SOIL STABILIZATION USING E-WIRES

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Abstract: Soil can be considered as very first element of construction industry as no construction work can be done without it. Soil plays an important role in construction industry such as in foundation works, pavement subgrade etc. Soil used in construction industry is first treated and convert into a technically sound which fulfill the criteria of good foundation soil. Soil stabilization is such process which improves the properties of soil such as strength, stress parameters, Atterberg's limit etc by mixing external agent or compacting it. Hence the requirement of engineering soil can be achieved by such processes.
In this study, soil stabilization of natural soil collected from local site is done by using E-wires. For soil stabilizing, the percentages of E-wires chosen are 5% and 7% in a definite aspect ratio. Liquid limit test, Proctor compaction test, CBR tests are performed on the soil alone and when mixed with E-wires. The liquid limit of soil decreases and CBR value increases in this experimental investigations.

***IndexTerms* - Strength, Subgrade, Atterberg's limit, CBR, E-wires.**

I. INTRODUCTION

Expansive soils are fine grained soil or decomposed rocks that show large volume change when exposed to the variations of moisture content. The expansive soils are most likely to be unsaturated and have montmorillonite clay minerals. Most of harsh damage relates to expansive soils is depended on the amount of monovalent cations absorbed to the clay minerals. Construction of housing buildings and other civil engineering structures such as highways, bridges, airports, seaports on expansive soil is extremely dangerouswhich results in cracking to structural and none structural elements of those structures.
Many studies have been done in practice to overcome the unfavourable effects of expansive soil including replacement of existing expansive soil with non-expansive soil, maintaining a constant moisture content, expansive soil stabilisation and so on. These control methods of expansive soil have their advantages and limitations based on different site conditions.
For any land-based structure, the inspiration is incredibly important and must be robust to support the complete structure. So as for the idea to be strong, the soil around it plays an essential role. So, to work with soils, we want to own correct data about their properties and factors that have an effect on their behavior. The method of soil stabilization helps to attain the specified properties in a very soil needed for the development work. From the start of construction work, the requirement of enhancing soil properties has come back to the sunshine. Ancient civilizations of the Chinese, Romans used many strategies to increasesoil strength etc., a number of these strategies were therefore effective that their buildings and roads still exist. In India, the period of soil stabilization began in early 1970‟s, with a general Shortage of and aggregates, it became necessary for the engineers to appear at suggests that to improve soil different than replacing the weak soil. Soil stabilization was used however thanks to the employment of obsolete methods and conjointly thanks to the absence of correct technique, soil stabilization lost favor. In recent times, with the rise within the demand for infrastructure, raw materials and fuel, soil stabilization has begin to take a replacement form. With the availability of higher analysis, materials and equipment, it's rising as a preferred and cost effective method for soil improvement.

For any ground-based structure, the foundation is very important and has to be tough to support the whole structure. In order for the substructure to be strong, the soil around it plays a very important role. So, to work with soils, we need to have proper information about their properties and factors which have an effect on their behavior. The procedure of soil stabilization helps to achieve the necessary properties in a soil needed for the construction work. The soil reinforcement system is well established and is used in variety of applications. Reinforced soils can be obtained by either incorporating reinforcement inclusions within a soil mass in a distinct pattern or mixing discrete fibers randomly with a soil fill. The main objective of this study is to investigate the use of waste electrical wire materials in geotechnical applications and to evaluate the effects of waste polypropylene fibers.

The results obtained are compared for the two samples and inferences are drawn towards the usability and efficiency of fiber reinforcement as a replacement for deep foundation or raft foundation, as a cost effective approach. The main objective of this study had been focused on the strength behavior of the unsaturated clay soils. Reinforced with randomly included waste polymer fiber.The reinforced soil samples were subjected to CBR test.
From the beginning of construction work, the necessity of enhancing the soil properties has come to the light and the process of soil stabilisation helps us to achieve the essential properties in a soil required for the construction work. Site possibility study for geotechnical projects is of far most useful before a project can take off.
The state of the art review focuses on soil stabilization method which is one of the several methods of soil improvement.
In the 20th Century, the information and communication revolution has brought massive changes in the way we arrange our lives, our economies, industries and institutions. These magnificent developments in modern times have certainly improved the

quality of our lives. At the same time, these have led to various problems with the problem of massive amount of hazardous waste and other wastes produced from electric products thus increasing the amount of E-waste per day. E-Waste dealts with disposal techniques as they are non-biodegradable substances, recycling is one of the another technique, but if it is not recycled then it has to be land filled in a nearby disposal area. So by taking this point in thought we have adopted the use of E-Wires whichb is a form of E-waste, for getting better the stability of the soils. Thus, after addition of E-wires, improvement in the soil properties can be seen which results in soil stabilization.

E-waste is one of the highest growing waste streams today and is increasing almost three times the rate of municipal waste. Plastic waste is a major portion of total municipal solid waste. It is estimated that about 10 thousand tons per day of plastics waste is produced. The world's annual expenditure of plastic materials has enlarged around 5 million annual tones in the 1950s to nearly 100 million tonnes today.

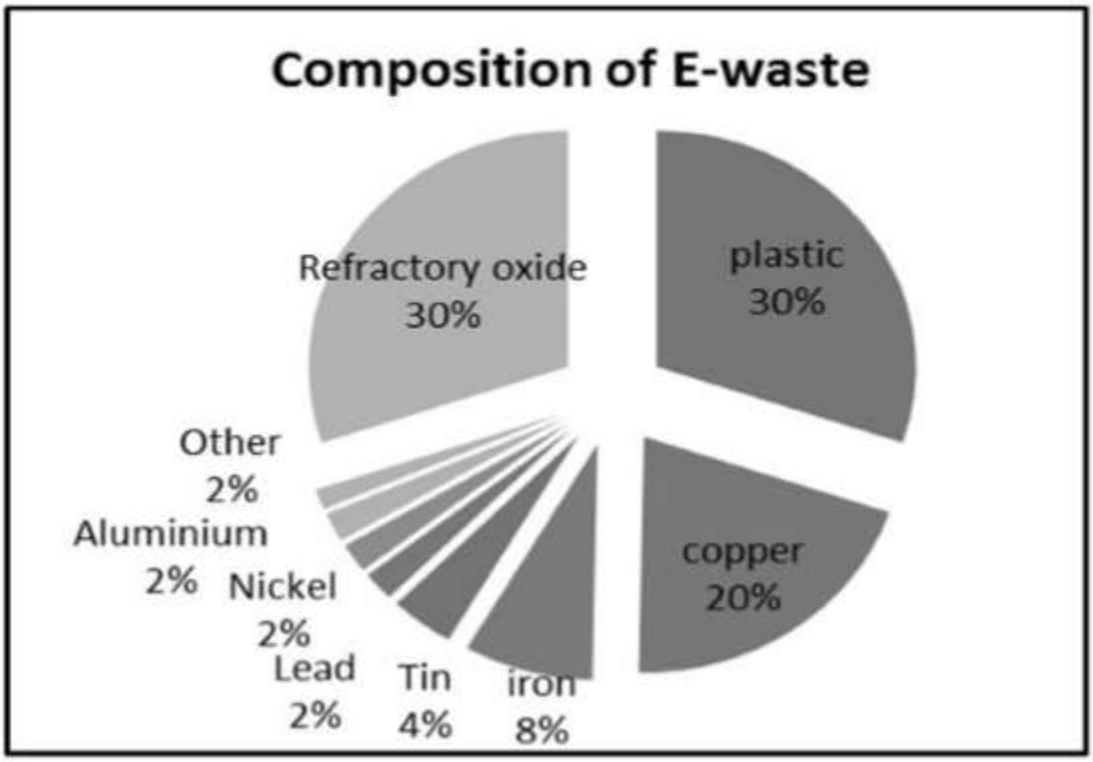

fig1: composition of e-waste

E-waste stabilization helps in increasing the strength, durability and also minimizes the moisture variations in the soil. E-waste must be well compacted for obtaining sufficient strength and durability by maintaining OMC and the same assumption is made in the experimental determination of the required E-waste proportion. Quality of E-waste to be added depends upon the specific surface area of soil particles. Therefore we have mixed E-waste with soil in 5%, and 7%, by weight of soil and investigated the change in engineering properties of natural soil.

In this stabilization is due to decrement in plasticity and development of matrix enclosing small clay lumps. By increasing percentage of E-waste there is increase in strength and decrease in volume change, moisture and plasticity.

II. NEEDS AND ADVANTAGES

It increases the strength of the soil, thus, increasing the soil bearing capacity. It is economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for replacing the expansive soil;

A. It is also used to provide more stability to the soil in slopes or other such places.

B. Sometimes soil stabilization is also used to prevent soil erosion or formation of dust, which is very useful especially in dry and arid weather.

C. Stabilization is also done for soil water-proofing; this prevents water from entering into the soil and hence helps the soil from losing its strength.

D. It helps in reducing the soil volume change due to change in temperature or moisture content.

E. Stabilization improves the workability and the durability of the soil.

III. PREVIOUS RESEARCH STUDY

Magdi M. E. Zumrawi, Omer S. M. Hamza (2014); they investigates the improvements in the properties of expansive soils, as road subgrade stabilized with lime and fly ash in varying percentages. Laboratory tests were undertaken to study the swelling and strength characteristics of expansive soils stabilized with lime, fly ash and a combination of both. Lime and fly ash were added separately to expansive soil at ranges 0-15% and 0-40%, respectively.

Issa Shooshpasha and Reza Alijani Shirvani (2014); an experimental program was performed to study the effects of cement stabilization on the geotechnical characteristics of sandy soils. Stabilizing agent included lime, Portland cement, and was added in dosage of 2.5%, 5% and 7.5% by dry weight of soils. Based on the experimental investigations, the utilization of cemented specimens increased strength parameters, reduced displacement at failures, and changed soil behavior to a noticeable brittle behavior.

Basit Riyaz, Muneeb Hilal, Mujtaba Mir, Muneeb Bashir, G.R. Shiromani (2015); the aim of the study is to review on stabilization of soil using cement. In this report soil has been taken from Abu Pur, Muradnagar (U.P.), and several laboratory tests is done on that soil sample and soil mixed with cement. The experiments done on the treated and untreated soil by adding 2%, 4% and 6% of cement on the soil sample.

Santosh Dhakar, S.K. Jain (2015); The study is done to review the applications of different stabilizing agents such as lime, fly ash, cement, rice husk, expanded polystyrene geo foam and waste paper sludge for different type of soil. If good earth is not available at the construction site, it becomes imperative to opt for soil stabilization. Soil stabilization is a process to treat a soil to maintain or improve the performance of the soil as a construction material. The stabilizing agent improves the strength parameters of sub grade of road pavement and leads to strengthening of embankment.

Y. Ramakrishna Reddy, T. Ram Prasanna Reddy (2016), presented their work on stabilization of soil using waste fiber material. The objective of their study is to investigate the use of waste fiber materials in geotechnical applications and to evaluate the effects of waste polypropylene fibers on shear strength of unsaturated soil by carrying out direct shear tests and unconfined compression tests on two different soil samples. The results of their work shows that fibers are effective and can be used in deep foundation works.

Gupta and Raghuwanshi (2016), had studied performance of E-waste stabilized soil and were evaluated using various physical and strength performance tests on different dosages of E-waste i.e. 3, 6, 9, and 12 were used to stabilize. Based on strength performance tests, it was observed that replacement of E-waste increases the strength of expansive soils.

Liet Chi Dang, Behzad Fatahi, and Hadi Khabbaz (2016), studied on behavior of expansive soils stabilized with hydrated lime and bagasse fibers. This investigation exhibits a series of laboratory tests conducted to evaluate the influences of bagasse fibers and hydrated lime addition on the engineering properties and shrink-swell behavior of stabilised expansive soils. In order to investigate the influences of bagasse fibers on the engineering behavior of expansive soil, varying proportions of randomly distributed bagasse fibers of 0.5%, 1.0%, and 2.0% were added to expansive soil and hydrated lime-expansive soils mixed with different bagasse fiber proportions were also investigated. Based on the reasonable laboratory test results, it can be noted that the expansive soils can be successfully stabilized by combination of hydrated lime and bagasse fibers and also improvement in strength parameters.

Chaugule, Deore, Gawade, Tijare, Banne (2017), had studied and presents the results of an experimental program undertaken to investigate the effect of E-waste at different dosages on black cotton soil. Different dosages of E-waste i.e. 2%, 5% and 8% were added in the soil. The performance of E-waste stabilized soil was evaluated using physical and strength performance tests. As the percentage of E-waste increased, Φ increased. As bearing capacity is dependent on C and Φ, it was also observed that there is an increase in bearing capacity of the soil.

Li Wei, Shou Xi Chai, Hu Yuan Zhang, Qian Shi (2018), presents a paper to find out the improvement in mechanical properties of soil using Lime and four different type of fiber. Wheat straw, Rice straw, Jute and polypropylene fiber was conducted to confirm the optimal fiber length and optimal fiber content. Triaxial compressive test of fiber-lime-soil was carried out to study the shear strength, deviatoric stress-strain properties and sample failure pattern. The results show that reinforcement significantly increased the cohesion and lightly improved the internal friction angle. The cohesion increments of polypropylene fiber-lime-soil, jute-lime-soil, rice straw-lime-soil, and wheat-lime-soil were decreased in turn. They concluded that all four type of fiber increases strength and stress-strain properties of soil and lime soil, in which polypropylene fiber for reinforcement is best.

IV. RESEARCH METHODOLOGY

Material used:

1. **Soil:** Soil is collected from locally site available near SATI Campus, Vidisha.
2. **E-wires:** The waste electric wires, which are used for electrification in buildings and other structures are used in this study.

Preparation of Sample:

The soil collected from site is brought in campus and air dried. After this screening of soil is done and kept ready for testing. The E-wires are cut into specific ratio (Length/Diameter = 2) and then mixed into the soil for further testing into appropriate proportion. The ratio taken for mixing is 5% and 7% by weight of soil.

Following test methods are used in this research work;

- **Liquid limit test:** Standard Liquid limit is defined as the minimum water content at which both faces of groove come close to each other at exactly 25 no. of falls in Standard Cassagrande's apparatus.
- **Plastic limit test:** It is defined as the minimum water content at which a soil will just begin to crumble when rolled into a thread approx. 3 mm in diameter.
- **Specific gravity test:** Pycnometer bottle is used for determination of specific gravity of soil. It is the ratio of the weight of a given volume of soil solids to the weight of an equal volume of distilled water.

- **Modified Proctor test:** For determination of optimum Moisture Content and maximum Dry Density, Proctor compaction test is done. Heavy compaction is done using 4.89 Kg hammer with 25 blows in each layer filled in proctor mould.
- **CBR Test:** California Bearing Ratio test is an important test used for determination of bearing capacity of soil. mould of 2250 cc volume is used and soil is filled in 5 layers with addition of water at OMC. 56 blows are given in each layer by 4.89 Kg hammer.

IV. RESULTS AND DISCUSSION

4.1 Results of Index properties of Soil

table 1: index properties of soil

Soils	Properties
Classification	OI (Organic clay with medium plasticity)
Specific Gravity	2.351
Liquid Limit	39.08%
Plastic Limit	28.83%
Plasticity Index	10.25%
OMC	13.75%
MDD	1.85 g/cc
CBR Value (Soaked)	4.96

4.2 Results of Soil when added with E-wires:

table 2: influences of e-wires on soil

Properties	Soil + 5% E-wires	Soil + 7% E-wires
Liquid limit	38.70%	38.23%
OMC	11.70%	10.90%
MDD	1.88 g/cc	1.86 g/cc
CBR (Soaked, 96 hrs),	5.58	10.27

4.3 Effect of E-wires on Liquid Limit of Soil;

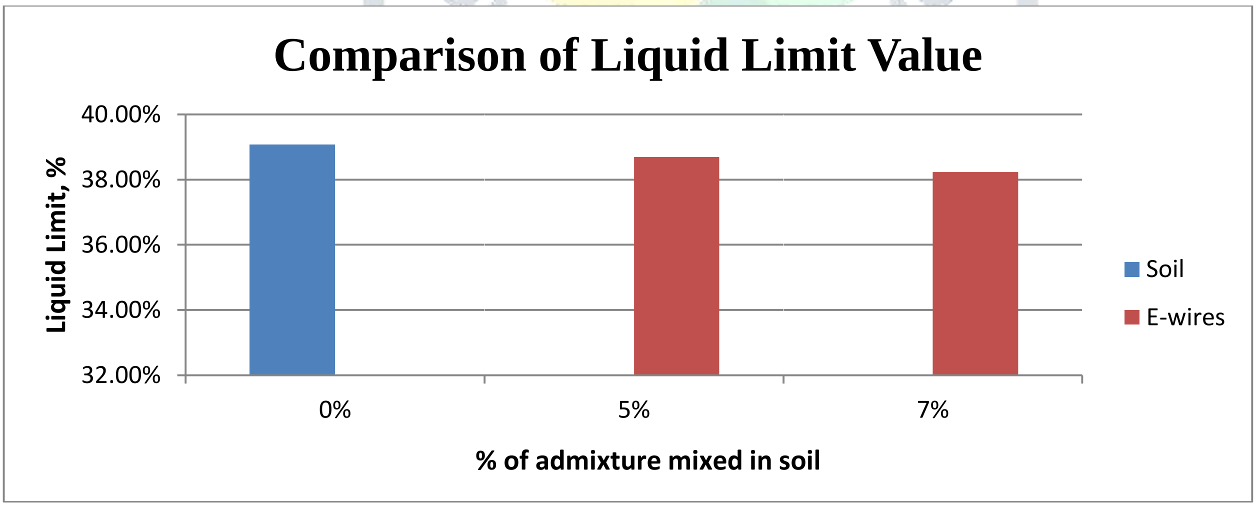

fig.2: comparison graph of liquid limit of treated and untreated soil

4.5 Effect of Admixtures on OMC of Soil;

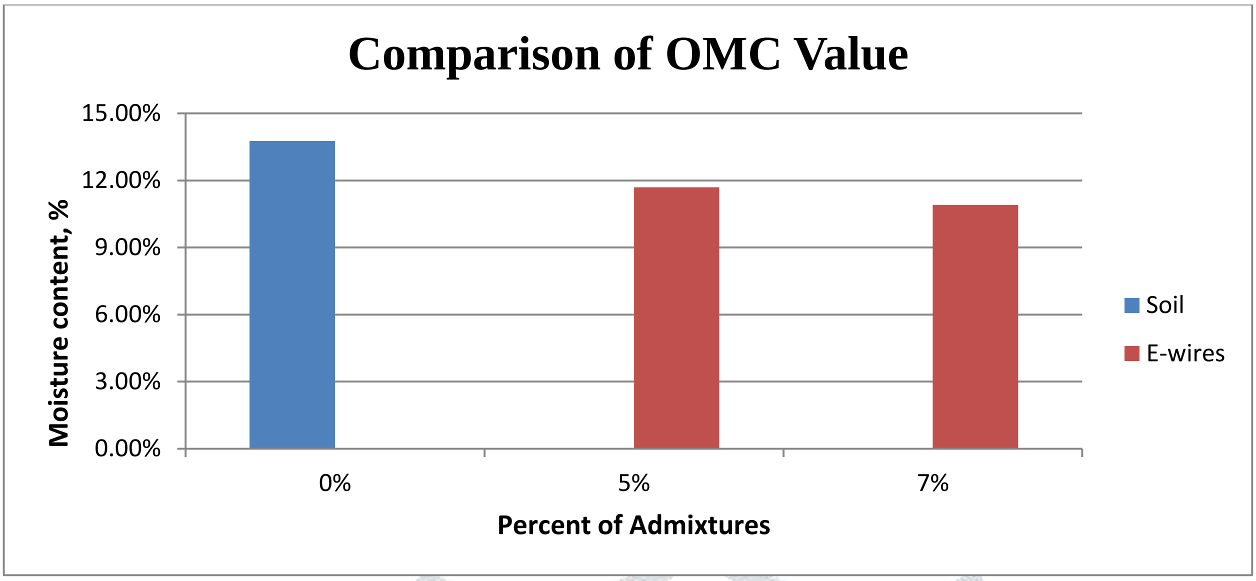

fig.3: comparison graph of omc of treated and untreated soil

4.5 Effect of E-wires on CBR Value of Soil;

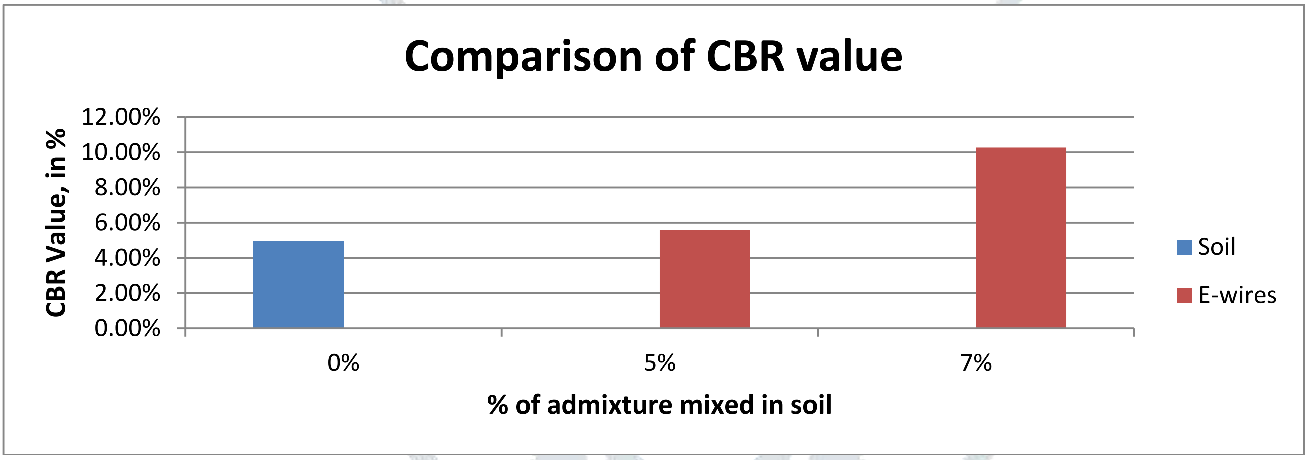

fig.4: comparison graph of cbr value of treated and untreated soil

V. CONCLUSIONS

On the basis of present study, the following conclusions are drawn

1. There is substantial decrease in Liquid Limit of soil with addition of 5% and 7% E-wires by weight.
2. There is substantial decrease in OMC with increase in addition of E-wires and MDD of soil increases.
4. The California bearing ratio (CBR) of the soil alone is obtained as 4.96 and it is increased with addition of E-wires, by 5.58 and 10.27 at 55 and 7% E-wires mix respectively.
5. From the results, it is concluded that E-wires has effective impact on soil.

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