

Stabilization of Soil by the Composition of Eggshell Powder and Shredded PPE Kit

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ABSTRACT

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In the world full of crises, also the rising demand for PPE suits and masks would lead to another wave of biomedical waste disposition crises. The disposal of thrown away wastes causes a serious issue as the waste are most of the time are non- biodegradable and these are also not fit for incineration. Soil stabilization improves the engineering properties of the weak soil, by proper compaction and additional materials such as lime, concrete, but these materials are becoming expensive day by day, hence plastic by the composition of egg shell powder could enhance the properties and can be a sustainable replacement for lime, concrete, etc. as stabilizer. Through much experimental investigation it has been showed that plastic and egg shell powder can be used as an effective stabilizer with encountering waste disposal problem as well, along with the economical solution for stabilizing weak soil. This PPE stripes/shredding are known for its high strength, low cost, significantly less dangerous for the environment. The combined effect of PPE stripes/shredding along with egg shell powder can enhance engineering properties of soil.

Keywords: Stabilization, Biomedical waste, Egg shell powder, PPE kit.

I. INTRODUCTION

Due to this pandemic, the world is suffering from various problems, such as biomedical waste generation, unplanned waste disposal, etc. According to a report by the Central Pollution Control Board (CPCB) India generates about 101 Metric tonnes per day (MT/day) and the amount is increasing day by day due to COVID-19 added on increase in biomedical waste. Along with this as the construction sectors are coming up with different trends with

respect to design, architectural aspects, heights, heavily loaded structures makes it a keen need for improvement in the properties of soil. This trend leads to shear failure, excessive settlement, differential settlement if constructed on weak or soil with weaker properties. We cannot find soil with good properties all over the world, but this cannot be a limit for changing structural specifications, architectural aspects, and desired heights beyond estimated parameters. Then the only option we are left with is improving soil properties which should be

suitable for the expected load. Soil stabilization is an economical solution that could reduce the major construction problems. There have been various research conducted by using various materials such as Lime, Rice husk, plastic strips, human hairs, etc. among all the materials used it has been found that plastic and lime are the most effective soil stabilizers. Lime is not a waste product it needs to be manufactured which could be an uneconomical process if the large area or very soft soil is concerned.

In this study, we made an attempt to replace lime with eggshell powder along with the composition of a shredded PPE kit in a striped manner. The eggshell powder is found to be a material with identical chemical composition as that of lime. There is a huge percentage of calcium carbonate is found in Eggshells similar to the case of lime. This is found in large amounts as kitchen waste is concerned. Powdering an eggshell is an easy task that does not cause CO₂ emission as in the case of lime it is heated at 720°C. The 2nd most important material we have used is shredded PPE Kit, it has been found that plastic is a most important invention as far as our daily needs are concerned and now this pandemic period has grown usage of plastics PPE kit, etc. which does not have proper disposal plan yet. But, the use of plastic Strips as a soil stabilizer would lead to improvement of soil properties. By conducting various experiments such as compressive, split tensile, and flexural strength so as to identify the effectiveness of this used PPE kit. It has been found that this could be used as good reinforcing material. By using this plastic strips, helps in reduction includes in porosity to some extent. Use of proper compaction, proper proportioning of plastic and egg shell powder leads to exceptional performance as soil stabilizer in weak soil.

II. LITRATURE REVIEW

1. Paul, (2014) conducted studies on soil stabilization using egg shell powder and quarry dust.
2. A. Ayyappan et.al (2018) Adding plastic strips into the soil, there have been a positive impact on properties of soil and increase the bearing capacity of the red soil. Uses of plastics a soil stabilizer road soil sub-grade can be recommended as it increases the CBR value and make the soil stable. It has been found that the Maximum CBR is obtained when the waste plastic is added up to 0.75% But the coir fiber stabilized the soil is lesser.
3. Barman et.al (2016) 0.4% Plastic content with strip size of (15mm x 15 mm). It is found that MDU and OMC Values of silty sand are 16.7kN/³ and 16.8%respectively. Direct Shear test, the cohesion and angle of internal friction for natural soil are 19kN/m² and 23.2°. The CBR Value for natural soil obtained is very low at 3.2%. It is observed from the study that, improvement in engineering properties of silty sand is achieved at 0.4% Plastic content with strip size of (15mm)

III.MATERIALS AND MIXES

The materials used for this experimental study consist of soil, Eggshell, and PPE kit strips. Local soft clay is used experiment. Eggshells were collected from household kitchen waste, hotels, and restaurants. Further, the eggshells were ground into powder. Then it was sieved through 75 microns IS sieve so as to match it up with fine-grained soil. PPE kit was collected from various hospitals with all the guidelines followed given as per central pollution control board. It was kept untouched for 72 hours and then kept in a disinfectant bin. Once all the primary staged is done, it is then shredded into very small strips for easy lying as reinforcement.

The materials mentioned above are mixed in various proportions for analyzing their effect on soil stabilization. Initially, the untreated soil was tested, and then as ASTM D 6276 standards optimum lime content was found, it came to be 4% of the weight of soil, it was just used for calculation purposes as we did

not have any standard formula to calculate eggshell powder content yet. Hence, we used ASTM D 6276 instead. This content is added to soil as a soil stabilizer and the proportions are being changed accordingly.

TABLE I
MIX DESIGN AND ITS DETAILS

Mix Design	Details
C	Untreated Soil
C+4% Lime	Clay + 4% weight of soil replaced by lime
C+3L+1ES&PPE	Clay + 3% lime replacement and 1% weight replaced by egg shell powder and shredded PPE kit in striped form.
C+2L+2ES&PPE	Clay + 2% lime replacement and 2% weight replaced by egg shell powder and shredded PPE kit in striped form.
C+1L+3ES&PPE	Clay + 1% lime replacement and 3% weight replaced by egg shell powder and shredded PPE kit in striped form.

IV. TEST CONDUCTED

Experimental test were conducted on soil without treatment and without any admixtures as well as on egg shell powder in order to examine the effect of egg shell powder addition. Tests such as atterberg limit, compaction and unconfined compression test are being carried out as per IS 2720 standards.

V. METHODOLOGY

Experimental tests were conducted on soil without treatment and without any admixtures as well as on eggshell powder in order to examine the effect of eggshell powder addition. Tests such as atterberg limit, compaction, and unconfined compression test are being carried out as per IS 2720 standards. The Experiment has been carried out with

striped/shredded PPE material and eggshell powder. The process includes mixing the eggshell powder into the local soil as per decided proportions, then lying of shredded/stripped PPE which includes gowns, and head-covers takes place. After following proper sanitation protocols, the material will be shredded/stripped and then layed properly under a certain depth of soil as a stabilizer. Safety and hygiene are followed while dealing with medical waste, as per Central Pollution Control Board guidelines. PPE waste should be kept untouched for 72 hours before disposal, so the Eco Bins should be opened 72 hours later and the waste should first be washed in a pool of disinfectant. The assembly of CBR mold is then kept in CBR assembly and a test is carried out.

[1] Waste collection- Initially the experiment is carried out on a small scale. The waste collection took place by the small house-to-house kitchen waste collection, hotels, hospitals, etc. As it has come out with successful results collection could take place on large scale, by collecting the biomedical waste from hospitals, schools, salons, bus stops, and other public places by placing 'Eco Bins'. These are meant only to collect PPE kit waste and similarly, special bins could be placed at hotels restaurants for the collection of eggshell waste.

[2] Disinfection- The bins will have an indication mark to show that it is full. Once it reaches that mark, the waste is left untouched for the next 72 hours, and then it will be disinfected thoroughly. It is just being used for the purpose of collection of used PPE kit waste.

[3] Shredding/Grinding - The disposed of PPE kits are shredded or stripped into required shapes and sizes and the eggshells are grinded well into fine powder.

VI. RESULT AND DISCUSSION

The soil mixes mentioned above were tested and the results obtained are summarized in the table II. Unconfined compressive strength of in situ soil was

found to be only 0.50 kg/cm² which indicates the necessity for soil stabilization. When the soil was mixed with optimum lime content, there was a drastic change in the strength of the soil sample. The strength almost doubled upon the introduction of lime.

TABLE III
CONDUCTED TEST RESULTS

Sample	Liquid Limit (%)	Plastic Limit (%)	OMC (%)	γ _d (g/cc)	Mean UCS (kg/cm ²)
Untreated Soil	28	12.22	17	1.74	0.50
C+4% Lime	32	12.46	18	1.79	0.92
C+3L+1E S&PPE	34	13.23	21	1.81	0.96
C+2L+2E S&PPE	35	13.57	22	1.86	0.98
C+1L+3E S&PPE	35	13.10	20	1.80	0.80

Compaction tests showed an increase in the dry density up to 50% replacement of lime by eggshell powder and shredded strips of PPE Kit. Above 50% replacement of lime by eggshell powder and shredded strips of PPE Kit, dry density started to decrease. Eggshell powder is not that compatible a material as lime and hence when added in large quantities to replace lime, soil properties could not be improved.

VII. CONCLUSIONS

The eggshell powder when combined with shredded PPE Kit, this mixture was found to be a very good alternative in replacing the costly lime used for soil stabilization. The use of eggshell powder and

shredded PPE Kit in soil stabilization will reduce the disposal problems of eggshell and PPE Kit as well as make the stabilization process economically and sustainable. From the study, it was seen that eggshell powder can replace up to 50% of the lime used for the stabilization process. This replacement also increased the strength of treated soil. Thus it can be concluded that eggshell powder and Shredded PPE Kit is an ideal material to replace lime in the soil stabilization process owing to its similar chemical compositions and properties

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