Effect of Fly Ash on Properties of Black Cotton Soil

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Abstract— In India regarding fifty one.8 million hectares of the area unita|acreage|area|expanse|surface area} are lined with Expansive soils (black cotton soil). The Black cotton soils square measure terribly laborious once dry, however lose its strength fully once in wet condition. Expansive soils square measure a worldwide downside that poses many challenges for civil Engineers. Varied ways square measure tailored to enhance the engineering characteristics of expansive soils. The problematic soils square measure either removed and replaced by smart and higher quality material or treated victimization additive. This paper deals with the properties of expansive soils of geographical region, Bharat at varied locations. During this study, black cotton was stable victimization ash (obtained from koradi thermal power plant). Expansive soils were stable with varied proportion of ash i.e. at 0, 10, 20 30, 40 & 50%. Ash possesses no malleability. Malleability index of clay ash mixes decreases with increase in ash content. Therefore addition of ash makes expansive soil less plastic and will increase its workability by mixture reaction and dynamical its grain size. The cosmic radiation values of clay with ash mixes, tested underneath unsoaked & soaked conditions & there results were ascertained, with associate degreealysis of results it's found that the ash features a smart potential to be used as an additive for up the engineering properties of expansive soils.

Key words: Expansive soil, fly ash, compaction characteristics, CBR value

I. INTRODUCTION

In india regarding 51.8 million hectares of the area unita|acreage|area|expanse|surface area} are lined with Expansive soils (black cotton soil). . The Black cotton soils square measure terribly laborious once dry, however lose its strength fully once in wet condition. Expansive soils square measure a worldwide downside that poses many challenges for civil Engineers. Various ways square measure tailored to enhance the engineering characteristics of expansive soils. The problematic soils square measure either removed and replaced by smart and higher quality material or treated victimization additive. The stabilization of the problematic soils is extremely necessary for several of the geotechnical engineering applications like pavement structures, roadways, building foundations, channel and reservoir linings, irrigation systems, water lines, and sewer lines to avoid injury as a result of settle of soppy soil or to the swelling action of expansive soil.

Generally, the stabilization construct will be dated 5000 years past. Treated earth roads were employed in ancient geographic area and Egypt, which the Greek and Roman used soil-lime mixtures. the primary experiments on soil stabilization were achieved within the USA with sand/clay mixtures around 1906. within the twentieth century, particularly within the thirties, the soil stabilization relevant to construction was applied in Europe The pavement soil qualities are going to be improved by totally combination and compacting with additives embody Portland cement, fly ash, bitumen, and combos of any of the additives. the kind of the additive and therefore the quantity needed square measure dependent upon the soil classification and therefore the degree of improvement desired.

Various investigators have studied the influence of lime, cement, lime-cement, lime-flyash, lime –ricehusk- ash and cement – ash mixes on soil properties, principally specializing in the strength aspects to review their quality for road bases and subbasess. As lime and cement square measure binding materials, the strength of soil-additive mixtures will increase provided the soil is reactive with them. However, for large-scale field use, the issues of soil pulverization and combination of additives with soil are according by many investigators.

II. MATERIALS AND METHODOLOGY

Black cotton soils square measure inorganic clays of medium to high softness and kind a significant soil cluster in Bharat. They're characterized by high shrinkage and swelling properties. This Black cotton soils happens principally within the central and western components and covers just about two hundredth of the whole space of Bharat. Attributable to its high swelling and shrinkage characteristics, the Black cotton soil (BC soils) has been a challenge to the route engineers.

A. Black Cotton Soil:

Expansive soils are called as Black Cotton soil. The name "Back Cotton" as an agricultural origin. Most of these soils are black in colour and are good for growing Cotton. All the black soils are not expansive soils and all the expansive soils are not black in colour. These soils passed high strength in summer and decreased rapidly in winter. The soil has a swelling property due to the presence of montmorillonite mineral. Geotechnical properties of black cotton soil are given in Table 1

S.No.	Colour	Black
1	Specific Gravity	2.69
2	Liquid Limit	40-60
3	Plastic limit (%)	15-25
4	Shrinkage Limit (%)	10--15
5	OMC (%)	20-30
6	MDD (g/cc)	1.5-1.7
7	Free Swell Index (%)	50-60
8	Swelling Pressure (kg/cm2)	4--6

Table 1: Properties of Black Cotton Soil

B. Fly Ash:

Fly ash additive in soil, fly ash is use due to Fly ash is costless and abundantly available all over the country.

As fly ash is a by-product of thermal power plants, land area required for its disposition is a great problem in a densely populated country like India. Utilization of fly ash solves the problem of air and water pollution. Properties of fly ash are given in table 2.

S.No.	Colour	Grey
1	Specific Gravity	1.90-2.55
2	Plasticity	Non-Plastic
3	OMC (%)	40-18
4	MDD (g/cc)	0.9-1.6
5	Cohesion (KN/m2)	Neglegible
6	Angle of internal friction	$30^0 – 40^0$
7	Swelling Pressure (kg/cm2)	4--6

Table 2: Properties of Fly Ash

Addition of Fly Ash	OMC (%)	MDD(N/m^3)	CBR (soaked) (%)	CBR (unsoaked)(%)
0%	20.4	14.7	3.1	6.89
10%	29.17	14.2	2.52	12.78
20%	22.19	14.97	2	22.9
30%	26.19	14.4	1.89	6.98
40%	27.1	13.9	2.49	7.68
50%	24.16	13.6	2.35	7.61

Table 3: Properties of soil-fly ash mix

III. Experimental Program

Several tests has been conducted to ascertained geotechnical properties of black soil like specific gravity and Atterberg limit tests. In case of versatile pavement construction bottom most layer is soil subgrade. it's want that soil subgrade ought to carry hundreds while not giant deformations that finally ends up in failure of pavements. For economic style, regionally on the market soil ought to use as soil subgrade. it's tedious job for engineer to provided versatile pavement on black soil as a result of swelling shrinkage nature of soil. As for soil Subgrade unremarkably regionally on the market soil square measure used, soil improvement are going to be needed. Currently a day varied techniques square measure on the market to stable soil. So, as a part of soil stabilization ash is employed in varied as 10,20,30,40 and; 50%, and impact of ash on water content density relationship & cosmic radiation price are going to be ascertained.

With following results it's ascertained that, the unsoaked cosmic radiation price is higher with two hundredth ash compared to alternative mixes. Relatively the dry density with two hundredth ash is above the opposite percentages of ash. Therefore it's going to be according that ash has smart potential to be used in geotechnical applications. The comparatively low unit weight of ash makes it well matched for placement over soft or low bearing strength soils. Its low relative density, freely debilitating nature, easy compaction, insensitiveness to changes in moisture content, good frictional properties, etc. can be gainfully exploited in the construction of embankments, roads, reclamation of low-lying areas, fill behind retaining structures.

IV. Result and Discussion

Effect of fly ash on geotechnical properties of soil are with following results it is observed that, the unsoaked CBR value is higher with 20% Fly ash compared to other mixes. Comparatively the dry density with 20% fly ash is higher than the other percentages of fly ash. So it may be reported that fly ash has good potential for use in geotechnical applications. The relatively low unit weight of fly ash makes it well suited for placement over soft or low bearing strength soils. Its low specific gravity, freely draining nature, ease of compaction, insensitiveness to changes in moisture content, good frictional properties, etc. can be gainfully exploited in the construction of embankments, roads, reclamation of low-lying areas, fill behind retaining structures, etc. result is shown in table 3 and graph 1,2 and 3.

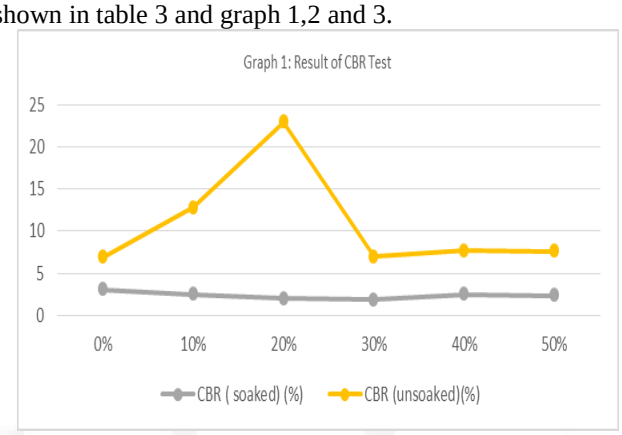

Fig. 1(a): Results

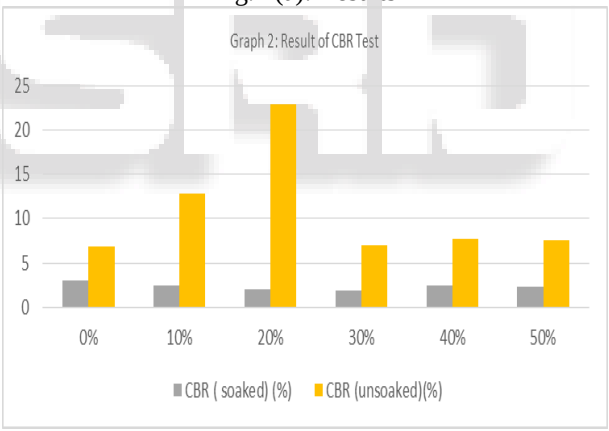

Fig. 1(b): Results

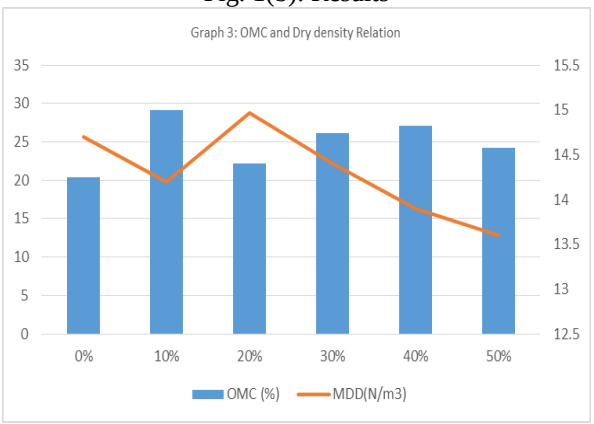

Fig. 1(c): Results

Fig. 1: Results and Effect of fly ash on geotechnical properties of soil

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