A REVIEW AND STUDY ON STABILIZATION OF EXPANSIVE SOIL USING BRICK DUST

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ABSTRACT

Black cotton soil is one of the major soil deposits of India. It is highly expansive in nature due to presence of clay minerals especially montmorillonite. It expands greatly when comes in contact with water and contracts when the water squeezes out. Due to this alternate swell and shrink behavior of the black cotton soil, severe damages cause to foundations of the buildings and structures founded on them. Many stabilization techniques are in usage for improving the geotechnical characteristics of black cotton soil. This experimental study was undertaken to improve the engineering characteristics of black cotton soil by utilization of brick dust. This research paper presents the effect of brick dust on engineering characteristics of black cotton soil. The evaluation involves the determination of the swelling potential, linear shrinkage, atterberg’s limits, & compaction test of expansive soil in its natural state as well as when mixed with varying proportion of burnt brick dust (from 30 to 50%).

KEYWORDS: Montmorillonite, Stabilization, Atterberg’s limit, Brick dust.
INTRODUCTION

The stability and bearing power of the soil is considerably improved by soil stabilization through controlled compaction, proportioning and the addition of suitable admixtures. Swelling soil is not suitable for the construction work on account of its volumetric changes. It swells and shrinks excessively with change of water content. Such tendency of soil is due to the presence of fine clay particles which swell, when they come in contact with water, resulting in alternate swelling and shrinking of soil due to which differential settlement of structure takes place. Stabilization of black cotton soil has been done in this project work by using brick dust as admixture. The object of our present studies is to improve the various properties of black cotton soil by mixing brick dust which is easily available locally.

LITERATURE REVIEW

[1] Muntohar et.al (2013) Conducted laboratory tests to evaluate the engineering properties of silty soil stabilized with lime, waste plastic fibers and rice husk ash. They have conducted CBR, UCS shear strength test to find out the strength of stabilized soil. From the test results, they have concluded that the proposed methodology is very effective for improving the engineering properties the clayey soil.

[2] Kumarwat et.al (2014) studied the effect of calcium carbide residue (CCR) and stone dust particle as a stabilized material on the property of black cotton soil. They have mixed stone dust and CCR in different percentages with black cotton soil and conducted various tests like UCS, OMS & MDD, CBR, etc on the prepared soil samples. From the tests results, they have demonstrated that when stone dust and CCR mixed in equal amount (10% -10%) gives the better results on the improvement of engineering properties of soil.

[3] Mousa f. atom & magdi el-emam, (2011), using cutting stone slurry waste as a stabilizing material with cohesive soil. Result indicate that mixing the cohesive soil with cutting stone slurry waste increased dry density and decreased optimum water content also increased direct shear and unconfined strength significantly due to addition of stone slurry to cohesive soil.

[4] Al zboon & mahasneh, (2009), the use stone sludge as water source in concrete production has insignificant effect on compression strength, while it has a sharp effect on slump values.


[7] Karthik et al., (2014) evaluated the effect of fly ash derived from combustion of sub-bituminous coal at electric power plants, for stabilization of soft fine grained red soil. The Liquid Limit, Plastic Limit and Specific gravity of soil was 32%, 23.37% and 2.7 respectively. Test was conducted on soil and soil-fly ash mixtures prepared at optimum water content of 9%. At 6% of fly ash the bearing capacity of soil changes from 10kg/mm² to 35kg/mm² and CBR value changes from 3.1% to 4.82%. Due to increase in CBR values the thickness of
pavement decreases from 12 inches to 8.5 inches.

[8] Ahmed (2014) stabilized the clayey soil for the construction of urban roads using fly ash. Author found that the optimum ratio of fly ash with clayey soil is 15% by weight of soil. A dramatic reduction in the properties of soil is seen for 0% to 15% of fly ash content but no noticeable decline appear in the range 15% to 20% of fly ash content. For compaction, the dry density and O.M.C were measured for various fly ash ratios. The dry density raise as the fly ash increases up to 15%, then reduced to 1.53 at 20% of fly ash. The liquid limit decreased from 55% to 48% for increase of fly ash from 0% to 15% by weight. Plasticity Index changes from 30% to 13% for addition of 0% to 15% of fly ash. C.B.R value of soil changes from 3% to 56%.

[9] Raut et al., (2014) stabilized the clayey soil collected from nearby of Yeshwantrao College of engineering, Wanadongri Nagpur. In his study murrum of Kalmeshwar quarry and fly ash of Koradi power plant near Nagpur is used. The clayey soil has Gravel 1%, sand 20%, silt 28%, and clay 51%. Based on these properties soil is classified as CH. Specific gravity, Liquid limit, plastic limit, plasticity Index, M.D.D and O.M.C of soil is 2.55, 52%, 20.80%, 30.50%, 16.88% and 19.0% respectively. Authors stabilized the soil by fly ash and murrum. With increase in content of fly ash and murrum UCS and M.D.D. increases up to certain proportion and then decreases. Maximum value of UCS and M.D.D, found at 7.5% of murrum and 5% of fly ash, was 4.95gm/cm3 and 0.328gm/cm2

[10] Olughenga et al., (2011) stabilized the Lateritic soil by the use of lime. Lateritic soil form a group comprising a wide variety of Yellow, brown, red, fine grained residual soil of light texture. They are characterized by the presence of iron and aluminum oxide or hydroxide which gives the colour to the soil. In this paper author studied the suitability and lime stabilization requirement of lateritic soil samples. Soil samples A, B, C collected from a dam site and stabilized with 0%, 2%, 4%, 6%, 8% and 10% of lime. Optimum lime content for the samples A, B, C were 8%, 6%, 6% respectively. Plasticity Indices is reduced as the lime increases. The C.B.R of sample „A“ increased from 10.6% at 0% to 29.0% at 8% lime, while that of „C“ improved from 2.5% to 8.6% at 6%. The compressive and shear strength were also improved. The uncured compressive strength of „B“ improved from 119.13KN/m2 at 0% to 462.81KN/m2 at 6% lime. Author concluded that sample A and B will be suitable as base material while sample „C“ will be suitable as sub grade material.

[11] Ankur et al., (2014) stabilize the Black cotton soil using Lime and stone dust. For his study, Black cotton soil sample were collected from Gwalior-Jhansi road (M.P) and stone dust was collected from Aman Vihar Industrial area, New Delhi. The Black cotton soil had specific gravity 2.61, percentage passing Is sieve 75 micron is 58.0%, liquid limit 57%, plastic limit 31.4%, plasticity index 26.5%, differential free swell 41.0%, M.D.D 16.1KN/m3 , CBR (soaked) 1.50% and unconfined compressive strength 166.2KN/m2. Author classified soil as CH according to the unified soil classification system. In their study, authors determine optimum percentage of lime was 9% and stone dust was mixed by 5%, 10%, 15%, 20% and 25% by weight of lime-black cotton soil. The MDD of lime stabilized B.C. soil increases up to the addition of 20% stone dust and further increase of the stone dust decreases the value. Similarly for CBR and UCS the strength
increases up to 20% addition of stone dust in lime stabilized soil.

[12] Oyediran and Kalejaiye (2011) studied the effect of increasing cement by weight on the strength and compaction parameter of lateritic soil of south-west Nigeria. Three soil samples were collected from pit at depths of 0.5m, 1.0m and 2.0m. The soil was stabilized with 2%, 4%, 8%, 10%, and 20% by weight of cement. The average of properties of soil collected from pit are as follows; Specific gravity 2.60, Liquid Limit 40.91%, Plastic limit 23.59%, Plasticity Index 17.31%, gravel 8.33%, sand 52.33%, silt 18.00%, clay 21.33% and amount of fineness 39.33%. M.D.D, C.B.R and UCS of soil increased while there is reduction in O.M.C as cement was increases. But addition of more than 10% by weight of cement decreased M.D.D, UCS and C.B.R and increase in the O.M.C. Author concluded that the increasing in percentage of cement was not guarantee for the improvement of geotechnical properties.

[13] Waste paper sludge (WPS) is a waste material collected from the paper industry. Elias (2015) stabilized the soil using waste paper sludge. Soil used in the study was clayey soil from kannadidakaves kundannoor of Ernakulam district. Soil contains 74% silt, 26% clay, having Liquid limit 60%, plastic limit 31%, shrinkage limit 23%, plasticity index 30%, specific gravity 2.59 M.D.D, 16.3 KN/m3, O.M.C 22%, UCS 316.4KN/m2 and cohesion 158.2KN/m2. The waste paper sludge sample was collected in plastic container from the sludge drying bed of the Hindustan newsprint, Vellore, Kottayam. When soil treated with WPS M.D.D of soil was decreased and O.M.C was increased. The UCS for soil for varying percentage such as 2%, 4%, 5%, 6%, 7% and 10% of WPS increased to better strength. The addition of WPS increased the strength at 5% and it was found to be constant and optimum value of strength to soil.

[14] Shelke and Murty (2010) used EPS Geofoam to reduce the swelling pressure of expansive soil. Black cotton soil from Ahmednagar district in Maharashta was taken for study. According to USCS soil classification, soil has CH type. The Liquid limit, Plastic limit, plasticity index, O.M.C, M.D.D and free swell index of soil was 61%, 31%, 30%, 20%, 16.2KN/m3 and 85.7% respectively. In his study, authors used two type of geofoam, viz. (1) 6mm thickness and (2) 12mm thickness. Swelling of Black cotton soil reduces from 8.64% to 82.72% when EPS Geofoam of 6mm and 12mm are used. Swelling pressure of 6mm geofoam is reduced to 42.86% and for 12mm thickness swelling pressure is reduced about 90%.

[15] Wu Li (2010) uses lime as stabilization material to stabilize the Tanzania soil. Author uses three types of soil moderately plastic silty clay, moderately plastic tan clay and Heavy clay with 5% of hydrated Lime. Author designated them as N-11, N-12 and N-13 respectively. Plasticity Index decreases form 25% to 4% for N-11, 29% to 6% for N-12 and 36to9% for N-13. Unconfined compressive strength changes from 145 to 2770KPa for N-11, 280 to 3000KPa for N-12 and 163 to 2200KPa for N-13. Resilient modulus changes from 79MPa to 275MPa for N-11, 53MPA to 63MPA for N-12 and 35.8MPA to 20MPa for N-13.

[16] Dilip Shrivastava et al., (2014) used the soil of Bilhari area of Jabalpur (M.P.). Soil has specific gravity 2.56, Liquid limit 48.5%, Plastic limit 22.7%, Plasticity Index 25.8%, shrinkage limit 8.61%. Authors made a series of laboratory experiments on 5% lime mixed with 5%, 10%, 15% and 20% of RHA by weight of dry soil.
The CBR value is increased by 287.62% and unconfined compressive strength is improved by 30%. The Differential free swell index is decreased by 86.92% with increase of RHA form 10 to 20%.

[17] **Yadu and Tripathi (2013)** stabilized the soft soil, collected from Tatibandh-Atari, rural road of Raipur Chhattisgarh, by the use of Granulated blast furnace slag and fly ash. The soil was classified as C-I-M as per Indian standard classification system. Different amount of GBS, i.e. 3, 6 and 9% with different amount of fly ash i.e. 3%, 6%, 9% and 12% were used to stabilize the soil. Based on compaction and C.B.R test, authors concluded that the optimum amount of GBS with fly ash was a 3% fly ash and 6% GBS.

[18] **Bhuvaneshwari et al., (2005)** studied the effect of fly ash on soil. Authors increase the fly ash content from 0 to 50%. The soil has Liquid Limit 30%, Plastic Limit 18%, Plasticity Index 12%, Dry Density 18.04 KN/m3 and Unconfined compressive strength 2697KN/m2. The Dry Density was continuously decreases and 15.13KN/m3 at 50% of fly ash. Unconfined compressive strength is also decreases and becomes 1176KN/m2 for 50% of fly ash.

[19] **Brooks (2009)** stabilized expansive soil of CH type. Author uses Fly ash and Rice Husk ash (RHA) to stabilize the soil. O.M.C and M.D.D of untreated soil is 20% and 15.5 kN/m3 respectively. In stress strain graph of unconfined compressive strength it is clearly shown that failure stress and strain increased by 106% and 50% respectively when the fly ash content was increased from 0 to 25%. When the RHA content was increased from 0 to 12%, unconfined compressive stress increased by 97% while CBA improved by 47%. Author concluded that 12% of RHA and 25% of fly ash is used for strengthening the expansive sub grade soil. Based on laboratory test 15% of fly ash was mixed with RHA to form a swell reduction layer.

[20] **Malhotra and John,** describes the use of mechanical equipment in the construction of four stretches of lime stabilized roads extending over a length of twenty kilometer. He selected four roads of Amraoti circle in Maharashtra, viz. (1) Amraoti Asra road, (2) Asra Mana road, (3) Daryapur Amla road, (4) Achaopur Kakda road. All the four roads were B.C soil of CH group. In his study authors stabilized the B.C soil by 2% of lime and their service behavior was observed. For a period of four year, stabilized sections behaved very satisfactorily but thereafter, the lime treated stretches started deterioration.

**CONCLUSION**

In this research we learnt about the stabilization of soils with admixtures like lime, iron dust, quarry dust, etc. We find out the ways how to come over the obstacles faced during the project. In view of our past research we found different ways to stabilize the soils using admixtures.

**REFERENCES**


