ISSN : 2455-9679
Impact Factor : 3.340

ijrtsm

IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"STABILIZATION OF EXPANSIVE SOIL USING FLY ASH"

Shahnawaz Khan [1]***, Veena Mandelekar*** [2]

[1] *M.Tech Scholar, Lakshmi Narain College of Technology, Bhopal, MP, India*

[2] *Assistant Professor, Lakshmi Narain College of Technology, Bhopal, MP, India*

ABSTRACT

Expansive clay soils are extensively distributed worldwide, and are a source of great damage to infrastructure and buildings. In monsoon they imbibe water and swell and in summer they shrink on evaporation of water from there. Because of this alternative swelling and shrinkage, lightly loaded civil engineering structures like residential buildings, pavements and canal linings are severely damaged. It is, therefore, necessary to mitigate the problems posed by expansive soils and prevent cracking of structures. Many areas in Gujarat are located on highly expansive soil. Extensive laboratory / field trials have been carried out by various researchers and have shown promising results for application of such expansive soil after stabilization with additives such as sand, silt, lime, fly ash, etc. As fly ash is freely available, for projects in the vicinity of a Thermal Power Plants, it can be used for stabilization of expansive soils for various uses. The present paper describes a study carried out to check the improvements in the properties of expansive soil with fly ash in varying percentages.

Keyword: *Compaction, Fly ash, Plastic clay, Cohesion, stabilization.*

I. INTRODUCTION

There are three basic types of soil naturally occurring in this area: sand, silt and clay. Clay soils are generally classified as "expansive. " This means that a given amount of clay will tend to expand (increase in volume) as it absorbs water and it will shrink (lessen in volume) as water is drawn away. The effects can be dramatic if expansive soils supporting structures are allowed to become too wet or too dry.

Building structures, foundations, driveways and walkways may crack and heave as the underlying expansive soils become wet and swell. Sometimes the cracking and heaving appear temporary as the soils dry and shrink back to their original position.

Map of soil deposits in Gujarat State shows that the majority of Gujarat area having black cottons soil as top layer. Table 1 shown the properties of black cotton soil.

Based on our visits to various industries we finally decided to take waste material (Fly ash) as soil stabilizers for chemical soil stabilization considering economic advantage and waste disposal problems.

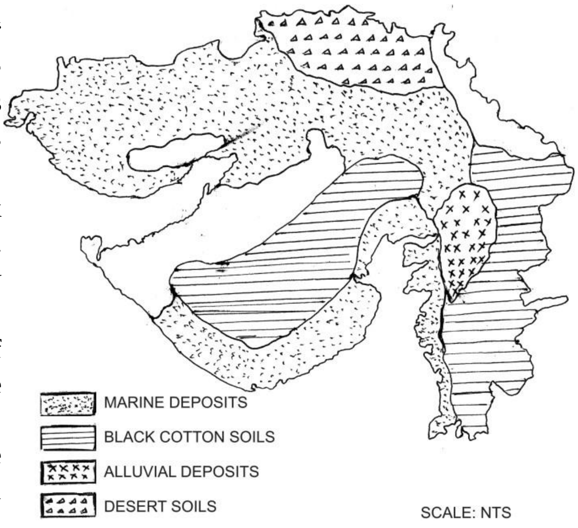

Fig. 1: Map of Soil Deposits in Gujarat State

ISSN : 2455-9679
Impact Factor : 3.340

TABLE: 1 PROPERTIES OF THE BLACK COTTON SOIL.

PROPERTY	RANGE
Field Moisture Content (%)	10 – 35
Field Dry Density (gm/cc)	1.15 - 1.65
Liquid Limit (%)	40 – 75
Plastic Limit (%)	18 – 35
Shrinkage Limit (%)	8 – 20
Free Swell Index	40 – 80
Swelling Pressure (kg/cm2)	0.065 - 0.258

SOIL STABILIZATION:

Soil stabilization is the alteration of one or more soil properties to create an improved soil material possessing the desired engineering properties.

Advantages of Soil Stabilization

- Improves soil strength
- Helps to reduce soil volume change due to temperature or moisture
- Improves soil workability
- Reduce dust in work environment
- Improves durability

Soil stabilization can be done by two methods.

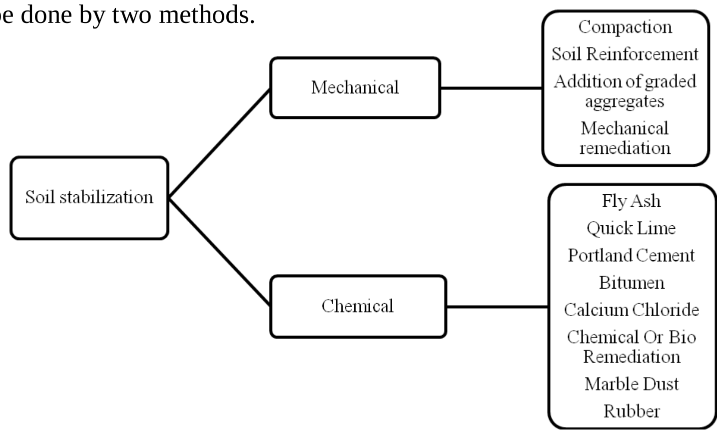

Fig. 2 Methods of Stabilization

II. LITERATURE STUDY

Pandianet.al. (2002). Studied the effect of two types of fly ashes Raichur fly ash (Class F) and Fly ash by itself has little cementatious value but in the presence of moisture it reacts chemically and forms cementatious compounds and attributes to the improvement of strength and compressibility characteristics of soils. It has a long history of use as an engineering material and has been successfully employed in geotechnical applications.

Naively fly ash (Class C) on the CBR characteristics of the black cotton soil. The fly ash content was increased from 0 to 100%. Generally the CBR/strength is contributed by its cohesion and friction. The CBR of BC soil, which consists of

ISSN : 2455-9679
Impact Factor : 3.340

predominantly of finer particles, is contributed by cohesion. The CBR of fly ash, which consists predominantly of coarser particles, is contributed by its frictional component. The low CBR of BC soil is attributed to the inherent low strength, which is due to the dominance of clay fraction. The addition of fly ash to BC soil increases the CBR of the mix up to the first optimum level due to the frictional resistance from fly ash in addition to the cohesion from BC soil. Further addition of fly ash beyond the optimum level causes a decrease up to 60% and then up to the second optimum level there is an increase. Thus the variation of CBR of fly ash-BC soil mixes can be attributed to the relative contribution of frictional or cohesive resistance from fly ash or BC soil, respectively. In Naively fly ash also there is an increase of strength with the increase in the fly ash content, here there will be additional puzzolonic reaction forming cementitious compounds resulting in good binding between BC soil and fly ash particles.

Phanikumar and Sharma (2004): A similar study was carried out by Phanikumar and Sharmaand the effect of fly ash on engineering properties of expansive soil through an experimental programme. The effect on parameters like free swell index (FSI), swell potential, swelling pressure, plasticity, compaction, strength and hydraulic conductivity of expansive soil was studied. The ash blended expansive soil with fly ash contents of 0, 5, 10, 15 and 20% on a dry weight basis and they inferred that increase in fly ash content reduces plasticity characteristics and the FSI was reduced by about 50% by the addition of 20% fly ash. The hydraulic conductivity of expansive soils mixed with fly ash decreases with an increase in fly ash content, due to the increase in maximum dry unit weight with an increase in fly ash content.

S. Bhuvaneshwari R. G. Robinson and S. R. Gandhi: Infrastructure projects such as highways, railways, water reservoirs; reclamation etc. requires earth material in very large quantity. In urban areas, borrow earth is not easily available which has to be hauled from a long distance. Quite often, large areas are covered with highly plastic and expansive soil, which is not suitable for such purpose. Extensive laboratory / field trials have been carried out by various researchers and have shown promising results for application of such expansive soil after stabilization with additives such as sand, silt, lime, fly ash, etc. As fly ash is freely available, for projects in the vicinity of a Thermal Power Plants, it can be used for stabilization of expansive soils for various uses. The present paper describes a study carried out to check the improvements in the properties of expansive soil with fly ash in varying percentages. Both laboratory trials and field tests have been carried out and results are reported in this paper. One of the major difficulties in field application is thorough mixing of the two materials (expansive soil and fly ash) in require proportion to form a homogeneous mass. The paper describes a method adopted for placing these materials in layers of required thickness and operating a "Disc Harrow". A trial embankment of 30m length by 6m width by 0.6m high was successfully constructed and the in-situ tests carried out proved its suitability for construction of embankment, ash dykes, filling low-laying areas, etc.
Use of fly ash as an additive in soil stabilization is effective. It reduces high compressibility and leading to dyke top settlement. It provides adequate shear strength for required slope stability.

Meei-Hoan Ho and Chee-Ming Chan: Soft clays generally display extremely low yield stresses, high compressibility, low strength, low permeability and consequently low quality for construction. Soil stabilization like soil-cement mixing can be effectively adopted to improve the strength and deformation characteristics of the soft clays. To incorporate a 'green' element in the existing stabilization technique, rubber chips derived from waste rubber tyres were used together with cement to stabilized kaolin in the laboratory, exploring the feasibility of the innovative stabilizer. A series of laboratory tests were carried out to study the fundamental mechanical and chemical properties of the cement-rubber chip stabilized kaolin. The mechanical properties examined included bender element and unconfined compressive strength, while the chemical properties included pH values, conductivity and the percentage of oxide concentration. The overall test results indicated that cement is effective in stabilizing the soils, where significant improvement of unconfined compressive strength (qu) and P- and S- wave velocities (vp and vs) were observed. Increasing the percentage of rubber chips alone did not contribute much to strength improvement of the kaolin specimens but are able to increase the percentage of axial strain at failure compared to those specimens without rubber chips.

Rubber is proved to be good soil stabilizer. Use of rubber chips as a soil stabilizing agent is economical. It also removes the problem of disposal.

ISSN : 2455-9679
Impact Factor : 3.340

III. EXPERIMENTAL WORKS

Following laboratory tests have been carried out as per IS: 2720. The tests were carried out both on natural soil and stabilized soil with fly ash.

Laboratory test on Natural soil

(i) Grain Size Analysis
(ii) Atterberg Limit Test
(iii) Proctor Compaction Test
(iv) Unconfined Compression Test
(v) Core Cutter

Laboratory test on Natural soil+ Different percentage of fly ash

TABLE: 2. Details Of Laboratory Tests

Test No.	Test Name	Fly ash proportion
1-3	Liquid limit test	15%,20%,30%
4-6	Plastic limit test	15%,20%,30%
7-9	Proctor compaction test	15%,20%,30%
10-12	Unconfined compression test	15%,20%,30%

After removing impurities like vegetation, stones etc. the soil was mixed with fly ash in varying proportion by volume. The Mixing was thoroughly carried out manually and the tests were conducted as per standard procedures.
Below results are the results of the tests performed on the soil in natural conditions shown in Table: 2. These Results will be the base of comparative study between the properties of soil in natural conditions and properties of soil after adding fly ash shown in Table:3. Bulk density and dry density were obtained by performing core cutter. Composition of the soil is also obtained by grain size and hydrometer tests which prove that soil is expansive.

TABLE: 3 Test Results Of Natural Soil

TEST	SOIL PROPERTES		
Core Cutter	**Bulk density**	**Dry density**	-
	1.92 gm/cc	1.66 gm/cc	-
Grain size analysis/ Hydrometer test	**% Gravel**	**% Sand**	**% Fines**
	1.11	9.89	89
Atterberg Limit Tests	**Liquid Limit**	**Plastic Limit**	**PI**
	74.4%	38.4%	37.6%
Shrinkage Limit	9.22%	-	-
Proctor Compaction Test	**OMC**	**MDD**	-
	14%	1.68gm/cc	-
Unconfined Compression Test	114kN/m^2	-	-

ISSN : 2455-9679
Impact Factor : 3.340

TABLE: 4 Test Results Of Soil - Fly Ash Mixtures

TEST	FLY ASH 15%	FLY ASH 20%	FLY ASH 30%
Liquid Limit	74	73.2	72.5
Plastic Limit	32.69	31.55	32.93
Plasticity Index	41.31	41.65	39.57
Maximum Dry Density(gm/cc)	1.67	1.69	1.71
Optimum Moisture Content (%)	14	14	14
Unconfined Compressive Stress	122	123	120

Comparison for liquid limit and plastic limit of the Natural soil with varying percentage of fly ash Shown in Fig. 3. And Fig. 4. The proctor tests carried out is summarized in Fig.5 at 14% OMC and also comparison for UN confined compressive stess of natural soil with varying percentage of fly ash Shown in Fig. 6.

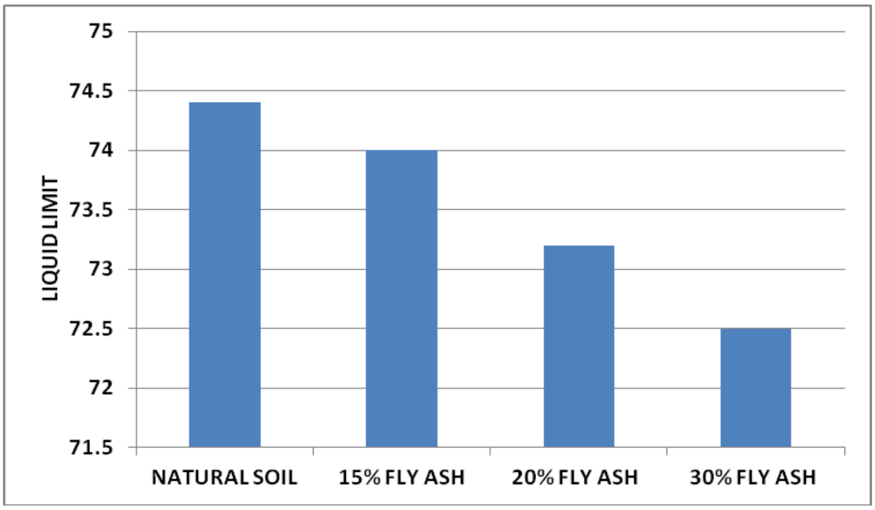

Fig 3. Comparison for liquid limit for natural soil –Fly ash Mixtures

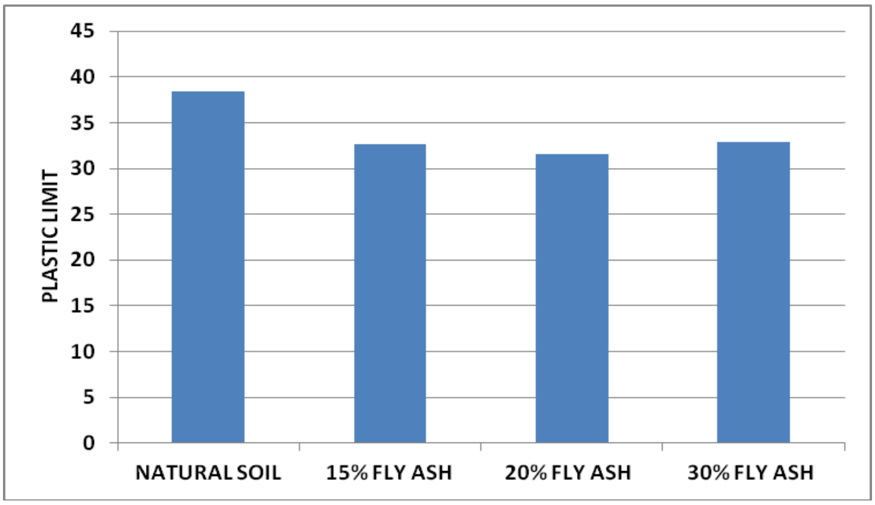

Fig 4. Comparison for Plastic limit for natural soil –Fly ash Mixtures

ISSN : 2455-9679
Impact Factor : 3.340

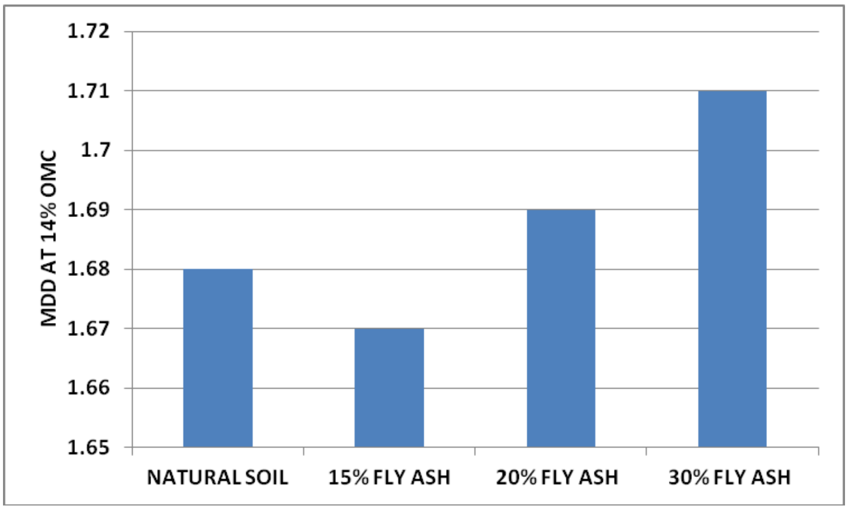

Fig 5. Comparison for MDD at 14 % OMC for natural soil –Fly ash Mixtures

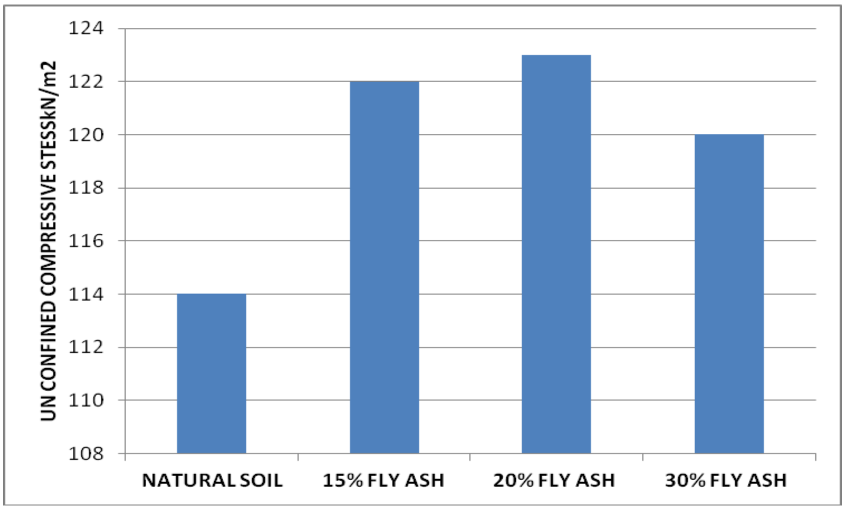

Fig 6. Comparison for Un confined compressive stess for natural soil –Fly ash Mixtures

IV. CONCLUSIONS

Based on the present tests, the following conclusions can be drawn:

- As the locally available borrow soil has generally high plasticity (LL > 50) it was difficult to construction on it.
- The inclusion of different percentage of fly ash in natural soil generally resulted in some increasing in unconfined compressive stress.
- The unconfined compressive stress of natural soil without fly ash which was 114kN/m2, increased to 123 kN/m2 at 20% fly ash in natural soil showing 7.89 % improvement.
- A liquid limit was decreases with increases in percentage of fly ash up 30% in natural soil which was 74.4%, decreased to 72.5%, showing 2.56 % decreased.
- Plastic limit was decreases with increases in percentage of fly ash up 30% in natural soil which was 38.4%, decreased to 32.93 %, showing 14.24 % decreased.
- Maximum dry density was increase with increases in percentage of fly ash up 30% in natural soil which was 1.68gm/cc, increase to 1.71gm/cc at 14% OMC showing 1.78 % increase.
- As per grain size analysis the percentage of gravel 1.11%, percentage of sand 9.89% and percentage of fines 89%.

ISSN : 2455-9679
Impact Factor : 3.340

REFERENCES

1. Berawala K. S. and Solanki C. H., 2010; "Empirical Correlations of Expansive Soils Parameters for the Surat Region", Indian Geotechnical Conference
2. Dr. B.C. Punamia, Arun Kumar Jain & Ashok Kumar Jain "Soil Mechanics and Foundation"
3. Chee-Ming Chan and Meei-Hoan Ho, 2010; "The Potential of Using Rubber chips as a Soft Clay Stabilizer Enhancing Agent", Postgraduate Incentive Research Grant, University Tun Hussein Onn, Malaysia.
4. Dr. K.R. Arora "Soil Mechanics and Foundation Engineering"
5. Pandian, N.S., Krishna ,K.C.& Leelavathamma B., (2002), Effect of Fly Ash on the CBR Behavior of Soils , Indian Geotechnical Conference , Allahabad , Vol.1,pp.183-186.
6. Phanikumar B.R., & Radhey S.Sharma(2004) "Effect of fly ash on Engineering properties of Expansive Soil" Journal of Geotechnical and Geoenvironmental Engineering Vol. 130, no 7,July, pp. 764-767.
7. S. Bhuvaneshwari and R. G. Robinson and S. R. Gandhi, 2005; "Stabilization of expansive soil using fly ash", India, Delhi.