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SOIL STABILIZATION OF LIME-FLY ASH- EXPANSIVE SOIL USING WTR REINFORCEMENT

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ABSTRACT: Expansive soil is profoundly dangerous and present issues to the constructions worked over them because of substitute enlarging and contracting, when exposed to occasional dampness changes. Among the accessible improvement techniques, generally conservative and viable strategy for balancing out sweeping soils is utilizing admixtures. By and large, mechanical waste causes numerous genuine climate issues and its use in development industry is the most ideal approach to arrange it. This paper presents the strength conduct of extensive soil, straightforwardly blended in with fly debris, lime and discrete waste tire rubber (WTR). The outcome shows promising improvement in the conduct of expansive soils.

INTRODUCTION

In India, about $1/5^{th}$ of the total land is covered by expansive soils, popularly known as black cotton soils, causing severe problems to the structures that are constructed upon them. These soils are generally found in arid and semi-arid regions of the world, hot climate and poor drainage conditions are usually associated with the formation of these soils. Expansive soils are found to be highly problematic because of their extensive swelling and shrinkage nature caused by imbibitions of water during monsoon and evaporation during summer. This rapid volume change may produce large amount of stresses some times as high as 15000 lb/ft^2 on the structures constructed in them, in the opposite direction of gravitational forces, leads to uplift of the foundations. The moisture variation in the foundation soil is not uniform and hence it causes differential settlement and heave, on the overlying structures. It causes rutting, cracking, longitudinal cracking, surface distress and transverse cracking in the pavements. Most of these problems are due the presence of Montmorillonite mineral in the clay. Because its high specific surface area ranges from 800-1000 m^2/g, it absorbs more amount water molecules on to its surface causing intense swelling. This swelling behaviour of soils has been influenced by many other factors such as amount of clay minerals, physicochemical properties of pore fluid, soil density, water content, plasticity indices, surcharge pressure, temperature and time. Another major disadvantage by these expansive soils is that it takes some years to cause an extensive damage to a structure; meanwhile the problem will tend to ignorance. Creeping in expansive soils will also tends to large lateral pressures and finally makes them vulnerable to slide over.

Concerning with the above problems various ground improvement methods are available in the literature such as soil replacement, moisture control, pre-wetting, stabilization etc. Among them an effective and economical method of ground improvement, i.e. lime stabilization has been selected as other techniques have their own limitations like high cost for hauling suitable refill material for soil replacement, difficulty in constructing the ideal moisture barriers and longer time periods are required for pre-wetting of highly plastic clays.

Lime has been proved as an effective stabilizing agent even from the period of Romans, in the soils with more percentage of fines. Lime stabilization is highly suggestible for expansive soils as it develops from base exchange and cementation

processes between clay particles and lime. In the stabilization process lime modifies the workability and compactability of soils. The initial reaction occurs as a result of cation exchange of calcium ions (Ca^{2+}). The result of cation exchange increases the flocculation of clay particles and changes the plasticity properties of clay.

Fly ash is the versatile industrial waste that was collected from the Electro Static Precipitators (ESP) of coal based thermal power plants. India was producing more than 112 million tons of fly ash per year which makes it as the largest industrial waste of our country. Among the total waste, that has been generated every year only 40% has been gainfully utilizing in different fields of engineering and the remaining 60% was dumping in the ash dykes, which requires huge land space approximately 48.4 million cubic meters of landfill space. If we can make use that remaining % also, then we can effectively conserve vast amount of land area and make use of the waste as an admixture for stabilizing weak soils.

Waste Tyre Rubber (WTR) was generated from rubber tyres and tubes that are no longer suitable for use on vehicles due excessive wear and tear or due to irreparable damage. These waste tyres and tubes are among the largest and most problematic source of waste as they generated in large volumes and also because of their durability. This same characteristic makes WTR as an effective usable material in different aspects Geotechnical Engineering as a land fill liners, for soil reinforcement etc.

In this work an attempt is made to study the effect of fly ash, Waste tyre rubber (WTR) and lime on the strength characteristics of expansive soil.

REVIEW OF LITERATURE

A good number of field studies and a few large scale model studies [1] are found the development of cohesion in the soil – water system which develops due to saturation of expansive soil arrests heave. Such a soil system is designated as Cohesive Non-swelling Soil (CNS). However, studies conducted later [2] indicated that CNS Cushion is effective in arresting heave only during the first cycle of seasonal moisture fluctuations, and during the subsequent cycles, the heave may be more than that recorded by a black cotton soil without cushion. Besides, soils conforming to the specifications suggested in [1] for suitability as CNS material are hard to find.

Several researchers [3, 4, 5 & 6] evaluated swell based on the relationships between suction and water content. A suction-potential model to estimate suction as a function of time, swelling and depth is developed in [7]. Swelling potential and swell pressure are increasing with increase in dry density [8]. Reinforcement effect on black cotton soils with fibres is studied [9, 10].

In the past several investigations had reported highlighting the beneficial use of lime for improvement of workability of clayey soils [11, 12]. The increase in CBR value and reduction in hydraulic conductivity with addition of Lime and Fly ash as admixtures to the expansive soil are observed [13]. The swell potential and swell pressure are decreasing with increase in the fly ash content mixed in the black cotton soils are observed [14]. The optimum fly ash content mixed with the clay observed as 20 % with respect to the unconfined strength [15, 16].

From the above literature, it is evident that the stabilizing materials like fly ash and lime proved to be effective and this led the authors to study the effect of these materials in combination with discrete inclusions of Waste Tyre Rubber (WTR). This paper presents the results of the experiments aimed at understanding the behaviour of expansive soil modified thorough addition of fly ash and lime and discrete inclusions of Waste Tyre Rubber (WTR).

METHODOLOGY

The expansive soil is treated with the different combinations of lime and fly ash and thereby determining the optimum contents of the stabilizer blends in terms of strength parameters (shear strength and CBR). Further, stabilizing the optimum blended expansive soil with discrete inclusions of Waste Tyre Rubber (WTR).

CONCLUSIONS

From the above study the following conclusions can be drawn.

1. The expansive soil chosen was a problematic soil having high swelling, with high plasticity and low strength characteristics.
2. Fly ash proved to be efficient replacing material with an optimum of 20% replacement.
3. The addition of Lime in combination with fly ash had given promising enhancements of strength behaviour of virgin expansive soil.
4. The shredded waste tyre rubber, an emerging disposal waste was used to further improve the blended expansive soil and found to be effective with an optimum dosage of 1%.
5. Finally, it can be concluded that the fly ash, lime and WTR treated expansive soil will be a potential fill material giving us three fold advantage of improving a problematic soil and utilizing two potential wastes fly ash and Waste Tyre Rubber.

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