International Journal of Modern Trends in Engineering and Research
www.ijmter.com
e-ISSN No.:2349-9745, Date: 2-4 July, 2015

Effect of Compaction Delay on Fly ash Stabilized Black cotton Soil

S.R. JOSHI[1], V.J. SHARMA[2]
1PG Student, Department of Civil Engineering, MCERC, Nashik, Maharashtra, India: swapnil.joshi1991@gmail.com
2Assistant Professor, Department of Civil Engineering, MCERC, Nashik, Maharashtra, India,:nitk.vijay@gmail.com

Abstract-Stabilization of soil is important to enhance the engineering properties of expansive soil like strength, volume stability and durability. During such process some unavoidable delays occurs between mixing the stabilizers with the soil and compaction of the stabilizers mix which affects the properties of stabilized expansive soil. The present paper focuses on the effect of compaction delay on the behaviour of black cotton soil mixed with fly ash has been investigated. The percentage of fly ash which is used in black cotton soil varies from 0%, 20%, 30% and 50% by dry weight of soil. The tests carried out on fly ash stabilize soil specimens were the Compaction tests (Modified Proctor), the Unconfined Compressive Strength test with time delay of 0, 12, 24, 48hrs. The results obtained indicated that the density and strength decreases with increase in compaction delay.

Keywords-Black cotton soil, Compaction delay, Unconfined Compressive Strength, Maximum Dry Density.

I. INTRODUCTION

Increased costs associated with the use of high quality materials led to the need for local soils to be used in geotechnical and highway construction. When these local soils used for these purpose it should possess engineering properties to meet the requirements like high strength, low settlement etc. In most of the condition the soil present in the field may be problematic one such as expansive soil like black cotton soil. In India expansive soils cover about 20% of the total land area (Ranjan and Rao 2005, Shelke and Murty 2010). These soils increase in volume on absorbing water during rainy seasons and decreases in volume when the water evaporates from them during dry seasons. Due to such swelling and shrinkage properties of soil causes impairment to many lightly loaded structures. Soil stabilization of black cotton soils with various additives is one of the techniques to reduce the problems possessed by expansive soils. Chemical stabilization of black cotton soils involves additives such as lime, cement, fly ash, bitumen etc. in different proportion. Soil stabilization has been used in the construction of roads and air craft runways etc .The properties like strength and durability of black cotton soils can be improved by mixing the stabilizers with soil at required water content and then compacting the soil stabilization mix to the desired density.

At the same time, fly ash is produced abundantly in coal based thermal power plant all over the world. The problem of disposal of fly ash is more vulnerable and complex, especially in India than due to high ash content in coals used (Sridharan, 2002). Studies have been conducted in the past by many investigators regarding the use of fly ash alone or in conjunction with lime or cement for improving properties of black cotton soil in many regions around the world. But delay between mixing the stabilizers with soil and compaction of the soil- stabilizers mix leads to change in both strength and density properties of the soil for fixed compactive effort. Most of the time delay is unavoidable due to any one reason of the following: sudden rainfall, delaying if compacting equipments after mixing, poor transportation etc. these makes the compaction process a delayed one. These delaying hours significantly affects the strength of stabilized soils. Hence it is necessary to study the effects of compaction delay between the mixing and compaction on the engineering properties of black cotton soil stabilized with fly ash.

This paper presents the results of an experimental study aimed at understanding the effect of compaction delay on maximum dry density, unconfined compressive strength of black cotton soil (BCS) stabilized with fly ash.

II.MATERIALS USED

2.1Characteristics of the Experimental Soil

Locally available soil was used for the experimental investigation. Soil sample was collected from the local area at a depth of 1.0m to 1.5m.Different experiments were conducted to characterize the soil.

Table No 1. Properties of Experimental Soil

Sr. No.	Parameter	Values
1.	Specific gravity(Gs)	2.60
2.	Liquid limit(LL)	65%
3.	Plastic limit(PL)	43.58%
4.	Shrinkage limit(Ws)	12.35%
5.	Plasticity index(Ip)	21
6.	MDD	1.627 g/cc
7.	OMC	19.20 %
8.	Swelling Index	37%
9.	C.B.R (unsoaked)	22.95%

2.2Chemical Properties of Fly Ash Used

Fly ash for the current investigation was collected from the coal based thermal power plant situated in Eklahara district Nashik. It was collected in a dry form and transported in airtight polythene bags. The chemical properties of the fly ash are shown in table 2.

Table No 2. Chemical Properties of Fly Ash Used

Sr. No.	Chemical Properties	% by mass
1.	SiO2	58.66%
2.	MgO	1.82%
3.	SO3	0.76%
4.	Na2O	0.62%
5.	SiO2+AL2O3+Fe2O3	92.56%
6.	Total chloride	0.027%
7.	Loss on Ignition	1.94%
8.	Moisture content	0.25%
9.	Specific gravity	2.23

III.EXPERIMENTAL PROCEDURE

The black cotton soil passing through 4.75 mm was mixed in dry state with different percentage of fly ash on weight basis. The required amount of water was added to the soil–fly ash mix to carryout modified proctor compaction test. Immediately after addition of water, the compaction was carried out without any delay to get compaction characteristics of the soil-fly ash mix for the given percentages of the admixtures. After getting the compaction curve, maximum dry density and corresponding optimum moisture content was obtained for the given soil-fly ash mix. The predetermined amount of water was added to the mix to achieve the water content of the mix equal to the optimum moisture content for the mix. Then this wet mix was left undisturbed for a period of 0hr (no delay), 12hrs, 24hrs, and 48hrs. During this period of time delay, care was taken to avoid the evaporation loss of water. After the required period of time delay the specimens were tested for MDD, UCS by applying modified proctor test.

3.1. Experimental Programme

Table 3 gives the details of testing programmed and different mixtures of soil and fly ash used in the present investigation. In the mix designation, the fly ash content is indicated by numerals. Thus 20 FA indicates that 20% by weight is fly ash and the remaining is soil and BCS stands for black cotton soil.

Table No 3. Testing programme

Designation of mix	Mixture	Delayed in compaction
Black cotton soil	100% BCS+ 0% F.A.	Immidiately,12,24,48 hours
20 F.A.	80% BCS + 20% F.A.	Immidiately,12,24,48 hours
30 F.A.	70% BCS + 30% F.A.	Immidiately,12,24,48 hours
50 F.A.	50% BCS + 50% F.A.	Immidiately,12,24,48 hours

IV. RESULTS AND DISCUSSIONS

Figure 1 shows the effect on Maximum Dry Density due to addition of different % of fly ash at no compaction delay. From the figure it can be observed that maximum dry density of modified compactive effort decreases with increases in % of fly ash. The addition of 0%, 20%, 30% and 50% of fly ash decreases the density from 1.627g/cc to 1.58g/cc,1.556g/cc, and 1.543g/cc respectively. The decrease in density is mainly due to lower specific gravity of fly ash as compared to black cotton soil and immediate formation of cemented products reduces the density.

Figure 2. shows the changes to the MDD due to delay in compaction of black cotton soil mixed with fly ash. It can be observed that MDD further decreases with increases in compaction delay. However with addition of 50% fly ash, the rate of decreases of MDD slows down.

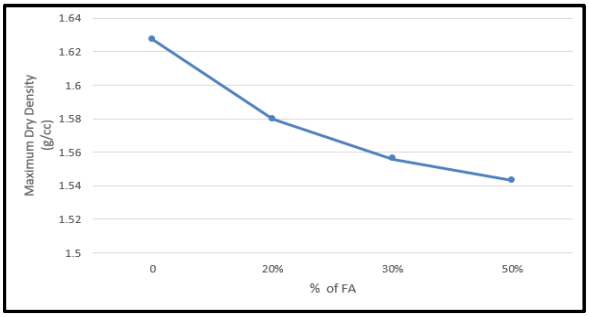

Fig.1 Variation of MDD of black cotton soil due to addition of different % of fly ash at no compaction delay

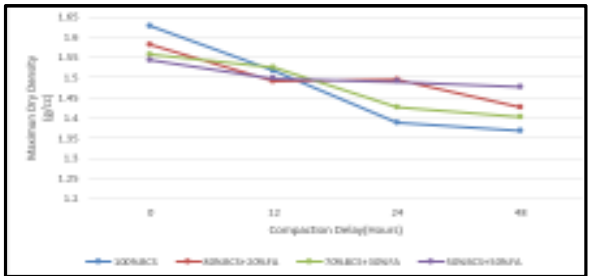

Fig. 2 Variation of MDD due to delay in compaction of black cotton soil treated with flay ash.

Figure 3. Shows the effect on unconfined compressive strength of black cotton soil mixed with different % of fly ash at no compaction delay. It can be seen that unconfined compressive strength of black cotton soil increases with increase in % fly ash, but strength was maximum at addition of 20% of fly ash. With the addition of 20%, 30%, 50% of fly ash the strength increases from 54kn/m2 to 107kn/m2, 96kn/m2, and 64kn/m2 respectively.

Figure.4 indicates that with increase in compaction delay unconfined compressive strength decreases. With 50% addition of fly ash, there is little increase in strength at 0 hour compaction delay but as the delay in compaction increases it attains almost a same strength as that of plane black cotton soil.

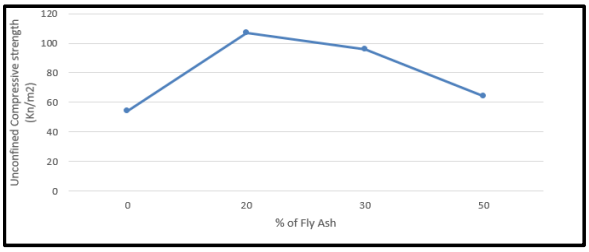

Figure 3 Variation of UCS of black cotton soil stabilized with different % of fly ash

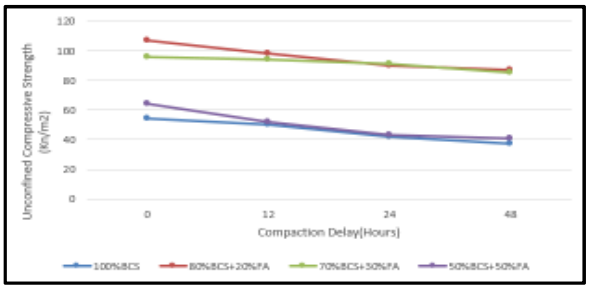

Fig. 4 Variation of UCS due to delay in compaction of black cotton soil stabilized with different % of fly ash.

V. CONCLUSIONS

The following conclusions were drawn after this work has been carried out:

1. The maximum dry density decreases with increase in fly ash content as well as increases in compaction delay.
2. Strength of soil increases with addition of fly ash, it attains maximum strength with 20% addition of fly ash at no compaction delay.
3. As the compaction delay increases strength decreases.

REFERENCES

[1] S. Sahayai, M.Muttharam.(2009) "Deleyed compaction effects on the behavior of stabilized soil". IGC 2009. Guntur India, 419-422.
[2] U.N. Okonkwo.(2009) "Effects of compaction delay on the properties of cement –bound lateritic soils". Nigerian journal of technology, September 2009, vol. 28,5-12.
[3] S. Bhuvaneshwari, R.G.Robinson,S.R. Gandhi(2005) "Stabilization of expansive soil using fly ash". Fly ash utilization Programme(FAUP), Journal of transportation engg. March 2005,149-155.
[4] J.M. Raut, Dr. S.P. Bajad (2014)" Stabilization of expansive soil using fly ash and murrum". International journal of innovative research and science, July 2014, Vol. 3, Issue 7

