

Stabilization of Expansive Soils with Flyash as Sub Grade in Roads

Dr. S. Siddiraju¹ & M. Muzafar Ahmed²Professor and Head, Department of Civil Engineering, Siddharth Institute of Engineering & Technology, Puttur,
A.P, India¹Assistant Professor, Department of Civil Engineering, Siddharth Institute of Engineering & Technology, Puttur,
A.P, India²

ABSTRACT: Swelling of soil always create problems for lightly loaded structures than the moderately loaded structures. This swelling of soils changes the volume due to clay swelling properties along with the variation in moisture content, these problems can measure through swelling, shrinkage and unequal settlement. As a result of these expensive soils, damage the foundation systems and structural elements. An investigation carried out to overcome these problems under control the backdrop. Pre-stabilization is the very effective method in for expansive soil. In this paper the experimental investigation on expansive soil with low cost material such as fly-ash is added to expensive soil. The addition of fly-ash to expensive soil to improve the properties of expensive soil. In this Pre and post stabilized results are compared to arrive at problems of expansive soil.

The index properties of expansive soil such as liquid limit, plastic limit and shrinkage limit are compared with and without fly-ash to expensive soil. Along with these Atterberg limits, grain size distribution also evaluated. The various swelling potential of expansive soil are determined with the addition of various percentage of fly-ash. For percentages of fly-ash, maximum dry density and optimum moisture contents are found by the proctor compaction test. The strength aspects of these expansive soils are determined for soil specimens with different percentage of fly-ash through California Bearing Ratio Test and the results are compared through.

The above experimental results are compared to obtain a various percentage of fly-ash with swelling soil which gives best results for lower value of higher strength.

KEYWORDS: Expansive Soil, Swelling Potential, Fly-ash, Atterberg limits, moisture content.

I. INTRODUCTION

From centuries of mankind was wondering at the instability of earth materials, especially on expansive soil. Swelling soil always creates a problem for lightly loaded structure by changing the volume of the soil with variation in moisture content. As a result the superstructures usually counter high excessive settlement and differential movements, resulting in to damage foundation systems and transportation structural elements. When efforts are to be made to improve the properties of swelling soil, a appropriate technology sometimes results to reduce the volumetric change that are responsible for damages in each year. It is due to that the present work is taken up. Soil stabilization is the general term for any physical, chemical, biological, or combined method of changing a natural soil to meet an engineering purpose. Soil stabilization is the process to improve the California Bearing Ratio value of in-situ soils by 4 to 6 times. The other objective of this soil stabilization is to improve the sub-base and sub-base course as strong. In certain regions of the world, mainly in developing countries soil stabilization is more frequently used to construct the entire road.

Why Fly Ash as Additive

In most of the centuries, coal is the primary fuel in many thermal power plant and other industry sector. The fine residue which is collected from the plant in a field is known as fly ash and it is considered as a waste material. The

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

fly ash is disposed either by dry or mixed with water and disposed into some locations called ash ponds. The quantity of fly ash that is produced world-wide is huge and it increasing day by day. In every year there are four countries, namely, India, China, Poland and United State are produce more than 270 million tons of fly ash.

In our country a totally installed capacity of 100,000 MW of electricity generation. Totally Seventy-three percentage of this is based on the thermal power generation. The coal India reserves are produce a fly-ash which is estimated around 200 billion metric tons. Because of this, 90% of Indian thermal power stations are running based of coal. In our countru a total of 85 coal based thermal power station and other power station are present.

Presently, India has produced nearly about 100 million metric tons of coal ash that is expected to be double in next 10 years. The most common method for adopted in India for disposal of coal ashes is wet method. This method is requires for a large capital investment of 1 acre of land of 1 MW of installed capacity. Thus ash ponds occupy nearly about 26,300ha of land in India. The utilization these fly ash was just about 3% in 1994, but there is a growing realization about the need for conservation of the environment in India.

With the above view, an experiment on swelling soil has been done with the addition of fly-ash as additive. This paper work has been done to see the effect on swelling aspect and on strength of some swelling soil by addion fly ash in various proportions into it as additive.

II. MATERIALS AND METHOD

Fly-ash is a waste product which is comes from thermal power plants. This fly-ash is added to expensive soils gives better result than without fly-ash. The following properties of expansive soil which are determined through laboratory are

- Grain Size Analysis
- Atterberg Limits
 - Liquid Limit
 - Plastic Limit
 - Shrinkage Limit
- Free Swell Index(DFSI)
- Compaction Characteristics (Standard Proctor Test)
 - Dry Density
 - Optimum Moisture Content
-
- CBR Test

III. TEST RESULTS

A) Grain Size Analysis

The result of sieve analysis are plotted to get a particle size distribution curve with the 'percentage finer N' as the ordinate on normal scale and the 'particle diameter' as the abscissa of logarithmic scale. A particle size distribution

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

curve gives us an idea about the type and gradation of the soil .the value of coefficient of Uniformity (Cu) and coefficient of curvature (Cc) are determined by the following formulae:

$$\text{And, } C_u = \frac{D_{60}}{D_{10}}$$

$$C_c = \frac{(D_{30})^2}{(D_{10} * D_{60})}$$

On the basis of Cu and Cc, the soils can be categorized as well graded or poorly graded, gap graded or uniformity graded.

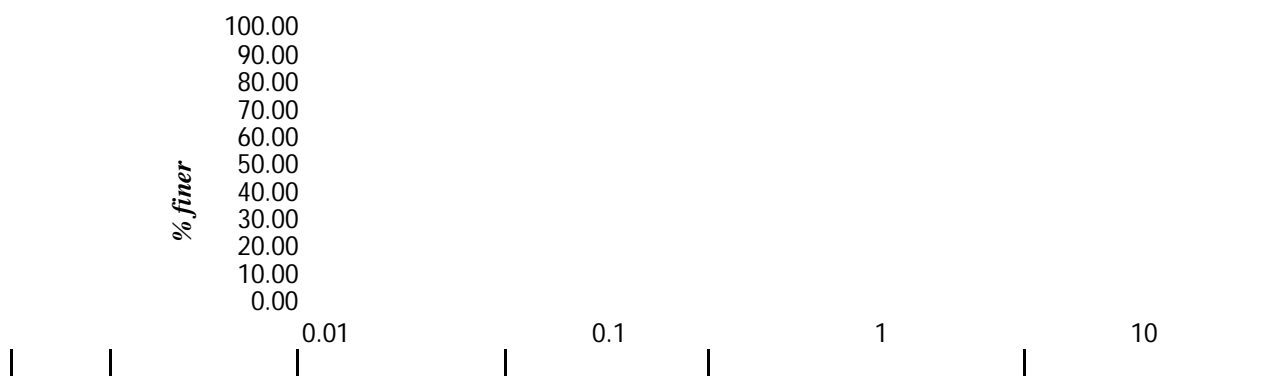
Total Weight of Soil = 1000g

Dry Weight of Soil Retained on 75µ Sieve = 466.5g

Table1: Sieve Analysis for expansive soil

S.No	Particle Size (mm)	Weight Retained(G)	% Of Weight Retained	Cumulative% Weight Retained	Cumulative % Finer
1	4.75	38	8.15	8.15	91.85
2	2.36	35	7.50	15.65	84.35
3	1.18	49.5	10.61	26.26	73.74
4	0.6	82.5	17.68	43.94	56.06
5	0.32	90	19.29	63.24	36.76
6	0.15	149	31.94	95.18	4.82
7	0.075	22.5	4.82	100.00	0.00

Particle size vs % finer



International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

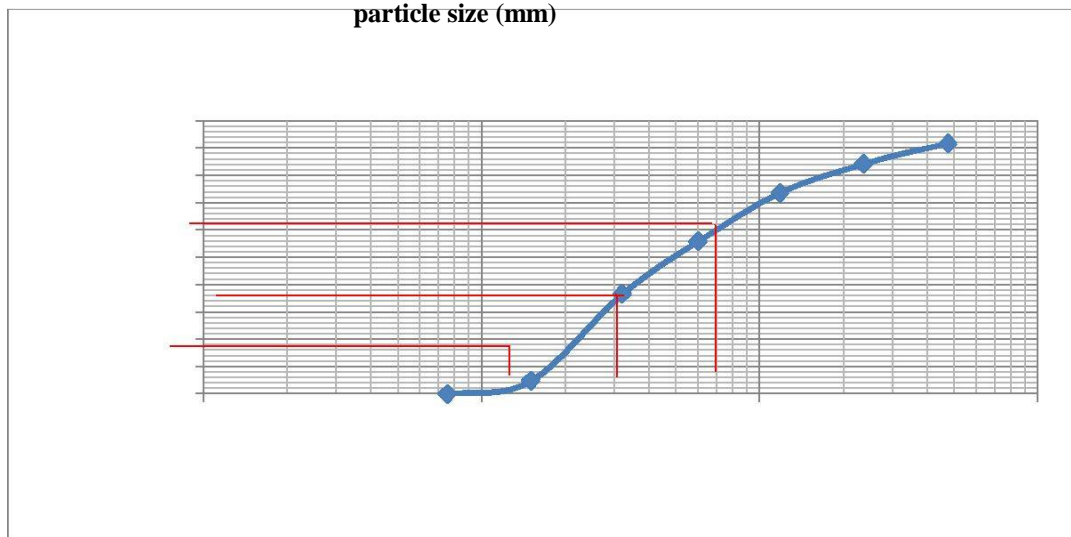


Figure 1: Sieve Analysis Chart for expansive soil

Where, Effective Size $D_{10} = 0.18$

$D_{30} = 0.27$

$D_{60} = 0.7$

Co-Efficient of Uniformity = $c_u = D_{60}/D_{10} = 3.89$

Co-Efficient of Curvature = $c_c = (D_{30})^2 / (D_{10} \times D_{60}) = 0.57$

B) Liquid Limit

The liquid limit is carried for various percentage of fly ash as 0%, 10%, 30% and 50% by weight of soil. The results of liquid limit are given in Table 2. From the table 2, the liquid limit of expansive soil is decreases with the addition of fly-ash to expansive soil.

Table 2: Liquid Limit for Various Percentage of Fly Ash

S.No.	% of fly ash	Liquid Limit (%)
1	0	68
2	10	64
3	30	55
4	50	48

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

C) Plastic Limit

The plastic limit is carried out for various percentage of fly ash as 0%, 10%, 30% and 50% by the weight of soil. The results of liquid limit are given in Table 3. From the table 3, the plastic limit of expansive soil is increases with the addition of fly-ash expensive soil.

Table 3:Plastic Limit for various percentage of fly ash

S.No.	% of fly ash	Shrinkage Limit (%)
1	0	32
2	10	36
3	30	36.8
4	50	38.1

D) Shrinkage Limit

The shrinkage limit is carried for various percentage of fly ash as 0%, 10%, 30% and 50% by weight of soil. The results of shrinkage limit are given in Table 4. From table 4, the shrinkage limit of expensive soil is increases with the increase of percentage of fly-ash.

Table 4: Shrinkage Limit for Various Percentage of Fly Ash

S.No	% of fly ash	Shrinkage Limit (%)
1	0	7.6
2	10	9.1
3	30	10.78
4	50	11.34

E) Free Swell Index

The free swell index is carried for various percentage of fly ash as 0%, 10%, 30% and 50% by weight of soil. The results of free swell index are given in Table 5. From the table, the free swell index for a expensive soil is decreases with the increases of % of fly-ash.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

Table 5: Free Swell Index for Various Percentage of Fly Ash

S.No	% of fly ash	Free Swell Index (%)
1	0	128
2	10	106
3	30	94
4	50	86

F) Compaction Characteristics

Dry Density

The standard proctor testis carried for various percentage of fly ash as 0%, 10%, 30% and 50% by weight of soil. The results of dry density are given in Table 6. The density of expensive soil is increases with the increase of percentage of fly-ash.

Table 6: Dry Density for Various Percentage of Fly Ash

S.No	% of fly ash	Dry density
1	0	1.4
2	10	1.876
3	30	2.542
4	50	2.92

Optimum Moisture Content

The standard proctor testis carried for various percentage of fly ash as 0%, 10%, 30% and 50% by weight of soil. The results of optimum moisture content are given in Table 7. From the table, the moisture content of expensive soil with the addition of fly-ash is increases.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

Table 7: Optimum Moisture Content for Various Percentage of Fly Ash

S.NO	% of fly ash	Optimum moisture Content
1	0	24.8
2	10	25.82
3	30	23.6
4	50	20.31

G) California Bearing Ratio (CBR) Test

CBR test is carried for both Soaked and Unsoaked conditions. The CBR Test is carried for various percentage of fly ash as 0%, 10%, 30% and 50% by weight of soil. The results of CBR values of Soaked and Unsoaked are given in Table 8. From the results, the CBR value is increases with the increases of percentage of fly-ash

Table 8: CBR Values (soaked and unsoaked) for Various Percentage of Fly Ash

S.No.	% of fly ash	CBR Results (%)	
		Soaked	Un soaked
1	0	2.01	5.3
2	10	3.56	6.71
3	30	5.25	7.4
4	50	4.98	8.2

IV. CONCLUSION

After studying experimental work in detail, following conclusion are drawn.

- The addition of fly ash reduces the plasticity characteristics of expansive soil. The liquid limit decrease and plastic limit increases with an increase in fly ash content. Plasticity index reduces by 22% with the addition of 0-10% fly ash. Shrinkage limit goes on Increasing constantly with uniform rate with increase in fly ash content.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

- The addition of fly ash to expansive soil reduces the free swell index. For the expansive soil used both free swell were reduced by 17% from 0-10% fly ash. At higher percentage of fly ash rate of reduction in free swell and swelling pressure gradually decreased.
- OMC decreases and MDD increases. Therefore addition of fly ash is equivalent to increased compactive effort. For the addition of 10-30% fly ash, MDD increased by 26.19% and OMC reduced by 10%. For higher percentage of fly ash more than 30% variation in MDD and OMC is not appreciable.
- In the present study CBR value is observed on both soaked and unsoaked soil sample, CBR values increases with increase in fly ash. CBR value increases with higher rate up to 10-30 % of fly ash and then with slower rate. For the expansive soil used, CBR increases by 32% with the addition of 10-30% fly ash.

REFERENCES

1. B. Bose, "Geo engineering properties of expansive soil stabilized with fly ash," Electronic Journal of Geotechnical Engineering, Vol. 17, Bund. J, 2012, pp. 1339-1353.
2. Bureau of Indian Standards (1973). Methods of Tests for Soil, Part 2, Determination of Water Content of Soil, IS 2720, B.I.S, New Delhi.
3. Bureau of Indian Standards (1985). Methods of Tests for Soil, Part 4, Grain Size Analysis, IS 2720, B.I.S, New Delhi.
4. Bureau of Indian Standards (1985). Methods of Tests for Soil, Part 5, Determination of Liquid Limit and Plastic Limit. IS 2720, B.I.S, N. Delhi.
5. Bureau of Indian Standards (1987). Methods of Tests for Soil, Part 16, Laboratory Determination of CBR, IS 2720, B.I.S, New Delhi
6. Bureau of Indian Standards (1992). Methods of Tests for Soil, Part 7, Determination of Water Content-Dry Density Relation using Light Compaction of Soil, IS 2720, B.I.S, New Delhi.
7. Mahesh G. Kalyanshetti, Satish Basavaraj Thalange "EFFECT OF FLY ASH ON THE PROPERTIES OF EXPANSIVE SOIL", International Journal of Scientific & Engineering Research, Volume 4, Issue 5, pp.37-40, 2013