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Stabilization of Expansive Soil using various Industrial Waste Materials

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A B S T R A C T

In many situations, soils in natural state do not present adequate geotechnical properties to be used as road service layers, foundation layers and as a construction material. In order to make deficient soils useful and meet geotechnical engineering design requirements researchers have focused more on the use of potentially cost effective materials that are locally available from industrial and agricultural waste in order to improve the properties of deficient soils and also to minimize the cost of construction. Hence this paper aims to investigate the use of some industrial wastes such as Steel slag, steel skin, broken bricks, coir waste, rice husk ash, groundnut shell ash, lime to stabilize the weak subgrade soil.

Keywords: Steel slag, steel skin, broken bricks, coir waste, rice husk ash, groundnut shell ash, lime

1. Introduction

Soil stabilization is the process of improving the engineering properties of weak soil and thus making it more stable. Clay possesses great threat for the construction of buildings due to its less characteristic shear strength and high swelling characteristics. In order to control this behavior, the cohesive soils have to be suitably treated with chemicals or any other available materials which can alter its engineering behavior. The Clay used in the study is collected from Coimbatore near Ramanathapuram area.

1.2 Needs & advantages

Soil properties vary a great deal and construction of structures depends a lot on the bearing capacity of the soil. Hence, we need to stabilize the soil which makes it easier to predict the load bearing capacity of the soil and even improve the load bearing capacity. The gradation of the soil is also a very important property to keep in mind while working with soils. The soils may be well-graded which is desirable as it has less number of voids or uniformly graded which though sounds stable but has more voids. Thus, it is better to mix different types of soils together to improve the soil strength properties. It is very expensive to replace the inferior soil entirely soil and hence, soil stabilization is the thing to look for in these cases.

- It improves the strength of the soil, thus, increasing the soil bearing capacity.
- It is more economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for deep foundation or raft foundation.
- It is also used to provide more stability to the soil in slopes or other such places.
- Sometimes soil stabilization is also used to prevent soil erosion or formation of dust, which is very useful especially in dry and arid weather.
- Stabilization is also done for soil water-proofing; this prevents water from entering into the soil and hence helps the soil from losing its strength.
- It helps in reducing the soil volume change due to change in temperature or moisture content.
- Stabilization improves the workability and the durability of the soil.

1.3 Methods

- Mechanical method of Stabilization
- Additive method of stabilization

1.3.1 Mechanical method of stabilization

In this procedure, soils of different gradations are mixed together to obtain the desired property in the soil. This may be done at the site or at some other place from where it can be transported easily. The final mixture is then compacted by the usual methods to get the required density.

1.3.2 Additive method of stabilization

It refers to the addition of manufactured products into the soil, which in proper quantities enhances the quality of the soil. Materials such as cement, lime, bitumen, fly ash etc. are used as chemical additives.

2. Literature review

2.1 Agricultural wastes as soil stabilizers:

M. Chittaranjan, M. Vijay and D. Keerthi (2011) studied the effect on using agricultural waste for soil stabilization purpose. It is found that soil in natural state do not posses adequate geotechnical properties to be used as road service layer , foundation and as construction material in order to adjust the geotechnical parameters to meet the requirements of technical specifications of construction industry, studying soil stabilization is more emphasized in this investigation, an attempt is made to utilize certain agricultural waste to stabilize weak subgrade soil in an economical way, which resulted in increasing percentage of CBR values.

2.2 Stabilization of soil using steel industry waste:

Shaukat Ali Khan carried out an investigation of stabilization of soil using steel industry waste. Unsuitable highway subgrade soil requires stabilization to improve its properties. Steel industry is producing substantial amount of waste with high tensile strength. In this research project, steel industry waste produced from the molds during forging process is used for the stabilization of soil. This resulted in improvement in density and strength of stabilized material. This method also provided an environmental friendly way of disposing the steel industrial waste. The rusting of steel waste is accompanied by an increase in volume of steel skin species thereby improving the state of packing. The free water within the voids was utilized in the rusting process which greatly added to the stability.

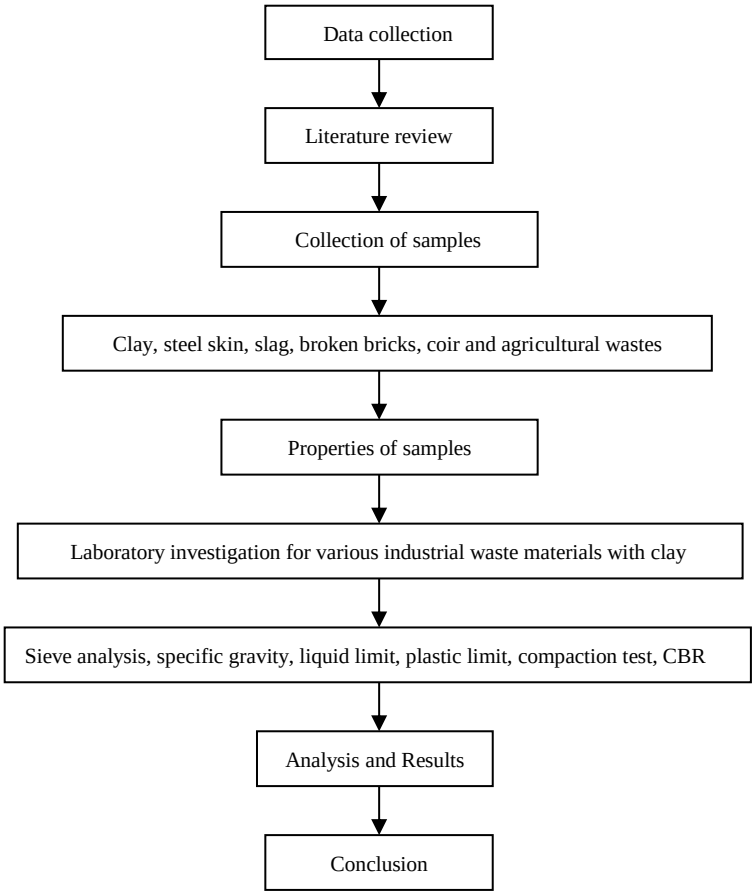
2.3 Stabilization of soil with coir wastes:

M.G. Sreekumar, Deepa G Nair (2013) studied the effect on using coir waste for soil stabilization purpose. This paper focuses on an experimental investigation for improving the clay soil with coir cutting waste from coir industry. The investigation successfully proved the improvement in strength (compressive strength @ 19% and tensile strength @ 9%) and durability characteristics were exhibited by the fibre with the content of 0.5%. Fibre content increased the ductility nature of the soil.

3.1 Methodology

- The clayey soil collected from the site is tested for its properties. Similarly the same sample is also tested with partial replacement (50%) of various industrial waste materials.
- For the purpose of stabilizing the clay soil various industrial wastes such as steel slag, coir, rice husk, and broken bricks are partially replaced.
- The tests carried out are Sieve analysis, Specific gravity, Liquid limit, Plastic limit, Proctor compaction & California bearing ratio test.
- The test results thus obtained on various materials are analysed using code books respectively.
- Comparison is carried out on results obtained for various waste materials & the suitable material is suggested for construction works.

3.2 Flow chart



4. Result and analyzing table:

Type of soil	Specific Gravity	Plastic Limit	Liquid Limit	Proctor Compaction	CBR
Clay soil	2.26	14.28%	18.23%	MDD 1.92g/cc (OPM10%)	0.97%
Clay soil with steel skin & slag	3.65	8.40%	71.60%	MDD 2.36g/cc (OPM10%)	9.79%
Clay soil with broken bricks	2.5	39.40%	24.31%	MDD 1.88g/cc (OPM14%)	10.28%
Clay soil with coir wastes	2.43	NON-PLASTIC	115.97%	MDD 0.64g/cc (OPM20%)	3.57%
Clay soil with agricultural wastes	1.87	NON-PLASTIC	83.04%	MDD 0.85g/cc (OPM20%)	26.00%

5. Conclusion

Geotechnical properties of all industrial waste materials have been determined. From the experimental results, it has been found that all the samples can be used for pavement construction. Since it has adequate dry density as per IS 1498. All samples representing various industrial waste materials can be used for backfill materials. Since it is a cohesionless soil and also it has good drainage property. Out of five representative samples, four has CBR value less than 20% as per IRC 37- 2001. Hence, these four samples can be used as a subgrade material directly without any additives. The remaining agricultural sample is stabilized with lime, optimum percentage is found to be 5% for having CBR value more than 20%. Instead of disposing the wastes and making the environment polluted it is effective in using in geotechnical applications and thereby reducing the cost.

6. Scope of future study

In this paper we have made an attempt to stabilize the weak clayey soil and for use in road pavement as subgrade material. This project can be further developed for use in foundation and as construction materials by trying out different percentage of these industrial waste materials with clayey soil, with the help of certain admixtures.

7. References

1. Soil mechanics and Foundations book by Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain.
2. Soil testing laboratory manual by K.V.S. Apparao and V.C.S. Rao.
3. Soil Testing for Engineers by S. Mittal and J.P. Shukla.
4. Principles and practices of Highway Engineering by Dr. L.R. Kadyali and Dr. N.B. Lal.
5. IS: 2720 Part (3, Sec 1)1980, Soil Test, Determination of Specific Gravity.
6. IS: 2720 Part (4)1985, Soil Test, Determination of Sieve analysis.
7. IS: 2720 Part (5)1985. Determination of Liquid and plastic limit.
8. IS: 2720 Part (7)1890 & IS 1498, Determination of Dry density.
9. IS: 2720 Part (16)1987 Laboratory Determination of CBR.
10. IRC 37- 2001 (subgrade) Road pavement.