iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** XI **Month of publication:** November 2017

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

Assessment of Geotechnical Properties of Black Cotton Soil Blended with Lime and Fly-Ash

Gunjagi Deepak[1], Patil Nitish[2], Patil Sagar[3], Kore Shripad[4]
[1, 2, 3, 4] Assistant Professor, Dept. of Civil Engineering, Sanjay Ghodawat Group of Institutions, Kolhapur, Maharashtra, India

***Abstract:** Urbanization and growth in the economy of cities of India have led to the steep increase in the building construction activities and has necessitated the implementation of infrastructure projects such as highways, railways, air strips, water tanks, reclamation etc. Black cotton soils of India are well known for their expansive nature and cover more than one-fifth of the country area. 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. Among various admixtures available lime, fly ash and cement are most widely and commonly used for the stabilization of the black cotton soils.*

This paper investigates the effect of fly-ash and lime on geotechnical properties of locally available black cotton soil. Concerning the major challenges regarding the safe reuse, management and disposal of these wastes an attempt has been made to mix fly ash at 5, 10, 15, 20 & 25% with varying percentage of lime from 0% to 10% on the basis of dry weight with local clay soil. To understand the behavior, numbers of laboratory experiments were performed on the local soil and contaminated soil with varying percentage of fly ash and lime. As the result, it is shown that all the investigated properties were decreased except CBR value and optimum moisture content.

Keywords: Expansive, Stabilization, Contaminated, management & disposal, etc.

I. INTRODUCTION

Development of the Nation depends upon their infrastructure and road constructions. Proper highway networks contribute to give the boost to the Economic development of country. Wide range of soil types available as highway construction materials. Roads running in black cotton soils are known for bad condition and unpredictable behavior for which the nature of the soil contributes to some extent. The black cotton soils possess low strength and undergo excessive volume changes, making their use in the constructions very difficult. Because of its high swelling and shrinkage characteristics, the Black cotton soil (BC soils) has been a challenge to the highway engineers. The Black cotton

soil is very hard when dry, but loses its strength completely when in wet condition. It is observed that on drying, the black cotton soil develops cracks of varying depth. As a result of wetting and drying process, vertical movement takes place in the soil mass. All these movements lead to failure of pavement, in the form of settlement, heavy depression, cracking and unevenness.

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. 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 is a pozzolanic material, which is defined as siliceous or siliceous and aluminous and, therefore, its engineering behavior can be improved by the addition of cement or lime. The use of lime for stabilizing plastic montmorillonitic clays has been increasing in favor during the last few decades because it lowers volume change characteristics.

Erdal Cokca (2001) plasticity index, activity and swelling potential of the samples decreased with increasing percent stabilizer and curing time and the optimum content of fly ash in decreasing the swell potential was found to be 20%. Pandian et al (2002) 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. Arvind Kumar et. al (2007) describes an experimental program with Lime and fly ash added to an expansive soil at ranges of 1–10% and 1–20%, respectively. Test specimens were subjected to compaction tests, unconfined compression tests and split tensile strength tests etc. P.P. Dahale (2011) fly ash and rice husk are added in to the soil on (weight) percentage basis varying from 1% to 15% and curing is done for 28 days. Rajesh Kumar Tripathi (2011) The soil was stabilized with different percentages of fly ash (i.e., 5, 8, 10, 12, and 15%) and rice husk (i.e., 3, 6, 9 11, 13, and 15%). Results indicate improvement in the strength properties of the soil. Based on the CBR and UCS tests, the optimum amount of FA and RHA was found to be as 12% and 9%, respectively. Udayshankar D. Hakari (2012) 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 cementations compounds. The presence of free lime and inert particles in fly ash suggests that it can be used for stabilization of expansive soils.

II. MATERIALS AND METHODS

The experimental investigation carried out to study the geotechnical properties included locally available black cotton soil, lime from local market and indian class F fly ash. The geotechnical characteristics of fly ash-soil specimens, lime-soil specimens, and lime-flyash-soil specimens mixed with different proportions were studied. Fly ash was added to the expansive soil at 0-25% by dry weight with every 2% increase in Lime from 0% to 10%.

Following laboratory tests were conducted as per IS: 2720. The tests were conducted on both normal soil and soil-lime-fly ash mix.

A. Atterberg limit test.

B. Proctor compaction test.

C. California Bearing Ratio test.

Table I to VI shows the mix proportions for current study.

Table I. BCS with Fly-Ash and 0% Lime (Group I)

Sr. No.	Mix No.	Soil	Fly Ash	Lime
1	M00	100%	0%	0%
2	M01	95%	5%	0%
3	M02	90%	10%	0%
4	M03	85%	15%	0%
5	M04	80%	20%	0%
6	M05	75%	25%	0%

Table II. BCS with Fly-Ash and 2% Lime (Group II)

Sr. No.	Mix No.	Soil	Fly Ash	Lime
1	M10	98%	0%	2%
2	M11	93%	5%	2%
3	M12	88%	10%	2%
4	M13	83%	15%	2%
5	M14	78%	20%	2%
6	M15	73%	25%	2%

Table III. BCS with Fly-Ash and 4% Lime (Group III)

Sr. No.	Mix No.	Soil	Fly Ash	Lime
1	M20	96%	0%	4%
2	M21	91%	5%	4%
3	M22	86%	10%	4%
4	M23	81%	15%	4%
5	M24	76%	20%	4%
6	M25	71%	25%	4%

Table IV. BCS with Fly-Ash and 6% Lime (Group IV)

Sr. No.	Mix No.	Soil	Fly Ash	Lime
1	M30	94%	0%	6%
2	M31	89%	5%	6%

3	M32	84%	10%	6%
4	M33	79%	15%	6%
5	M34	74%	20%	6%
6	M35	69%	25%	6%

Table V. BCS with Fly-Ash and 8% Lime (Group V)

Sr. No.	Mix No.	Soil	Fly Ash	Lime
1	M40	92%	0%	8%
2	M41	87%	5%	8%
3	M42	82%	10%	8%
4	M43	77%	15%	8%
5	M44	72%	20%	8%
6	M45	67%	25%	8%

Table VI. BCS with Fly-Ash and 10% Lime (Group VI)

Sr. No.	Mix No.	Soil	Fly Ash	Lime
1	M50	90%	0%	10%
2	M51	85%	5%	10%
3	M52	80%	10%	10%
4	M53	75%	15%	10%
5	M54	70%	20%	10%
6	M55	65%	25%	10%

III. RESULTS AND DISCUSSIONS

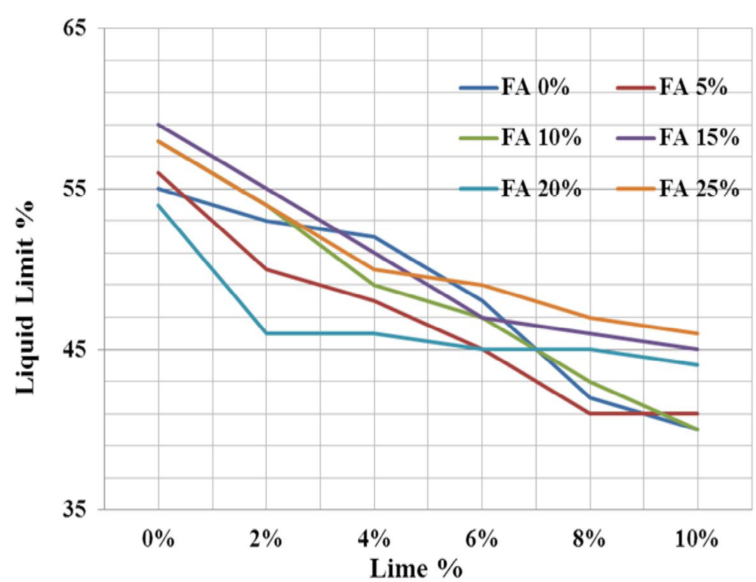


Fig.1 Liquid Limit vs. Percentage of Lime

Figure 1 indicated that the liquid limit decreases with the increase in percentage of lime & fly ash. The results show a considerable decrease in the liquid limit upto 4% increase in the lime and then the decrease is observed to be marginal for further increase of lime percentage. The soil having fly ash 25% shows linearly varying result as compared to other percentage of fly ash content in soil.

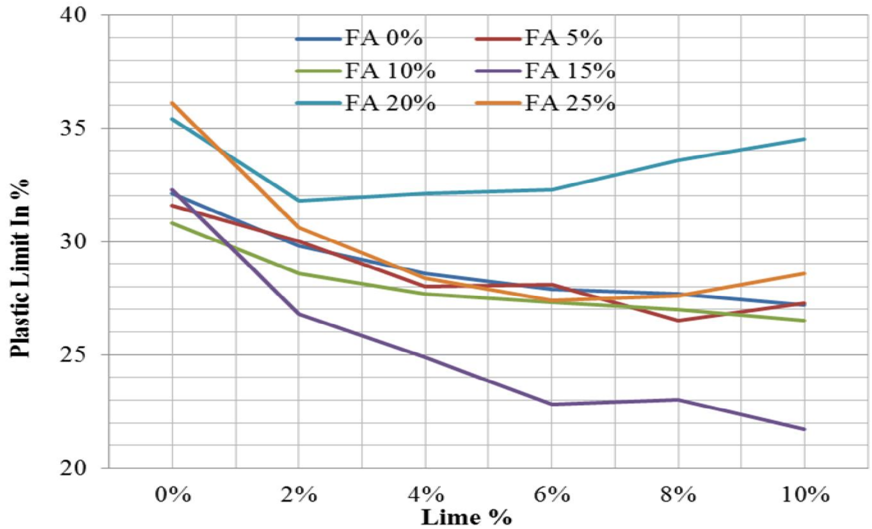


Fig.2 Plastic limit vs. percentage of lime

Figure 2 indicated that addition of lime results in a steady decline in the plastic limit of the soils (FA 20% and FA 25%) On addition of fly ash and lime, the plastic limit of the soil may increase due to flocculation owing to the presence of free lime. Further increase in the addition of fly ash results in the increase of plastic limit. This is because of the fact that as the quantity of fly ash in the mix increases, the amount of soil to be flocculated decreases and also the finer particles of fly ash may be incorporated in the voids of flocculated soil

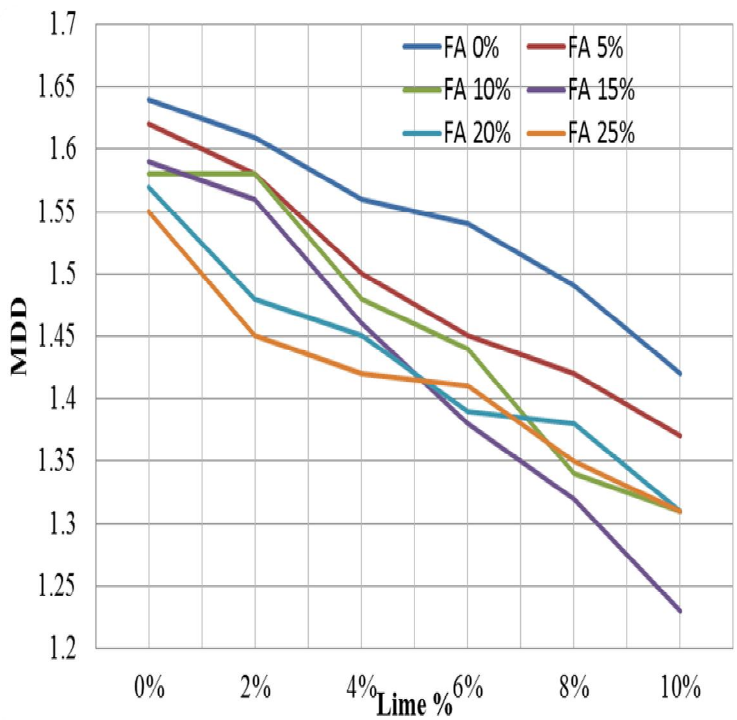


Fig.3 Maximum dry density vs. percentage of lime

Figure 3 indicated that with the increase in lime content, the maximum dry density of soil-lime mixes decreases and optimum moisture content increases. The fall in density is more significant at higher percentages of lime. When fly ash is added to soil-lime mixture, maximum dry density decreases further and optimum moisture content increases. The results of compaction tests showed that a considerable decrease in the maximum dry density upto 20% with 25 % increase in optimum moisture content.

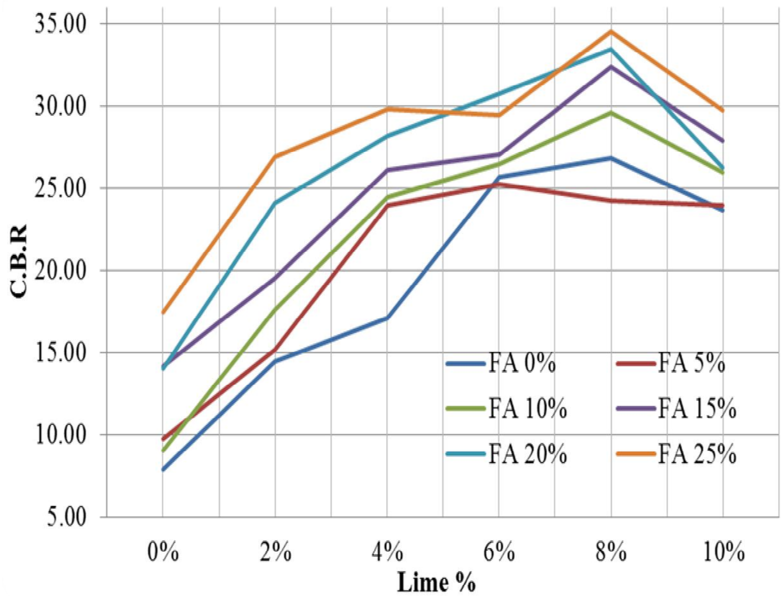


Fig.4 CBR value vs. percentage of lime

Figure 4 shows the variation of CBR (unsoaked condition) of the black cotton soil samples with the addition of lime in increasing percentages. The CBR value of the soil increases with the addition of lime up to a certain percentage of (8%) lime and there after it starts decreasing with further addition of lime. Addition of fly ash to the black cotton soil with lime increases the CBR of the mix up to a peak value of addition of 25% of fly ash. This is due to the frictional resistance contributed from the FA in addition to the cohesion from the black cotton soil. Further increase in the fly ash percentage causes a reduction in the CBR due to the reduction in the cohesion because of the decreasing black cotton soil content in spite of increase in strength due to increase in fly ash content. It is hence observed that, a suitable mix proportion (M45 i.e. 8% lime and 25% fly ash) optimizes the frictional contribution of fly ash and the cohesive contribution from black cotton soils; leading to the maximization (peak value) of the CBR.

IV. CONCLUSIONS

From the literature it appears that a number of stabilizers are available like lime, cement, lime and cement combinations etc. Through this experimentation it is concluded that the by-product (fly ash and lime) are also good stabilizing compound. The main engineering properties of the black cotton soil can be improved by using the byproducts and lime. The following conclusions can be derived from the present investigation

A. Fly ash is beneficial in combination with lime in improving properties of soil. With the increase in the percentage of fly ash keeping amount of lime as constant, strength tends to increase and reaches a certain maximum value and thereafter it starts decreasing.
B. Utilization of fly ash in this manner also has the advantage of reusing an industrial waste by-product without adversely affecting the environment or potential land use.
C. The results show a considerable decrease in the liquid limit. Decrease in Liquid limit means there is decrease in permeability & increase in dry strength of black cotton soil.
D. With the increase in lime content, the maximum dry density of soil-lime mixes decreases and optimum moisture content increases. The fall in density is more significant at lower percentages of lime. When fly ash is added to soil-lime mixture, maximum dry density decreases further and optimum moisture content increases.
E. The CBR value of the soil increases with the addition of lime up to a certain percentage i.e 8% lime up to 3.4 times and there after it starts decreasing for further addition of lime.

The optimum value of lime content and fly ash content in fly ash & lime soil mixtures may be taken as 8% and 25%, respectively.

REFERENCES

[1] Prof. N. R. Patil, Prof. Mrs. D. R. Kulkarni & Prof. S. D. Talegaonkar, "Economical Pavement Design by Stabilizing Effect of Fly Ash and Lime" Paripex - Indian Journal Of Research. Volume : 2 | Issue : 3 March 2013

[2] Gyanen. Takhelmayum, Savitha.A.L, Krishna Gudi, "Laboratory Study on Soil Stabilization Using Fly ash Mixtures" International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 2, Issue 1, January 2013

[3] Udayashankar D.Hakari, S.C.Puranik, "Stabilization of Black Cotton Soils Using Fly Ash" Global Journal of researches in engineering Civil And Structural engineering Volume 12 Issue 2 Version 1.0 February 2012.

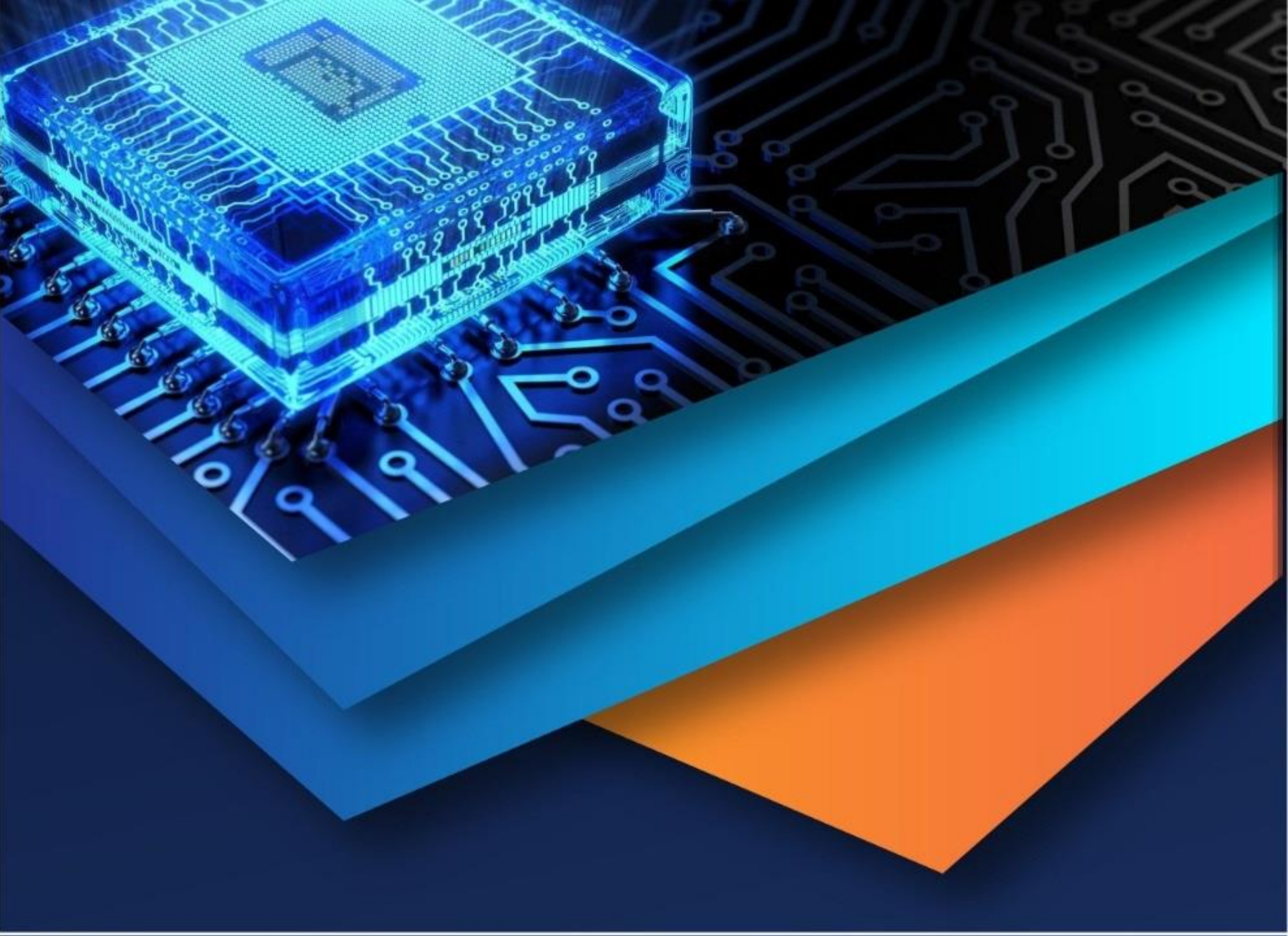
[4] Saeid. Amiralian, Amin. Chegenizadeh, and Hamid. Nikraz, "A Review on The Lime and Fly ash Application in Soil Stabilization" International Journal of Biological, Ecological and Environmental Sciences (IJBEES) Vol. 1, No. 3, 2012 ISSN 2277 – 4394

[5] Rajesh Kumar Tripathi & Laxmikant Yadu, "Comparison of Fly Ash and Rice Husk Ash Stabilized Black Cotton Soil", International Journal of Earth Sciences and Engineering ISSN 0974-5904, Volume 04, No 06 SPL, October 2011

[6] P. P. Dahale, "Disposal of solid waste for black cotton soil Stabilization", (Ijaest) International Journal Of Advanced Engineering Sciences And Technologies Vol No. 8, Issue No. 1, 113 – 120. 2011

[7] Arvind Kumar, Baljit Singh Walia and Asheet Bajaj, "Influence of Fly Ash, Lime, and Polyester Fibers on Compaction and Strength Properties of Expansive Soil" Journal Of Materials In Civil Engineering © Asce / March 2007

[8] Erdal Cokca, "Use of class-C fly ashes for the stabilization of expansive soil" Journal of Geotechnical and Geoenvironmental engg.,vol.127,pp.568-573, 2001



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY