Issue 1 vol 4 ISSN: 2321-8134

IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

STUDY OF NANOMATERIAL OVER CONVENSTIONAL ADDITIVES

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ABSTRACT

In constructions, soil is the important part of the building process. If performed improperly, the settlement of the soil could occur and can result in unnecessary maintenance cost or structure failure. Soft soils have high moisture, low shear strength, low bearing capacity, high settlement and swelling properties. These soils contain minerals that are capable of absorbing water and as a result of absorbing water, their volume increases. The building constructed on such soil may fail due to its volume change. Thus structures on soft soil are always associated with the problems of settlement and stability of constructed structure. Soil stabilization is the method used for improving engineering properties including hydraulic conductivity, compressibility, strength and density of in-situ soil. This is done by mixing other materials. Various stabilization techniques are available to improve soft soil properties like addition of cement, lime, bitumen etc. As an emerging technology, nanomaterials are used as additives and researches are going on to find its effect in soil properties. This paper aims to study the effect of nano materials over the conventional materials.

1. INTRODUCTION

Civil Engineers face many difficulties when construction activities are to be done in expansive soils because of their unconventional behavior. Thus, land is getting existence due to increasing population, so the remaining land must be utilize for construction in any conditions. These soils have large tendency to swell and shrink with respect to variation moisture content, thus causing serious problem to the structures build on them. The high cost of repairing the damaged structures has bought attention to the need for more reliable investigation of such soils. Also, the rapid industrialization has resulted in generation of large quantities of wastes. These materials possess more problems of disposal, health hazards and aesthetic problem. Most of the wastes do not decomposed and create environmental and ecological problems apart from occupying large tracts of valuable cultivable land. It has been observed that some of these wastes have high potential and can be gainfully utilized in stabilization works. The utilization of the industrial solid wastes Stabilization works will help in solving the environmental pollution problems associated with the disposal i.e. ecofriendly.

Soil stabilization is the method of improving engineering properties including hydraulic conductivity, compressibility, strength and density on site. This is done by mixing other materials. Various stabilization techniques are available to improve soft soil properties like addition of cement, lime, bitumen etc. As an emerging technology, nanomaterial's are used as additives and researches are going on to find its effect in soil properties. Researchers had done research on nanomaterial in soil found that even a small amount of nanomaterial could bring significant change in physical and chemical properties of soil. This is because of the very high specific surface area of nanomaterial. Many of the soil and rock minerals are nanomaterial's and their chemical reactions occur in nano scale.as a result of this reactions, there is a greater potential of nano technology application in soil mechanics. The main aim of nano technology in geotechnical engineering is to improve the properties of soil with the application of nano materials.

Soil is one of nature's most important construction materials. Almost all construction is built on soil. When suitable condition is not encountered then it is problematic to contractor. He has to apply the stabilization method and the most economical and traditional method i.e. remove and replace. Poor soil is removed and improved soil is replaced with it.so the soil is improved bt method of stabilization.

There are two types of stabilization-

1. Stabilization with additives
2. Stabilization without additives

Mostly the stabilization with additives is done; some part of soil is replaced with the additives such as fly ash, cement, lime, etc.

2. LITERATURE REVIEW

Researches are done to study the effect of adding nano additives to the soil in the presence of optimum cement content. Nano silica and nano clay are the major additives being used in soil stabilization**.**

Zaid Hameed Majeed and Mohd Raihan Taha *et al* (2012) conducted a study to investigate 'The Effect Of Addition Of Different Nanomaterials', including nano Cu, nano MgO, and nano clay on the geotechnical properties of soft soil.

Sayed Hessam Bahmani *et al* (2014) conducted an experimental study in order to determine the effect of SiO2 Nanoparticles on consistency, compaction, hydraulic conductivity, and compressive strength of cement-treated residual soil.

Norazlan Khalid, Mazidah Mukri, Kamaruzzaman Mohamad and Faizah Kamarudin *et al* (2015) studied "The Effect Of Using Nano Materials Particles In Soft Soils Stabilization". He studied the effect of nano materials on soil.

Ebrahim Nohani and Ezatolah Alimakan *et al* (2015) studied the effect of nanomaterial's on geotechnical properties of clay.

Asskar Janalizadeh Choobbati, Ali Vafaei and Saman Soleimani Kutanaei *et a*l (2015) conducted research to study the mechanical propreties of sandy soil improved with cement and nano silica.

Dr. Sunil Pusadkar *et al.* investigate effect of nano-copper on black cotton soil. His work is to study the effect of adding Nano-copper on properties of black cotton soil which are Liquid limit, Compaction characteristics, unconfined compression strength, CBR value and swelling pressure.

Seyedi Gelsefidi alireza *et al.* studied 'The Application of Nanomaterial to Stabilize a Weak Soil'. The aim of authors was to make a comparison between traditional stabilization methods of adding lime and the new procedure of adding a suitable nanomaterial in the mixture of soil lime. The result showed that the optimum amount of lime in the mixture of soil-lime was 5% in which the highest amount of CBR strength was achieved. Therefore based on the result the optimum dose was found as 5% lime and 3% Nano silica.

3. MATERIALS

The materials used in this study are nano materials, soft soil, and the other additives such as cement, lime, fly ash. The main aim of this study is to compare stabilizing materials for the best results.

3.1 Nano material

Nano materials are characterized by their tiny sizes.

Classification of nano materials on the basis of Particle size

i. 1nm-100nm are ultrafine particles
ii. 100nm-200nm are fine particles
iii. 200nm-1000nm are coarser particles

Nano particles interact very actively with soil constituents. The presence of only small amount of Nano material in the soil could influence significantly engineering properties of soil due to very high specific surface area on nano material. Different types of nano material are nano copper, nano silica, nano magnesium, etc.

3.2 Soft Soil

Any soil, which exhibits high swelling and shrinkage properties which changes its volume when come in contact with moisture is soft soil. These soils are highly expansive in nature. So the construction on this soils are highly risked because it can cause damage to our structure. Therefore the soil is stabilized.

3.3 Cement

This is also one additive which binds the soil particles together and improves the stability of soil. The particles of cement are fine, so it can fill the voids present in the soil. This also helps in stabilizing the soil.

3.4 Lime

This is also one additive which is used mostly in stabilizing the soils. Addition of hydrated lime with soil improves the strength of soil and holds the particle of soil together. Mostly it act as cementious material.

3.5 Fly Ash

These are a cementious material obtained by burning of coal from thermal plant where it is waste product which cannot be further decomposed. These material is available everywhere. It is also a cementious material which on addition to soil improves swelling property and improves bearing capacity of soil.

Tests

As the test are carried out by addition of the following additives following tests where done.

- Compaction test

- CBR test
- Free swell index
- Atterberg's limit.

These tests are carried to know the properties of soil which have being improved by addition of additives. All the types of soil will give different reacting results, so the result may vary from soil to soil. By these test we will know the bearing capacity of soil, compressive strength, and optimum moisture content, maximum dry density.

Following are the results of Addition of Nano materials, Fly ash, Cement and Lime.

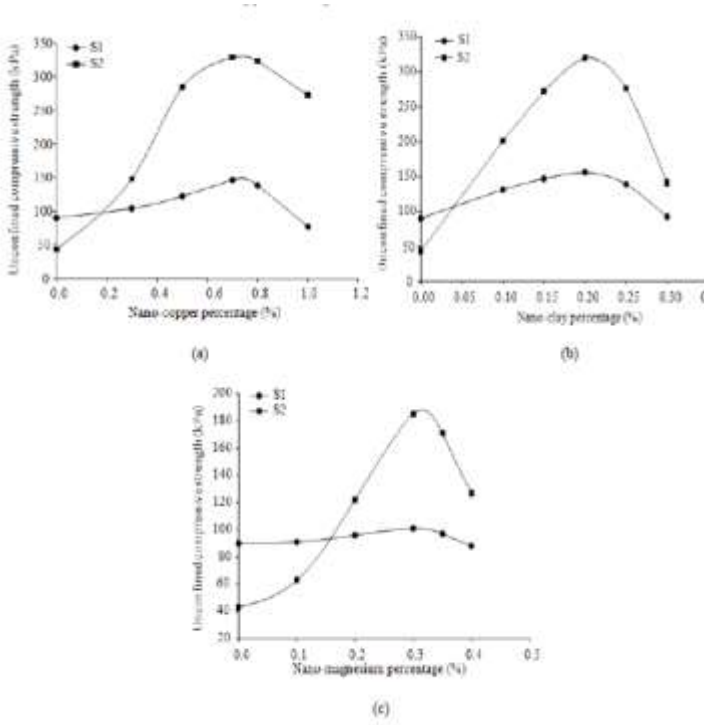

Fig 1.1 - Effect of different nanomaterial's percentage and unconfined compressive strength

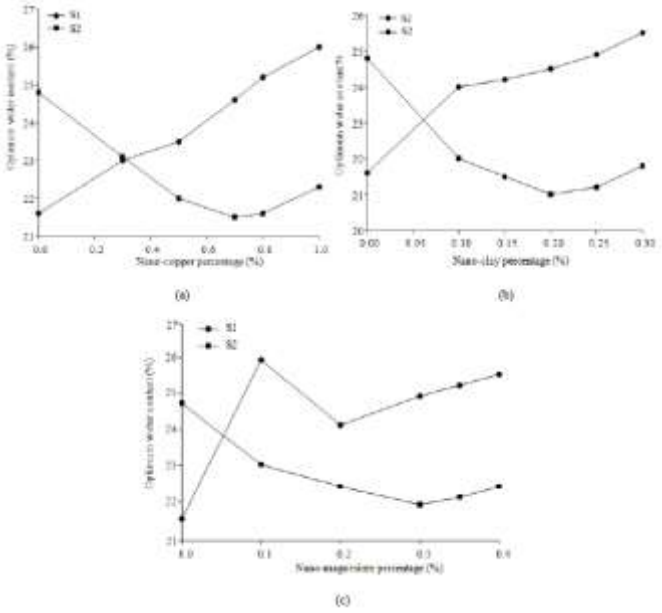

Fig 1.2 - Effect of different nanomaterial's on the optimum water contents

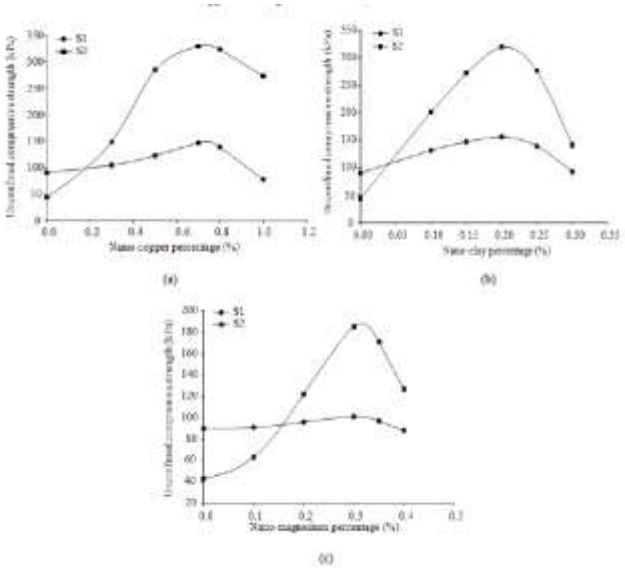

Fig 1.3- Effect of different nanomaterial's percentage and unconfined compressive strength

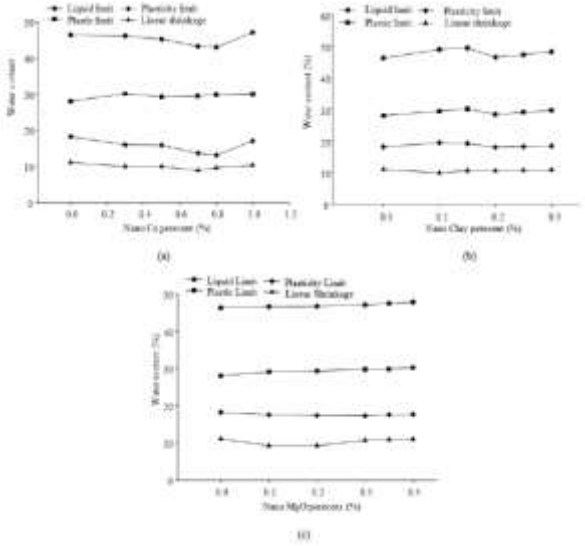

Fig 1.4- Effect of different nanomaterial's and water content on engineering properties of the soil

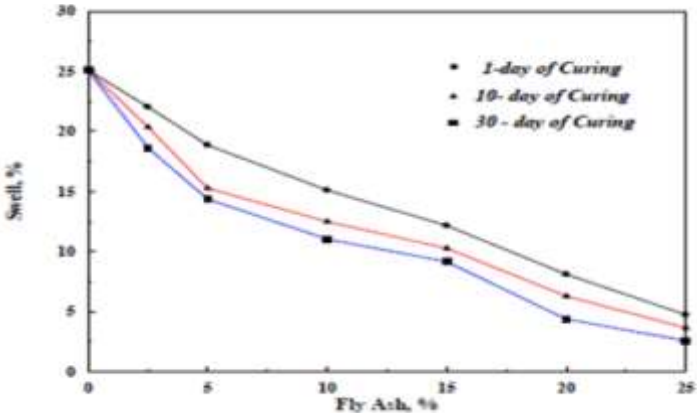

Fig 2.1 - Effect of fly ash on swell percent

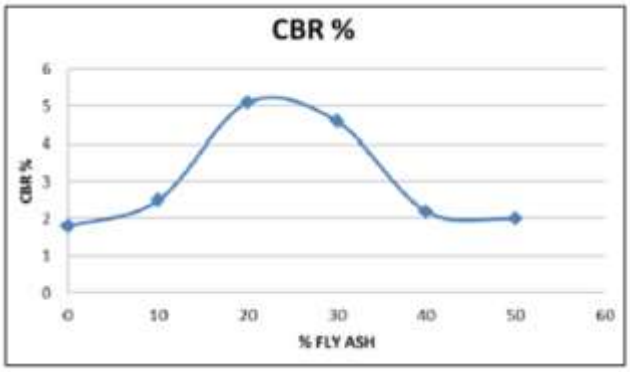

Fig 2.2- Variation of CBR for black cotton soil mixed with fly ash

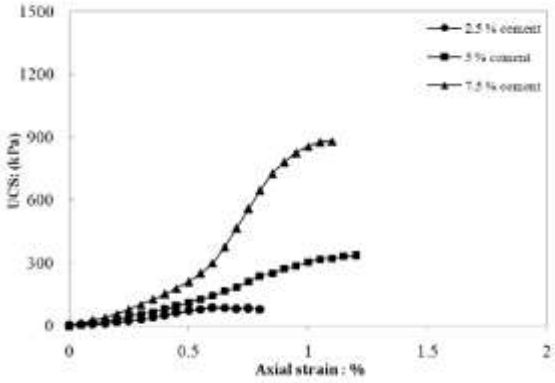

Fig 3- Effect of cement stabilization on unconfined stress-strain behavior of soil

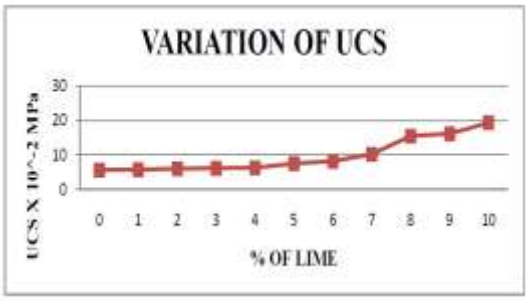

Fig 4.1- Variation of Unconfined compressive strength on addition of lime

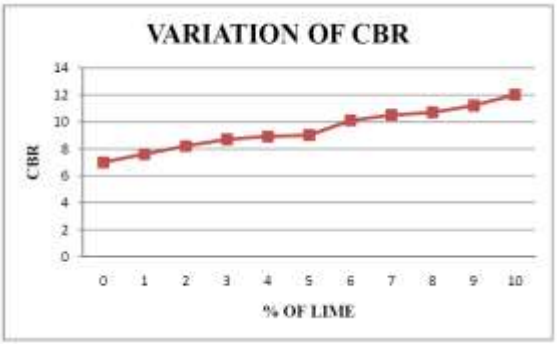

Fig 4.2- Variation of CBR value on addition of lime

4. CONCLUSION

From the given data above we can clearly see that the addition of different material to soft soil make the soil suitable or stabilized, but each had some consequences i.e. if the one material could only stabilize the soil partially not fully. So the single material won't give all the properties of soil but if we use the two materials which would stabilize the soil completely by observing from above graphs the combination of nano material with fly ash could fulfill all the requirement of stabilize soil. The liquid limit, plastic limit, shrinkage limit is mostly enhanced by nano material. The compressive

strength, CBR value and swell index is enhanced by Fly ash, cement and lime. From above result, we can see that nano materials can give all the properties which we want for stabilization as they have large surface area to react with the soil particle and in addition to it if any of above combination is used then there is mostly chances of getting the soil completely stabilized. We can also conclude that the nano material can be used with all the other materials. As nano material is used in plenty of percentage the cost of it will be less as compare to other materials. The results obtained are different for different soils.

5. REFERENCE

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