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A Study on Properties of Black Cotton Soil with Flyash and Marble Dust

Pooja N[1], Ashwini B[2],Neelam P[3], Laxmi[4], Sandeep Patil[5],Gajendra[6]

[1,2,3,4]*Student (BE Final Year), Civil dept, AIET, Kalaburgi*
[5,6]*Assistant Professor, Dept. of civil Engineering, AIET college, Kalaburgi, Karnataka, India*

Abstract - *The property of the Black cotton soils, in general, is that they are very hard when in dry state, but they lose all of their strength when in wet state. In light of this property of expansive soils, these soils pose problems worldwide that serve as challenge to overcome for the Geo-technical engineers. In the present study, using fly ash obtained from Raichur Thermal power station. With various proportions of this additive i.e. 10%, 20%, 30%, 40% & 50%, expansive soils is stabilized. Owing to the fact that fly ash possess no plastic property, plasticity index (P.I.) of clay-fly ash mixes show a decrease in value with increasing fly ash content. In conclusion, addition of fly ash results in decrease in plasticity of the expansive soil, and increase in workability. Marble dust is obtained from Kalaburgi , Industrial area, Marble power is to improve the engineering properties Black cotton soil with a proportion of 5%,10%,15%,20%,25% and studied the compaction characteristics and strength characteristics.*

Key Words: FA(Flyash), BC (Black Cotton soil), MD(Marble Dust)

1.INTRODUCTION

Expansive soils, which are also called as swell-shrink soil, have the tendency to shrink and swell with variation in moisture content. As a result of this variation in the soil, significant distress occurs in the soil, which is subsequently followed by damage to the overlying structures. During periods of greater moisture, like monsoons, these soils imbibe the water, and swell; subsequently, they become soft and their water holding capacity diminishes. As opposed to this, in drier seasons, like summers, these soils lose the moisture held in them due to evaporation, resulting in their becoming harder. Generally found in semi-arid and arid regions of the globe, these type of soils are regarded as potential natural hazard – if not treated, these can cause extensive damage to the structures built upon them, as well causing loss in human life. Soils whose composition includes presence of montmorillonite, in general, display these kind of properties.

1.1 Flyash

A waste material extracted from the gases emanating from coal fired furnaces, generally of a thermal power plant, is called fly ash. Essentially consisting of alumina, silica and iron, fly ashes are micro-sized particles. Fly ash particles are generally spherical in size, and this property makes it easy for them to blend and flow, to make a suitable concoction. Both amorphous and crystalline natures of minerals are the content of fly ash generated. Its content varies with the change in nature of the coal used for the burning process, but it basically is a non-plastic silt. The flyash has been obtained from Raichur Thermal Power Station(RTPS).

1.2 Marble Dust

The Marble has very high lime (Cao) content up to 55% by weight. Thus, stabilization characteristics wastes marble dust is mainly due to their high lime (Cao) content. Increasing of usage fields of waste marble products will eliminate the potentially harmful effects of them on environment and minimize the cost due to storage. Many research works have been done in the direction of utilizing of marble dust waste into the soil stabilization technique in worldwide.They reported that CBR value increases due to addition of this material and also modify the engineering properties. The utilization of waste marble slurry to enhance the soil properties was studied. The main is to improve the characteristics of black–cotton soil by using marble slurry .There was an improvement in compaction and CBR characteristics.

2. Materials and Methodology

The black cotton soil used in this study was mixed with flyash and marble dust powder in different proportions and a series of laboratory tests were conducted on samples containing various percentages of flyash 10%,20%,30%, 40%, 50% and marble dust 10%,15%,20%,25%,30% by weight of dry soil. The following tests were conducted on black cotton soil, marble dust & flyash mixes as per relevant IS code practice.

2.1 Marble Dust: The stabilizer material used in this study was marble dust. The marble dust was obtained from a marble cutting and polishing industry located at KALABURGI.

Table -1: Chemical Composition of Marble Dust

Component	Chemical composition
Sio_2	6.2
Fe_2O_3	0.8
Al_2O_3	4.8
CaO	30.1

2.2 Fly Ash : Sample was collected from Raichur Thermal Power Station (RTPS), Raichur, Karnataka.

Table 2: Geo-Technical Properties of Flyash

Parameters	Range
Specific Gravity	7.6-2.6
Plasticity(%)	Lower or Non plastic
Maximum Dry Density(gm/cc)	0.9-1.3
Optimum Moisture Content	18-38
Cohesion(KN/m2)	Negligible
Coefficient of Consolidation	1.75x10.5-2.01x10.3
Compressive Index	0.05-0.4
Permeability(cm/sec)	8x10.6-7x10.4
Coefficient of Uniformity	3.1-10.7

2.3 Methodology

In the present investigation following tests have been conducted according to the specification of IS: 2720

- Specific Gravity- IS: 2720 (Part III/Sec I) – 1980.
- Liquid limit- IS: 2720 (Part-V):1985.
- Plastic limit -IS: 2720 (part V).
- Compaction- IS: 2720 part-VI (1974).
- Unconfined compression test-IS 2720 part X (1973).
- California Bearing Ratio- IS 2720 part XVI (1979).

3. RESULTS AND DISCUSSION

The Specific Gravity of the Flyash is found to be 1.94 and that of soil is 2.69. It is helpful in determining the parameters such as void ratio, density etc.

Table 3 Geotechnical Properties of Soil

Sl No.	Soil characteristics	Description
1	Specific gravity	2.69
2	Maximum dry density	1.4 g/cc
3	Optimum moisture content	16 %
4	Specific gravity	2.63
5	UCS	220 kN/m²
6	CBR	2.36%
7	Liquid limit	68%
8	Plastic limit	25%
9	Plasticity Index	43%

Liquid Limit Test Results of Expansive soil With Marble dust and Fly ash

Table 4 Different percentages of Fly ash and marble dust with soil

Sl.No	Description	Results
1	Soil+5% of Flyash+5% of Marble dust	48
2	Soil+10% of Flyash+10% of Marble dust	36
3	Soil+15% of Flyash +15% of Marble dust	25
4	Soil+20% of Flyash+20% of Marble dust	20
5	Soil+25% of flyash+25% of Marble dust	10

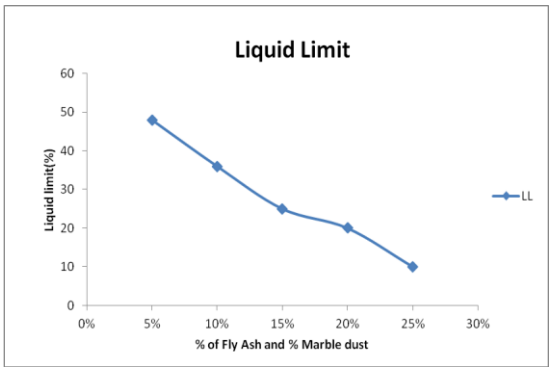

Fig 1 Variations of Liquid Limit value with equal percentages of Fly ash and marble dust

3.1 Proctor compaction characteristics

With different percentages of marble dust and flyash to the soil, the maximum dry density and optimum moisture content was found by proctor compaction test as per IS 2720.

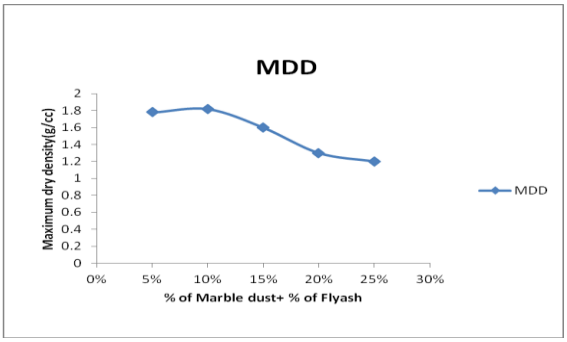

Fig 2 Variation of MDD value with different percentage of flyash and marble dust

From fig 2 it was observed that with addition of flyash and marble dust with soil the maximum dry density value has decreased with increase in water content.

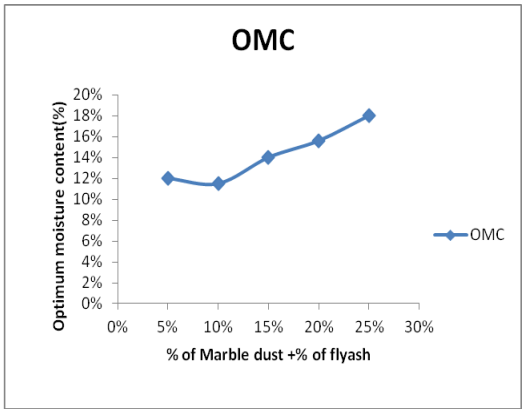

Fig 3 Variation of OMC value with different percentage of flyash and marble dust

From fig 3 it was observed that with addition of flyash and marble dust with soil the optimum moisture content has increased with decrease in maximum dry density.

3.2 Unconfined Compressive Strength Test (UCS):

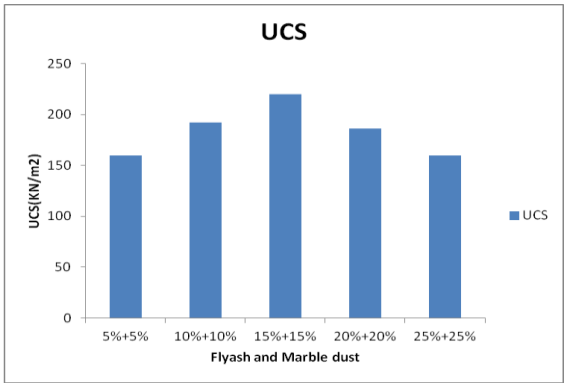

Fig 4 Variation of UCS value with different percentage of flyash & marble dust

The UCS was conducted on the marble dust and fly ash with soil sample. From the figure 4.12 it is noted that UCS value of fly ash and marble dust in various proportions has gradually increased upto addition of 15% of flyash and marble dust, further increase in percentage of flyash and marble dust the strength has reduced.

4. CONCLUSIONS

It is observed that in the addition of combined flyash and marble dust in Black cotton soil the strength was increased upto 15% of addition, further increase in stabilizers decreased the strength. Liquid limit of the soil should be less for construction purpose. Black cotton soil of this project had a liquid limit of initially 61%. In addition of flyash and marble dust it was observed that the liquid limit value of soil was reduced to 10%.Finally it can be concluded that the stabilizer like fly ash and marble dust will help in increasing the mechanical properties of the black cotton soil like Liquid limit compaction characteristics and unconfined compressive strength.

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