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A-STATE-OF-THE-ART-REVIEW ON ADVANCEMENT OF ALTERNATE SOIL STABILIZING AGENTS

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Abstract

Damaging effect of traditional binder on environment, forced engineers to adopt new technologies, which provide better stabilization in more sustainable way. The criteria for this review is to identify some useful novel binders from past researches and to provide a collective review on them. In this review authors identified 4 main categories on which different newly adopted binders, their composition, properties and their ability to modify soil parameters are discussed. Different methodologies under different sections like bitumen with crumb rubber, enzyme based carbonate precipitation (EICP), biopolymer based treatment (BPST), agar gum and guar gum under the category of biopolymer are deliberated. Construction demolish waste (CDW) are considered in this review as stabilizing agent. The collective effect of these binders under different soil parameter i.e., unconfined compressive strength, bearing capacity, plasticity, shear strength, stabilization of soil containing heavy metal, CBR, and permeability are discussed. Authors found that Most of the binder provide satisfactory result and improve different soil parameters. By this review authors try to present a study on alteration of different soil function after using of different novel binders, which will provide better understandings of these new binders and can be helpful in the area of evaluation on effect of other novel binders on soil functions.

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1. Introduction

Improvement in different parameter of soil is named as soil stabilization [1, 2]. This is a very old practice which can be seen in ancient civilization for example Greeks used to stabilize soil to provide better and firm ground for path way. Romans and population of china also utilize this process to create better ground condition to build strong structure which are stand still without being affected till now [3]. One of popular method of stabilizing soil is addition of additive in form of chemical substances. Most used stabilizing agents are cement and lime. There are three type of additive method to stabilized the soil mass. First one is pulverization, in which no need of additive is required. 2nd is application of single chemical, in this type of stabilization most used single chemicals are cement and lime ad 3rd type is use of multiple chemical where first layer of additive is added either in dry or wet form but second layer should only be in slurry form [4-6].

2. Importance of Soil Stabilization

Importance of studying soil stabilization is, to find and achieve suitable combination of different binders which maximize the effectiveness of these binders. Rise in consumption of cement and other traditional binder, participate in about 7% hike on greenhouse gas emission. Also Lime's carbonation process give rise to the production of CO2. To evade all these environmental issues we require green, sustainable binding alternatives. Objective of study is to identify and study novel alternate soil binders which provide better stabilization in more sustainable way. Which will help in presenting a study on alteration of different soil function after using of different soil binders [7-9].

3. Advancement on Novel Alternate Binding Agent

A. Bitumen based alternate binder

a. Asphalt modified with crumb rubber

Waste tires are used in pavement making as CR (crumb rubber). Rubber size ranges from 4.75 mm to 0.0075 mm. there are two methods which are adopted for grinding of tire, ambient and cryogenic. However ambient

grinding provides rough surface to CR, which helps in better absorption of oil and resin from asphalt due to higher surface area. Adding crumb rubber enhance the viscosity of bitumen which provide workability. Also it enhance the resistance against susceptibility towards moisture, cracks due to temperature and compressibility [10-15].

B. Enzyme based alternate binders

a. Eko soil stabilizing red mud

Red mud (properties in Table 1) is waste from aluminum industry having high dry density and high specific gravity. Eko soil is a manmade replica of termite saliva. Eko soil promotes the cations of red mud to react with clay particles to stabilize it [16].

S.N.	constituents	composition
1.	Al_2O_3	20.10
2.	$CaCO_3$	3.99
3.	Fe_2O_3	34.21
4.	Na_2O	5.0
5.	SiO_2	7.8
6.	TiO_2	15.5
7.	Loss of Ignition	11.0
8.	other	2.4

C. Bio polymer based soil treatment (BPST)

Polymers obtained from naturals resources like silk, marine prokaryotes gellangum called as bio polymers.

(a) Agar gum

Agar gum is a galactose molecules (show in Figure 1) having linearly linked polysaccharide biopolymer. Dehydration of agar gum provide strength to the soil and improve compressive strength of soil [17-21].

D. Alkali activated construction demolish waste (CDW) as soil binder

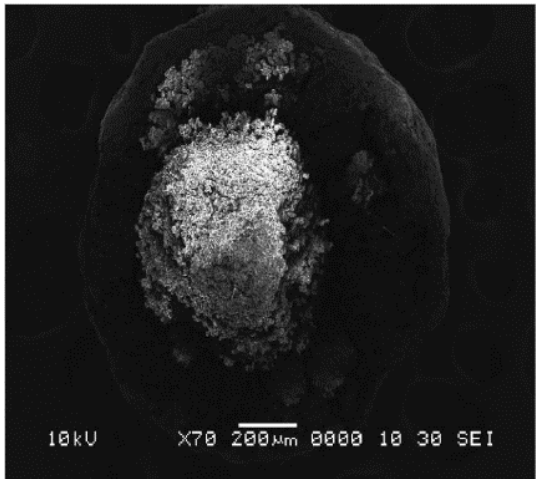

Figure 1. Agar coated pallets.

Different type of civil engineering application produce some waste in form of tiles, bricks concrete fragments, steel parts, ceramic glass, wood, plastic etc. which named as demolition waste. For alkaline media NaOH, KOH and CaO is used in molarity of 10M, 10M, and 6M respectively. 16% CDW found to be optimal for stabilization of sand [22-24].

4. Results

Different parameters which is affected by use of different novel binders

A. Compressive Strength

Demolish waste with NaOH as activator enhance the unconfined strength for sandy soil. Agar gum gain a 3% of improvement and gaur gum gain 12% of improvement.

B. Plasticity Reduction

Eko soil also reduce the plasticity of red mud. C. Bearing Capacity Alkali treated demolish waste imparts better bearing capacity, NaOH starts hydration process which gives CDW its improved bearing capacity at optimum 16% of dry weight of sand. D. Shear Strength Agar gum increase shear strength of sand. Also addition of 4% of lime and Eko soil each respectively increases the shear strength. E. Heavy metal stabilization Stabilization of red mud by Eko soil (ES) reduces the heavy metal

concentration and bring it to the limit which is slightly above of the WHO's(world health organization) guideline for drinking water. Heavy metal concentration is very low in red mud for 4% ES. F. CBR and permeability improvement Addition of 4% of Eko soil along with gypsum and lime shoot up the unsoaked CBR value by 274.87% of red mud also for soaked condition this value increases up to 854.20%. Increase in ES content reduce the permeability and decrease leach ability.

5. Conclusion

This study provide us the different soil stabilizing agents which were used I novel form different results on different property of soil is studied ad results were found under different points.

- When asphalt is mixed with crumb rubber it imparts protection against water susceptibility also thermal and compression cracks reduce significantly.
- Eko soil and EICP both are enzyme based stabilizers helps in increment of compressive strength, reduces plasticity, and imparts cohesion. Eko soil helps in immobilization of heavy metal. Also bearing strength, shear strength, CBR, increased significantly with use of Eko soil.
- Uses of construction demolishing waste about 16% (optimal dose) improve bearing capacity but it should be of activated before, by any type of alkaline media.

6. Future Scope

Although there is vast opportunity is available with use of novel binders, but some of the area of future consideration is enlisted below A. By using these novel binders we ca improve the shoulders of pathways which ca reduce the cost ad effort of stabilizing these shoulders. B. These chemical can mix in to rainwater which flow and eventually end up in over food chain. Hence study of these binders entering over food chain should be studied.

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