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An Efficient and Stabilization of Lithomargic Soil Using alkali activated Fly ash

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ABSTRACT: *Due to cohesiveness property in expansive soil, it becameweak and good for foundation or pavement subgrade. Soil Stabilization is one of the most important aspects ofthe construction industry, which is used widely in foundation and road pavement constructions; this is because suchstabilization improves Geotechnical properties of the soil, such as volume stability, strength and durability.Alkali activated flyashes are the cement for the future. The alkali activation of wastematerials is a chemical process that allows the user to transform glassy structures (partially ortotally amorphous and/or metastable) into very compact well-cemented composites.The present study focuses on investigations on the engineering properties of Lithomargicsoils. Attempts are being made to investigate the study on Stabilization of Lithomargic soil (silty-soil) by using alkali activated polymers combined with Fly-ash.*

KEYWORDS-Lithomargic soil, Fly-ash, GGBS, NaOH, Stabilization, Geopolymer

I. INTRODUCTION

Stabilization is one of the methods of treating the expansive soils to make them fit forconstruction. Variety of stabilizers may be divided into three groups (Petry 2002): (a) traditionalstabilizers (lime, cement, etc.), (b) by-product stabilizers (fly ash, quarry dust, phosphor-gypsum,slag etc.) and (c) non-traditional stabilizers (sulphonated oils, potassium compounds, polymer,enzymes, ammonium chlorides etc.).

II. RELATED WORKS

Sharma et al. (1992) studied stabilization ofexpansive soil using a mixture of fly ash, gypsum andblast furnace slag. They found that fly ash, gypsumand blast furnace slag in the proportion of 6: 12: 18decreased the swelling pressure of the soil from 248

kN/m2 to 17 kN/m2 and increased the unconfinedcompressive strength by 300%.

Srivastava et al. (1997) studied the change in microstructure and fabric of expansive soil due to additionof fly ash and lime sludge from SEM photograph andfound changes in micro structure and fabric when16% fly ash and 16% lime sludge were added toexpansive soil. Srivastava et al. (1999) have alsodescribed the results of experiments carried out tostudy the consolidation and swelling behavior ofexpansive soil stabilized with lime sludge and fly ashand the best stabilizing effect was obtained with 16%of fly ash and 16% of lime sludge.

Coke (2001) used up to 25% of Class-C fly ash(18.98 % of CaO) and the treated specimens werecured for 7 days and 28 days. The swelling pressureis found to decrease by 75% after 7 days curing and79% with 28 days curing at 20% addition of fly ash.Pandian et al. (2001) had made an effort to stabilizeexpansive soil with a class –F Fly ash and found thatthe fly ash could be an effective additive (about 20%)to improve the CBR of Black cotton soil (about200%) significantly.

Tucker and Cokca (2004) used Class C and Class Ftype fly ash along with sand for stabilization ofexpansive soil. As expected Class C fly ash was moreeffective and the free swell decreased with curingperiod. The best performance was observed with soil, Class C fly ash and sand as 75% , 15% and 10%respectively after 28 days of curing.Satyanarayana et al. (2004) studied the combinedeffect of addition of fly ash and lime on engineeringproperties of expansive soil and found that theoptimum proportions of soil: fly ash: lime should be70:30:4 for construction of roads and embankments.Phani

Kumar and Sharma (2004) observed thatplasticity, hydraulic conductivity and swellingproperties of the expansive soil fly ash blendsdecreased and the dry unit weight and strengthincreased with increase in fly ash content. Theresistance to penetration of the blinds increasedsignificantly with an increase in fly ash content for giving water content. They presented a statisticalmodel to predict the undrained shear strength of thetreated soil.

Baytar (2005) studied the stabilization of expansivesoils using the fly ash and desulpho-gypsum obtainedfrom a thermal power plant by 0 to 30 percent. Variedpercentage of lime (0 to 8%) was added to theexpansive soil-fly ash-desulphogypsum mixture. Thetreated samples were cured for 7 and 28 days.

Swelling percentage decreased and the rate of swellincreased with the increasing stabilizer percentage.Curing resulted in further reduction in swellingpercentage and with 25 percent fly ash and 30 percentdesulphogypsum additions reduced the swellingpercentage to levels comparable to lime stabilization.

Army et al. (2005) used cement and fly ash mixturefor stabilization of expansive clayey Soil. Threedifferent classes of sample (i) 12% cement, (ii) 9%cement + 3% fly ash and (iii) natural clay soil samplewere tested for maximum dry densities (MDD),optimum moisture contents (OMC), Californiabearing ratio (CBR), unconfined compressivestrength (UCS) and the undrainedTriaxial tests. Theresults showed that the soil sample stabilized with amixture of 9% cement + 3% fly ash is better withrespect to MDD, OMC, CBR, and shearing resistancecompared to samples stabilized with 12% cement,indicating the importance of fly ash in improving thestabilizing potential of cement on expansive soil.

Sabbath et al. (2005) observed that fly ash-marblepowder can improve the engineering properties ofexpansive soil and the optimum proportion of soil:fly ash: marble powder was 65:20: 15

III. THE PROPOSED APPROACH

The main objective of the study is to

1. Study the basic Engineering properties of Lithomargic soil (Shedi Soil).

2. Preparation of alkali-activated fly ash by using Sodium Hydroxide at morality of 14M.

3. Proposed to involve GGBS to check the strength improvement of Lithomargic soil atvarious proportions (10, 15, 20, 25, 30 percentages).

4. Evaluation of unconfined compressive strength of fly ash treated soil on an interval of 0,7, 14 and 28 days at different percentages of fly-Ash and GGBS.

5. Strength characteristics of alkali activated soil using California Bearing Resistance test(CBR) and study the penetration resistance.

6. Comparative study on the strength versus days of curing.

Fly ash is generally captured byelectrostatic precipitators or other particle filtrationequipment before the flue gases reach the chimneysof coal-fired power plants and together with bottomash removed from the bottom of the furnace is in thiscase jointly known as coal ash. Depending upon thesource and makeup of the coal being burned, thecomponents of fly ash vary considerably, but all flyash includes substantial amounts of silicon dioxide(SiO2) (both amorphous and crystalline) and calciumoxide (CaO), both being endemic ingredients in manycoal-bearing rock strata.In the past, fly ash was generally released into theatmosphere, but pollution control equipmentmandated in recent decades now requires that it becaptured prior to release. In the US, fly ash isgenerally stored at coal power plants or placed inlandfills. About 43% is recycled, often used as apozzolan to produce hydraulic cement or hydraulicplaster or a partial replacement for Portland cementin concrete production.

IV. EXPERIMENTAL SETUP

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The experimental investigation was made onexpansive soils and stabilized expansive soil by usingfly-ash as per standards. Fly-ash was added toexpansive soil with 10%, 20%, 30%, 40%and 50%.We find the Geotechnical properties of expansive soiland stabilized soil and compare the characteristicThe experimental investigation was made onexpansive soils and stabilized expansive soil by usingfly-ash as per standards. Fly-ash was added toexpansive soil with 10%, 20%, 30%, 40%and 50%.We find the Geotechnical properties of expansive soiland stabilized soil and compare the characteristic.

1. General engineering properties of Lithomargic soil are tested to determine specific gravity,grain size distribution, Atterberg's Limit as per IS recommendations.

2. Maximum dry density and Optimum Moisture Content will be determined using heavy compaction tests as per IS 2720 Part VII.

3. Preparation of alkali-activated polymers.

4. Samples will be prepared using OMC with and without the addition of Geo-polymer atvarious proportions.

5. Strength test is determined on various samples for 0, 7, 21 and 28 days curing.

6. C.B.R tests were conducted on stabilized soil samples with an optimum percentage of Geopolymer under soaked and un-soaked condition.

Fig. 1 UCC samples with Alkaliactivated Fly-ash.

Fig. 2Samples afterCompression test

Fig. 3 CBR Testing

Experimental results of UCS showed that the addition of alkali activated geopolymer increasedthe Compression Strength of soil samples.Based on CBR values of lithomargic soil without alkali activated fly ash was found to be5.1% and CBR value with alkali activated fly ash with different percentages is carried and the resultsshows that the CBR value increases as proportion added is increased from 10% to 20% anddecreased from 20% to 30%.

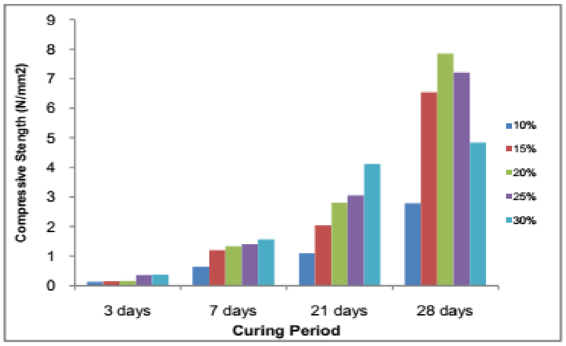

Fig. 4 Comparison between Compressive Strength Vs Curing Period

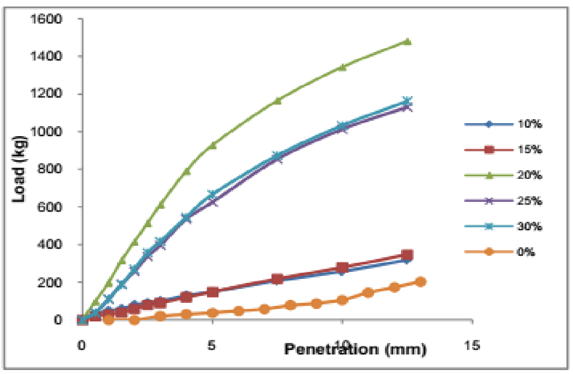

Fig. 5 Load Vs Penetration curve for CBR results.

From the above results it is concluded that when 20% of alkali activated fly ash isadded to lithomargic soil a maximum Compressive strength and Resistance is offeredhence 20% of alkali activated fly ash with GGBS can be used as the optimum value for soilstabilization of lithomargic soil

V. CONCLUSION

The suitability of alkali activated fly ash has been demonstrated by the laboratory study.

1. The\ applicant of alkali activated fly ash for locally available lithomargic soil should beinvestigated by using an optimum percentage of Geo-polymer cement in the construction of a smallstretch of a road (0.5km to 1km) and testing the same using field CBR test.

2. More laboratory tests must be conducted on various types of soils with different percentage ofalkali activated fly ash to evaluate its usefulness in stabilizing other type of soil in the region.

3. In order to check the durability of alkali activated fly ash stabilized layers durability tests must be conducted on various soils under freeze-thaw conditions and also of leaching on alkaliactivated fly ash stabilizer may be studied.

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