# PERFORMANCE EVALUATION OF SUBGRADE SOIL STABILIZED USING MANGO DRY LEAVES ASH

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**ABSTRACT-**This paper investigates the geotechnical properties of soil stabilized with mango dry leaves ash. The soil taken for the test was locally available soil and it was subjected to preliminary soil test such as Sieve analysis, Atterberg's limit, Proctor testand California Bearing Ratio test were also carried out on the soil at its natural state and at when the mango dry leaves ashes were added to soil at varying proportions of 4, 8, 12, 16% by weight of soil.

From the results it was found that with increase in percentage of mango dried leaves ash the CBR value is increased up to 12%. It is therefore concluded that in addition of mango dry leaves ash which increases the properties and can be effectively used for subgrade soil.

**Keywords** – mango leaves ash, subgrade soil, stabilization.

## 1. INTRODUCTION

Soil has been used as construction material from time immortal. In transport engineering, subgrade is the native material underneath a road, pavement etc. It is also called formation level. Soil being poor in mechanical properties has been putting challenges to civil engineers to improve its properties. A solid sub base is a key to a successful project. Soil stabilization is a general term for any physical, chemical, mechanical, biological or combined method of changing a natural soil to meet an engineering purpose. Improvements includes increasing the weight bearing capabilities, tensile strength and overall performance.

Disposal of solid waste on landfill can be minimized if the waste is having desirable properties such that they can be utilized for various geotechnical applications. There are several methods used for improving geotechnical properties of soil that include densification, drainage inclusions and stabilizations. Stabilization is required when the soil available is not suitable for the intended purpose. Flyash is a solid waste from thermal power plant which is used for various civil engineering applications [14].

Ash is the general term used to describe the solid remains of fire. It refers to all non-aqueous, non-gaseous residues that remain after something is burned. Ashes as the end product of incomplete combustion will be mostly mineral, but usually still contain amount of combustible organic or other oxidizable residues.Stabilized sub-bases can be used for both flexible and rigid pavements, although the reasons for doing this can vary [11]. In the recent years a considerable number of laboratory experiments have been carried out and extensive studies have been conducted on soil using rice husk [16], industrial waste and lime [12], banana leaves ash [4], fiber coir [15], fly ash [13], [14], natural materials [11], coconut shell powder and lime [3].

In this investigation the type of solid waste namely mango dry leaves ash is selected to improve the properties of subgrade soil. Compaction and CBR test have been conducted on the soil with increasing percentage of solid waste.

## 2. OBJECTIVE

Objective of this study is to improve the properties of subgrade soil by addition of mango dry leaves ash at various proportions such as 4%, 8%, 12% and 16%.

## 3. MATERIAL USED

### *3.1. Soil used in this study*

Locally available soil was collected at a depth of 0.5m below ground surface. Index properties of the soil were determined, and the soil is classified according to ASTM standards.

### *3.2. Mango dry leaves ash as waste material*

Mango dry leaves ash is a residue obtained from the burning of mango dry leaves. Global production of mangoes was 50.6 million tons, led by India with 39% of the world total. It has fibrous property which can develop good bonding and hence suitable for using it as a stabilizer. Mango dry leaves are collected and burned into ashes and the material passing through 75µsieve is used in this study.



**Fig .1** Mango dry leaves**Fig2.**Mango dry leaves ash

### *3.3. Sample preparation:*

The locally available soil was first sieved through 4.75mm sieve as per the requirement. The material to be added to the soil was also sieved through 75µ 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. The soil and the material were mixed together in dry condition and then used for performing the various test.

## 4. EXPERIMENTAL STUDY:

To study the effect of mango dry leaves ash on soil, the various proportions like 4%, 8%, 12%, and16% were mixed with locally available soil. Tests such as sieve analysis, specific gravity, Atterberg limits, proctor, and CBR were conducted on normal soil and proctor and CBR(tests as per IS code provisions)[5],[6],[7],[8],[9],[10] tests are conducted on soil stabilized with ash of proportions 4%, 8%,12% and 16% by weight of soil.

## 5. RESULTS AND DISCUSSIONS

The results from the preliminary tests such as optimum moisture content, specific gravity, particle size analysis, Atterberg limits and engineering propertiesbefore the addition ofmango dry leaves ash are presented in Table 1.

**Table 1.** Results on test of locally available soil

| TESTS | RESULTS |
|---|---|
| Specific gravity | 2.692 |
| Liquid limit | 21% |
| Plastic limit | 22% |
| Optimum moisture content | 14% |
| Dry density | 1840Kg/m$^3$ |
| CBR | 5.95% |
| Soil type | Poorly graded (SP) |



### *5.1. Effect of waste on compaction characteristics:*

The variation of Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) with mango dry leaves ash stabilizer at 0, 4, 8,12 and 16% by weight of soil is depicted below on Table no.2 and graphically represented in Fig.3.

The value of MDD decreased as values of OMC increased accordingly. The MDD reduced from 1840 to 1680Kg/m$^3$, while the OMC increased from 14% to 20%. The observed decrease in MDD may be explained by considering the mango dry leaves ash as filler in the soil voids. Increase in OMC values implies that more water is needed to compact the soil.

**Table 2.**Results onproctor test for soil stabilized with mango dry leaves ashes.

| Mango dry leaves ash (%) | OMC (%) | MDD (Kg/m$^3$) |
|---|---|---|
| 0 | 14 | 1840 |
| 4 | 14 | 1790 |
| 8 | 14.2 | 1770 |
| 12 | 17 | 1720 |
| 16 | 20 | 1680 |

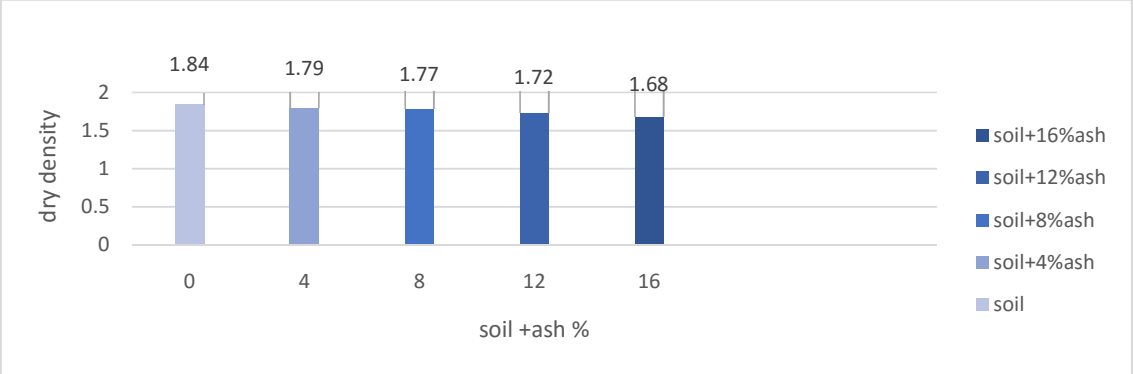


**Fig.3** Effect of addition of mango dry leaves ash on MDD of samples

***5.2 Effect of solid waste on California Bearing Ratio:***

It is one of the common tests widely used in the design of base and subbase material for pavement design and it is used to evaluate the strength of stabilized soil. For mango dry leaves ash, the CBR increased progressively from 5.95% at 0% to 21.96% at 12%. Then it reduced to 3.72% at 16%.

Increase in the values of CBR may be because of its fibrous property which can develop good bonding between mango dry leaves ash and soil. Theoptimum value is therefore at 12% of weight of soil. The variation of mango dry leaves ash with different proportions in the CBR test is depicted and graphically represented in Table no.3 and Fig.4.

**Table.3**. shows variation of CBR value at different proportions:

| Mango dry leaves ash (%) | CBR value(%) |
|---|---|
| 0 | 5.95 |
| 4 | 11.16 |
| 8 | 12.28 |
| 12 | 21.96 |
| 16 | 3.72 |

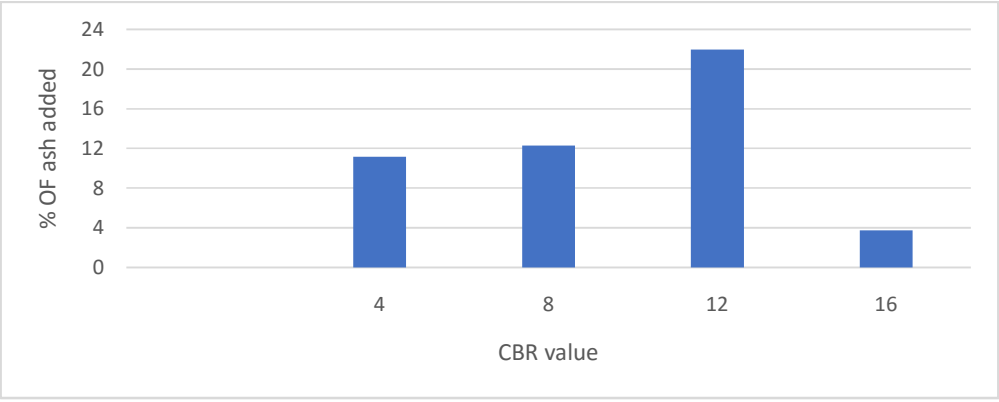


**Fig 4.**Effect of mango dry leaves ash on the CBR of samples

## 6. CONCLUSION

The effectofwaste namely mango dry leaves ash in soil on the variation in compaction characteristics and CBR values are analyzed. On the basis of present experimental study, the CBR value of the soil increased from 5.95% to 21.96% by the addition of 0% to12% of ash andthe optimum value of CBR is attained at the addition of 12% of mango dry leaves ash and also the maximum dry density of soil decreases with increase in mango dry leaves ash content by 1.84g/cc to 1.68g/cc.

The study has revealed that mango dry leaves ash satisfactorily act as cheap stabilizing agents for subgrade purposes and hence it reduces the cost of construction.

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