A Review Paper on Study on Soil Stabilization with Partial Replacement of Rice Husk in Subgrade Soil

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Abstract— In today climatic changes, lack of stable ground for development of infrastructures is very common. In fact of this, construction of buildings on unsuitable ground is unavoidable and making a suitable ground before constructions is real difficult issue for Geotechnical Engineers. To overcome the difficulties experienced with problematic soil in geotechnical applications on one side and safe disposal of solid wastes on the other side, an attempt is made in this investigation to explore the possibilities of utilizing wastes to improve the engineering behavior of problematic soil. In this, in this present investigation the type of waste namely Rice Husk Ash for stabilization is selected to study the effects of same on the properties of problematic soil.

Keywords: Subgrade Soil, Rice Husk, Soil Stabilization

I. INTRODUCTION

Soil Stabilization is the alteration of soils to enhance their physical properties. Stabilization can increase the shear strength of a soil and/or control the shrink-swell properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavements and foundations. Soil Stabilization can be utilized on roadways, parking areas, site development projects, airports and many other situations where sub-soils are not suitable for construction. Stabilization can be used to treat a wide range of sub-grade materials, varying from expansive clays to granular materials. This process is accomplished using a wide variety of additives, including lime, fly-ash, and Portland cement, Marble dust, Foundry sand and Rice husk. Other material byproducts used in Stabilization include lime-kiln dust (LKD) and cement-kiln dust (CKD).

There are advantages and disadvantages to many of these soil stabilizers:

1) Many of the "green" products have essentially the same formula as soap powders, merely lubricating and realigning the soil with no effective binding property. Many of the new approaches rely on large amounts of clay with its inherent binding properties. Bitumen, tar emulsions, asphalt, cement, lime can be used as a binding agents for producing a road base. When using such products issues such as safety, health and the environment must be considered.
2) The National Society of Professional Engineers (NSPE) has explored some of the newer types of soil stabilization technology, specifically looking for "effective and green" alternatives. One of the examples utilizes new soil stabilization technology, a process based on cross-linking styrene acrylic polymer. Another example uses long crystals to create a closed cell formation that is impermeable to water and is frost, acid, and salt resistant.
3) Utilizing new soil stabilization technology, a process of cross-linking within the polymeric formulation can replace traditional road/house construction methods in an environmentally friendly and effective way.
4) There is another soil stabilization method called the Deep Mixing method that is non-destructive and effective at improving load bearing capacity of weak or loose soil strata. This method uses a small, penny-sized injection probe and minimizes debris. This method is ideal for re-compaction and consolidation of weak soil strata, increasing and improving load bearing capacity under structures and the remediation of shallow and deep sinkhole problems. This is particular efficient when there is a need to support deficient public and private infrastructure.

II. TYPES OF SOIL STABILISATION

Soil stabilization is a general term for any physical, chemical, biological, or combined method of changing a natural soil to meet an engineering purpose. Usually compaction is done to stabilize the soil. Apart from compaction, draining out of the excess water also helps in increasing the stability of the soil. Adding various materials in the soil also helps in stabilizing it. Lime and cement have been the main sources of soil stabilization since many years. But gradually, utilization of cement for stabilization is decreased because of its increasing cost and the pollution caused in the environment due to CO2 emitted during its production. Utilization of lime is also not much suitable because lot of CO2 is emitted during its production too. These facts necessitated the need for utilizing the waste products from various industries so that they can be used as an alternative to the conventional resources. Some of the waste products used for the stabilization of soil are fly ash, marble dust, foundry sand, rice husk ash etc. Various studies have proved that utilization of these waste materials as a soil stabilizing agent have not only improved the soil properties but also helped in reducing the cost of the project gradually. There are three main methods of stabilization i.e. mechanical stabilization, chemical stabilization and stabilization with the help of geo synthetics. These three methods are as followings:

A. Mechanical Stabilization

Mechanical solutions involve physically changing in the property of the soil somehow, in order to affect its gradation, solidity, and other characteristics. Dynamic compaction and vibro compaction are the two techniques used for mechanical stabilization. In vibro compaction the soil is compacted with the help of vibrations while dynamic compaction uses a heavy weight for the same. This is one of the oldest methods of stabilizing the soil.

B. Chemical Stabilization

Chemical solutions are the techniques that rely on adding an additional material to the soil that will physically interact with it and change its properties. Lime and cement are the most common materials that are being used for stabilizing the soil. But with the advent of new materials and excess of industrial waste available, lime and cement are now used less. Some of the industrial wastes that are used are fly ash, kiln dust, marble dust, foundry sand etc.

C. Geosynthetic Stabilization

Geo-grids are used in geo synthetic stabilization, to reinforce the soil. Geo-grid with reduced aggregate thickness option is designed for urban area and this provides a stable working platform corresponding to 97 percent of CBR. Soil modification and soil stabilization are the two processes to provide strength to the weak soil. Soil Modification changes the characteristics of soil by adding soil amendments to strengthen physical and chemical conditions to improve the bearing capacity of the soil. Soil Stabilization is the process of blending and mixing materials with a soil to improve certain properties of the soil. The process may include the blending of soils to commercially available admixtures that may alter the gradation, texture or plasticity, or act as a binder for cementation of the soil. The main purpose of the soil stabilization process is to increase the bearing capacity of the soil, thus making it fit for construction. A lot of methods are employed for stabilizing the soil.

Soil properties vary from place to place depending upon the climatic and geographical conditions of that area. They are not suitable for construction always and need to be modified so that they do not cause any damage to the structure built on them. The main need of stabilizing the soil is to improve the bearing capacity so that they are able to withstand the load applied on them.

III. Material Used in Study

In this study, to soil stabilize the soil, Rice husk is use and are discussed below:

A. Rice Husk

Rice husks are the hard protective coverings of rice grains which are separated from the grains during milling process. Rice husk is an abundantly available waste material in all rice producing countries, and it contains about 30%–50% of organic carbon. In the course of a typical milling process, the husks are removed from the raw grain to reveal whole brown rice which upon further milling to remove the bran layer will yield white rice. Current rice production in the world is estimated to be 700 million tons. Rice husk constitutes about 20% of the weight of rice and its composition is as follows: cellulose (50%), lignin (25%–30%), silica (15%–20%), and moisture (10%–15%). Bulk density of rice husk is low and lies in the range 90–150 kg/m^3.

Sources of rice husk ash (RHA) will be in the rice growing regions of the world, as for example China, India, and the far-East countries. RHA is the product of incineration of rice husk. Most of the evaporable components of rice husk are slowly lost during burning and the primary residues are the silicates. The characteristics of the ash are dependent on, composition of the rice husks, burning temperature and burning time. Every 100 kg of husks burnt in a boiler for example will yield about 25 kg of RHA. In certain areas, rice husk is used as a fuel for parboiling paddy in rice mills, whereas in some places it is field-burnt as a local fuel. However, the combustion of rice husks in such cases is far from complete and the partial burning also contributes to air pollution.

IV. Scope of Study

Dissertation entitled "Study on soil stabilization with partial replacement of Rice Husk in subgrade soil" Improvement in CBR value of Soil by adding Rice husk aims at conducting laboratory investigation on some selected soils of Haryana with the addition of Rice husk in varying proportions to determine changes in California Bearing Ratio of the soils. The soil used from Naraingarh, Ambala, Haryana. Improved subgrade soil with higher CBR value reduces the pavement crust requirements. The soil which possesses low CBR value can be improved by the use of additives such as Rice husk.

V. Literature Review

Over the years a lot of research has been carried out on the possible use of different materials for soil stabilization. The summary of few such researchers is given below:

Anand et al., (2000) [1] improving the characteristics of organic soil by adding lime. The results show that fibers with different percentages improve the UCS of the soil and reduce both volumetric shrinkage strain and swell pressure of the expansive soil.

Parsons et al., (2004) [2] used cement kiln dust in soil stabilization. Durability test were followed by strength test and atterberg limits. Relative values of soil stiffness were also tracked over a 28 days curing period. The test results show a significant improvement in performance with addition of cement kiln dust.

A. K. Choudhary (2010) [3] studies the effect of high density polyethylene on highway subgrade. CBR tests were conducted with varying percentage and length of high density polyethylene. Results showed the improvement in strength and deformation behavior of soil.

Brooks et al., (2012) [4] performance of subgrade and sub grade layers by addition of demolished waste quite effective in the stabilization process.

Yadu and Tripathi (2013) [5] studied the effects of granulated blast furnace slag in the engineering behaviour of stabilized soft soil. The performance of GBS stabilized soil was evaluated using physical and strength performance tests. Based on strength performance tests the optimum GBS was determined as 9% among 3%, 6%, 9% and 12%. Inclusion of GBS increases the strength of soil as well as the soaked and unsoaked CBR values.

Amrendra Kumar et al., (2014) [6] accomplished the study on the compaction and sub grade characteristics of clayey soil by mixing it with foundry sand, fly ash and tile waste. These materials were taken in a ratio of 10% to 50% with an increment of 10%. Results showed an increase in the value of the CBR value from 2.43% to 7.35% when all the three materials were added into the soil. Thus they concluded that clayey soil mixed with foundry sand, fly ash and tile

waste can be effectively used in the construction of sub-grade so roads with low traffic volume.

Jadhav and Kulkarni (2014) [7] premeditated the feasibility study of Improving Properties of Black Cotton Soil Using Industrial Wastes. The studies revealed that stabilization using industrial wastes from 0% to 60% saves the natural materials. The pavement thickness for stabilized road is reduced by 280 mm and cost saving is 21.91% with respect to flexible pavement of 1km road length. It is economical to construction as well as maintenance of road.

Parte Shyam Singh and R. K. Yadav (2014) [8] carried out study on the effect of marble dust on the index properties of black cotton soil. Marble dust was taken in the ratio of 0% to 40% by the dry weight of the soil. Results concluded that the plasticity index of the black soil decreased gradually from 28.35% to 16.67%, while the shrinkage limit increased from 8.06% to 18.34% at 40% addition of marble dust. Apart from this the expansiveness of the soil reduced from being very high to low on addition of marble powder, thus making the soil suitable for construction.

Sachin N. Bhavsar et al., (2014) [9] had studied the impact of marble powder on engineering properties of black cotton soil. The experiment involved determining the swelling potential of expansive soil in its natural state as well as when mixed with different proportion of marble dust from 30 to 50%. The test results showed a positive impact of marble powder on the black soil. The optimum moisture content of the soil decreased from 18.08% to 12.2% while the maximum dry density increased from 1.71 g/cc to 1.95 g/cc on addition of 40% marble powder.

VI. METHODOLOGY

Different %ages of rice husk ash waste material partially replaced with soil and find the changes in properties of soil i.e. CBR, LL, PL, PI, FDI.

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