International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 03 , March 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

USE OF DIFFERENT NON – TRADITIONAL ADDITIVES FOR SOIL STABILIZATION

Vidya V. Pathak[1] Vrushali A. Sant[2]

[1,2]*Student, Final Year M.E.C.E.,Matoshri College of Engineering Nashik (India)*

ABSTRACT

Geotechnical engineers around the world are in search of new alternative materials which is required for both cost effective solution for ground improvement and for conservation of scarce natural resources. In present economic and environmental ambiance, high pressures are laid on engineers to reuse any locally available waste material in order to minimize the cost of a project and its impact on environment. In ground improvement methods, waste materials are also used to improve geotechnical properties of soil .Waste materials such as scrap tyres / ETP sludge and fly ash offers a viable alternative from economical, technical and environmental points.

The utilization or reactive magnesia or quicklime as novel activators for slag offers a rang of technical and environmental benefits never conventional caustic aural activators and showed great potential in soil stabilization.

The addition of nano – particles was found to advantageously affect the hydraulic conductivity. Also addition of 0.4 % non silica to the cement treated soil improves the compressive strength by up to 80 % .

The waste material produced from the incineration processor in domestic energy power plant and it is available in two grades of fineness, Coarse waste material (CWM) and fine waste material (FWM).

Molasses is used in combination with lime for stabilization purpose. The purpose of mixing the lime with molasses as the molasses has high affinity towards water.Coconut shell and husk ash (CSHA) is also used as a admixture for stabilization in varying percentage.Calcium carbide residue (CCR) has been recently introduced as a sustainable cementing agent. Use of Non traditional additive – TX 85, SH-85 by macro and micro structure study result in denser soil fabric.Also chemicals like potassium chloride (KCL), calcium chloride (CaCl2) and ferric chloride can also be used effectively in place of lime because these chemicals are dissolvable in water making it to mix easily with soil and supply adequate cations.Waste plastics and water tyre rubber could also be used as a reinforcement material in place of conventionally used reinforcing materials.The effect of bioeneyme (terrazyme) with different dosage significantly improves the strength behaviour of black cotton soil. The various types of enzymes used are ligosulphonate, synthetic polymer, emulsions, bio-grouting, synthetic polymer, emulsions, tree resin remulsions, renolith, perma-zyme, fujibeton, XRF chemical.The focus of the paper is to study of various Non traditional additives which are used recently and in future for soil stabilization purposes in road pavements and other construction works.

Keywords: Additives,chemicals,soil stabilization,waste materials,soil properties.

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

I. INTRODUCTION

1.1 Background soil stabilization is a technique to improve the soil parameters such as shear strength, compressibility, density, hydraulic conductivity etc. The technique of soil stabilization can be categorized into a number of ways such as consolidation, vertical lairs, vibration, surcharge loads, admixtures, grouting and reinforcement and other methods.

Waste materials such as scrap tyres / ETP sludge and fly ash offers a viable alternative from economical, technical and environmental points.505The utilization or reactive magnesia or quicklime as novel activators for slag offers a rang of technical and environmental benefits never conventional caustic aural activators and showed great potential in soil stabilization.The addition of nano – particles was found to advantageously affect the hydraulic conductivity. Also addition of 0.4 % non silica to the cement treated soil improves the compressive strength by up to 80 % .

The waste material produced from the incineration processor in domestic energy power plant and it is available in two grades of fineness, Coarse waste material (CWM) and fine waste material (FWM).

II. LITERATURE SURVEY

2.1 Soil stability which every civil engineer is concerned is closely associated to the structures and mineralogy of the clay particle's, clay – water interrelations, clay particle's ionic exchange capacity and clay organic or clay inorganic interaction .Majority of road failures are associated with the action of water or the interaction between water and clay particles in the road.

Haji Ali et ac, 1992 b, jan 1998 shows that clay minerals consists of layers with variety of ions on the surface of these layers and surrounded by a hydro sphere of adsorbed water molecule which is strongly attracted to clay mineral surfaces.

Quabain et as (2000) is the first person who explained about the benefits of soil stabilization in sub grade of Pennsylvania region soil. He described about the short term effects of hydration, flocculation and long term effects of cementation in his studies.

Syed et all (2007) directed execution on the soil test gathered from different borings in expansion of 3,4, and 5 % bord. Results demonstrate that it is the Fast approach to set up the sub grades for the recreation of asphalts. The ucs of settled soils expanded with expansion of bend as for curing days.

Ravi Shankar et al (2013) reported that the expansion of pond debris to laterite soil enhanced the quality ,properties and imperviousness to dampness. It likewise brought about the minimizing of MDD ,with slight increment in the OMC.

Yi ot al,(2013 a, 2013 b, 2013c) studies that the brucite and magnesium carbonate were responsible for soil strength. It was reported by several researchers that in situ carbonation by reactive magnesium oxide treated soils can be achieved by resorting to two approaches in including a mass carbonation stabilization method and a deep mixing carbonation method (cai et al 2015, yi at al, 2013b).

2.2 Many highway agencies, private organization and researchers are doing extensive studies on waste materials and research projects concerning the feasibility and environmental suitability. The amount of wastes as increased year by year and disposal become a serious problem. It is necessary to utilize the waste effectively

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

with technical development in each field.Commonly murrum soil has been used for construction of all categories is a good construction material due to scarcity they income the construction coast at some part of the country.

2.4 Reinforcement of soils with natural and synthetic fibers is potentially an effective technique for increasing soil strength. The growing interest in utilizing waste materials in civil engineering applications has opened the possibility of constructing reinforced soil structure with unconventional backfills such as waste plastics and waste tyre shreds.

The results of direct shear tests performed on sand specimens by Gray and Osashi (1983) indicated increased strength.

Rao and dutta (1997) reported that sand waste plastic mixture improves the bearing capacity of granular trench and consequently the bearing capacity ratios.

The use of tyre shreads and sand (rubber sand) as light weight fill was studied by Bernal et.as (1997) could provide an alternative solution for waste tyre disposal.

III. MATERIALS AND METHODS

3.1 By Using Chemical Additives

3.1.1 Olivine:

Olivine is widely distributed around the word and has been found all over the earth. The carbonation of olivine breaks the chemical bond between magnessium oxide and silicon oxide to produce magnesium carbonate (MgCo3) with quartz as the main byproduct.

In this study, olivine can potentially be utilize to stabilize soil through Magnesite production during olivine carbonation, which is capable of binding soil particles. Thus olivine acts as an intelligent sustainable soil stabilizer.

The chemical reaction can be explained as below :

1. $Mg_2\ Sio_4 + 2\ CO_2 \longrightarrow 2\ MgCo_3 + Sio_2 + 95$ kg/ml
2. $Mg_2\ Sio_4 + 3H_2O \longrightarrow Mg_3\ SiO_2\ (OH)_4 + Mg\ (OH)_2$

3.1.2: Non traditional stabilizers SH-85 and TX – 85:

Both SH-85 and TX-85 can increase the laterite soil strength and contribute to denser soil fabric.The liquid (TX-85) and powder type (SH-85) are the chemical additive which are manufactured by Probes soil stabilizer company in Malaysia. TX-85 is an ionic type of stabilizer which provides cation exchange inside the soil and influence the plasticity characteristics of soil due to its water based nature.SH-85 is a calcium based stabilizer which can used increase in LL and PL by by adding a small amount of SH85 (3 %) pores between particle particle are filled with with gel formed for both of powder and liquid treated sample the treatment of SH -85 and TX 85 contributed to denser soil fabric.

3.1.3: Molasses and cement:

Molasses used in combination with cement and lime for stabilization purpose. The lime content is half of molasses content. The design is based on IS 37-2012. It is suggested to use 9 % of cement and 9 % to molasses by experimental analysis by use of molasses, the maximum only density of soil has with cement and with the

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

help of molasses. The purpose of mixing stabilized soil which is a water resistant material and has high affinity towards water. By the use of this additive, bearing capacity of soil increases and thickness of pavement decreases and eventually the cost of constructing the project decreases.

3.1.4: Sio2, Nano particles and cement:

In this cement treated residual soil is strengthened with nonsilica as a supplementary material. Inclusion of nanosilica reduce cement consumption in the soil and accelerate the stabilization process .

The different size of Sio_2 Nano particles ranging from 15 nm to 80 mm in powder form can be obtained from Nano structure and amorphous materials. It is observed that an increase in the nano material content resulted in a decrese in the MDD but an increase in OMC. Addition of nano sillica increases the hydraulic conductivity.

3.1.5 Chloride Chemical Compounds:

Magnesium Chloride ($MgCl_2$) and Aluminum Chloride (Al_3Cl_3) are widely used recently for stabilization purpose as they can easily soluble in water and uniform mixing can be easily achieved. These chemicals are added to expansive soil samples in varying percentage of 0.5 %, 1 %, 1.5%, 2 % of dry of soil.

Chemicals like Potassium Chloride (KCL), Calcium Chloride ($CaCl_2$) and Ferric Chloride ($FeCl_3$) can be used effectively in place of lime because these chemicals are dissolvable in water. The adequale cations increase in strength and reduction in swelling is observed with the addition of $CaCl_2$ and KCL to the expansive soil.

3.1.6 Use of XRF:

Liquid stabilizer like XRF reduces plasticity and shrinkage by elimination of reabsorption of water molecules. They reduce the moisture content by ionizing and exchanging the water molecule on the surface of clay platelets. Maximum dry density is increased by nutralizing and orderly rearranging the clay platelets.The compressive strength is increased by inter particles bonding.

3.1.7 Terrasil: Terrasil is nanotechnology based 100 % organo saline, water dissolvable soil modifier to waterproof soil sub grade.

3.1.8: Zycobond :

Zycobond is acrylic copolymer scattering for holding soil particles and soil disintegration are just control resistance. It enhance quality of soil layer, controls soil disinetegration, quick drying of soil layer after downpours.

3.2 By using Enzymes: 3.2.1 The enzymes increases the wetting and bonding capacity of the soil particles. Densification of enzyme- An enzyme is an organic catalyst that speeds up a chemical reaction, that otherwise would happen at much slower rate without allows soil material to become more easily wet and more densely compacted between soil particular and creating bonding a more permanent structure that is more resistant to weathering and wear and tear.

3.2.2 Renolith: This product is developed in Germany. Renolith significantly improves the strength of soil in cement stabilization process in a variety of roads such heavy haul roads, rail earthwork capping.

Renolith's usual application is as a mixture with water in specific properties. Renolith when thoroughly mixed and stabilized with a soil produces on exothermic chemical reaction and forms a polymer when compacted provides a very dense layer.It is a cost effective method of sub grate enhancement and pavement rehabilitation

A) With the use of Renolith above 20-40 % reduction in the cost of pavement construction can be achieved .

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

B) There is no need of import of an aggregate of required specification hence locally available materials can be used.

C)It provides adequate flexibility and durability to the pavement and avoids the formation of cracks.

3.2.2 Permazyme and Fujibeten:

Advantages :

A)They increase lubricity of soil particles

B)They provide rapid saturation and inhibits surface evaporation that reduces requirement of water

C)These are environmentally friendly and biodegradable.

3.2.4 Terrazyme:

It is a natural nontoxic liquid formulated using vegetable extracts,. It is used to modify engineering properties of soil.

Advantage :

A)It increases durability of paveerment and reduces swelling properties of soil

B)Reduce construction cost by 20-40 %

C)It improve the load bearing capacity of soil

3.3.3 Coconut shell and husk ash (CSHA):

CSHA can be used can a admixture for stabilization in varying percentage at a constant percentage of OPC. CSHA and OPC increase the California bearing ratio and can be used to improve soils with low CBR values. Inter particle cohesion also can be increased which is most important for road construction .Agriculturalwaste material like coconut shell husk ash can be used as stabilizing agent to improve engineering properties of soil.

IV.TESTS CONDUCTED

Various tests have to be performed for indentifying the effects of the Non traditional additives to improve Engineering Properties of soil as per Indian standards.

4.1: Consistency limits : Addition of liquid stabilizer should reduce shrinkage and plasticity of soil.

4.2: Moisture Density relationship : Liquid stabilizer should increase the MDD of natural soils.

4.3 Unconfined compressive strength (UCS):MDD and compressive strength of soil should be increased by non traditional additives.

V. RESULT AND DISCUSSION

5.1 Soil stabilization using chemicals:Chemical compounds have a strong bond to the surface of soil particles and reduce its susceptibility to water. This will result in making the soil material less sensitive to moisture and be compacted to better particle interlocking there for greater density and less penetration of water.The result shows that addition of the liquid in the soil reduces optimum moisture content. Also maximum dry density and compressive strength are increased.

5.2 By using enzymes :In developing country like India the most important requirement of any project after performance criteria is its economical feasibility and serviceability criteria. The conventional method are time consuming and are not economically feasible. The stabilization of soil by bio-enzyme is a revolutionary

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

technique and can be adopted in future to stabilize the sub grade strength and load bearing capacity of treated material.

5.3 By using waste materials: Waste material obtained from incineration processes in domestic energy power plant and is available in two different grades of fineness i.e. coarse waste materials (CWM) and fine waste material (FWM) both WM can be used to improve properties of soil.

VI. CONCLUSION

Following conclusion are made after study of various Non traditional additives for the stabilization process.

[1.]From economic perspective advantage connected with usage of terrasil (0.41 %) + zycobond (0.020 %) is the supportable improvement in road strength development.

[2.]The chemical like $MgCl_2$, Al Cl_3 and fly ash combination is very effective in reducing the swell pressure, swell potential of the compessive soil.

[3.]Liquid stabilizer reduces plasticity and shrinkage by eliminating reabsorptions of water molecules.

[4.]Liquid stabilizer reduces optimum moisture content by ionizing and exchanging the water molecules on the surface of the clay platelets and also they increases maximum dry density by neutralizing and orderly rearranging the clay plateletes.

[5.]Compressive strength also can be increased by liquid chemicals by incurring the inter particle bonding.

[6.]The load carrying capacity of flexible pavement system have significantly increased for both murum and fly ash subbases.

REFERENCES

[1] A.U. Ravi Shankar, H.K. rai and R. mithanthaya. " *Bioenzyme stabilized lateritic, oil as a highways material*, " Indian Road Congress in press.

[2] T.T. abood, A.B. Kasa, Z.B. XChik, " *stabilization of silty clay soil using chloride compounds*, 'Journal of Engineering Science and Technology, Vol 2, No.1, 2007 pp.102-110

[3] Amin Esmaeil Ramaji, " *A review on the soil stabilization using low-cost methods"*. " Journal of applied science research 2012.

[4] www.googleschloar.com

[5] Soil mechanics and foundation engineering by V.N.S. murthy.

[6] EJGE (Vol.13) Bund D.

[7] International Journal of engineering and advanced technology (IJEAT) ISSN : 2249-8958, 70 % -03, Issue-05, June 2014, EJGE (Vol.17) (2012), Bund D.

[8] www.irjet.net