STRENGTH IMPROVEMENT OF SOIL WITH PERIWINKLE SHELL ASH AND MARBLE DUST POWDER

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Abstract - Stabilization of clay soil has been carried out for improving its engineering properties of soil. For this study, the soil samples were collected from Mishriwala located in Jammu and periwinkle shell powder from Mumbai. To stabilize the clayey soil use periwinkle shell powder and Marble Powder, an experiment is conducted to evaluate the properties of soil mixing with 3%, 6%, 9%, 12% percentage of periwinkle shell powder and marble powder 4%, 8%, 12%, 16% by weight of soil sample and then the test perform. Test conducted for the clayey soil mixed with periwinkle shell powder and marble powder are liquid limit, plastic limit.Substantial decreases in Atterberg's limit, liquid limit, plastic limit and plasticity index were observed. The liquid limit decreases, the plastic limit decreases and the plasticity index decreases with increasing amount of marble powder and periwinkle shell powder. Compaction test (OMC and MDD) the maximum dry density (MDD) and optimum moisture content (OMC) of soil increases with increasing percentages of marble powder and periwinkle shell powder. California bearing ratio (CBR) the unsoaked CBR of soil goes on increasing with an increase in the percentage of addition of marble powder and periwinkle shell powder. The soaked CBR has also increased by the addition of marble powder and periwinkle shell powder up to 16 % both.Unconfined compression test (UCS)the unconfined compressive strength increases by the addition of marble powder and periwinkle shell powder. Laboratory test shown the significant improvement in soil properties. The study therefore concluded that periwinkle shell powder and marble powder could be considered as good stabilizer for clayey soil.

Key Words: Rice Husk, Nylon Fibre, CBR test, UCS test

1. INTRODUCTION

Soil stabilization is a technique meant at increasing or maintaining the stability of soil mass and chemical alteration of soil to enhance their engineering properties."

Stabilization occupancies for the establishment of design criteria as well as the determination of the proper chemical additive and admixture rate to be used in order to achieve the desired engineering properties. Benefits of the stabilization procedure can include higher resistance values, reduction in plasticity, lower permeability, reduction of pavement thickness, elimination of excavation material carrying or handling. Stabilization of expansive soils with admixtures control the potential of soils for a change in volume and improves the strength of soils.

Soil stabilization is done by many methods by Adding marble dust powder and periwinkle shell ash powder. Soil stabilization allows engineers to distribute a larger load with less material over alonger life cycle.

Literature Review

Hassim et al. (2022)

The purpose of this research is to investigate how marble dust powder touches the performance of subgrade soil. Different percentages of marble dust (MD) (0, 3, 6, 9, 12, 15) were employed. Particle size distribution, maximum dry density, optimal moisture content, and unconfined compressive strength (UCS) remained all determined by laboratory testing. The study found that adding 3% marble dust to untreated soil produces the best outcomes when compared to other percentages of marble

dust. The collected findings indicated that at 3% MD, the greatest price of UCS is attained. The findings revealed that adding marble dust to clay samples determination lower the cost of erecting structures on poor soils, and that producing new uses for discarded marble dust will minimize pollution.

Waheed et al. (2021)

The soils which show very high shear strength in a dry state but rapidly lose their strength on wetting are recognized as collapsible soils. Such rapid and massive loss of strength produces severe distress leading to extensive cracking and differential settlements, instability of building foundations, and smooth collapse of structures built on these soils. Waste marble dust is an industrial byproduct and is being produced in large quantities globally poses an environmental hazard. So, it is of the utmost need to look for some sustainable solution for its disposal. The present study focused on the mitigation of the collapse potential of CL-ML soil through a physio- chemical process. The soil is sensitive to wetting, warranting its stabilization. Waste marble dust (WMD) in varying percentages stayed used as an admixture.

Hussein et al. (2021)

In this most of these wastes are dumping on exposed land which creates serious environmental problems. The amount of waste marble from the processing stage is about 20 to 25% of the total processed stone. The waste marble dust was mixed with expansive soil samples with various percentages of 5%, 10%, 15%, 20%, and 25% by dry weight of soil. Different tests including Atterberg's limits, standard Proctor compaction, unconfined compressive strength (UCS), California bearing ratio (CBR) analyses were conducted for natural and marble dust stabilized soils. The results showed that as the percentage of the marble dust increases the plasticity index, the swelling potential of the expansive clayey soil decreases. the optimum moisture content decreases, and themaximum dry density increases. Also, UCS, CBR, and the calcite content of the soil mixtures increase with the increase in marble dust content.

Kufre et al. (2021)

The study investigated the use of Portland limestone cement (PLC) and periwinkle shell ash (PSA) under laboratory circumstances on geotechnical properties of lateritic soil to enhance its suitability as pavement layer material. The soil was treated with variable percentages of PLC at 0–8% and PSA at 0–10% (each at an increment of 2%) and compacted using standard Proctor. The results show a general decrease in Atterberg's limit, an increase in maximum dry density (MDD) surveyed by a decrease in optimum moisture content (OMC). Peak California bearing ratios (CBRS and CBRU) and unconfined compressive strength (UCS) for various curing ages considered were obtained at 6% PLC 6% PSA. On the overall, PLC and PSA can be used in improving the properties of weak soils to make them fit for road highway construction.

Ekpo et al. (2021)

In this research, lime and periwinkle shell ash (PSA) under laboratory conditions were effectively utilized in steadying lateritic soil to validate its potentials for use as pavement layer materials. Lateritic soil treated with lime at 0–8% and PSA at 0–10% (each at 2% increments) by dry weightof soil was evaluated for index properties, maximum dry density (MDD), optimum moisture content (OMC), California bearing ratio (CBRS and CBRU) and unconfined compressive strength(UCS) using the standard Proctor test.

2. Materials and Methods

Section 2.1 periwinkle shell ash and marble dust powder as stabilizer.

PERIWINKLE SHELL ASH

Periwinkle shell ash has similar calcium carbonate content with limestone aggregate. Using PSA as a partial coarse aggregate at up to 50% replacement equal can produce normal-weight concrete which possesses over 60% of the contro strength. The shells of periwinkle were sourced from a dump site. It was further calcined and allowed to cool inside kiln. The

calcined ash was brought out of kiln and further pulverized to crushed form. The ash was then sieved through

75um and thereafter stored in seal polythene bag before it was mixed with requisite percentages by dry weight of the soil.

MARBLE POWDER

Marble Dust Powder is a metamorphic rock composed of recrystallized carbonate minerals, most commonly calcite or dolomite. Marble may be foliated. Geologists use the term "marble" to refer to metamorphosed limestone; though, stonemasons use the term more broadly to encompass un- metamorphosed limestone.

Marble is known as metamorphic rock. The marble dust remained generated from marble industries. The major constituent of marble powder is calcium carbonate which aids in the stabilization of the soil. The soil stabilized by using marble dust can be utilized in the construction of pavement structures and foundations. This work aims to reduce the properties of expansive soils by using marble powder and study of the variations found in index properties of soil samples with increasing percentage of marble powder.

Table -1: Properties of PSA used

S.No	Compound	Value (%)
1	Sio2	31.52
2	Al2O3	9.75
3	Fe2O3	9.68
4	CaO	43.00
5	MgO	0.75
6	So3	0.07
7	K2o	0.4

Table -2: Properties of Marble dust used

S.No.	**Property**	**Value(%)**
1.	Calcium oxide (Cao)	50-56
2.	Silica	0.33-1.20
3.	Alumina	0.42-0.86
4.	Iron oxide	0.10-0.28
5.	Magnesium oxide	0.8-1.8
6.		

Results and Discussion

The soil used in this project was collected from local soil deposits in Jammu. Then the soil is prepared by doing sieveing with 4.75mm sieve, the quantity retaining on 4.75 mm sieve is taken out of the sample soil and the soil passing 4.75mm sieve is over dried with a temperature of 105°C for 24 hours. All the lumps if present in the soil were cleared with hammer.

Tests conducted in the laboratory for different objectives areas follows:

1. Liquid Limit Test (Casagrande's method)
2. Plastic Limite test (Thread method)
3. Standard Proctor test (OMC and MDD)
4. California Bearing Ratio test
5. Unconfined Compression strength test

MIX PROPORTIONS USED

Different proportions of different materials were used in the project work.MD-4%, 8%, 12%, 16% and PSA-3%,6%, 9%, 12%.

EXPERIMENTAL RESULTS

Section 1 Standard Proctor Test

Table no. 3: Results of OMC and MDD for mix proportions of Soil, MD,PSA

SOIL:MD:PSA	**MDD (kN/m³)**	**OMC (%)**
85:12:3	2.013	9.859
82:12:6	2.140	10.014
79:12:9	2.190	10.067
76:12:12	2.144	9.995

Section 2 Unconfined Compression Strength Test

Table no. 4: Results of UCS of D and PSA with Soil

Clayey Soil	**Curing Period (Days)**	**UCS (Kg/cm²)**
85:12:3	7	1.047
82:12:6	7	1.064
79:12:9	7	1.099
76:12:12	7	1.099

Section 3 California Bearing Ratio Test

Table no. 5: Results of CBR of MD and PSA Mix with Soil

Soil:MD:PSA	CBR (%)
85:12:3	5.284
82:12:6	5.284
79:12:9	5.724
76:12:12	5.724

DISCUSSIONS

Proctor Soil Compaction Test:

Compaction is the process of densification of soils by reducing air voids. The degree of compression of a given soil is measured in terms of its dry density.

. **Dry density of soil:** $= \frac{M / V}{1 + w}$ Where M = total mass of the soil, V= volume of soil, w= water content.

.Equipment for proctor' test : compaction mould, capacity 1000ml,rammer mass 2.6kg,detachable base plate,collar 60mm high, oven,large maximum pam etc.

UCS TEST:

Is a laboratory test used to drive the unconfined compressive strength of a rock spicemen. UCS stands for the maximum axial compressive stress that a spicemen can bear under zero confining stress.

The UCS is a parameter widely used in geotechnical design , but may not represent the strength in-situ.

The reason behind of this when Rice Husk ash and Nylon Fibre comes in contact with

water, pozzolanic reactions takes place during the curing period.

Specific gravity of Rice Husk Ash is lower than as compared to soil. So MDD is decreased and OMC is increased.

There is an expansion in OMC when the amount of Rice husk ash is expanded. The purpose for of this pozzolanic response of Rice husk powder with soil that needs more water for completion of cation trade response.

With Rice Husk ash kept constant at 25% MDD decreases with an addition of Nylon Fibre content in soil and Rice husk Ash mix. The reason behind of such behavior is Rice Husk Ash is lighter in weight and it has high water absorption properties because of presence of calcium oxide and hence OMC increases with increase of Rice Husk Ash content.

CBR TEST:

The California Bearing Ratio or CBR test is performed in construction materials laboratories to evaluate the strength of soil subgrades and base course materials. Those who design and engineer highways, airport runways and taxiways, parking lots, and other pavements rely on CBR test values when selecting pavement and base thicknesses.

Conclusions

Following conclusions can be inferred on the basis of theexperiments performed:

1. Substantial decrease in Atterberg limit, liquid limit, plastic limit and plasticity index were observed. The liquid limit from 31.30 % to 27.00 %, the plastic limit decreases from 22.15 % to 20.77 % and the plasticity index decreases from 9.15 % to 6.23 5%with increasing amount of marble dust and periwinkle.
2. The maximum dry density and OMC of soil increase with increasing percentage of marble dust and perwinkle .
3. The UCS increase from 0.996 kg/cm2 to 1.099kg/cm2 by the addition of marble dust and perwinkle shell ash from the soil..
4. The unsoaked CBR of soil gos on increase with an increase in the percentage of additional of marble dust and perwinkle. The value of unsoaked CBR increase from 7.045 to8.806 at 2.5mm and 6.751 to 8.219 at 5mm.
5. The soaked CBr value has also increased from 4.4.3 to 5.724 at 2.5mm by addition of marble dust and perwinkle upto 12% both

Addition of Rice Husk Ash and Nylon Fibre stabilizer makes the soil mixes durable, low cost and effective for soil improvement. If these two materials are easily available near to the site.

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