Second ASCE India Conference on "Challenges of Resilient and Sustainable Infrastructure Development in Emerging Economies" (CRSIDE2020)

March 2-4, 2020

Strength and Durability Characteristics of Fly Ash Admixed Black Cotton Soil

***Chethan B A [a], A U Ravi Shankar [b], Raghuram K Chinnabhandar [c] and Avinash H T [d]**

[a] Research Scholar, NITK Surathkal, Civil Engineering Department, Mangaluru - 575025, India, chethanba@gmail.com

[b] Professor, NITK Surathkal, Civil Engineering Department, Mangaluru - 575025, India, aurshankar@gmail.com

[c] Research Scholar, NITK Surathkal, Civil Engineering Department, Mangaluru - 575025, India, raghuramkchinnabhandar@gmail.com

[d] Research Scholar, NITK Surathkal, Civil Engineering Department, Mangaluru - 575025, India, avinashmng@gmail.com

Abstract—**Black cotton soil (BCS) encountered during the construction of roads usually will be replaced by good quality earth. Increased construction activities and scarcity of suitable quality materials enforce to stabilize weak soils by using marginal materials. Laboratory investigations were performed on BCS by admixing marginal material Class F fly ash (FA) procured from a thermal power plant. Mechanical characteristics of BCS such as Unconfined Compressive Strength (UCS), California Bearing Ratio (CBR), Split Tensile Strength (STS) and Flexural Strength (FS) were evaluated at varying dosages of FA (0, 5, 10, 15, 20, 25, and 35%) and various curing periods (0, 3, 7, 28, 60, and 90 days). Predominantly FA has modified the plasticity characteristics of BCS with the increase in dosages. Because of minimal calcium oxide content available in FA for the pozzolanic reaction, the UCS variations of the mixes were dominated by the availability of moisture in the specimen at the time of testing. Even though CBR is as high as 25% under unsoaked condition, on soaking, most of the cured mixes have lost their strength and reached a value close to 2%. Cured and soaked cylindrical samples have shown low STS (i.e., around 10 kPa). Low moisture contents were observed in the middle of 4 days soaked specimens due to a low moisture penetration rate. Low FS values were found for all mixes. All samples tested for wet-dry (WD) cycles of durability test failed within 5 hours of soaking in water. A significant increase in the volume of the specimens was observed during the thawing cycle of freeze-thaw (FT) durability test when enclosed in absorptive felt pads. On freezing of absorbed water, samples have developed cracks due to the formation of ice crystals, lead to the disintegration with increased cycles. No significant chemical changes were observed in the FA admixed and cured BCS, justifying the poor performance under high or low moisture contents. Hence, the FA used in the investigation cannot suit the requirements as a stabilizer for BCS.**

* Corresponding author: **Chethan B A, chethanba@gmail.com**

Keywords—**Stabilization, Class F fly ash, Black cotton soil, UCS, CBR**

I. Introduction

Black cotton soil (BCS) covers around 20% of Indian subcontinent viz. entire Deccan Plateau, Western Madhya Pradesh, portions of Rajasthan, Bundelkhand region in Uttar Pradesh, and some areas of Andhra Pradesh and Karnataka. Because of the black color and usefulness in growing cotton, it is named BCS (Malik & Priyadarshee, 2018). Rainwater, water and sewer line leakages, low evaporation rates can lead to high water content conditions in this soil. This soil tends to swell with the increase in water content, hence, termed as expansive soil. Enormous volume change of expansive soil is due to the presence of Montmorillonite clay mineral (Chen, 1975). Along with shrink-swell behavior, it has low strength and low permeability.

Pavement structures constructed on expansive soils show signs of cracks, with settlement or uplift, hence making them unsuitable for use. Whenever road alignments pass over weak and soft ground, then good quality earth obtained from borrow pits is used for the construction of subgrades. However, the depletion of good quality material enforces engineers to use in-situ soils by improving their properties. BCS alone is unsuitable for the subgrades, and hence the necessity of soil stabilization comes into the picture.

Coal-based thermal power plants are the source of a large quantity of FA in India. Burning of anthracite/bituminous coal produces class F FA, whereas burning of sub-bituminous coal produces class C FA. Disposal of unused FA creates an enormous amount of environmental stress. FA is an inexpensive binder used for soil stabilization compared to