International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

STABILIZATION OF SOIL BY USING INDUSTRIAL & AGRICULTURAL WASTE IN ROAD CONSTRUCTION

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ABSTRACT

The safe disposal of both hazardous and nonhazardous waste becomes a problematic for the civil engineers. This is because only few states are able to dump these wastes emanate from industries safely. This research on safe disposition of industrial and agricultural waste such as wheat husk ash (WHA) and sugarcane straw ash(SCSA). So, efforts have been made using WHA and SCSA in this research to revamp the quality of the soil. The main objective of the ground improvement is increasing the shear strength and decreasing the compressibility of the soil. The study was conducted using the expansive soil by taking varying quantities, which are then mingled with the different proportions of stabilized material for Atterberg limit tests and Unconfined compressive strength(UCS) test and soil retained within 7 days curing period for bearing ratio(CBR) test. These tests are experimented and proved by the standard tests IS 2720 and finally concluded that test results ameliorate the geotechnical properties of the soil.

Keywords: Stabilization of soil, waste material and environmental impacts.

I.INTRODUCTION

Road surface should be smooth and unyielding to enable free movement of vehicles. Road is very important for all human. Road pavement should provide good support in all seasons. Road pavement is two types such as: Flexible pavement and rigid pavement. India, being the seventh largest country in the world, it requires a, network of structures and roads to serve its large population. The land available for any construction is very less because of increasing urbanization and modernization. For such type of large structures for road surfaces, a large amount of construction materials like suitable earth, stone aggregates binders etc. are required.

This will impose heavy pressure on limited resources and therefore, for sustainable development use of locally available materials, waste material should be encouraged in order to save the natural resources for future generation. Waste material like industrial, building, household, agricultural etc. it includes coal ash, stone quarry, plastics, glass, recycled aggregate, geo-naturals, fibers and polythene bags etc. Use the waste material to improve the strength of sub grade soils is by using any one or composite material of lime, fly ash, coir fiber etc. This will result in reduction of overall thickness of pavement and saving of construction materials. Literature suggests that in recent times, fly ash, cement and other materials have been extensively used in the construction

of embankment and highways. Traditionally soil, stone aggregates, sand, bitumen, cement etc. are used for road construction. Natural materials being exhaustible in nature, its quantity is declining gradually. Also, cost of extracting good quality of natural material is increasing.

Engineers have been always with open mind to adopt any material available to them for its use for the construction purposes. Research facilities at hand help them to judge the suitable of the materials. Sen and Mishra (2010) gave a review of various Industrial wastes for use in the construction of road. Kolisetty and Chore (2013) described optimum utilization of waste materials in some construction activities. They described how to utilize different waste material for civil engineering works. Anupama et al. (2013) it is represented a study on the usefulness of agricultural and industrial waste as a soil admixture, and focused to improve the engineering properties of soil to make it capable of lower layer (sub- base and base course) of road construction. In their study they describes the behavioral aspect of soils mixed with industrial waste materials viz. fly ash (FA), rice husk ash (RHA) & bagasse ash (BA) and agricultural waste material rice straw ash (RSA) to improve the strength and load bearing capacity of the soil. Mishra and Mishra (2015) also carried out a study on o safe disposal of industrial wastes. There studies reveal that in recent years, industrial wastes are successfully used in soil improvement and road construction in many developed countries. The use of these materials (industrial waste) in road making is based on technical, cost and ecological criteria.

II.OBJECTIVES OF STUDY

The main objective of the study is to enhance the quality of the soil using the flour nutshell ash and sugarcane straw waste. Addition of such material will enhance both physical as well as chemical properties of the soil. This research undertakes the use of agricultural waste in stabilizing black cotton soil, various attempts have been made to improve the strength of soil using different chemical additives in combination with straw ash. Therefore, by using agriculture waste various properties of soil are improved. The physical properties of soil include horizonation, color, texture, structure, consistency and bulk density. The chemical properties consist of soil cations exchange and soil reaction that is pH value. Chemical analysis was performed to identify the constituents of the sugarcane waste and flour nutshell ash after burning at 600°C.

III.AGRICULTURAL AND INDUSTRIAL WASTE MATERIAL

I.Wheat Husk Ash (WHA)

WHA has a good pozzolanic property. It is used for various purposes. It is the staple food produced in large quantity for living and non-living beings. It has high calorific value of about 3.5 kcal/g. Its by-product is often found in the fields because waste is burned by the farmers after extracting grains. In this research, the effect of WHA on the soil is studied. Wheat husk is taken from the agriculture fields and burned at 600°C to convert into fine ash. This ash has highest amount of silica which helps in fertility of soil. Wheat husk ash, basically a waste material, is produced by burning crops waste while processing wheat from paddy. About 20 – 22% wheat husk is generated from paddy and about 25% of this total husk become ash when burn. It is non – plastic in nature. Its properties also varied depending on its burning temperature.

II. Sugarcane Straw Ash (SCSA)

Sugarcane straw ash is also called bagasse ash. Sugarcane is used by many large industries and mills to make sugar by extracting juice. Sugar is used as a food product by every household person. The waste produced from these large mills creates disposal problem. There is about 30% bagasse produced from the crushed sugarcane. This bagasse is utilized by many researchers for soil stabilization due to fibrous material contained in it, which aids the soil to bind the particles of the soil together by reducing the void ratio and increasing their shear strength. The technique of using the bagasse ash of every researcher for calcination process is different.

III. Silica fumes

Silica fumes are the waste generated from production of silicon and ferrosilicon alloys. It is wider application in construction industry due to its pozzolanic properties.

IV. Fly Ash.

Fly ash is an industrial waste produced by burning of pulverized coal in electric generator power plants. It is in fine powder form. It is pozzolana substance which contains and siliceous material. These materials form a cement when required amount of water is added to it.

IV.METHODOLOGY

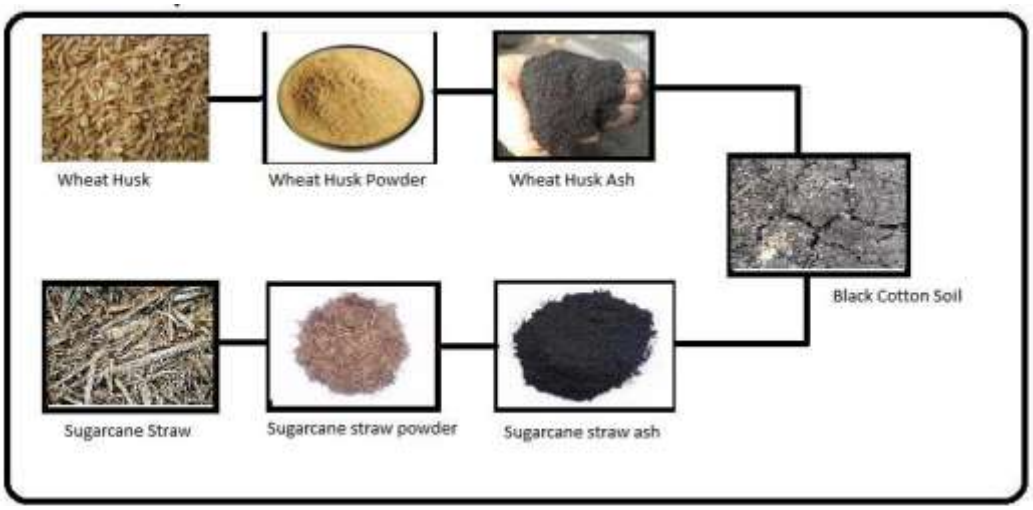
Wheat husk and sugarcane straw was firstly washed thoroughly with distilled water and then dried under sunlight for 24 hours within 49°C temperature. The dried straws are heated and burnt in a preheated oven at 600°C separately as shown Figure. The obtained ashes are then experimented for various tests and retained under curing period of 7 days for CBR test.

Preparation of the sample

1. The pulverized soil sample was first sieved through the required sieve for a particular test.
2. The required quantum soil was weighed out for the test.
3. The material to be added to the soil was also sieved through the required sieve, for the particular test and then the required quantum was weighed out on the weight basis as per the percentage to be added to the soil for test.
4. Then, black cotton soil was kept in oven for removing moisture content and drying at 110°C temperature for 24hrs is done. Then the agricultural waste ash is also kept in oven for maintaining the dry form of the ash.
5. For different blend mixtures, the ash content was taken according to certain percentages by weight of soil and it is mixed with soil in dry form itself. Similarly, for the blend mix with WHA and SCSA, all the materials are taken in dry form and mixed. The results are analyzed according to the standard [19] and on this basis the synergic effect is taken into account by replacing ternary blends of WHA and SCSA ratios such as (3+3%), (5+5%), (9 +9%), (7+7%) and (11+11%).The mixed sample was then used for performing the various tests.

In this research, remolded expansive clay was blended with WHA and sugarcane straw ash and strength tests were conducted. The potential of WHA blend as a swell reduction layer between the footing of a foundation and sub grade was studied. In order to examine the importance of the study, a cost comparison method was made for the preparation of the sub-base of a highway project with and without the admixture stabilizations. The strength

parameters like CBR, UCS are determined to know the suitability of material. It is found that results of soil replacement by both WHA and SCSA proved to be soil modification and improvement.



Block diagram of stabilization of soil.

V.EXPERIMENTAL WORK

1. **Liquid Limit:**

   Liquid limit is defined as the moisture content at which soil begins to behave as a liquid material and begins to flow. The importance of the liquid limit test is to classify soils. Different soils have varying liquid limits. Also, once must use the plastic limit to determine its plasticity index.

2. **Plastic Limit:**

   Plastic limit is defined as the projects moisture content and expressed as a percentage of the project of the oven dried soil at which the soil can be rolled into the threads one-eighth inch in a diameter without the soil breaking into pieces. This is also the moisture content of a solid at which a soil changes from a plastic state to a semisolid state.

3. **Sieve Analysis:**

   A sieve analysis is a practice or procedure used assesses the particle size distribution of a granular material.

4. **Specific Gravity:**

   Specific gravity is defined as the ratio of the weight of soil solids to the weight of water. The specific gravity is needed for various calculation purposes in soil mechanics, e.g. void ratio, density etc.

5. **Standard Proctor Compaction Test**

   Compaction is the process of densification of soil mass by reducing air voids under dynamic loading. This test is conducted in order to find out the optimum moisture content and maximum dry density of the soil.

6. **Unconfined Compressive Strength**

   The unconfined compression test is used to measure the shearing resistance of cohesive soils which may be undisturbed or remolded specimens. An axial load is applied using either strain-control or stress-control

condition. The unconfined compressive strength is defined as the maximum unit stress obtained within the first 20% strain.

VI.OUTCOMES

In rural village, the development of road network is of vital importance in socioeconomic development. It is very difficult to lay the pavement in the rural areas having black cotton soil or the compressible soil as a subgrade.

Fly ash and the rice husk, bagasse ash are the agricultural and industrial waste optimum use of these material in soil stabilization will bring down the construction cost of pavements. In this study attempt have been made to stabilize the soil by using varying proportion of these material. CBR ,UCS and standard proctor test are carried out to know the suitability of the material used.

Also the waste material is not good for the society it creates the environmental issues so by using these waste material these problems can be solved. Also dumping problems of these material is minimized. Treatment for the soil increases performance and service life of the pavements**.**

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