

# Soil Stabilization Using Human Hair Fibre

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**ABSTRACT:** Accumulation of solid waste requires a large area for its disposal. Human hair fibre (HHF) a non- degradable matter is creating an environmental problem so its use in soil improvement can minimize the problem. Accumulation of solid waste is another serious problem faced by the world for which huge area of land is required for its disposal. Alternatively, engineers try to utilize these solid waste materials in the civil engineering construction based on its feasibility / suitability on their performance. The main objective this study is to investigate the suitability of solid waste materials such as human hair fibres in the process of soil stabilization as a reinforcement which can replace conventional commercial fibre materials. The influence of reinforcement parameters. fibre content on Kaolinite clay was observed through a series of laboratory tests such as consistency limit tests, compaction tests and unconfined compression test.

**KEYWORDS:** Human Hair Fibre (HHF), Environmental pollution,

## I. INTRODUCTION

Soil stabilization is the method of refining the engineering properties of soil. stabilization of soil is needed when the available soil at site is not suitable for the proposed purpose. Environmental problems associated with Human hair fibre. a non-degradable matter can be minimized by using the same as a reinforcing agent in soil stabilization. Studies shows that Human hair fibre, as a cheap reinforcing agent, can be used for stabilizing clayey soil found in low lying areas of Kerala, India. Stabilisation is can also be defined as the process which changes the composition of soil for betterment of its properties. Generally, soil stabilisation is used to reduce compressibility and permeability of the soil and to increase bearing capacity and shear strength. The process of increasing bearing capacity and shear strength of soil is found to be cost effective and more economical in terms of energy consumption.

Human hair fibre is considered as waste material and creating environmental problems. In recent research it has been found that human hair can be used as a reinforcing fibre in soil stabilization to increase its shear strength and bearing capacity and hence the problem associated with disposal of human hair is minimized significantly. Stabilized soil is, in general, a composite material that results from combination and optimization of properties in individual constituent materials. The major classifications are mechanical stabilization, hydraulic stabilization, physical & chemical stabilization and stabilization by inclusion and confinement. Of these methods, last two methods are by which we can effectively use solid waste materials. Substitution of natural soils, aggregates, and cement with solid industrial or natural wastes is highly desirable. Recently soil reinforcement with short, discrete, randomly oriented fibres is getting more attention from many researchers around the world. Extensive studies were carried out on the stabilization of soft clays and expansive clays using various additives such as lime, cement, synthetic and natural fibres. Ranjan conducted a series of tri-axial tests to study the behaviour of Plastic Fibre. The test result reveals that the strength significantly improves with the inclusion of Human hair and it further improved when optimum percentage of both lime and human hair were added together. Thus soil properties of low-lying areas can be improved to a great extend while suggesting a solution to a major environmental issue of human-hair disposal.

## II. EXPERIMENTAL INVESTIGATION

### 2.1 Material used

#### 2.1.1 Soil

Sample of soil was taken from college football ground and lab tests for evaluating different index properties of soil sample were conducted as per IS code. Nearly 4kg of soil sample was collected from ground and add required

water. Then the soil was sieved through 4.75mm sieve so as to remove the gravel fraction.

### 2.1.2 Human Hair Fibre

Human hair fibres were used throughout this study to reinforce the soil. They are considered as valueless solid wastes which are being dumped to waste landfills. They consist of fibres of varying length (5–50 mm) and diameter (17–100 micro meter). Scanning Electron Microscope analysis was conducted to obtain the average diameter of human fibre. The parameter of concern in fibre selection was fibre content by weight of soil. Samples were prepared by adding fibre content of 0%, 1.0%, 1.5%, 2.0% and 2.5% by weight of soil. typical fibres used in this study.

**Table 1 Properties Of Soil**

| properties               | Result    |
|--------------------------|-----------|
| Specific gravity         | 2.61      |
| Liquid limit             | 34.1      |
| Plastic limit            | 21.15     |
| Maximum dry density      | 1.89gm/cc |
| Optimum moisture content | 20%       |

**Table 2 Properties Of Human Hair**

| Properties      | Result             |
|-----------------|--------------------|
| Cross-section   | circular           |
| Diameter        | 17-100 micro meter |
| Length          | 5-50mm             |
| Outer covering  | cuticle            |
| Protein present | Keratin            |

### 2.2 Preparation Of Samples

All the samples were prepared at OMC and MDD. Different percentages of fibre content are 0% 1%, 1.5%, 2%, 2.5%. fibres are mixed in soil.

### 2.3 Laboratory Tests

- The liquid limit and plastic limit of soil sample is determined as per IS: 2720 ( part-3)
- Specific gravity of soil sample is determined as per IS:2720 (part-5)
- Determination of OMC and MDD as per IS :2720(part 7).
- CBR value is determined using CBR test.

### 2.4 MINITAB Software

Minitab is a software package that helps you to analyse data. Analysing data is an important part of Six Sigma but it's not the whole story. particularly in the Measure and Analyse phases of DMAIC. Minitab provides a quick, effective solution for the level of analysis required in most

Six Sigma projects. Minitab's capabilities extend far beyond those required for most Six Sigma projects. But, it's also very easy to use for a range of basic graphs and statistical tools that are used in Six Sigma. You don't need to know all of Minitab's functions to produce simple histograms, Pareto or Run charts for example.

## III. RESULT AND DISCUSSION

Proctor test is conducted on soil to determine the maximum dry density and optimum moisture content with different percentage of human hair fibre. At 0.5% of HHF the MDD increases and OMC decreases after increasing the % of HHF it become reversed ie. MDD decreased and OMC increased .similarly the CBR value increased with different % of HHF as compared with unreinforced soil. The maximum CBR value at 2% of HHF after increasing the % of HHF the CBR value decreased.

**Table 3 CBR Test Result**

| Percentage of HHF | CBR value in % |
|-------------------|----------------|
| 0%                | 1.37%          |
| 1%                | 2.43%          |
| 2%                | 2.9%           |
| 2.5%              | 2.73%          |

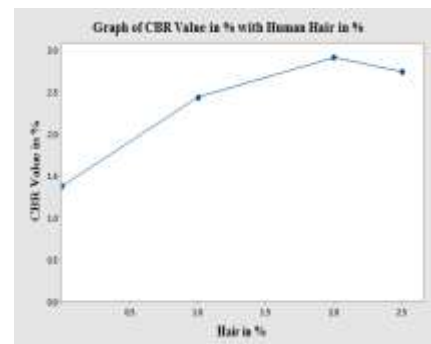


Fig 1 CBR value is % with human hair

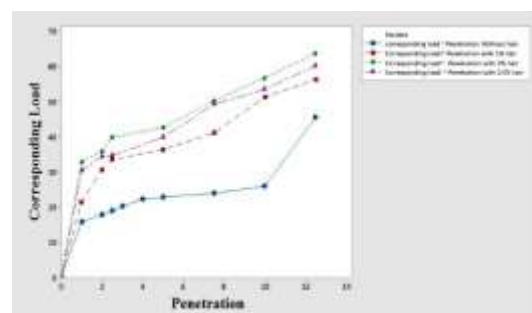


Fig 2 load verses penetration curves for different fibre content

#### IV. CONCLUSION

- CBR Value is observed to be maximum at 2 % of HHF Content in soil specimen. Further addition of human hair fibre CBR value tends to decrease.
- At high fibre Content decrease in CBR value can be due to balling effect.
- MDD initially reduces lightly due to addition of light weight hair fibre and then practically remains same. OMC increases marginally due to moisture absorption of hair fibres.

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