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Review on Improvement of Engineering Properties of soil

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ABSTRACT: A major problem associated with socio-economic development of a country is waste disposal. Safer disposal of rubber tyre waste has become a challenging job. The soil often is weak and has no enough stability in heavy loading. The aim of the study was to review on stabilization of soil using low-cost methods. Several reinforcement methods are available for stabilizing expansive soils. These methods include stabilization with chemical stabilization, mechanical stabilization, soil replacement, compaction control, moisture control, surcharge loading, and thermal methods. All these methods may have the disadvantages of being ineffective and expensive. Based on literature, fly ash and scrap tire are low-cost and effective to soil stabilization.

Keywords: UCS (unconfined compressive strength), CBR, OMC, MDD

I. INTRODUCTION

Soil properties is very important for every construction work, because we can change the material if it hasn't good quality, but it is very difficult to replace the soil If the property of soil is not too good, because the transportation of soil and change of all existing soil is very difficult work. for such condition we use some admixture and material which improve some important property of soil. Method of using low cost material and admixture to improve the property of soil is called soil stabilization.

Soil stabilization is the route of improving the engineering performance of soil. Stabilization is constrained to the routes which modify the soil material itself for upgrading its properties. The existing soil at construction site may not always be totally suitable for supporting structures, for example, granular soil may be very loose and indicate large elastic settlement so, the soil needs to be densified to increase its unit weight and thus shear strength. Various materials are used to stabilize the soil like cementing materials or chemical etc. Stabilization is used to condense the permeability and compressibility of the soil and to increase the shear strength. Soil stabilization is required to increase the bearing capacity of foundation soil by using controlled compaction, proportioning and the addition of suitable admixtures and stabilizers.

It is desirable from an engineering standpoint to build upon a foundation to ideal and consistent density. Thus, the goal of soil stabilization is to provide a solid, stable foundation. Density is the measure of weight by volume of a material and is one of the relied upon measure of the suitability of a material for a construction purposes. The more density a material possesses, the fewer voids are present. Voids are the enemy of the road construction, voids provide a place for moisture to go, and make the material less stable by allowing it to shift under changing pressure, temperature and moisture condition. Improving an in situ soil engineering properties is referred to as either soil modification or soil stabilization. The term modification implies a minor change in the properties of soil, while stabilization means that the engineering properties of the soil have been changed enough to allow field construction to take place.

II. PRINCIPLES OF STABILIZATION

The main principles of soil stabilization are mentioned below:

i) To improve the onsite material to create a solid and strong sub base and base courses.
ii) To improve CBR value of the soil.
iii) To reduce the plasticity index of soil.
iv) To increase the strength and durability of weak soil.
v) To reduce the cost of construction by making best use of locally available material.

vi) To reduce the need for landfill site for dumping of poor material as well as construction waste

III. MATERIALS AND METHOD OF SOIL STABILIZATION

Mechanical Stabilization. Mechanical solutions involve physically changing the property of the soil somehow, in order to affect its gradation, solidity, and other characteristics. Dynamic compaction is one of the major types of soil stabilization; in this procedure a heavy weight is dropped repeatedly onto the ground at regular intervals to quite literally pound out deformities and ensure a uniformly packed surface. Vibro compaction is another technique that works on similar principles, though it relies on vibration rather than deformation through kinetic force to achieve its goals.

Chemical Stabilization. Chemical solutions are another of the major types of soil stabilization. ll of these techniques rely on adding an additional material to the soil that will physically interact with it and change its properties. There are a number of different types of soil stabilization that rely on chemical additives of one sort or another; you will frequently encounter compounds that utilize cement, lime, fly ash, or kiln dust. Most of the reactions sought are either cementitious or pozzolanic in nature, depending on the nature of the soil present at the particular site you are investigating.

Additive Stabilization. Stabilizing Agents. These are hydraulic (primary binders) or non-hydraulic (secondary binders) materials that when in contact with water or in the presence of pozzolanic minerals reacts with water to form cementitious composite materials. The commonly used binders are:

i) Lime
ii) Cement
iii) Blast furnace slag
iv) Fly ash
v) Pozzolanic Materials

Fly Ash. Fly ash itself has less cementitious value but it reacts chemically and form cementitious compound in presence of moisture. Cementitious compound formed improves the strength and compressibility of soil (Karthik *et al.,* 2014).

Pandian *et.al.* (2002) Studies the effect of fly ash on black cotton soil.effect of mixing of fly ash with black cotton soil was studied.CBR value is due to the cohesion and friction .black cotton soil consist of finner particle and has CBR value due to cohesion. The CBR of fly ash, which consists predominantly of coarser particles, is contributed by its frictional component. The addition of fly ash to BC soil increases the CBR of the mix up to the first optimum level due to the frictional resistance from fly ash in addition to the cohesion from BC soil. Further addition of fly ash beyond the optimum level causes a decrease up to 60% and then up to the second optimum level there is an increase. Thus the variation of CBR of fly ash-BC soil mixes can be attributed to the relative contribution of frictional or cohesive resistance from fly ash or BC soil, respectively.

Ahmed (2014) Stabilized the clay soil using fly ash. Author found that the optimum ratio of fly ash with clayey soil is 15% by weight of soil. Dry density of soil increase with increase in the content of fly ash upto 15%.then reduced to 1.53 at fly ash content 20%.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%.

Hakari and Udayashankar has discussed in Indian geotechnical conference. (Dec-2010) has studied a use of fly ash for improves the property of black cotton soils of Hubli-Dharwar region. The liquid limit decreases from 63% to 46%, plastic limit from 28.9% to 23.1% and the plasticity index from 34.1% to 22.9%; for the corresponding increase in the addition of DFA from 10% to 50% respectively. The shrinkage limit increases from 17.3% to 37% for increasing in the addition of DFA from 10% to 50% respectively the optimum moisture content decreases from 24.3% for M-10 mix to21.3% for M-50 mix. The CBR value Increases from0.77% for M-10 mix to 2.64% for M-50 mix.

Waste plastic bottles. Use of plastic products such as bottles is increasing day by day. The disposal of the plastic wastes without causing any ecological hazards has become a real challenge to the present society. Thus using plastic bottles as a soil stabiliser is an economical and gainful utilization since there is scarcity of good quality soil for embankments and fills. Thus this project is to meets the challenges of society to reduce the quantities of plastic waste, producing useful material from non-useful waste materials that lead to the foundation of sustainable society and various researches are done using waste plastic fibre.

Abhishek and Girish Waghere (2016) Author used waste plastic bottles for stabilization of soil.the plastic bottles are cut with a size of 1cm*1cm.experimental study shows that after adding plastic in soil, cohesion of soil increased by 67.18% by Triaxial test similarly we have performed Direct Shear test on the same soil where we have found that the cohesion increased by 24%. On the above basis we observed the increase in cohesive property of soil so bearing capacity of soil increases and settlement as well as compressibility decreases.

Shish *et al.,* Laboratory investigations were conducted on the plain soil and soil reinforced with the fibres of the waste polypropylene in variation of length of 10mm, 20mm & 30mm at different percentage 0.15%, 0.25% and 0.35% of waste fibre material by weight of the dry soil sample for the improvement of Compressibility (MDD), Direct Shear Strength (DSS) and Unconfined Compressive Strength (UCS) of the soil.

Experimental study show that there is decrease in MDD with increase of plastic fibre. The direct shear strength parameters of the soil reinforced with waste fibres of polypropylene used for the improvement of the engineering properties of the soil with 20 mm length and 0.35% weight of polypropylene by weight of dry soil sample, is found as 25.18% increase in the angle of internal friction (Φ) and 46.88% increase in cohesion (c).and The unconfined compressive strength(UCS) of the soil reinforced with waste fibres of polypropylene used for the improvement of the engineering properties of the soil with 20mm length and 0.25% weight of polypropylene by weight of dry soil sample, is found as 52.80% increase in UCS.

Scrap Tyre. Now a days scrap tyre is used as stablizing material of soil. Tyre has many good properties like flexibility, strength, resiliency, and high frictional resistance and also the weight of tyre is light. Today huge amount of waste tyre is accumulated because use of motor vechicle is very common in every country and this waste is burned and this makes air pollution or this waste thrown at some dumping yard. and it also makes unhealthy conditions for the people living in that area. In order to eliminate the negative effect of these depositions and in terms of sustainable development there is great interest in the recycling of these non hazardous solid wastes.

Tyre wastes can be used as light weight material either in the form of powder, chips, shredded and as a whole. Applications of tyre rubber proven to be effective in protecting the environment and conserving natural resources. They are used above and below ground water. Many work regarding the use of scrap tyres in geotechnical application have been done especially as embankment materials. The reuse application for tyre is how the tyre are processing basically includes shredding, removing of metal reinforcing and further shredding until the desired materials are achieved.

Due to the light weight of tyre it can be used as filling material at site. And also due to high permeability it can be used below road to drain out the water.

Scrap tyre can be used as crumb rubber, or in shredded form. Due to the following advantages

(i) The consumption of natural soil will be reduced ,there by rendering cost saving benefits.

(ii) The property like shear strength bearing capacity and drainage can be improved.

Amin *et al.* (2012). . Described that Portland cement, lime, fly ash and scrap tire are low-cost and effective for soil stabilization. Annually, a lot of waste rubber is generated and occupies a great space. It is necessary to find a solution to solve this problem. Based on literature, one of the solutions of different sizes of waste rubber is used in soil reinforcement.

Ajay and Jawaid (2013) experimental study of author shows that on increasing tire proportion in soil the CBR values increase so tire chips are used for highway embankments, backfills behind retaining structures, roadways backfill, soil reinforcement etc. It is found that rubber tire have low density in comparison to soil so it is used as light weight geometrical material.

Shiva Prasad. and Ravichandran (2014). This paper presents the stabilization of soils using crumb rubber at varying percentages (5%, 10%, 15% and 20%). The soil properties, compaction and unconfined compression strength were used to gauge the behavior and performance of the stabilized soils. From the tests conducted on the two soils, it was observed that maximum dry density and optimum moisture content decreases with increase in percentage of crumb rubber on soils. The UCS value increased with increase in percentage of crumb rubber and the maximum values were observed at 10% and 15% for the soil sample S1 and soil sample S2 respectively. Waste crumb rubber-soil mixture showed an improvement in UCS value for both the soils S1 and S2 upto 10% and 15% addition of crumb rubber respectively. Further the addition of crumb rubber to soils lead to a decrease in UCS values. The percentage improvement in UCS value of soil S1 stabilized with 10% of crumb rubber was 45% and soil S2 stabilized with 15% of crumb rubber was 80%.

IV. CONCLUSION

From this review paper. it can be concluded that a lots of waste of scrap tyre is generated due to the very high use of motor vechicles and if this waste is burned it makes air pollution if it is thrown it make conditions unhealthy, so to minimize this effect we use it as soil reinforced material and give strength and stability to the soil. Detailed study of scrap tyre use with different percentage and size are not carried out, and very little work is done on the compressive strength improvement of clayey soil with different percentage and size of tyre.

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