# STRENGTH IMPROVEMENT OF SOIL WITH PERIWINKLE SHELL ASH AND BRICK KILNDUST 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 and brick killn dust powder were collected from Mishriwala, located in Jammu and periwinkle shell powder from Mumbai. To stabilize the clayey soil use periwinkle shell powder and Brick Killn Powder, an experiment is conducted to evaluate the properties of soil mixing with 3%, 6%, 9%, 12% percentage of periwinkle shell powder and brick killn powder 8%, 12%, 16% , 20 % by weight of soil sample and then the test perform. Test conducted for the clayey soil mixed with periwinkle shell powder and Brick killn 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 Brick Killn 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 Brick Killn 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 Brick Killn powder and periwinkle shell powder. The soaked CBR has also increased by the addition of Brick Killn powder and periwinkle shell powder up to 16 % both.Unconfined compression test (UCS)the unconfined compressive strength increases by the addition of Brick Killn powder and periwinkle shell powder. Laboratory test shown the significant improvement in soil properties. The study therefore concluded that periwinkle shell powder and Brick Killn powder could be considered as good stabilizer for clayey soil.

***Key Words*:** Plastic limit ,SPC test, 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

## Roland Kufr et. al [ 2021]

The study investigated the use of Portland limestone cement (PLC) and periwinkle shell ash (PSA) under laboratory conditions on geotechnical properties of lateritic soil to enhance its suitability as pavement layer material. The soil was treated with varying 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 calcite, an increase in maximum dry density (MDD) followed by a decrease in optimum moisture content (OMC). On the overall, PLC and PSA can be used in improving the properties of weak soils

## Roland Kufr et. al [2021]

In this research, lime and periwinkle shell ash (PSA) under laboratory conditions were effectively utilized in stabilizing lateritic soil so as 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 weight of 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. Furthermore, MDD decreased with increase in OMC. The study concluded that the inclusion of lime and PSA could …….

## Satish et. al [2021]

In this project work, Soil stabilization is done with the addition of Fly Ash which is added from 0% to 20% by dry weight of soil. First of all, native soil properties like compaction characteristics, Atterberg's limits, compressive strength has been checked and then compared after addition of Fly Ash from 0% to 20%. An attempt is done to alter the engineering properties with brick kiln dust and fly ash in appropriate proportions for clayey soil collected. The Results achieved from addition of brick kiln dust in proportions of 10% to 50% shows that the maximum dry density (MDD) increases and optimum moisture content (OMC) decreases when the quantity of admixture is increased. And the bearing capacity of soil increases when BKD is added.

## 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 andmarble 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 concretewhich 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.

### BRICK KILN POWDER

Brick kiln dust is the mixture of coal ash, wood ash, and brickbats produced by fuel combustion the brick kilns. Brick kiln dust finds its potential application in the design of perpetual pavements over weak subgrades. Because of burning of soil bricks, it has hardened and at the time of removal the setup it produces the powder form of brick. It has red color and fine in nature. It has great ability to reduce the swelling potential for highly expansive clay soil. The brick kiln dust is a waste fine material generated through the burning of bricks with the soil, which covered by surroundings it. Due to burning of soil bricks, it becomes hardened; after which when the set-up covering is removed, the powder in the form of brick is obtained.

**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 Brick Kiln used

| S.No. | Property | Value(%) |
|---|---|---|
| 1. | Calcium oxide (Cao) | 24.48 |
| 2. | $Sio_2$ | 46.52 |
| 3. | $Al_2O_3$ | 10.62 |
| 4. | $Fe_2O_3$ | 4.29 |
| 5. | Na2O | 1.02 |
| 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 PSA-3%,6%,9% And BK-8%,12%,16%,20%..

### EXPERIMENTAL RESULTS

Section 1 Standard Proctor Test

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

| SOIL:BK:PSA | MDD (kN/m³) | OMC (%) |
|---|---|---|
| 81:16:3 | 2.073 | 9.886 |
| 78:16:6 | 2.166 | 9.856 |

| | | |
|---|---|---|
| 75:16:9 | 2.178 | 10.169 |
| 72:16:12 | 2.148 | 10.00 |

Section 2 Unconfined Compression Strength Test

**Table no. 4:** Results of UCS of B K and PSA with Soil

| Clayey Soil | Curing Period (Days) | UCS (Kg/cm$^2$) |
|---|---|---|
| 81:16:3 | 7 | 1.047 |
| 78:16:6 | 7 | 1.064 |
| 75:16:9 | 7 | 1.099 |
| 72:16:12 | 7 | 1.099 |

**Section 3 California Bearing Ratio Test**

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

| Soil:BK:PSA | CBR (%) |
|---|---|
| 81:16:3 | 6.164 |
| 78:16:6 | 6.604 |
| 75:16:9 | 7.485 |
| 72:16:12 | 6.604 |

Husk ash could not be mobilized for the reaction at 25% of Perwinkle shell ash in soil.

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The CBR value of virgin soil is 3.82 and it increase to

1.59 times when perwinkle shell ash 25% and Nylon Fibre 1.5% is added to virgin soil. This enhancement in CBR may be because of the gradual formation of hydration compounds in the soil due to the reaction between the stabilizers and the essentials particle present in the soil.

## UCS TEST:

The expansion in U.C.S. value might be a direct result ofthe slow advancement of the cementitious mixes in the soil by the response between pozzolanic mixes in Perwinkle shell ash and CaOH accessible in soil.

The UCS values of virgin soil also improves considerably with expansion of perwinkle shell ash ash 25% and 15%. The value increases from 240.05 kN/m² to 323.5 kN/m² with addition of Perwinkle shell ash and Nylon Fibre.

The reason behind of this when perwinkle shell ash and Nylon Fibre comes in contact with

water, pozzolanic reactions takes place during the curing period.

# DISCUSSIONS

## MODIFIED PROCTOR TEST:

There is an also increase of OMC from 14.7 to 16.10% and decrease of MDD from 18.10 to 17.27% when the percentages of Nylon Fibre vary from 1.0%, 1.5% and 2.0% and Perwinkle shell ash is fixed at 25%.

Specific gravity of perwinkle shell 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 Perwinkle shell 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 Perwinkle shell ash kept constant at 25% MDD decreases with an addition of Nylon Fibre content in soil and Perwinkle shell ash mix. The reason behind of such behavior is Perwinkle shell 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 Perwinkle shell ash content.

## CBR TEST:

Presence of pozzolanic compounds in Periwnkle shell Ash and CaOH available in soil might be increase the CBR value due to formation of cementitious compounds in soil. Due to excess of periwinkle shell ash in soil ultimately occupies spaces within sample because of this Rice

# Conclusions

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

1. From this study it is concluded that Perwinkle shell ash iswaste product from industries that can be used as stabilizers to clay soil and this would help to solve the conventional problem of disposal of them. .
2. The optimum value of Perwinkle shell ash is used for this work was 25 % because of the optimum value of
   C.B.R. is found at 25% of Perwinkle shell ash when added to soil.
3. The C.B.R value increases with increase of Nylon Fibre along with fixed quantity of Perwinkle shell ash. It increased 1.59 times from the untreated soil.
4. The optimum value of Nylon Fibre and Perwinkle shell ash ash required for soil stabilization is 1.5 % and 25
   % by weight of soil respectively.
5. Unconfined compressive strength increases with increase of quantity of Nylon Fibre and with fixed quantity of Perwinkle shell ash. The value of Unconfined compressive strength is increased 1.34 times from the untreated soil.

Addition of Perwinkle shell 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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