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Improvement of Engineering Properties of Cohesive Soil of Surendranagar By Adding Fly ash

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Abstract *— Urbanization and Transportation growth in the economy of India have led to the steep increase in the construction activities and has necessitated the implementation of infrastructure project such as highway, railway, water reservoir, reclamation etc. requires earth material in very large quantity. In urban areas, borrow earth is not easily available. Quite often, large areas are covered with highly plastic and expansive soil like cohesive soil, which is not suitable for such purpose. Various stabilizers' are used such as lime, cement and calcium chloride. In the present scenario fly ash has emerged as a one of the potential admixture to stabilize the soil. In the present work an attempt is made to understand the effect of fly ash on various properties of cohesive soil. Fly ash is mixed in various proportions in a parent soil. For these various proportions of fly ash different properties of soil are determined in laboratory and compared with the parent expansive soil properties.*

Keywords- Engineering Properties, Laboratory test, cohesive soil, Flay ash

I. INTRODUCTION

*U*rbanization and Transport in the Republic of India is an important part of the nation's Economy. Roads are the vital life lines of the economy making possible trade and commerce. They are the most preferred modes of transportation and considered as one of the cost effective modes. An efficient and well-established network of roads is desired for promoting trade and commerce in any country and also full fills the needs of a sound transportation system for sustained economic development. To provide mobility and accessibility, all weather roads should connect every nook and corner of the country. Sub grade is the in situ material upon which the pavement structure is placed. Although there is a tendency to look at pavement performance in terms of pavement structures and mix design alone, the sub grade soils can often be the overriding factor in pavement performance. The construction cost of the pavements will be considerably decreased if locally available low cost materials are used for construction of lower layer of pavements such as sub grade, sub base etc. If the stability of local soils is not adequate for supporting the loads, suitable methods to enhance the properties of soil need to be adopted. Soil stabilization is one such method. Stabilizing the sub grade with an appropriate chemical stabilizer (such as Quicklime, Portland cement, and Fly Ash or Composites) increases sub grade stiffness and reduces expansion tendencies, it performs as a foundation (able to support and distribute loads under saturated conditions).

II. Scope of project

The soil used in the study is brought from Surendranagar (Gujarat) there is composed of clayey soil whose bearing capacity is extremely low. Due to this reason, the roads require periodic maintenance to take up repeated application of wheel loads. This proves to be costly, and at the same time, conditions of roads during monsoon seasons are extremely poor. Therefore, a thought on how to enhance the stability of roads by cheaper means demands appraisal. Soil stabilization can be done using different additives, but use of fly ash which is a waste material from thermal power plants, at the same time difficult-to-dispose material will be much significant.

III. LITERATURE REVIEW

1.) Udayashankar D. Hakari, S. C. Puranik, "Stabilization of Black cotton soil using Fly ash" Feb 2012 stated[1]

Abstract: The black cotton soils possess low strength and undergo excessive volume changes, making their use in the constructions very difficult. The properties of the black cotton soils may be altered in many ways viz. mechanical, thermal, chemical and other means. Modification of black cotton soils by chemical admixtures is a common stabilization method for such soils (Bell, 1993). Among various admixtures available lime, fly ash and cement are most widely and commonly used for the stabilization of the black cotton soils. Fly ash contains siliceous and aluminous materials (pozzolans) and also certain amount of lime. When mixed with black cotton soils, it reacts chemically and forms cementitious compounds. The presence of free lime and inert particles in fly ash suggests that it can be used for stabilization of expansive soils. The Hubballi-Dharwad Municipal Corporation (HDMC) area lies between $15^0$18' 25" – $15^0$30' 47" North latitudes and $74^0$57' 37" - $75^0$11' 0" East longitudes. Most of these areas comprise of agricultural fields with the black cotton soil coverage. As a matter of fact, the construction of the buildings, roads and other structures on these expansive soils has become inevitable. The wide spread of the black cotton soil in the twin city of Hubballi - Dharwad has posed challenges and problems to the construction activities.

Conclusion: To overcome this problem they add fly ash as a stabilizer into the soil and conclude that: Addition of fly ash significantly improves the index properties, compaction and strength characteristics of black cotton soils understudy and the effects of fly ash treatment vary depending upon the quantity of fly ash that is mixed with the study black cotton soil samples. The liquid limit and plastic limit of the soils decrease with the addition of fly ash which indicates a desirable change as the soil + fly ash mix can gain shear strength at an early stage than the virgin soil with the change in the water content. Addition of fly ash increases the maximum dry density of soil with decrease in optimum moisture content. The unconfined compression strength increases with addition of fly ash. The California bearing ratio of the study soils increase gradually with the addition of fly ash up to a certain percentage of Dandeli fly ash, beyond which, further increase in fly ash percentage is observed to cause a decreasing trend in the California bearing ratio values.

2.) Mahesh G. Kalyanshetti, Satish BasayrajThalange, "Effect of fly ash on the properties of expansive soil" May 2013 stated [2]

Abstract: Expansive soil is found in arid and semi-arid regions of the world and is in abundance where the annual evaporation exceeds the precipitation. Hot climate, poor drainage conditions are usually associated with the formation of this soil. In India these soil are generally called as black cotton soil (BCS) and it covers about 20% of the total land area. The BCS has the tendency of undergoing volumetric change due to change in moisture content. This will create instability to the structure resting on it. Various innovative techniques are developed to mitigate the problem posed by expansive soil. Stabilization of expansive soils with various additives such as lime, cement, calcium chloride and fly ash is also practiced.

Conclusion: After conducting the test of fly ash mixed soil they conclude: 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 30-40% with the addition of 10-15% fly ash. Shrinkage limit goes on increasing constantly with uniform rate with increase in fly ash content. For the addition of20-25%fly ash, MDD increased by 15-17% and OMC reduced by30- 35%.CBR value is observed on both soaked and un-soaked soil sample CBR values increases with increase in fly ash. CBR value increases with higher rate up to 25-30 % of fly ash and then with slower rate. For the expansive soil used, CBR increases by 70-75% with the addition of 25-30% fly ash.

3.) Hayder A. Hasan, "Effect of fly ash on geotechnical properties of expansive soil" June 2012 stated [3]

Abstract: In the field of geotechnical engineering, it has been known that swelling of expansive soils caused by moisture change result in significant distresses and hence in severe damage to overlying structures. Expansive soils are known as shrink-swell or swelling soils. Different clays have different susceptibility to swelling. The greatest problems occur in soils with high montmorillonite content. Such soils expand when they are wetted and shrink when dried. This movement exerts pressure to crack sidewalks, basement floors, driveways, pipelines and foundations. The damages due to expansive soils are sometimes minor maintenance but often they are much worse, causing major structural distress. In the United States, 10% of the 250 000 new houses built on expansive soils each year experience significant damage, some beyond repair. To overcome this problem soils can be treated with fly ash to modify engineering properties as well as produce

rapid strength gain in unstable soils. The volume of fly ash currently used for soil stabilization is less than that used for cement replacement in concrete.

Conclusion: After conducting tests they conclude: Liquid Limit value, plastic limit value, and plasticity index decreased with increasing fly ash content. Value of maximum dry density (MDD) decreased with increasing fly ash content, while optimum moisture content (OMC) increased with added fly ash. Specific gravity decreased with increasing of fly ash. The value of cohesion increased with increasing the amount of fly ash in soil mixtures to 15% fly ash then decreased. The increase in Ø with added fly ash in all samples is independent of curing time of the mixture. The increase in Ø of all the mixtures for 7, 14 and 21 days curing time is more than that of no cure time.

1. OBJECTIVE OF THE PROJECT

- To check the expansive characteristics of cohesive soil.
- To improve the expansive characteristics of cohesive soil by adding fly ash.
- To check the swelling characteristics of cohesive soil by adding fly ash.
- To strengthen the soil and control the volume changes.
- To explore the possibility of using fly ash in construction program.

3.1.1. Material and Methodology

3.1.2 Cohesive Soil

Expansive soils are soils or soft bedrock that increases in volume or expand as they get wet and shrink as they dry out. In India this Expansive soil is called 'black cotton soil'. Colour of this oil reddish brown to black and this helps for cultivation of cotton, so is called black cotton swelling soil covers about 30% of the land area in India. They are also commonly known as bentonite, expansive, or Black Cotton soil. In India Black Cotton soil also known as 'regurs' are found in extensive regions of Deccan Trap. They have variable thickness and are underlain by sticky material locally known as "Chikani Mitti" In terms of geotechnical Engineering, Cohesive soil is one which when associated with as engineering structure and in presence of water will show a tendency to swell or shrink causing the structure to experience moments which are largely unrelated to the direct effect of loading by the structure.

3.1.3 Fly ash

Table 3.1 Physical and Chemical properties of class C fly ash

Physical Properties	
Loss of ignition	6%
Moisture content	3%
Chemical composition	
$Sio_2 + Al_2O_3 + Fe_2O_3$	50%
SO_3	5%

3.1.4 Lab testing

1. Sieve analysis
2. Plasticity index
3. Specific gravity
4. Free Swell Index
5. Proctor Compaction Test
6. Box Shear Test
7. Mechanical analysis

IV. RESULTS

1. ATTERBERG'S LIMITS:

Table 4.1 Test Results of Atterberg's Limits

Soil-Fly ash Mixture	Specific Gravity	Liquid Limit	Plastic Limit	Plasticity Index
100% SOIL + 0% FLY ASH	2.53	52%	23%	43%
900% SOIL + 10% FLY ASH	2.23	47%	25%	22%
80% SOIL + 20% FLY ASH	2.17	48%	31%	16%
70% SOIL + 30% FLY ASH	2.10	51%	31%	16%
60% SOIL + 40% FLY ASH	2.05	55%	38%	15%
50% SOIL + 50% FLY ASH	2.00	58%	41%	13%

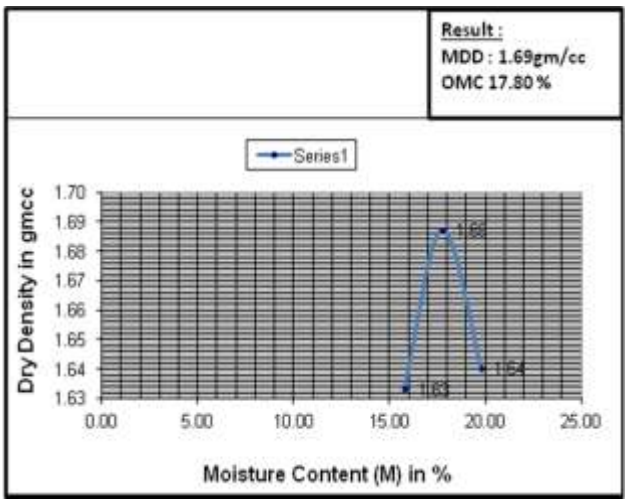

Fig 4.1: 100% Soil + 0% F.A.

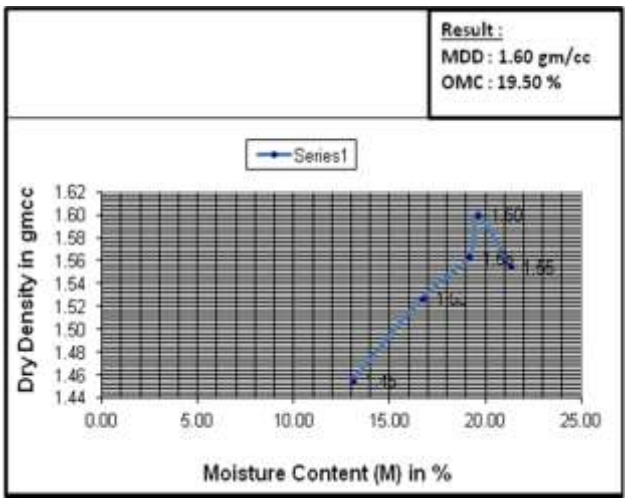

Fig 4.2: 90% Soil + 10% F.A.

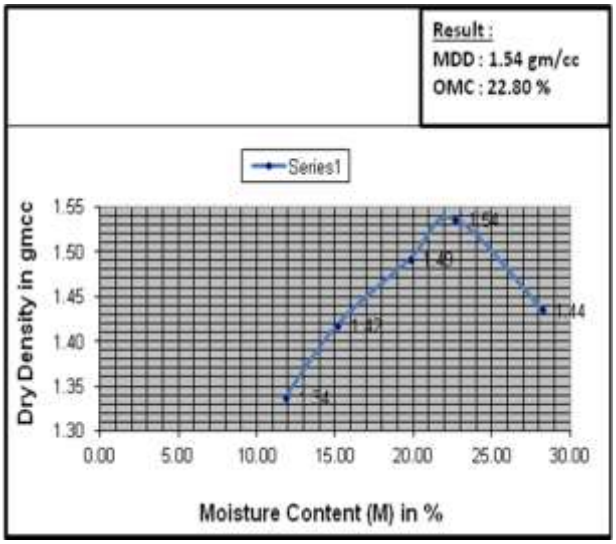

Fig 4.3: 80% Soil + 20% F.A.

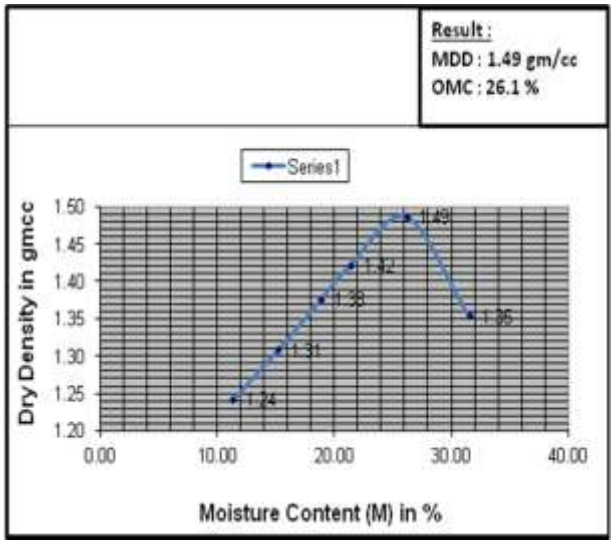

Fig 4.4: 70% Soil + 30% F.A.

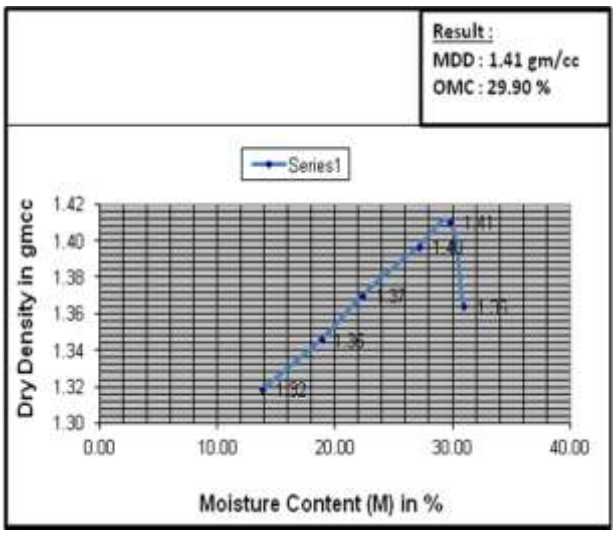

Fig 4.5 : 60% Soil + 40% F.A.

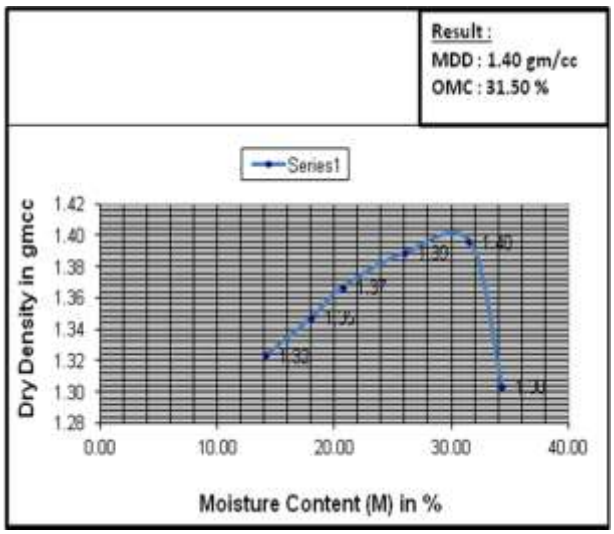

Fig 4.6 : 50% Soil + 50% F.A.

Table 4.2 : Result of Proctor Compaction

Soil-Fly ash Mixture	**MDD gm/cc**	**OMC %**
100% SOIL + 0% FLY ASH	1.69	17.80
900% SOIL + 10% FLY ASH	1.60	19.50
80% SOIL + 20% FLY ASH	1.54	22.80
70% SOIL + 30% FLY ASH	1.49	26.10
60% SOIL + 40% FLY ASH	1.41	29.90
50% SOIL + 50% FLY ASH	1.40	31.50

V. CONCLUSION

1. The liquid limit and plastic limit of the soil increase with the addition fly ash which indicates a change as the soil + fly ash mix can gain shear strength. The relative decrease in the plasticity index of the soil is another favourable change since it increases the workability of these soil ..
2. The maximum dry density is highest (1.69g/cc) and optimum moisture content is least (17.80 percent) found by proctor compaction test, are obtained at 0 percent content of fly ash, But the maximum optimum moisture content is(31.50percent) founded by proctor compaction test, are obtained at 50percent flay ash.

REFERENCES

[1] Udayashankar D. Hakari, S. C. Puranik(Feb 2012), "Stabilization of Black cotton soil using Fly ash" As, Vol 12.
[2] Mahesh G. Kalyanshetti, Satish BasayrajThalange(May 2013), "Effect of fly ash on the properties of expansive soil".
[3] Hayder A. Hasan(June 2012), "Effect of fly ash on geotechnical properties of expansive soil".
[4] Gyanen. Takhelmayum, Savitha.A.L, Krishna Gudi(Jan 2013), "Laboratory study on soil stabilization using fly ash mixtures".
[5] BindulaBose(2012), "Geo-Engineering properties of Expansive soil stabilization with fly ash"
[6] S. Bhubaneshwari, R. G. Robinson, S. R. Gandhi(2005), "STABILIZATION OF EXPANSIVE SOILS USING FLYASH ".
[7] P.S.Patil, Dr. R. M. Damgir, S.L.Hake(May 2014), "Strengthening of Soil by Using Fly Ash".
[8] BairwaRamlakhan, Saxena Anil Kumar, Arora T.R.(November 2013),"Effect of lime and fly ash on Engineering Properties of Black Cotton Soil".
[9] Gourav Dhane, Dhiraj Kumar, AkashPriyadarshee(February 2015), "EFFECT OF FLY ASH ON THE PROPERTIES OF BLACK COTTON SOIL: A REVIEW".
[10] Rajendra Prasad Hardaha, M.L.Agrawal, AnitaAgrawal(2013), "Useofflyashinblackcottonsoilforroadconstruction".
[11] Sanjeev TanajiJadhav, SushmaShekharKulkarni(June-July 2014), "Feasibility Study of Improving Properties of Black Cotton SoilUsing Industrial Wastes".