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Stabilization of Clay Using Rubber and Fibre Material

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Abstract:- **The objective of this paper is to study the effectiveness of soil stabilization using waste rubber and fibre material. The coir fibre is a natural material obtained from coconut which helps in improving sub grade soil strength. The strength of the soil can be improved by the use of rubber tyre chips. The process of soil stabilization helps us to achieve required properties of soil needed for construction of structures. Shredded rubber tyre passing through 75 micron I.S Sieve and coir fibres of varying length from 0.5 to 3 cm of varying percentage is used. The percentage of rubber used are 4%, 6%, 8% and 10% and the percentage of coir fibre are 0.25%, 0.5%, 0.75% and 1%. From the test results, it is found that the optimum moisture content(OMC) decreases with increase in addition of rubber, CBR and UCS values are also increases. It is also found that, on addition of these waste materials in pavement, the strength of soil is increased and thickness of pavement is reduced. By the use of these waste materials, the hazards in environment are highly reduced and quantity of stone aggregate in pavement is reduced. From this paper it is concluded that, by the addition of waste materials, clay soil is stabilized, it is found to be environment friendly and cost effective.**

Key Words: Rubber, coir, OMC, CBR, UCS, Pavement.

1. INTRODUCTION

Clay is a fine-grained natural rock or soil material that combines one or more clay minerals with traces of metal oxides and organic matter. Geologic clay deposits are mostly composed of phyllosilicate minerals containing variable amounts of water trapped in the mineral structure. Clays are plastic due to that water content and become hard, brittle and non-plastic upon drying or firing. Depending on the soil's content in which it is found, clay can appear in various colors from white to dull grey or brown to deep orange-red. Although many naturally occurring deposits include both silts and clay, clays are distinguished from other fine-grained soils by differences in size and mineralogy. Silts, which are fine-grained soils that do not include clay minerals, tend to have larger particle sizes than clay. Clay minerals typically form over long period of time as a result of the gradual chemical weathering of rocks, usually silicate bearing by low concentrations of carbonic acid and other diluted solvents. These solvents usually acidic, migrate through the weathering rock after leaching through upper weathered layers. In addition to the weathering process some clay minerals are formed through hydrothermal activity. There are two types of clay deposits, they are primary and secondary. Primary clays form as residual deposits in soil and remain at the site of formation. Secondary clays are clays that have been transported from their original location by water erosion and deposited in a new sedimentary deposit.

Stabilization is the process of blending and mixing materials with a soil to improve the soil's strength and durability. The process may include blending soils to achieve a desired gradation or mixing commercially available additives that may alter the gradation, change the strength and durability, or act as a binder to cement the soil.

The method adopted for stabilization of soils may be grouped under two main types

a)Mechanical stabilization – improvement of soil properties without adding any additives.

b)Chemical stabilization – improvement of soil properties with the help of additives.

2. MATERIALS USED

1.Clay soil: Clay is a fine grained natural rock or soil material that combines one or more clay mineral with traces of metal oxide and organic matter. Clay are plastic due to their water content and become hard, brittle and non plastic upon drying or firing.

2.Crumb rubber: Crumb rubber when mixed with clay soil, it behaves like a good stabilizer. There is a improvement over the soil properties by increasing percentage of crumb rubber upto 15% is studied by CBR. UCS and CBR value increases at an optimum fiber content of 5% and also said that shredded rubber fibre can be considered as a good reinforcement material.

3. Coconut coir: Coir fibre is a natural material obtained from coconut, which helps in improving subgrade soil strength. CBR value increases with the addition of coconut

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coir fibre. The addition of 1% of coconut fibre into the expansive soil, increases the CBR values from 3.9% to 8.6%. coir is a good stabilizing agent.

3. GENERAL PROPERTIES OF CLAY SOIL

Table 1: General properties of clay soil

Description	Results
Specific gravity	2.54
Liquid limit	26.5%
Plastic limit	11.11%
Maximum dry density	2.14 g/cm^3
Optimum moisture content	5%
California bearing ratio test	3.6
Unconfined compression test	0.490 kg/cm^2

4. RESULT AND DISCUSSION

The test which is conducted on normal clay soil is repeated with the addition of admixture (crumb rubber and coconut coir) and the results are discussed.

Table 2 : Optimum moisture content of soil for rubber

S.No	Sample	Moisture content(%)	Dry density(g/cm^3)
1	Normal soil sample	5	2.14
2	Soil with 4% rubber	7.7	1.995
3	Soil with 6% rubber	5.7	1.988
4	Soil with 8% rubber	6.8	1.983
5	Soil with 10% rubber	6	1.980

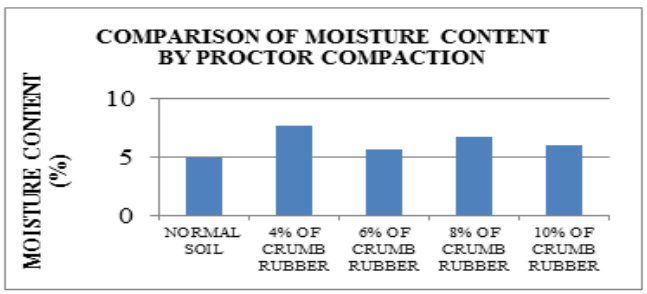

Fig 1.1 Optimum moisture content graph (rubber)

From the above graph it is known that addition of 4% crumb rubber to the clayey soil gives optimum moisture content.

Table 3: Optimum moisture content of soil for coir

S.no	Sample	Moisture content (%)	Dry density (g/cm^3)
1	Normal soil sample	5	2.14
2	Soil with 0.25% coir	7.6	1.998
3	Soil with 0.5% coir	8	2.01
4	Soil with 0.75% coir	7.6	1.95

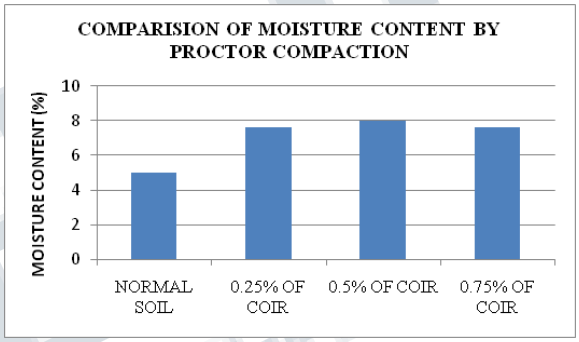

Fig 1.2 Optimum moisture content graph (coir)

From the above graph it is known that addition of 0.5% coir to the clayey soil gives optimum moisture content.

Table 4: California bearing ratio test for rubber

S. No	Sample	Liquid limit
1	Normal soil sample	3.6
2	Soil with 4% rubber	3. 3
3	Soil with 6% rubber	4.43
4	Soil with 8% rubber	3.8
5	Soil with 10% rubber	3.6

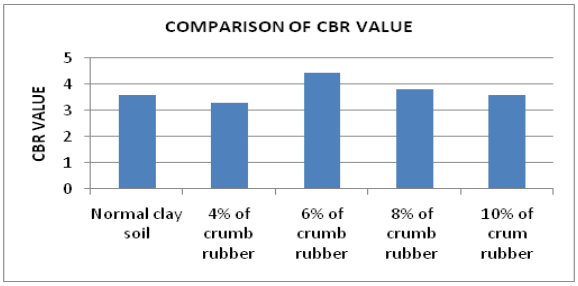

Fig 1.3 CBR value for rubber

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Addition of 6% of rubber to the clayey soil is effective as it increases the bearing capacity of the soil.

Table 5: California bearing ratio test for coir

S. No	Sample	CBR
1	Normal soil sample	3.6
2	Soil with 0.25% coir	4.06
3	Soil with 0.5% coir	4.43
4	Soil with 0.75% coir	4.16

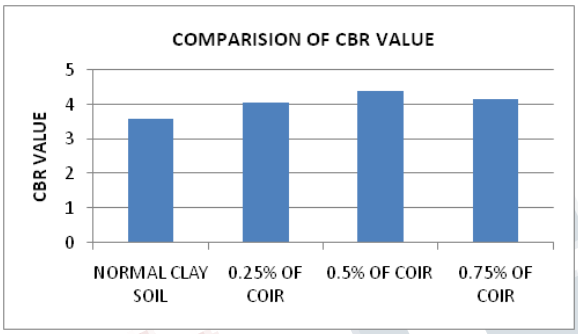

Fig 1.4 CBR value for coir

Addition of 0.5% of coir to the clayey soil is effective as it increases the bearing capacity of the soil.

Table 6: Unconfined compression test for rubber

S. No	Sample	Shear strength (kg/cm^2)
1	Normal soil sample	0.49
2	Soil with 4% rubber	0.60
3	Soil with 6% rubber	0.56
4	Soil with 8% rubber	0. 39
5	Soil with 10% rubber	0.56

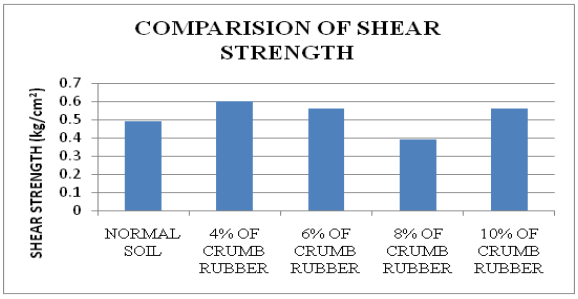

Fig 1.5 Shear strength value for rubber

Shear strength value increases with the addition of 4% rubber compared to the normal soil.

Table 7: Unconfined compression test for coir

S. No	Sample	Shear strength
1	Normal soil sample	0.490
2	Soil with 0.25% coir	0.535
3	Soil with 0.5% coir	0.60
4	Soil with 0.75% coir	0.58

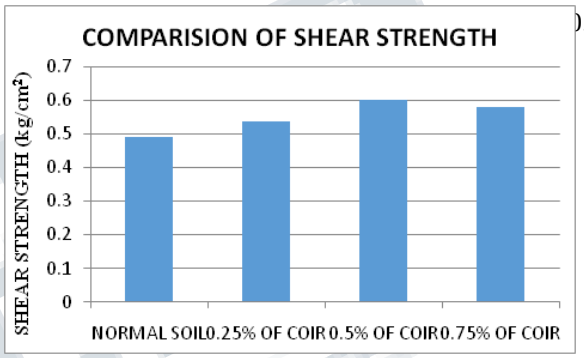

Fig 1.6 Shear strength value for coir

5. CONCLUSION

- The characteristics of soil sample is determined from the test conducted and also for soil sample mixed with different ratio of rubber (4%, 6%,8%,10%) and coir (0.25,0.5,0.75).
- Addition of 4% crumb rubber to the clayey soil gives optimum moisture content.
- Addition of 6% of rubber to the clayey soil is effective as it increases the bearing capacity of the soil.
- Shear strength value increases with the addition of 4% rubber compared to the normal soil. Addition of 0.5% coir to the clayey soil gives optimum moisture content.
- Addition of 0.5% of coir to the clayey soil is effective as it increases the bearing capacity of the soil.
- Shear strength value increases with the addition of 0.5% coir compared to the normal soil.
- The obtained from the from the unconfined compression test, proctor compaction test,

California bearing test shows that adding 6% of rubber and 0.5% of coir gave the improved result than other ratio.

- From the result we conclude that addition of 6% of rubber and 0.5% of coir increase the shear

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