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# Stabilization of Soil by Using Agricultural Waste

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***Abstract*— Many geotechnical structures are constructed on weak and loose soil deposits with deeper foundations. Thus for safe design this formation needs improvement before construction starts. A popular technique to improve such soil condition is to use rice husk ash and sugar cane straw ash in the soil. This technique is now being used all over the world in various applications such as embankment, foundations, road pavement, bridges, buildings etc. The soil properties need to be improved by using rice husk ash and sugar cane straw ash as admixtures. For this reasons a detailed investigation of the behaviors of the soil-rice husk ash and soil-sugar cane ash therefore became essential. In the present study it is aimed that the usage of rice husk ash and sugar cane straw ash with lateritic soil to improve the properties the soil and to study the influence of addition of materials like rice husk, sugar cane ash. It is planned to add admixtures at a dosage of 2%,4%,6%&8% of total weight of soil and the index properties and engineering properties are to be determined the will be compared with the normal soil which is un stabilized.**

***Index Terms*— Rice husk ash, Sugar cane straw ash, Lateritic soil, Soil stabilization, Index properties, Engineering properties.**

## I. INTRODUCTION

For any land-based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work.

From the beginning of construction work, the necessity of enhancing soil properties has come to the light. Ancient civilizations of the Chinese, Romans and Incas utilized various methods to improve soil strength etc., some of these methods were so effective that their buildings and roads still exist.

In India, the modern era of soil stabilization began in early 1970's, with a general shortage of aggregates, it became necessary for the engineers to look at means to improve soil other than replacing the poor soil at the building site. Soil stabilization was used but due to the use of obsolete methods and also due to the absence of proper technique, soil stabilization lost favor. In recent times, with the increase in the demand for infrastructure, raw materials and fuel, soil stabilization has started to take a new shape. With the availability of better research, materials and equipment, it is emerging as a popular and cost-effective method for soil improvement.

Here, in this project, soil stabilization has been done with the help of randomly distributed rice husk ash and sugar cane straw ash obtained from agricultural waste materials. The improvement in the index properties and engineering properties has been stressed upon and comparative studies have been carried out. The liquid limit, plastic limit, plastic index, OMC is increased by 12.22%, 7.2%,44.3%&5% respectively for sugar cane straw ash but there is a decrease in MDD by 1.9 %. The liquid limit, plastic limit, plastic index increased by 9.25%, 17.76%&49.22% respectively for sugar cane straw ash but there is a decrease in MDD by 1.98%.

## II. EXPERIMENTAL PROGRAM

### *2.1 Materials*

*2.1.1. Lateritic soil*: Lateritic soils are soil types rich in iron and aluminum formed in wet and hot tropical areas. Nearly all lateritic soils are rusty red because of iron oxides. They develop by intensive and long lasting weathering of the underlying parent rock. Lateritic soils cover about one third of the earth's continental land area with the majority of that in the land areas between the tropics of cancer and Capricorn. Historically, Lateritic was cut into brick-like shapes and used in monument building.

*2.1.2. Rice Husk Ash*: Rice is the primary source of food for billions of people around the world. Rice husk is the shell produced during husking of paddy. Rice husk is amenable for value addition so that national economy may accrue. Its uses without conversion or with conversion (ash form) are many. Most of the husk from the milling is either burnt or dumped as waste in open fields and a small amount is used as fuel for boilers, electricity generation, bulking agents for composting of animal manure, etc.

TABLE 1 Chemical Composition of Rice Husk Ash Used

| Oxide | Concentration |
|---|---|
| SiO2 | 60.80 |
| AlO3 | 1.10 |
| Fe2O3 | 2.79 |
| CaO | 5.23 |
| MnO | 0.38 |
| K2O | 6.58 |
| SO3 | 0.52 |

| | |
|---|---|
| P2O5 | 8.9 |
| Colour | Grayish |

*2.1.3. Sugar Cane straw Ash:* Sugarcane straw ash which is a voluminous by-product in the sugar mills and jagarry house when juice is extracted from the cane. It is, however, generally used as fuel to fire furnaces in the same sugar mill that yields about 8-10% ashes containing high amounts of un-burnt matter, silicon, aluminum, iron and calcium oxides. The ash, therefore, becomes an industrial waste and poses disposal problems. Sugarcane straw ash is rich in amorphous silica indicated that it has pozzolanic properties, which helps in stabilization of soil.

TABLE 2 Chemical Composition of Sugar Cane Straw Ash Used

| SL.NO | PARAMETERS | RESULTS |
|---|---|---|
| 1 | Silica content | 69.32% |
| 2 | Alumina oxide content | 0.12% |
| 3 | Ferric oxide content | 2.32% |
| 4 | Calcium oxide content | 4.24% |
| 5 | Magnesium oxide content | 4.01% |
| 6 | Sodium oxide content | 1.26% |
| 7 | Potassium oxide content | 6.70% |

Fig 2 Rice husk ash

## III. SOIL STABILIZATION

Soil stabilization is the process of altering some soil properties by different methods, mechanical or chemical in order to produce an improved soil material which has all the desired engineering properties. Soils are generally stabilized to increase their strength and durability or to prevent erosion and dust formation in soils. The main aim is the creation of a soil material or system that will hold under the design use conditions and for the designed life of the engineering project. The properties of soil vary a great deal at different places or in certain cases even at one place; the success of soil stabilization depends on soil testing. Various methods are employed to stabilize soil and the method should be verified in the lab with the soil material before applying it on the field.

### 3.1.1 OBJECTIVE

To review the Existing methods for strengthening the soils.
To improve the geotechnical properties of Lateritic soils.
To stabilize the lateritic soil for the construction of engineering structures.
To solve the problem of ash disposal.
To increase the life of the structure.
To make stabilization process economical.

### 3.1.2 SCOPE

The stabilized soil may used in low grade concrete mixes in temporary structures.

The same criteria may be applied for different agricultural waste by-products to get good geotechnical properties.

## IV. RESULTS AND DISCUSSION

After the detailed investigation on different index and engineering properties has been done, the following result has been achieved.

TABLE 3 Results of Soil

| Sl.no | property | Results |
|---|---|---|
| 1 | Moisture content | 11.3% |
| 2 | Specific gravity | 2.6 |
| 3 | Sieve analysis | $C_U$=4.63<br>$C_C$=1.67 |
| 4 | Liquid limit | 40.2 |
| 5 | Plastic limit | 30.4 |
| 6 | Plastic index | 9.8 |
| 7 | Swelling index | No swelling |
| 8 | OMC | 19% |
| 9 | MDD | 2.020g/cc |

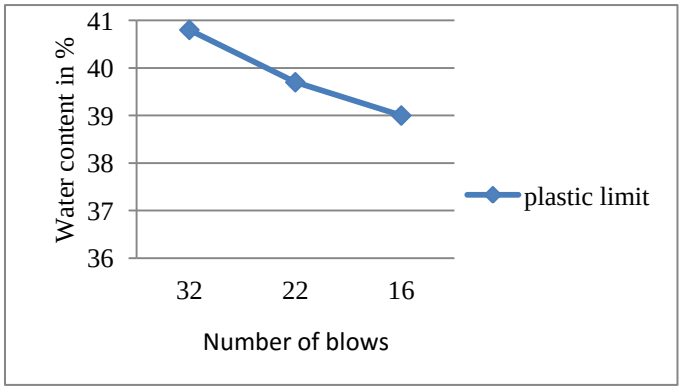


Fig 4 Graph for plastic limit

TABLE 4 Results for Lateritic Soil Stabilized with Rice Husk Ash

| Rice husk ash added | Liquid limit (%) | Plastic limit (%) | Plastic index (%) | OMC | MDD |
|---|---|---|---|---|---|
| 0 | 40.2 | 30.4 | 9.8 | 19 | 2.020 |

| | | | | | |
|---|---|---|---|---|---|
| 2 | 36.4 | 22.7 | 13.7 | 18.7 | 1.950 |
| 4 | 35 | 24.4 | 10.6 | 16 | 1.975 |
| 6 | 44.3 | 25 | 19.3 | 19 | 1.980 |
| 8 | 30.4 | 20 | 10.4 | 19 | 1.885 |

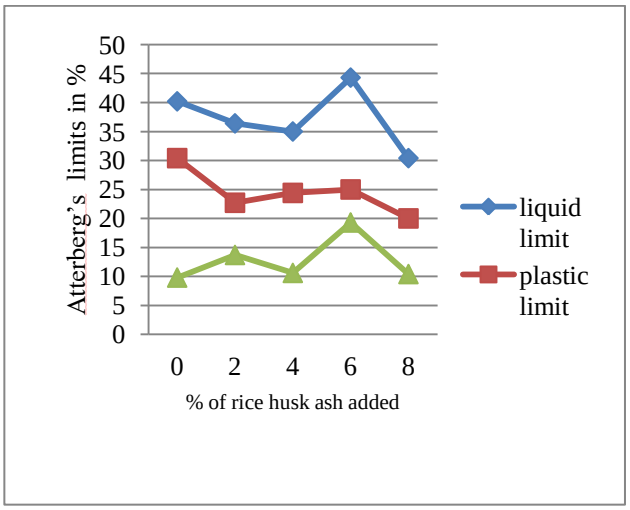


Fig 5 Graph Variation of atterberg's limits with rice husk ash

TABLE 5 Results for Lateritic Soil Stabilized with Sugar cane Straw Ash

| Sugarcane straw ash added (%) | Liquid limit (%) | Plastic limit (%) | Plastic index (%) | OMC | MDD |
|---|---|---|---|---|---|
| 0 | 40.2 | 30.4 | 9.8 | 19 | 2.020 |
| 2 | 38.4 | 26.7 | 11.7 | 19.5 | 1.952 |
| 4 | 45.80 | 28.2 | 17.6 | 20 | 1.980 |
| 6 | 27.2 | 14.57 | 12.63 | 17 | 1.975 |
| 8 | 25 | 12 | 13 | 20 | 1.87 |

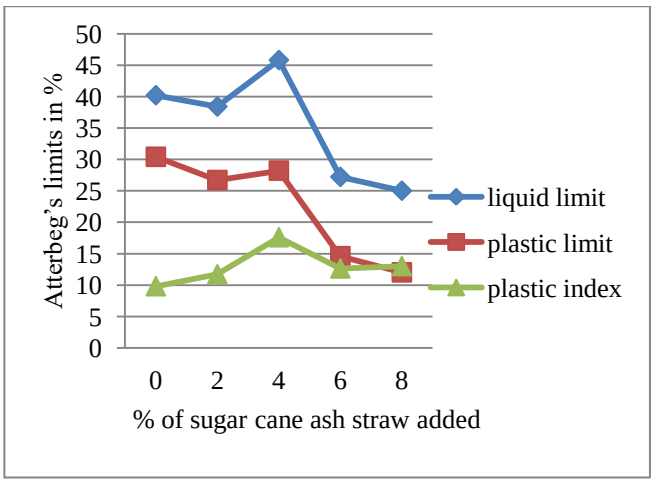


Fig 6 Graph variation of atterberg's limits with sugar cane straw ash

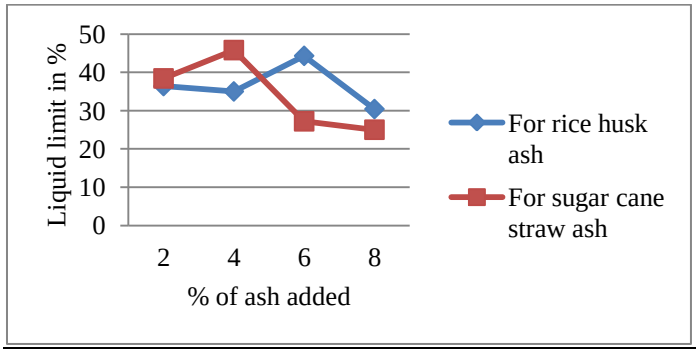


Fig 7 Comparison of liquid limit between rice husk ash and sugar cane straw ash

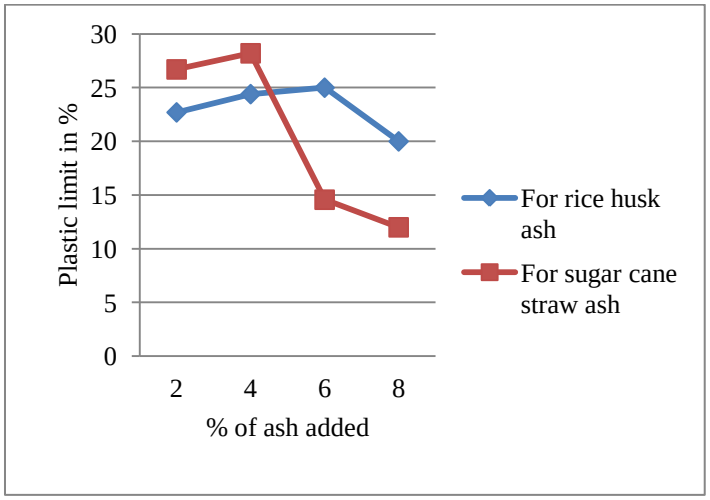


Fig 8 Comparison of plastic limit between rice husk ash and sugar cane straw ash

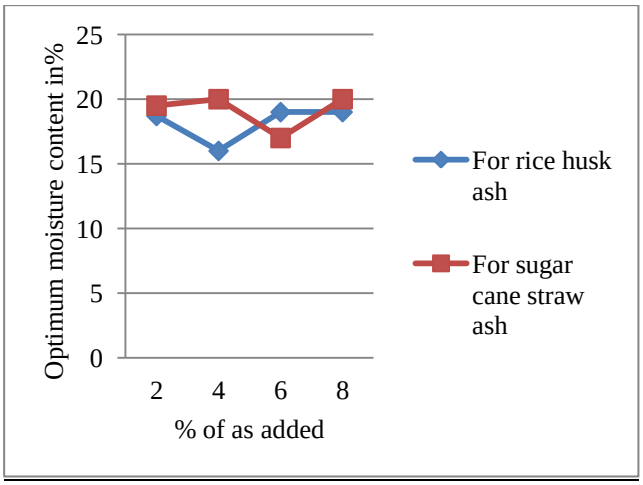


Fig 9 Comparison of OMC between rice husk ash and sugar cane straw ash

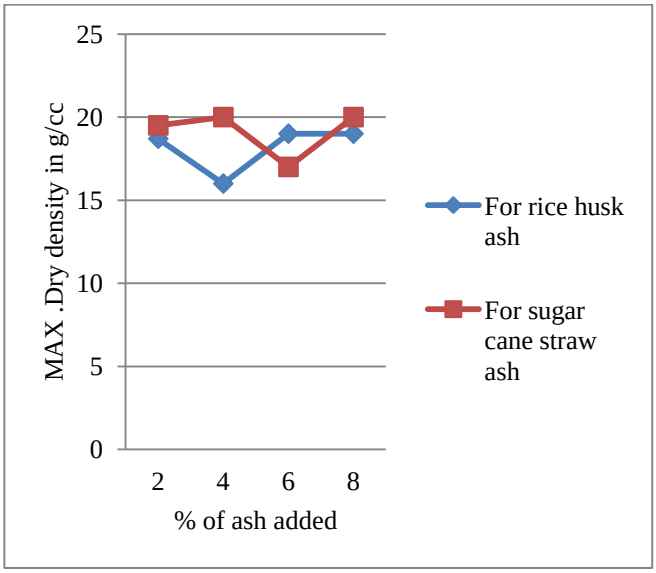


Fig 10 Comparison of OMC between rice husk ash and sugar cane straw ash

## V. CONCLUSION

- By comparing the soil parameters while using rice husk ash and sugar cane ash we observed that sugar cane straw ash found to be yielding good results.
- The properties of the lateritic soil are improved by the addition of sugar cane straw ash and rice hush ash at 4% and 6% respectively.
- Based on the summary of results discussed above, it was concluded that sugarcane straw ash was an effective stabilizer for improving the geotechnical properties of lateritic soil samples. The liquid limit, plastic limit, plastic index, OMC is increased by 12.22%, 7.2%,44.3%&5% respectively for sugar cane straw ash but there is a decrease in MDD by 1.9 %. The liquid limit, plastic limit, plastic index increased by 9.25%, 17.76%&49.22% respectively for sugar cane straw ash but there is a decrease in MDD by 1.98%.

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