International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

Stabilization of Soil using Fly Ash and Gypsum

Anshul Verma[1], Prof. Dhirendra Kumar Singh[2]

[1]*PG student Department of Civil Engineering, IEC-CET Greater Noida, Uttar Pradesh*
[2]*Assistant Professor, Department of Civil Engineering IEC-CET Greater noida, Uttar Pradesh*

Abstract–Urbanization and growth in the economy of cities of India have led to the steep increase in the building construction activities, due to which implementation of highway, building, railway, water tank is necessary. These type of work required quality earth in massive quantity. In city area, that amount of borrow earth is not available hence it is transported form other village areas. These village areas has high plastic and expensive soil which is not suitable for such purpose. The city Jhansi is a fastest growing city of uttar pradesh. The wide spread of black cotton soil in jhansi city is a challenge and problem to the construction activity. There are many mills like ma pitambra concrete udyog, madhu concrete etc which generate a huge quantity of fly ash and fly ash management is posing a serious problem, hence these fly ash is chosen for the use of stabilizing the black cotton soil. It is observed that the geotechnical properties of jhansi black cotton soil is improved by using these fly ash as stabilizer. The plasticity parameter also have favorable change in their value, means shrinkage limit is decrease and liquid limit and plastic limit is increased. Maximum dry density, CBR value and Unconfined compressive strength is also increased by using that fly ash. This study says that most favorable result can be obtained by using fly ash at 20 % to 25% which is known as optimum percentage of fly ash that can be mixed with soil under study.

***Key Words*: Stabilization of sail, black cotton soil, fly ash, plasticity parameter, CBR value, Jhansi, Uttar pradesh, India**

1. INTRODUCTION

Soil stabilization is a process of treating a soil in such a manner as to maintain, alter or improve the performance of the soil as a construction material.

The property of volumetric changes with the change of atmospheric conditions makes black cotton soil dangerous to be founded Pavements & buildings. It swells excessively when wet and shrinks excessively when dried, these resulting terrible cracks in soil without any warning. It has a great affinity to water. This tendency of soil is on account of the presence of fine clay particles. Cracks are formed due to movement of the ground on account of alternate swelling and shrinkage. The cracks thus formed are sometimes 15 to 20 cm wide and 2.5 to 4 m deep.

These type of waste material are genrally used for soil stabilization:-

- Fly ash
- Lime
- Gypsum

FIGURE 1 - BLACK COTTON SOIL

AREA IN UTTAR PRADESH

In this figure pink area represent the area of black cotton soil in uttar Pradesh.

1.1 OBJECTIVES

To study behaviour of Fly ash with Black cotton soil, samples are collected from surrounding area of Uttar Pradesh region (Jhansi, Mahoba, Hamirpur, Lalitpur) and experimental works carried out for evaluation of Fly ash, Lime and gypsum

The study for soil characteristics, Free Swell Index, Standard Proctor Test, Specific Gravity, CBR and UCS are conducted for natural and treated soil samples.

2. MATERIALS AND METHODS

a) MATERIAL USED

Mainely three type of material are used to stabilizing the soil

1. Lime
2. Fly ash
3. Gypsum

1. LIME

A General term for burned limestone, also known as quicklime, hydrated lime and unslaked or slaked lime. Its predominant usage (90%) is as a basic industrial chemical. It still enjoys its traditional building use.

2.FLY ASH

Fly ash is a waste by product from Thermal power plants which use coal as fuel. Generally, fly ash can be classified as Class-C fly ash and Class-F fly ash. This classification is based on the percentage of calcium oxide available in fly ash. At present about 100 Thermal power plants in India produce about 130million tonnes of fly.

On the basis of a lime reactivity test, fly ashes have been classified into four different type, given as

1.Cementitious fly ash

2.Pozzolanic fly ash

3.Cementitious and pozzolonic fly ash

4.Non pozzolonic fly ash

3.GYPSUM

Gypsum is the by-product of phosphoric acid industry, consists of CaSO4.2 H2O and contains some impurities such as Phosphorus pent oxide (P2O5), F and organic substances. These impurities seriously restrict the industrial use of Phosphogypsum in cement industry as a retarder.

b) METHODS

To evaluate the effect of fly ash as a stabilizing additive in expansive soils, series of tests, where the content of fly ash in the expansive soil was varied in values of 10% to 25% (multiples of 5) by weight of the total quantity taken. The Indian Standard codes were followed during the conduction of the following experiments:

Standard proctor test – IS: 2720 (Part 7) - 1980

Unconfined compressive strength (UCS) test – IS: 2720 (Part 10) - 1991

California bearing ratio (CBR) test – IS: 2720 (Part 16) - 1987

Free swell index test – IS 2720 (Part 40) - 1977

Liquid & Plastic limit test – IS 2720 (Part 5) - 1985

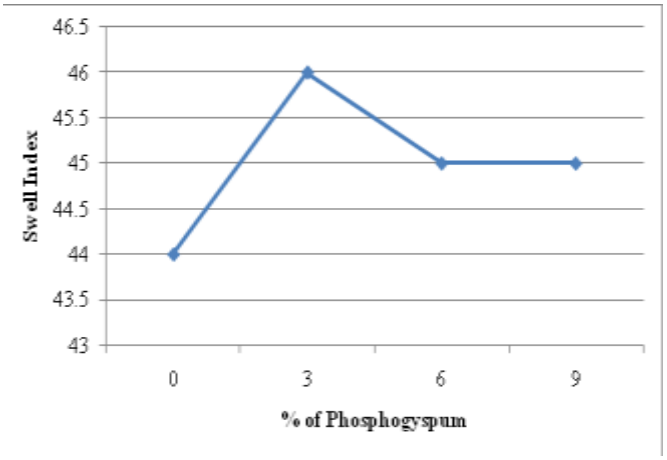

FIG.3- UCS TEST

2.1 DATA ANALYSIS AND DISCUSSION

1. **SPECIFIC GRAVITY**

Specific gravity G is defined as the ratio of the weight of an soil mass to equal volume of distilled water at that temperature both weights taken in air Gs=Ps/Pw.

This test is useful in determining the specific gravity of the materials and is carried out according to IS: 2720 (part 3, section I)

Table 1 - specific gravity

S.N.	MATERIALS	G
1	LIME	2.58
2	FLY ASH	2.42
3	GYPSUM	2.33

2. FREE SWELL INDEX TEST

At constant fly ash content (25%) and plasticity index if only changes in phasphogypsum percentage then swell index first INCREASE and then DECREASE and then tends to constant at 9% of plasticity index and 25% of fly ash content.

Table 2 - swell index test

S.N.	MIX PRAPORTION	SWELL INDEX
1	SOIL+25%FA+0%L+1.0%PG	44
2	SOIL+25%FA+3%L+1.0%PG	46
3	SOIL+25%FA+6%L+1.0%PG	45
4	SOIL+25%FA+9%L+1.0%PG	45

3- UNCONFINED COMPRESSIVE STRENGTH TEST

Uconfined compressive strength is always increase with increase in fly ash, lime, gypsum .for greatest ucs value, 25% fly ash, 9% platicity, 0.3% gypsum is used.

S.N.	MIX PRAPORTION	UCS VALUE
1	SOIL+25%FA+0%L+1.0%PG	3.9
2	SOIL+25%FA+0%L+1.0%PG	4.5
3	SOIL+25%FA+6%L+1.0%PG	4.7
4	SOIL+25%FA+9%L+1.0%PG	5.1

TABLE 3 - UCS TEST

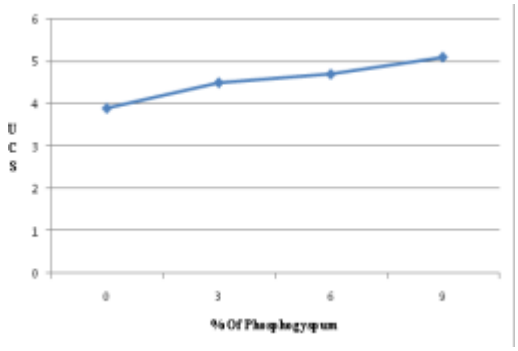

FIG.3- UCS TEST

4- CBR VALUE TEST

Genrally at 25% of fly ash the soil give best result and at this fly ash content CBR value is considerabley good. At this fly ash content by adding 1% of gypsum ,the CBR value will also be improved.

Table-4 - CBR VALUE

S.N.	MIX PRAPORTION	CBR VALUE
1	SOIL+25%FA+0%L+1%PG	5.2
2	SOIL+25%FA+3%L+1.0PG	7.2
3	SOIL+25%FA+6%L+1.0PG	8
4	SOIL+25%FA+9%L+1.0PG	9.8

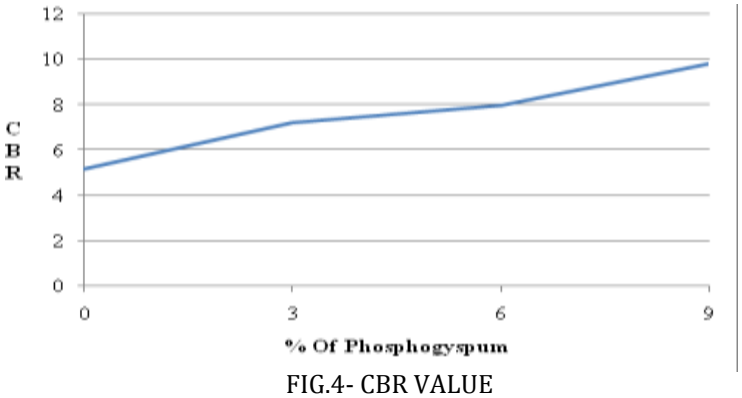

FIG.4- CBR VALUE

3. CONCLUSIONS

I. THE compressive strength of soil canl be increased by 15% by adding gypsum at 1% by weight. Hence gypsum may increase strength of soil .

II. Addition of fly ash to soil-gypsum mix leads to increase the compressive strength by 90% at 25% fly ash by weight.hence fly ash- gypsum mix may be used for better quality of soil.

III. Stabilization of sub grade soil by fly ash(25%)+gypsum(1%) significantly improve the CBR value and can be effectively implemented in local soil, which will significantly reduce the thickness of component layer.

4- REFERENCES

1. Bose, B. (2012), "Geo-engineering Properties of Expansive Soil Stabilized with FlyAsh", Electronic Journal of Geotechnical Engineering, Vol. 17, pp. 1339-1353
2. Holtz, W. G., and Gibbs, H. J. (1956),"Engineering properties of expansive clays" Transactions ASCE. Vol. 121, pp. 641–677.
3. Phanikumar, B.R. and Sharma, R. S. (2004), "Effect of Fly Ash on Engineering Properties of Expansive Soil", Journal of Geotechnical and GeoenvironmentalEngineering. Vol. 130, Issue 7, pp. 764-767.
4. Phanikumar, B. R., Naga Reddayya, S. and Sharma, R. S. (2001), "Volume Change Behavior of Fly Ash Treated Expansive Soils", 2nd International Conference on CivilEngineering, Indian Institute of Science, Bangalore, India. Vol. 2, pp. 689–695.
5. Phanikumar, B.R. (2009), "Effect of Lime and Fly Ash on Swell, Consolidation and Shear Strength Characteristics of Expansive Clay: A comparative study", Journal of Geomechanics and Geoengineering: An international journal, Vol. 4, Issue 2, pp.

6. Raut, J.M., Bajad, S.P., and Khadeshwar, S.P. (2014), "Stabilization of Expansive Soils Using Fly ash and Murrum", International Journal of Innovative Research in Science,Engineering and Technology. Vol. 3, Issue 7