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STUDY OF SOIL STABILISATION USING DIFFERENT NATURAL MATERIALS

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Abstract

The present study focuses on the impacts of standard ground improvement techniques on the environment, supporting the argument with piece of writing proof and alternatives to those techniques. The study aims at testing the effectiveness of natural materials as soil stabilizers and comparisons the results of these minimal invasive alternatives with the present techniques, to see how effective are the new alternatives in serving their purpose and saving the surrounding. The alternative techniques think about the employment of natural materials like tamarind kernel powder, egg shell powder, jaggery, chebula, etc. Either in partly or whole within the method of soil stabilization. Several parameters are designated for comparison, including index properties, ucc strength and consolidation characteristics.

Out of the materials identified, tamarind kernel powder, egg shell powder and a combination of jaggery, chebula and lime have been adopted for use in soil stabilization. Each material has been tested for its capability in soil stabilization by testing the index and engineering properties of the soil once addition of the fabric. The addition of tamarind kernel powder to soil resulted in increase in the liquid limit of the soil from 67% to 117% when 10% tamarind kernel powder was added to it. The addition of this material additionally resulted in decrease in shrinkage limit from 15.4% for 2% addition to 11.4 % for 8% addition of tamarind kernel powder. It also resulted in the increase in the free swell index of the soil from 60% to 146% for 80% addition of (tkp) to the soil. The maximum dry density of the soil decreases from 17.1kn/m2 to 14kn/m2 on addition of 8% tamarind kernel powder. The optimum moisture content of the soil also increases from 17.5% to 25%. The ucc strength quartered from 215 kn/m2 to 64 kn/m2 for associate degree addition of mere 8% tkp, which is 70% lesser than the ucc strength of soil. Similar tests were done adding egg shell powder and jaggery:chebula:lime combinations to soil and the results were promising.

Keywords: *natural materials, tamarind kernel powder, egg shell powder, jaggery, soil stabilization*

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Introduction:

In this advanced age of science and technology, man has made rapid strides in all fields since the ancient ages. Right from the middle ages until the current modern era,man has mature by leaps and bounds and has tried to come around all types of problems encountered by him. From an engineering purpose of read, especially from a geotechnical perspective, land use for development work has brought to the fore, the problem of acute land shortage. This has led to the reclamation of unusable land for development activities. Ground improvement technology has been the driving force that has brought about this revolution in reclamation of unusable land, which has lead to a sudden spurt in developmental activities. However, as all human technologies, since Times immemorial have proven to have their own drawbacks in most of the cases. Similarly, this technology, though beneficial in several ways, had environmental impacts. With rapid urbanization and industrialization, this technology became the driving force for all land reclamation work. With the rising use of some of these techniques such as cement grouting, lime columns etc., the impact on the environment came to be slowly recognized. Natural materials and their use in ground improvement is one such area of potential and promise. In this study an attempt has been made to explore the possibilities of using natural

materials like tamarind kernel powder (tkp), egg shell powder(esp and saccharide etc to improve problematic soil.

Principles of Soil Stabilization :

Stabilization is defined as the process of improving the soil aggregate properties by blending in materials that increase the load bearing capacity, firmness and resistance to weathering or displacement. It can be defined as the process of altering the soil properties by mechanical or chemical means thereby improving the desired engineering properties of such soils. There are three purposes for soil stabilization namely strength improvement, permeability control and enhancement of soil durability and resistance to weathering.

Need of study:

The need for ground improvement by stabilizing soil arises beneath the subsequent circumstances:

i. Fast urban associate in nursing industrial development move an increasing demand for land reclamation
ii. Utilization of unstable and environmentally affected ground.
Iii. Safe disposal of waste materials by their use in ground improvement choices.

Natural materials:

Tamarind kernel powder:

Tamarind kernel powder (tkp) has not been documented for its use in industry itself, however its perform as an additive to boost the performance of materials like cement has been recently recognized.Tkp are often used as hydrocolloids in cement and lime to boost their performance.The hydrocolloids perform as water retention agents, thickener, binder, suspending agent, lubricator and friction reductant, air entraining agent reducing the load while not sacrificing strength and eliminating the requirement of other additives. (praveen mathur and n.k.mathur, 2007).

Egg shell powder:

The main aim of victimisation egg shell powder (esp) is to create the soil well stable at low value. Esp, because the name suggests is pulverized kind of the outer shell of eggs. The use of psychic phenomenon in soil stabilisation has been documented to offer moderate leads to up problematic soils.The performance of psychic phenomenon has been documented as lesser compared thereto of simple proteinpowder (monther abdelhadi and keinosuke gotoh, 1998).The use of esp as a replacement in lime stabilization was studied to find out the optimal percentage of lime for stabilization followed by the optimum quantum of esp that can replace lime in the stabilisation. The results indicated that the performance of the esp replaced lime stabilisation gave results marginally lesser than pure lime stabilisation (amu et al., 2005)

Fig.-1: Egg shell powder

Jaggery and chebula:

Jaggery and chebula has long been utilized in the development trade since ancient days in southern bharat. There are many instances of its use within the field of applied science.Brick jelly concrete, made with broken bricks, lime, kadukkai (chebula), and jaggery and so on, was preferred in the south india for roofing works since olden days for thermal insulation of roofs (the hindu, 2004).

Fig-2: Jaggery and chebula

Methodology:

Materials:

The materials used for study include the sample soil on which the performance of these materials were evaluated and the alternative natural materials. The basic properties of the soil are tabulated in table 1. The particle size distribution was determined by conducting the dry sieve analysis for coarse fractions and the hydrometer analysis for the fine fractions. The particle size distributions as obtained given in following table 2.

Table 1: Properties of soil

Soil Property	Value (%)
Liquid Limit	67
Plastic Limit	28
Shrinkage Limit	10.2
Free Swell Index	60
Max. Dry Density	1.71 g/cc
OMC	17.5
UCC Strength	58.5 kN/m^2

Table 2: Particle size distribution

Fractions	Particle Size (mm)	Distribution (%)
Fine gravel	20 – 4.75	1.4
Coarse sand	4.75 – 2	5.1
Medium sand	2 – 0.425	9.3
Fine sand	0.425 – 0.075	10.6
Silt	0.075 – 0.002	7.0
Clay	<0.002	66.5

1.Index tests:

The various index tests that were conducted to review the performance of the natural materials in soil stabilization were liquid limit, shrinkage limit and free swell index tests.

All the index tests were performed as per procedure stipulated within the indian standards code.

2. Compaction test

3. Unconfined compressive strenght test

Literature Review:

Results :

General:

Index tests which include liquid and plastic limit, shrinkage limit, free swell index and compaction tests, unconfined compressive strength tests and consolidation tests have been conducted on the soil sample with varying percentage of tamarind kernel powder (tkp), egg shell powder (esp) and jaggery, chebula and lime (j: c: l). The changes within the index, compaction, ucc strength and the consolidation characteristics for the soil with natural materials are analysed and discussed here.

Effect of natural materials on liquid limit:

As different percentages were adopted for different materials, varied from 0 to only 20 % addition .Of all the natural materials, it is seen that only the addition of tkp results in increase in liquid limit whereas the addition of rest of the materials results in a decrease in liquid limit. When these materials are compared, the mixture of jaggery, chebula and lime shows better performance in decreasing the liquid limit than esp.This may be attributed to the additive impact of jaggary and lime within the soil.

Among the opposite materials it will be seen that the mixture of jaggary, chebula and lime showed the best response in terms of its relation to soil improvement.

Effect of natural materials on free swell index:

It is seen that out of all the materials adopted in the study, only tamarind kernel powder (tkp) caused a swelling, worse than virgin soil.The other materials offer satisfactory leads to dominant the swelling nature of the soil.Egg shell powder (esp) and jaggary offer terribly satisfactory leads to dominant the swelling of soil.In the case of the mixture of jaggary, chebula and lime, the concoction leads to swelling within the earlier stages however on any addition, leads to higher management ofswelling behavior of the soil. The swell control capacity of esp and the two proportions of jaggery: chebula: lime (j: c: l) are more or less on the same level and are comparable with easoil with j: c: l are known to give promising results as reflected in the reduction of liquid limit by a greater magnitude. Addition of esp improved properties of lateritic soil by reducing its plasticity index (a.j. olerawaju et al., 2011)

Effect of natural materials on shrinkage limit:

All the materials other than tkp show an increase in the shrinkage limit value with increase in the percentage of the addendum.. Among the other materials the combination of jaggery, chebula and lime showed the best response in terms of its relation to soil improvement.

Effect of natural materials on compaction:

The maximum dry density of the soil decreases addition of tkp. The optimum moisture content of the soil also increases .the reason for the decrease in the dry density and increase in omc can be attributed to the organic nature of the material and its water retention capability. The maximum dry density of the soil and the optimum moisture content decreases on addition of esp. The addition of esp resulted in increase in dry density and decrease in optimum moisture content for lateritic soils (a.j. olerawaju et al., 2011). In case of esp, the increase in dry density can be attributed to the granular nature of the shell particles which result in better packing of the soil particles.

The decrease in omc can be attributed to the inert nature of esp particles towards water. As they do not absorb moisture, with increasing esp content the soil that requires moisture for moulding decreases thereby requiring lesser moisture. On addition of j:c:l, the maximum dry density of the soil decreases and the optimum moisture content increases .

Effect of natural materials on strength (ucc):

The ucc strength of the soil, in general, decreases with the increase in quantum of tkp. The addition of esp in the soil also improved the strength of the soil. The strength of the soil increases.the addition of j: c: l resulted in the increase in the strength of the soil the strength of the soil increases. It can be seen that the addition of esp and j:c:l has resulted in increase in the strength of the soil at a particular percentage. The increase in the strength due to addition of esp can be attributed to the increase in the frictional resistance of the soil. The increase in the strength of the soil on addition of j:c:l may be attributed to the physical binding nature of the jaggery and the physio-chemical reactions of lime with the soil. The decrease in strength of the soil due to addition of tkp can be attributed to the organic nature of tkp.

Conclusions:

Tamarind kernel powder:

The addition of tamarind kernel powder (tkp) resulted in the increase of liquid limit of the soil .the swell-shrink behaviour of the soil on an addition profoundly altered with the shrinkage limit of the soil decreases.it is observed that the free swell index of the soil was greatly enhanced .. Thus the swell/shrink characteristics of the soil were modified in the negative direction, which may result in the extreme swell related distress under water logged conditions. The maximum dry density of the soil decreases on addition of tkp. The optimum moisture content of the soil also increases. The ucc strength of the soil decreases whereas the compressibility characteristic of the soil also was poor on addition of tkp. Thus tkp cannot be considered as a viable option for soil improvement.

Egg shell powder:

The addition of egg shell powder (esp) resulted in the decrease in the liquid limit of the soil. The shrinkage limit of the soil increases while the effect of esp on the free swell index of the soil was positive with swell. Decreased swell shrink properties of the soil showed a marked improvement upon addition of esp. The maximum dry density of the soil increases and the optimum moisture content decreases on addition of esp .The strength of the soil increases the compressibility of the soil also reduced due to the granular nature of esp. Thus addition of esp to soil can be opted for considering the improvement in soil properties on all fronts.

Jaggery: chebula: lime:

The addition of the soil with jaggery: chebula: lime (j: c: l) reduced the liquid limit of the soil and the swell shrink characteristics of the soil also improved with the addition of the j: c: l. The swell rduces.and the shrinkage limit of the soil increases. On addition of j:c:l, the maximum dry density of the soil decreases the optimum moisture content is increases. Addition of j: c: l resulted in the increase in the strength of the soil.

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