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A Review on Efficient Improvement and Stabilization of Clay Soil with Waste Material (Nano-Silica)

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Abstract – *Clay soil is a problematic issues for all civil engineers and need to be stabilized for civil engineering work such as foundation, embankment, bridges, tunnels, canals and highways.*

Expansive soil cannot fulfil all engineering properties and cannot stand on load which is carried by foundation to the earth. Soil should has good quality and high bearing capacity value, soil must has good compressibility and durability against water and must reduce its permeability factor as well. There are different waste materials that are used for stabilization of expansive clay soil and has four main sources such as industrial, agriculture, mineral and domestic based waste material origin.

In this review I have tried to collect and review vastly on best and valid research papers and transfer their experimental work as well. Among all paper which has reviewed Nano-Silica and nano-Silica+white cement are most sound and eco friend waste materials for clay soil stabilization. This type of stabilization techniques are also economic and easy found waste materials.

***Key Words*: Stabilization, Clay soil, Engineering properties, waster materials**

1. INTRODUCTION

Soil is one of the most important substance which all creatures in the world used that for different purposes. Soil has an extremely high impact on the living of different creatures on the global earth.

One of the most importance impact of soil is on humans and animals living condition, Civil engineers also keep try to build suitable shelter and homes for them from soil. From civil engineering side soil has its own different properties, engineering properties is the most important topic in soil stabilization cases and all civil engineers working for that to rise the engineering possessions of clay soil with different techniques and materials. Soil should fulfill all engineering properties for example mechanical strength of soil, permeability, compressibility of soil, toughness, and also plasticity for better results in civil engineering works. Soil has concluded as high role substance in different civil engineering structure such as highways, Canals, Tunnels, Bridges, Building, Dames, Embankments, Foundations and Underground Structures. One of the most problematic issue for civil engineer is the strength of soil, which all soil is not suitable for construction and they are clay soil which should be stabilized and strengthen. Clay soil cannot fulfill all engineering properties of soil, it must be improvement with different techniques and low economics waste materials. There are different economic waste materials can be find in markets for effective stabilization of clay soil.

The major source and origin of waste materials for stabilization of clay soil are I) Agriculture origin waste materials(Rice Husk Ash, Biomass, wheat husk ash…) II) Industrials origin waste materials(Fly ash, Cement kiln, Copper slug, Silica fume …) III) Mineral origin waste material(Ceramic dust, Granit dust…) IV) Domestic origin waste materials(ESP, Unused tire…).

Clay soil are those soil which their particle size is less than 0.002mm and it expand while water reach them. Clay soil loss itself strength while attach with liquid and absorb water after a while it shrinkage and break like concrete.

1.1 Scope of paper

- To find eco friend waste materials for soil stabilization.
- To evaluate and study those waste materials that could be economic and sound found in market for stabilization of clay soil in the modified methods and techniques.
- To find sound facility and workability during compaction of soil in subgrade of highways and so on.

1.2 Additives and waste materials

Additives and waste materials are those admixture that are mixed with clay soil and rise it's a strength, workability,

toughness, mechanical strength and engineering properties of clay soil.

Additive can be in different form, it can be solid, powder, liquid and so on form that add during and before working time.

S.NO	Different Waste materials name
1	Fly Ash
2	Cement Kiln
3	Silica fume
4	Copper slag
5	Nano-Silica
6	Ceramic dust
7	Rice Husk Ash (RHA)
8	Grain storage dust
9	ESP (Egg shell powder)
10	Blast furnace slag
11	Ceramic dust waste
12	Lime
13	Bagasse ash
14	wheat husk

Table.1. list of some different waste materials

Fly Ash

Fly Ash is the most popular waste materials that is used for effective stabilization of clay of soil and produced from the scorching of pummeled coal in coal-terminated electric and steam manufacturing plants.

Cement Kiln

Cement kiln has an industrial waste materials origin that can be utilize for stabilization of clay soil, it is in form of dust powder and produce during cement production.

Silica fume

Silica fume is I the form fine powder and created from products of silicon. It's a kind of industrial waste materials base origin and used in soil stabilization techniques.

Copper slug

Copper slug is another kind of waste materials which vast used in soil improvement techniques and it's produced from smelting of copper process.

Nano-Silica

It is in form of industrial waste materials origin base and collect from chemical industry, vast use in soil stabilization techniques.

Ceramic dust

It's collected during ceramic bricks production and it's come in industrial base origin waste materials. It's vast used in flexible and rigid pavement subgrade soil.

Rice Husk Ash

RHA is in form of ash and collected from rice production process and it is in base of agriculture waste materials origin and used in soil stabilization techniques. It's in form industrial waste materials origin and produced during loading and unloading of grain in storages and it appear as a fine powder and used in clay soil improvement.

Egg shell powder

It's appear as powder and in form of domestic waste materials and used in soil stabilization techniques and replace as other admixture waste materials.

2. Literature Review

Phanikumar et al. have shown the effect clay soil which is treated with lime, fly ash, and cement. They have found that these waste materials highly impact on mechanical and physical properties of clay soil. [1] Fly ash is one of the economic and most easy found waste materials which can be used for effective improvement of clay soil. This waste material is produced from industrials waste materials origin and produced from the scorching of pummeled coal in coal-terminated electric and steam manufacturing plants.

Brooks et al. have examined and found the impact of class C fly ash and limestone on the problematic clays soil. They have expressed that the geotechnical belongings of clay soil increased with reduction in plasticity of loam and also its shown increase in CBR as well. [2]

So far, lots of researches has shown that researchers would like to research on modification form of clay soil that used

waste materials on stabilization of soft soils, they have focused more on waste materials such as Lime, cement, and mineral additive in form of fly ash classes. [3]

In addition of tradition methods for stabilization of clay soil, new method and availability of new waste materials for improvement of geotechnical properties of clay soil highly impact and role in stabilization of expansive soil. These new waste materials such as limonite, colloidal, silica and bentonite has promoted for modification stability purposes of clay soil. [4]

Over in last two decades using of nanotechnology in soil stabilization methods were interested for researchers and was impressible topic for them. [5]

Unlike of traditional waste materials of soil such as lime and cement, nanomaterial are the permanent, nontoxic, biologically and chemically inert, has excellent durability characteristics. [6]

An a research shown from economic side that utilization of 5% colloidal silica solution is same at cost with a micro-fine cement soil stabilization. [7]

Spencer has expressed dynamic triaxial test and shown a proportional analysis between dynamic possessions of different substances of colloidal of silica mixed sand and clan sand, and also elaborate that both shear modulus and damping ratio rise with enhancing colloidal silica content. [8]

Taha 2012 has elaborate and shown the effects of Nano materials (Al2O3) on expansive soil. This research has shown that with addition of (Al2O3) the expansive and shrinkage behavior of soil decreased. [9]

Khalid et al.2015 has examined on an experimental investigation the effect of Nano clay on expansive soil. The consolidated drained test, unconfined compression test and atterberg limit test were tested on soil sample and founded that mixing of 3% Nano clay with clay soil enhanced the shear strength of expansive soil. [10]

Sridevi and Rao 2005 shown in an experimental investigation the effects of lime and fly ash on California bearing ratio test of clay soil. They had varied the amount of lime in the laid of fly ash from 0% to 10% with an increment of 2 %. In this research CBR test has done for sample which is prepared and result shown the preparation of lime stabilized fly ash layer can improve CBR value of expansive soil. [11]

3. Conclusions

1. Engineering possessions of clay loam is one of the problematic issue for civil engineer, and needs to be researcher's research in new methods and find modification techniques.
2. Waste materials has different origins and sources that can be used in soil stabilization techniques. Industrial, mineral, agriculture and industrial are the most popular sources which waste materials can be produced.
3. Researcher try to find an economic waste materials for large projects that can be impact on budget of huge project such as highways, tunnels, bridges and foundation.
4. Eco friend waste materials another hot issues for environmental researchers that should be undertake in soil stabilization.
5. Nano-Silica is one of the economic and best waste materials that is re interested for researchers in a two decades.
6. White cement is industrial base waste materials which is used for expansive soil stabilization.
7. Limonite, colloidal, silica and bentonite are another types of new modified waste materials that can be found in market which has vast used in soil stabilization in now days.
8. Unlike of traditional waste materials of soil such as lime and cement, nanomaterial are the permanent, nontoxic, biologically and chemically inert, has excellent toughness characteristics.

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BIOGRAPHIES

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