AN EXPERIMENTAL STUDY OF EXPENSIVE SOIL STABILIZED WITH FLY ASH AND PLASTIC FIBERS

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Abstract *Numerous causes over the past few decades have increased the number of individuals moving to big cities. Due to the overpopulation of these big cities and the rising need for commercial and residential building, one of the most frequent issues throughout the world is the location of civil engineering projects on unsuitable soil. By executing soil stabilisation, the inappropriate soil (Black cotton Soil) may be stabilised. Black soil presents the greatest construction challenges in India. Black cotton soil swells and becomes sticky during the rainy season. While in the summer, the soil shrinks and the moisture it contains evaporates, causing a crack that is roughly 10 to 15 cm wide and up to 1 metre deep. 16.6% of India's geotechnical areas are covered by black cotton soil, which indicates that a sizable portion of the country's soil requires stabilization. To enhance the soil's engineering properties, a variety of techniques including mechanical, chemical, electrical, thermal, and others are used. For roads and airports, chemical stabilisation is the most effective technique.*

When exposed to moisture, the expansive form of soil known as black cotton expands quickly and begins to inflate. The strength and other characteristics of soil are particularly low as a result of this attribute. It is required to stabilise the soil using various stabilisers in order to improve its qualities. Expansive types of soil exhibit unexpected behaviour when stabilised with various substances. The process of treating a soil to maintain, change, or enhance its functionality is known as soil stabilization. In this project, expansive soil's engineering properties are improved by using stabilised materials like fly ash and plastic fibers. The evaluation entails figuring out the expansive soil's swelling potential, atterberg's limits, and compaction test both in its unaltered state and when combined with various amounts of fly ash and plastic fibers.

Key words: *unsuitable soil, black cotton soil, strength, fly ash, plastic fibers*

1. INTRODUCTION

Expansive soils, also known as swell-recoil soil, have a tendency to therapist and swell with a variety of moisture contents. Due to this variety in the dirt, significant problems arise, which is followed by damage to the structures above. These soils soak up the water and swell during periods of more intense dampness, such as storms; as a result, they become brittle and their capacity to hold water decreases. Instead of this, these dirts lose the moisture held in them due to vanishing in drier seasons, similar to summers, causing them to become more diligent.

Broad soils on the Indian subcontinent, also known as Black Cotton soils or Regur soils, are mostly found over the Deccan trap (Deccan magma tract), which includes the states of Maharashtra, Andhra Pradesh, Gujarat, Madhya Pradesh, and some isolated areas of Odisha. Additionally, these sands may be found in the Narmada, Tapi, Godavari, and Krishna river valleys. In the upper portions of the Godavari and Krishna rivers as well as the northwestern portion of the Deccan Plateau, the depth of dark cotton soil is extremely vast. Fundamentally, they are the residual soils left behind at the scene of such an event following the artificial deterioration of rocks, such basalt, by various disintegrating operators. These kinds of soils are also developed by processes like cooling volcanic ejection (magma) and enduring another type of shaking from molten rocks. These dirts, which are abundant in lime, alumina, magnesia, and iron, require natural material, nitrogen, and phosphorus.

Fig 1: Major Soil Types in India

Fly ash

Fly cinder is a waste product derived from the gases radiated by coal-fired heaters, often of a thermal power plant. Fly slag resembles these volcanic cinders to some extent. One of the principal applications of volcanic fiery remnants in earlier times was their usage as pressure-driven bindings. Comparing these fiery debris to other pozzolans (restricting operators) used globally, experts considered them to be exceptional.

Due to the miracles of rising urbanisation and industrialization, the interest in intensity supply has drastically increased in recent years. As a result, this growth has led to an increase in the number of heat-producing power plants that use coal as a consuming fuel to produce electricity. The fly fiery debris is the mineral buildup left over after coal has been consumed. These fly cinders are collected by the power plants' Electro Static Precipitator (ESP).

The production of fly slag raises two important issues: safe transportation and the board of fly-fired debris. Given the complex characteristics of the waste products produced by businesses and their hazardous nature, these wastes represent a need to be organised in a secure and compelling manner in order to not disturb the environmental framework and not cause any kind of disaster to human life and nature. Unless these modern wastes are pre-treated before being transferred or used, natural contamination is imminent.

Plastic fiber

Expanded use of plastics in common consumer applications has led to the creation of the urban strong trash, a continually growing category of plastic materials that were only used briefly before being discarded. Straightforward uses of plastic bags, such as single-use and subsequent transfer, have led to environmental issues like reduced landfill space and urban and marine littering. Therefore, there is a growing need to find alternative uses for recycled plastic packaging waste in order to prolong the useful life of the plastic and thereby prevent deterioration.

Another innovation is the notion of bolstering soil masses using dispersed sections of plastic. Interestingly, the use of irregular materials as soil fortification is probably not older than recorded history, but just underexposed. The basis for this investigation is the desire for improved soil structure and the cost-effectiveness of its development and slant adjustment.

Objectives of the study

From this study the following objectives were made

1. To investigate the atterberg limits for soil utilising fly ash and plastic fibres in the ground.
2. To investigate the OMC and maximum dry density for various fly ash concentrations such as 5%, 10%, 15%, 20%, and 25% with 1% plastic fibre as an addition.
3. To investigate the soil's maximum strength for various ratios of plastic fibre and fly ash.
4. To determine the UCS values for various mixtures of plastic fibre and fly ash.

2. LITERATURE STUDIES

Ankita Sonkar, S. Srividhya, et al.,(2017)

This study examined the quality and behaviour of the resulting swelling when haphazardly circulating palm filaments are used to fortify distant soil and balanced out using bagasse pyrophoric debris.

According to the results of this investigation, soils with fibre balance continue to have a decreasing Maximum Dry Density (MDD) and an increasing Optimal Moisture Content (OMC) as the amount of fibre in the soil increases.

Amit Tiwari[1], H. K. Mahiyar[2], et al.,(2014)

Due to the Black Cotton Soil's unfavourable design characteristics, such as its high swelling when wet, low compressive quality at higher water contents, and excessive volume variation with changing water content, broad breaks can develop as a result of drying's impressive shrinkage.

To achieve this objective test study, 48 preliminary examples were put through two stages of testing. For instance, in the first stage, the physical characteristics of the soil, such as hygroscopic dampness substance grain size dispersion, explicit gravity, Atterberg's breaking points, Direct shear test, Swelling weight, MDD-OMC, CBR, and permeability test esteems, are resolved.

3. MATERIAL USED AND METHODOLOGY ADOPTED

Expansive soil

The sweeping black cotton dirt was taken from the location for this investigation. Following that, bags were used to transport the black cotton soil to the study facility. To determine the common dampness substance of the equivalent, a small sample of soil was taken, sieved through a 4.75 mm strainer, gauged, and air-dried before being gauged again.

Fly ash

Fly fiery debris is a waste product derived from gases emitted from coal-fired heaters, often of a heated power plant. Fly cinder is the mineral deposit left over after coal has been used. These fly cinders are collected by the power plants' Electro Static Precipitator (ESP). Fly fiery remnants are tiny size measurable particles that mostly consist of alumina, silica, and iron. Fly powder particles are frequently round in shape, and because of this, it is easy for them to mix and stream to create the right mixture. Fly fiery remains are made of the undefined and crystalline nature of minerals.

Fig 2: Fly ash

Plastic fiber

Plastic fibres were obtained from leftover milk and curd packaging. The plastic spreads were shredded into filaments each with a normal thickness of 2mm after proper cleaning and air drying. These plastic spreads are typically thought of as trash.

Fig 3: Plastic fiber

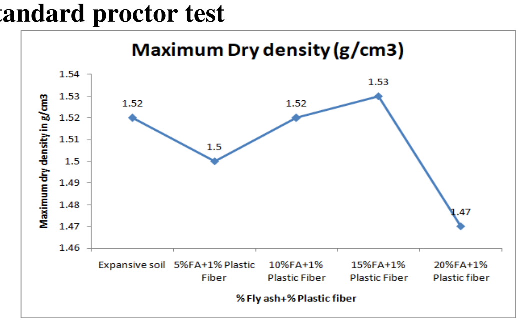
Methodology adopted

In a series of tests, the amount of fly powder in the sweeping soil was varied in amounts ranging from 5% to 40% (products of 5), and 1% plastic fibre by weight of the total amount taken, in order to evaluate the impact of fly fiery debris and plastic fibre as a balancing out added substance in far-reaching soils. The Indian Standard codes were pursued during the conduction of the accompanying analyses:

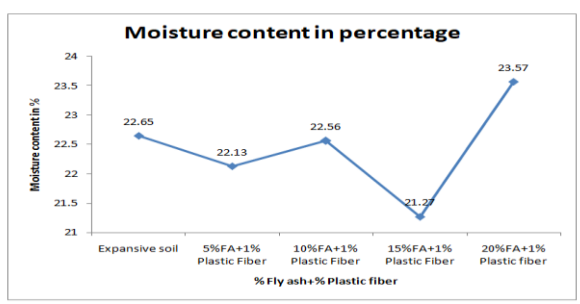
- Standard proctor test – IS : 2720 (Part 7) - 1980
- Unconfined compressive strength (UCS) test – IS : 2720 (Part 10) - 1991
- California bearing ratio (CBR) test – IS : 2720 (Part 16) - 1987
- Liquid & Plastic limit test – IS 2720 (Part 5) - 1985

4. RESULTS AND ANALYSIS

Standard proctor test

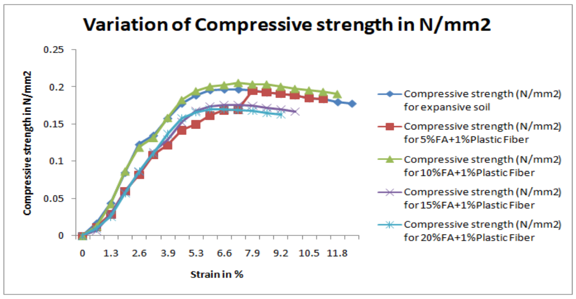


Graph 1: Comparison of maximum dry density

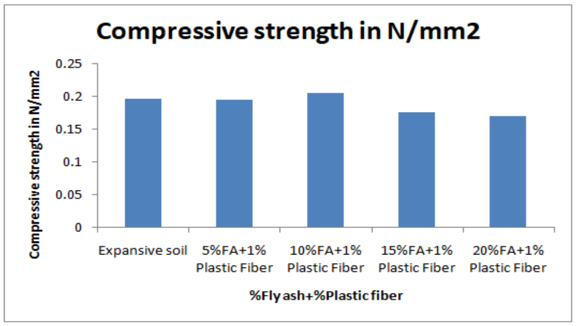


Graph 2: Comparison of moisture content

UCS Test results

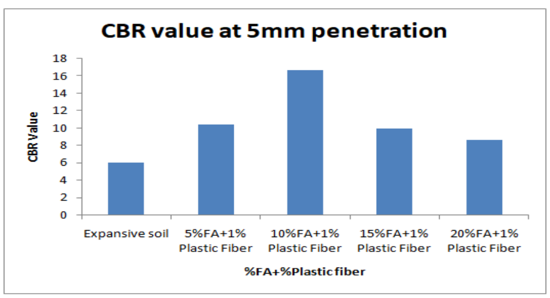


Graph 3: Variation of compressive strength



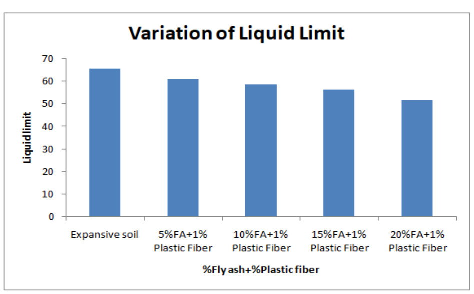
Graph 4: Compressive strength of soil

Comparison of CBR Values

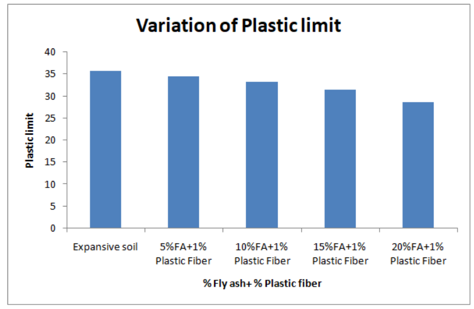


Graph 5: Comparison of CBR values at 5mm penetration

Liquid & Plastic limit test results



Graph 6: Variation of liquid limit values



Graph 7: Variation of plastic limit values

5. CONCLUSIONS

This project is focused on the review of performance of fly ash and plastic fiber as a soil stabilization material. The study suggests that if fly as and plastic fiber if properly mixed and applied, can be used as a great soil stabilization technique .On the basis of this project the following results were obtained.

1. Fly ash is used as an excellent soil stabilizing materials for highly active soils which undergo through frequent expansion and shrinkage.
2. The Fly ash as an additive decreases the swelling, and increases the strength of the expansive soils.
3. The higher value of maximum dry density was observed at 15% fly ash and 1% plastic fiber and the maximum value of Optimum moisture content was observed at 20% fly ash and 1% plastic fiber.
4. The optimal value of unconfined compressive strength was observed at 10 % fly ash and 1%plastic fiber.
5. The optimal value of CBR value was observed at 10% fly ash and 1%plastic fiber.
6. The values of liquid limit and plastic limits decreases with increasing the percentages of fly ash from 0% to 20% with 1% plastic fiber.

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