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Performance Analysis of Clayey Soil treated with low cost materials

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***ABSTRACT*—** In this paper, the combine effect of two industrial wastes flyash and stone dust on Atterberg's limit, compaction characteristic, unconfined compressive strength (UCS), California bearing ratio (CBR) of clayey soil have been discussed. To maintain Sustainable environment, there is need to utilize industrial wastes for improving geotechnical properties of soil. Therefore in this paper an attempt is made to stabilize expansive clayey soil by using two low cast materials fly ash and stone dust fly ash possesses only pozzolanic properties and no coarser soil particles whereas stonedust is a material that possesses pozzolanic as well as coarser contents in it.

KEYWORDS: fly ash, stone dust, Atterberg's limit, compaction characteristic, unconfined compressive strength (UCS), California bearing ratio (CBR), clayey soil, pozzolanic.

I. INTRODUCTION

The term expansive soil or swelling soil applies to the clayey soils that have tendency to swell when their moisture content is increased and shrink when their moisture content is decreased, due to this alternate swell-shrink behaviour and because of low california bearing ratio (CBR) value, construction of pavements in black cotton expansive soil areas creates a lot of problems for civil engineers, This results in high cost of construction as well as necessitate frequent repairing as cracks of different shapes and varying depths are seen on these soils. Among different techniques to increase the CBR value and to reduce lthe swelling pressure of soil. Stabilization using industrial wastes is one of them. Fly ash is an industrial waste produced by combustion of pulverised coal in coal fired electric & steam generating plants. It is estimated that about 120 million tons of fly ash is produced from different thermal power plants in India, It consumes several thousand hectares of precious land for its disposal. This causes several health and environmental hazards.

In Maharashtra, large number of crusher units are available, which produces huge quantities of stone dust. Stone dust pollutes water, air or land. And also its disposal in critical problem, about 20-25% of the total production in each crusher unit is left out as the waste material- quarry dust.In the present work an attempt is made using flyash and stonedust in equal proportion (1:1) for the clayey soil. Then strength characteristics, variation in liquid limit, plastic limit and compaction characteristics obtained for light compaction such as OMC and MDD, CBR results are presented and discussed.

II. EXPERIMENTAL STUDY

Materials used

1) **Local soil** is collected near tapi river, shirpur in Maharashtra

Geotechnical properties of soil are.

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Properties	Values
Liquid limit (%)	54.23
Plastic limit (%)	52.27
Shrinkage limit (%)	15.75
Specific gravity	2.7
OMC (%)	37.5
MDD (gm/cc)	1.47
UCS (kpa)	156.4
Unsoak CBR%	3.51
Soak CBR%	1.95

2) **Flyash-** Flyash is collected from Bhusaval thermal power station, Maharashtra, India. Specific gravity of flyash was 1.83.

Chemical cormposition of flyash follows.

Elements	Flyash
(% Wt)	
Silica	40-60
Aluminium	15-30
Iron oxide	2-7
Calcium oxide	3-7
Aluminium oxide	20-27
Magnesium oxide	0.5-1
Phosphorous	Less than 1

2) **Stonedust** -Stonedust is collected from crusher units near songir.

Specific gravity of stone dust is 2.6

Admixture Proportions and tests conducted.

The laboratory tests carried out on the raw BC soil and flyash – stonedust stabilized BC soil. Laboratory tests were carried out for determining combined effect of flyash and stonedust on BC soil include Atterberg limit test, specific gravity test, Proctor compaction test, CBR, UCS test.

The equal propotions of (Flyash +stonedust) used along with the soil in the study are 5%, 10% , 15% , 20% respectively, The liquid limit and plastic limit tests were conducted as per IS: 2720(part 5) -1985. Specific gravity test were conducted as per IS :2720 (Part 3/section-1)1980. Proctor compaction test was carried out according to IS: 2720(part 7) -1980 Unconfined compresive strength (UCS) tests were conducted at OMC and MDD as per IS: 2720 (part 10) -1991. The California Bearing Ratio (CBR) tests were conducted as per IS: 2720 (part 16)1987

Analysis of test results and discussions.

Liquid limt and plastic limit.:-

Result of L.L and P.L tests on the expansive clay treated with flyash and stonedust are shown in figures 4 and 5. It is observed that as the percentage of admixture increases, there is a reduction in liquid limit and plastic limit of clay tested . From this it was noticed that the flow characteristic and plastic charactenstics of soil sample are gradually decreasing with increase in percentage of stondust and flyash This reduced plasticity of clay is necessary to avoid the failure patterns in road construction over the expansive sub grade soils.

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% Fly ash and stone dust added	Liquid limit (%)
0	54.23
5	47.94
10	42.18
15	38.92
20	33.43

Table: Variation of LL with percentage fly ash and stone dust added

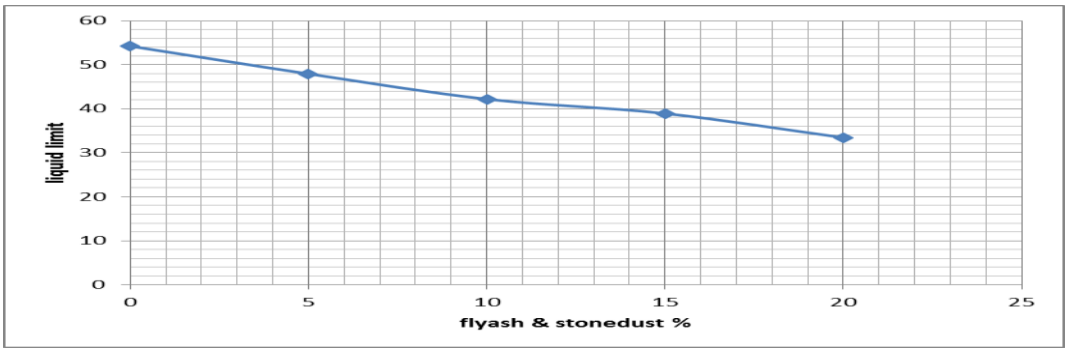

Fig. 1 Influence of fly ash and stone dust on liquid limit

% Flyash and stonedust added	Plastic limit(%)
0	54.77
5	51.92
10	47.38
15	46.06
20	42.70

Table : Variation of PL with percentage Flyash and stonedust added.

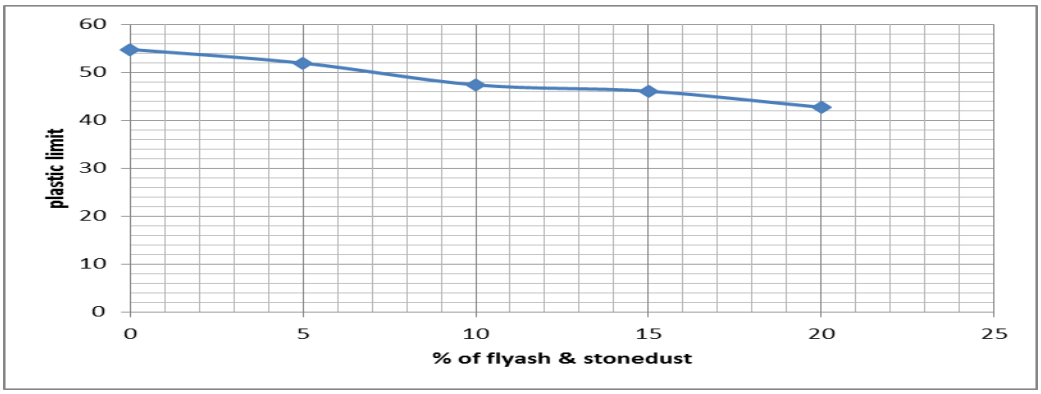

Fig. 2 Influence of flyash and stonedust on plastic limit

Optimum moisture content (OMC) and maximum dry density (MDD)

The compaction characteristics for standard proctor compactive effort for the black cotton soil only and soil with flyash and stonedust mixes shows that the MDD increases and OMC decreases with percentage increase in flyash and stonedust addition.

The variation of OMC and MDD with flyash and stonedust is shown below.

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% Flyash and stonedust added	OMC(%)	MDD(gm/cc)
0	37.5	1.47
5	31.85	1.49
10	31.25	1.5
15	31.21	1.52
20	26.31	1.54

Table: Variation of OMC and MDD with flyash and stonedust %

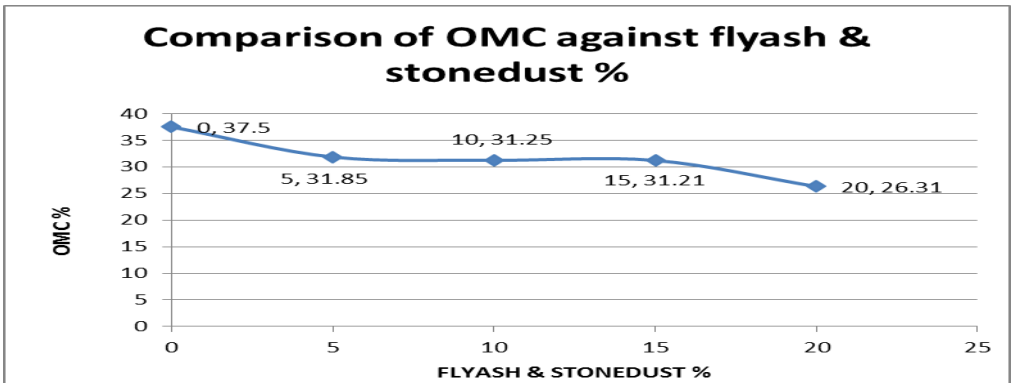

Fig. 3 Variation of OMC with flyash and stonedust %

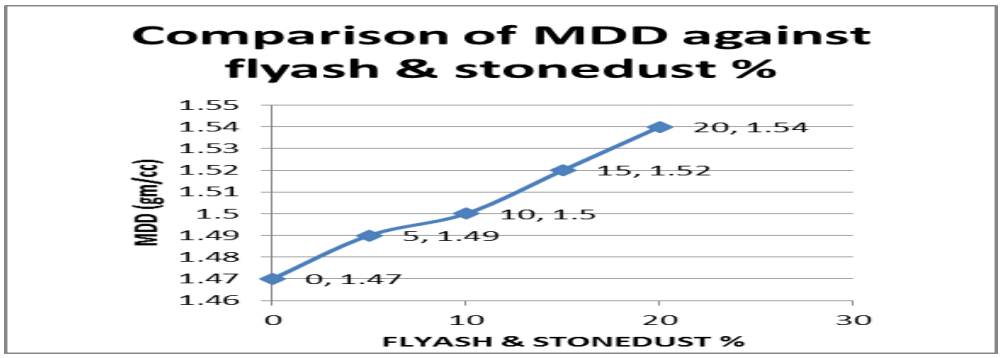

Fig. 4 Variation of MDD with flyash and stonedust %

Unconfined Compressive strength (UCS)

From fig-8, It can be observed that ultimate UCS of clay sample increases gradually upto 10% addition of flyash and stonedust and then decreases. Though the increase in strength is marginal with addition of flyash and stonedust, there is good control over plasticity characteristics of clay.

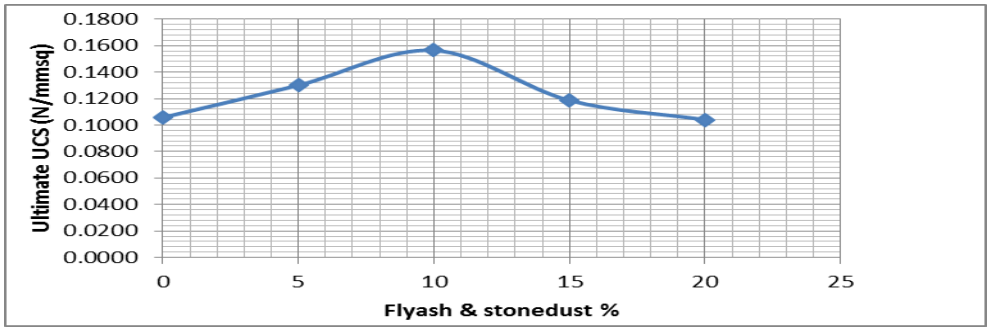

Fig. 5 Influence of flyash and stondust on ultimate UCS

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California bearing ratio (CBR)

Fig.9 Shows effect of flyash and stondust addition in BC soil on unsoaked, and soaked CBR values. Thus optimum percentage of flyash and stonedust combinations for unsoaked and soaked CBR is in between 10- 15%.

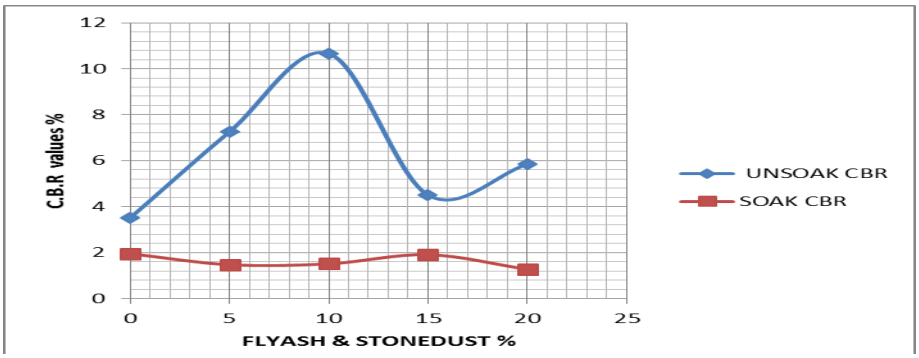

Fig. 6 CBR Values with various percentage of flyash and stonedust.

V. CONCLUSION

The following conclusions can be drawn from the experimental work carried out in this investigation.

1) After addition of flyash & stonedust admixture to the expansive soil, the atterberg's limit, OMC, are decreased.
2) Due to addition of stonedust & flyash admixture, MDD, UCS, CBR values are increased.
3) Addition for stonedust & flyash combine at equal propotion to the expansive soil, increases dry density & decreases optimum moisture content.
4) It is found that there is a maximum improvement in strength properties for the combination of flyash & stonedust individually.
5) Optimum Percentage of flyash & stonedust admixture are observed in betn 10% to 15% for improving the properties of expansive soil
6) Form the economic analysis, it is found that, a substantial save in cost of construction is possible, if the two industrial waste flyash & quarry dust can be utilized upto10%-15% in propotion of 1:1 to strengthen expansive soil subgrade for construction of flexible pavement.

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