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Review on Stabilization of Black Cotton Soil by Using Fly Ash

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ABSTRACT

The Black cotton soils are very hard when dry, but lose its strength completely when in wet condition. Expansive soils are a worldwide problem that poses several challenges for civil Engineers. Soil stabilization can be defined because the change of the soil property by using chemical or physical means if you want to decorate the engineering first-class of soil. Black cotton soil expands easily by a large amount in presence of a little water which is not desirable for construction work. One of the most important aspects for construction purposes is soil stabilization, which is used widely in foundation and road pavement constructions; this is because such a stabilization regime improves engineering properties of the soil, such as volume stability, strength and durability. In that, black cotton was stabilized using fly ash. Expansive soils were stabilized with various proportion of fly ash i.e. at 0, 10, 20, 30, 40 & 50%.

Soil stabilization performed the use of technique to adding a binder to the soil in order to improve the engineering performance of soil. Researches were illustrated that adding the additives leads to progress in workability and mechanical behavior of soil after stabilization. Fly ashes as local natural and industrial resources were applied for chemical stabilization. These additives could improve the mechanical properties of soil such as strength, swelling, plasticity index and compressibility. It indicated that, for progressing in soil properties the combination of fly ash might be more effective than use of fly ash.

Keywords- Black Cotton Soil, Fly Ash, Material, Soil Stabilization.

1. INTRODUCTION

India has 51.8 million hectares land region that is included with black cotton soil. Various techniques are adopted to enhance the engineering belongings of black cotton soil. Over the past few periods several factors have led to an increase in the number of people migrating to large cities. Consequently these large Cities are getting over populated and quite expectedly necessity of business, residential construction has increased the civil engineering projects located in areas with unsuitable soil is one of the most common problems in many parts of the world. Black cotton Soil can be replaced with stronger material by usual method of soil stabilization.

Main objective of our research is to stabilize the locally available black cotton soil near Akola city. The stabilization is done for the following reasons. Soil stabilization is widely used in connection with road, pavement and foundation construction. It improves the engineering properties of the soil, e.g.:

a) Strength - to increase the strength and bearing capacity,
b) Volume stability - to control the swell-shrink characteristics caused by moisture changes,
c) Durability - to increase the resistance to erosion, weathering or traffic loading.
d) To reduce the pavement thickness as well as cost.

2. SOIL STABILIZATION.

Soil stabilization is a general term for any physical, chemical, biological or combined method of changing a natural soil to meet an engineering purpose. Improvements include increasing the weight bearing capabilities & performance of in-situ subsoil, sands & other waste materials in order to strength.

2.1 Methods of Soil Stabilizations:-

There will be four methods of soil stabilization are as follows:

A. MECHANICAL STABILIZATION
B. PHYSICAL STABILIZATION
C. CHEMICAL STABILIZATION
D. PHYSIO CHEMICAL STABILIZATION

2.2 Benefits of Soil:-

a) Improve the mechanical qualities of local road construction soil.
b) Increase loading capacity.
c) Improve structural integrity.
d) Reduce harmful moisture penetration.
e) Provide longer economic life of road bed.
f) Reduce maintenance costs.
g) Lower road constructions costs.

2.3 Soil Properties:-

Some of the important properties of soils that are used by geotechnical engineers to analyze site conditions & design earthworks, retaining structures, & foundation are-

a) Specific weight or Unit weight.
b) Porosity.
c) Void ratio.
d) Permeability.
e) Compressibility.
f) Shear Strength.
g) Atterbegs Limits.

3. MATERIAL

3.1 Black Cotton Soils:-

Black cotton soils are inorganic clays of medium to high compressibility and form a major soil group in India. They are characterized by high shrinkage and swelling properties. This Black cotton soils occurs mostly in the central and western parts and covers approximately 20% of the total area of India.

Also called as Black Cotton soils or Regur soils, expansive soils in the Indian subcontinent are mainly found over the Deccan trap, which includes Maharashtra, Andhra Pradesh, Gujarat, Madhya Pradesh, and some scattered places in Odisha. These soils are also found in the river valley of Narmada, Tapi, Godavari and Krishna. The depth of black cotton soil is very large in the upper parts of Godavari and Krishna, and the north-western part of Deccan Plateau. Basically, after thechemical decomposition of rocks such as basalt by various decomposing agents, these are the residual soils left behind at the place of such an event.

In the semi-arid regions, just in the last couple of decades, damages due to the swelling-shrinking action of expansive soils have been observed prominently in form of crackingand break-up ofroadways, channel and reservoir linings, pavements, building foundations, water lines, irrigation systems, sewer lines, and slab-on-grade members.

Table 1: Standard Properties of black cotton soil

Properties	Range
colour	Black
Sp. Gravity	2.65
Liquid limit (%)	40-100
Plastic limit (%)	15-25
Shrinkage limit (%)	8-15
O.M.C (%)	20-30
M.D.D (%)	1.4-1.6
Swell index (%)	Sometimes>50

3.2 Fly Ash:-

A waste material extracted from the gases emanating from coal fired furnaces, generally of a thermal power plant, is called fly ash. One of the chief usages of volcanic ashes in the ancient ages were the use of it as hydraulic cements, and fly ash bears close resemblance to these 5 volcanic ashes. The mineral residue that after the burning of coal is the fly ash. The Electro Static Precipitator (ESP) of the power plants collect these fly ashes.

Production of fly ash comes with two major concerns – safe disposal and management of fly ash. Because of the possession of complex characteristics of wasters which are generated from the industries, and their hazardous nature, these wastes pose a necessity of being disposed in a safe and effective way, so as to not disturb the ecological system, and not causing any sort of catastrophe to human life and nature. Environmental pollution is imminent unless these industrial wastes are pre-treated before their disposal or storage. Essentially consisting of alumina, silica and iron, fly ashes are micro-sized particles.

Fly ash particles are generally spherical in size, and this property makes it easy for them to blend and flow, to make a suitable concoction. Both amorphous and crystalline nature of minerals are the content of fly ash generated. Its content varies with the change in nature of the coal used for the burning process, but it basically is a non-plastic silt. For waste liners, fly ash is a potential material that can be employed; and in combination with certain minerals (lime and bentonite), fly ash can be used as a barrier material. In present scenario, the generation of this waste material in fly ash is far more than its current utilization.

Fly ash additive in soil, fly ash is use due to

a) Fly ash is costless and abundantly available all over the country.
b) As fly ash is a by-product of thermal power plants, land area required for its disposition is a great problem in a densely populated country like India.
c) Utilization of fly ash solves the problem of air and water pollution.

Table 2: Properties of fly ash.

Properties	Range
Colour	Grey
Sp. gravity	1.95-2.55
Plasticity	Non-plastic
O.M.C (%)	38.0-18.0
M.D.D(gm/cc)	0.9-1.6

3.2 Classification of fly ash:

The extracted ash from the flue gases via an Electro Static Precipitator, after the process of pulverization, is called fly ash. It is the finest of particles among bottom ash, pond ash and fly ash. With some unburned carbon, the fly ash chiefly consists of non-combustible particulate matter. These generally consists of silt-sized particles. On the basis of a lime reactivity test, fly ashes have been classified into four different types, as given:

a) Cementations fly ash
b) Cementations and pozzolanic fly ash
c) Pozzolanic fly ash
d) Non-pozzolanic fly ash

With free lime content and negligible reactive silica, this fly ash is called as cementations. As opposed to this, with negligible free lime content, and chiefly reactive silica, this fly ash is called pozzolanic fly ash. Both reactive silica and free lime are predominant in cementationsand pozzolanic fly ash. Neither free lime, nor reactive silica are present in non-pozzolanic fly ash. The distinguishable difference between cementations fly ash and pozzolanic fly ash is that the cementations fly ash hardens when it comes in connexion with water, whereas the pozzolanic fly ash hardens only after the activated lime reacts with water. Cementations&Pozzolanic Fly Ash and Pozzolanic Fly Ash are the types that are found widely. Based on the chemical composition of fly ash, fly ash has been categorized into two categories, as given:

A. Class C fly ash
B. Class F fly ash

Burning of sub-bituminous type of coal and lignite, which contains more than 20% Calcium
Oxide, gives the Class C fly ash. By ignition of anthracite and bituminous type of coal, Class F fly ash. This fly ash contains less than 20% Calcium Oxide.

4. METHODOLOGY

The effect of fly ash as a stabilizing additive in expansive soils, series of tests, where the content of fly ash in the expansive soil was varied in values of 10% to 50% (multiples of 10) by weight of the total quantity . The Indian Standard codes are as follows:

a) Standard proctor test – IS : 2720 (Part 7) - 1980
b) Free swell index test – IS 2720 (Part 40) - 1977
c) Liquid & Plastic limit test – IS 2720 (Part 5) – 1985

5. Utilization of Fly Ash

The utilization of fly ash can be largely grouped into following three classes:

a) The Low Value Utilizations, which includes back filling, structural fills, road construction, soil stabilization, and embankment & dam construction, ash dykes, etc.
b) The Medium Value Utilizations, which includes grouting, cellular cement, pozzolana cement, bricks/blocks, soil amendment agents, prefabricated building blocks, fly ash concrete, weight aggregate, etc.
c) The High Value Utilizations, which includes, fly ash paints, ceramic industry, extraction of magnetite, distempers, metal recovery, acid refractory bricks, floor and wall tiles, etc.

6. CONCLUSIONS

On the basis of the use of Fly Ash on black cotton soil shows an effective use. Fly Ash can be used as an additive for the stabilization of soil. In geotechnical engineering applications Fly Ash may befeasible. By the addition of Fly Ash in the poorlygraded soil improve the bearing capacity of soil. Theswelling of expansive soil decreases with increasing swell reduction layer thickness ratio.

7. REFERRNCE

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