excessive variation in volume and stability with variation in water content.
- There is considerable shrinkage on drying, resulting in the formation of extensive cracks. Black cotton soil compacted at OMC will also shrink when dried as shrinkage limit is much lower than OMC.
- The black cotton soil exerts high swelling pressure from below on being soaked.

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- Conventional construction material like hard aggregates may not be available within easy reach.

The black cotton soil are very poor and undependable subgrade material. Hence the main problem is to treat the subgrade soil itself such that the undesirable characteristics are modified by a suitable stabilization technique. Also suitable method of constructing sub grade and base courses are to be decided based on practical considerations.

If the stability of the local soil is not adequate for supporting wheel loads, the properties are improved by soil stabilization techniques.

Hence, where there is majority of black cotton soil, we have to alter the properties of that soil to increase the engineering properties of soil using method such as soil stabilization. Soil stabilization is one of the most suitable alternatives which are widely used in pavement construction.

So to avoid such kinds of damages the technique of stabilization is used and it is done with the help suitable additives.

OBJECTIVES

The basic objectives of study of black cotton soil are as following:

- Improvement of compressive strength on addition of stone dust.
- Variation of OMC at different stone dust content.
- Effect of stone dust on MDD of soil.

MATERIALS AND METHODS

Black Cotton Soil

The black cotton soil containing the properties of inercosing in volume and gets expanded when they get wet and shrink in the process of drying out.

Kota Stone

Kota stone is fine grained variety of limestone.

Fly Ash

It is generally grey to black in color, abrasive and acidic in nature and particles consist of silica, alumina, oxides of iron, calcium, and magnesium and toxic heavy metals like lead, arsenic, cobalt, and copper.

For this work we collected Black cotton soil sample from GUNA district (M.P.) About 125 Kg soil sample was brought by us to soil mechanics lab for carrying out our project work.

Table 1: Grain size distribution

Sl. No.	Sieve size	Mass of soil retained in each sieve (g)	Percentage retained (%)	Cumulative percentage Retained (%)	Percentage finer
1	4.75mm	0	0	0	100
2	2.36mm	1.11	4.16	4.16	95.84
3	1.18mm	5.82	21.75	25.91	74.09
4	600µ	5.224	19.52	45.43	54.57
5	425µ	2.519	9.41	54.84	45.16
6	300µ	5.516	20.61	75.45	24.55
7	150µ	4.71	17.60	93.05	6.95
8	75µ	1.402	5.24	98.29	1.71
9	PAN	0.447	1.67	99.96	

RESULTS AND DISCUSSION

For Kota Stone Dust

Index Property

1. Liquid Limit is 34.19 % (by one point method)
2. Plastic Limit is 27.3 %
3. Specific Gravity is 2.59
4. Optimum Moisture Content is 10.8 %
5. Maximum Dry Density is 18.5 KM/M^3

For Silty Clay Soil

Index Property

The index properties of black cotton soil are below in the table.

Table :3 Index properties of black cotton soil

S No.	Property	Test Result
1.	OMC (%)	18.02
2.	MMC (gm/cc)	1.664
3.	Liquid Limit (%)	54.5
4.	Plastic Limit (%)	22.43
5.	Plasticity Index (%)	32.07
6.	Sp. Gravity	2.335
8.	Degree of Saturation	1.926
9.	CBR @ 2.5mm (%)	2.1
10.	Coefficient of uniformity (C_u)	4.705
11.	Coefficient of curvature (C_c)	0.823

OMC, MDD and CBR Results

The results of OMC, MDD and CBR of treated black cotton soil samples are shown in below:

Table 2: Results of OMC, MDD and CBR of BC soil and Mix specimen

S No.	Mix Propertion	OMC (%)	MMD (KN/M³)	CBR value (Soaked)
1	Black cotton soil	18.06	1.66	4.2
2	B.C.S+2% F.A. + 2% K.S.D.	17	1.725	4.9
3	B.C.S+2% F.A. + 4% K.S.D.	17	1.710	5.2
4	B.C.S+4% F.A. + 2% K.S.D.	16.5	1.725	5.4
5	B.C.S+4% F.A. + 4% K.S.D.	16.8	1.71	5.8
6	B.C.S+10% F.A. + 10% K.S.D.	16	1.73	5.5
7	B.C.S+10% F.A. + 20% K.S.D.	14.5	1.715	6.25
8	B.C.S+20% F.A. + 10% K.S.D.	16.5	1.71	4.68
9	B.C.S+20% F.A. + 20% K.S.D.	16	1.72	4.2

Results of Liquid limit, Plastic limit and Plasticity Index:

The results of Liquid limit, Plastic limit and Plasticity Index of treated black cotton soil samples are shown in below:

Table: 4 Results of Liquid limit, Plastic limit and Plasticity Index of BC soil and Mix specimen

S No	Mix Propertion	liquid limit	Plastic Limit	Plasticity Index
1.	Black cotton soil	56	28	28
2	B.C.S+2% F.A. + 2% K.S.D.	53.5	26.8	26.7
3.	B.C.S+2% F.A. + 4% K.S.D.	54	27.2	26.8
4.	B.C.S+4% F.A. + 2% K.S.D.	51	29.62	21.38
5.	B.C.S+4% F.A. + 4% K.S.D.	49	30.2	18.8
6.	B.C.S+10% F.A. + 10% K.S.D.	51	34.06	16.94
7.	B.C.S+10% F.A. + 20% K.S.D.	51	33.6	17.4
8.	B.C.S+20% F.A. + 10% K.S.D.	49	34.86	14.44
9.	B.C.S+20% F.A. + 20% K.S.D.	48	35.04	13

DICUSSION

Objectives of this study to effects of fly ash and Kota stone dust on CBR of soils including index properties of black cotton soil. In this experiment analysis stabilization of soil has been carried out by mixing fly ash and Kota stone dust in varying percentages.

The black cotton soil change it is behavior due to fly ash and Kota stone dust. The additives materials are non-plastic and BC soil is inorganic clay of medium plasticity but when the amount of additives materials increases, the BC soil changes behavior from CI to CL. When plasticity of the mix specimen decreases, it means the differential free swell and swelling pressure also decreases. Soil density is usually measured in dry unit weight, when dry unit weight is higher means that the number of smaller pores and higher compaction. It can be observed that from present experiment study, the value of LI and PI decreased with increasing percentage of fly ash and Kota stone dust. Also observed that CBR value increases with the increase in percentage of mix specimen.

CONCLUSION

After performing various experiments on soil, fly ash, Kota stone dust and soil mixed with varying proportion of fly ash and Kota stone dust, it has been observed that fly ash and Kota stone dust is improving the soil. Based upon results of present study various conclusions are summarized as:

1. With help of test on Kota stone dust it is concluded that CaO is in about 30 % in it, so we can adopt the stabilization method as used by lime.
2. Index property of Kota stone dust has lower value except plastic limit.
3. Kota stone has lower value of MDD while has high value of OMC.
4. Optimum water content decrease with increasing fly ash and Kota stone dust content and maximum decrement is obtained at 10% fly ash and 20% Kota stone dust mixing, further increasing fly ash and Kota stone dust content results in increasing optimum moisture content.
5. Maximum dry density increase with increasing fly ash and Kota stone dust content and maximum increment is obtained at 10% fly ash and 10% Kota stone dust mixing. However, further increasing fly ash and Kota stone dust content mixed in soil results in decrement of maximum dry density.
6. Maximum value of CBR obtained at 10% fly ash and 20% kota stone dust during mixing.

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