# Improvement in Strength of Road by Use of Nano Material

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*Abstract*— Our purpose is to improve engineering properties of soil, To improve load bearing capacity of soil, To reduce the cost of construction, by laying stabilized gravel road in low traffic volume areas. To construct the road with low cost, with the help of nanomaterials, to construct the road with zero bitumen. Materials used here are soil, cement, chemical solutions (nanomaterial).

***Key words:*** Nanomaterials, Roads, Uses, Technology, Soil Tests

## I. INTRODUCTION

"Nanotechnology is an enabling technology that allows us to develop materials with improved or totally new properties"

- Soil stabilization is the good lasting alteration of any property of the soil to improve its property as well as engineering performance.
- Stabilization of low quality aggregate or soil can be done by mechanical, chemical, electrical or thermal. Chemical stabilization involves addition of cement, lime, fly-ash, bitumen, chemical compounds etc.
- Stabilization is being used for a variety of engineering works, the most common application being in the construction of road and airfield pavements, where the main objective is to increase the strength or stability of soil and to reduce the construction cost by making best use of locally available materials.

### A. *Need of Study*

- Local soils often have low CBR, and are not useful for road construction.
- Good soils and aggregates are limited and may have to be brought from a long distance.
- This may be expensive and fuel intensive (carbon footprint).
- Surface waterproofing with Terrasil and ZycoBond ensures reduction in water permeability.

### B. *Scope of Study*

- Study of IS: 4332(Method of Soil stabilization) and relevant IS codes required for our project.
- Various Soil test (as per IS: 2720) are to be carried out in laboratory.
- Analysis of collected data and perform tests as per requirement of IS of Soil Stabilization.
- Compare Test results of treated soil and untreated soil. We have interest in analyzing rural roads using nanomaterial and cement.

### C. *Objectives*

- Implement technology on rural road construction.
- To improve engineering properties of soil and to reduce the thickness of the pavement layers and to reduce the cost of construction, by laying stabilized gravel road in low traffic volume areas.

## II. SOIL TEST REQUIRED

Various soil test to be carried test to be carried out are listed below.

| No. | Soil Test | Is code |
|---|---|---|
| 1 | Sieve Analysis | IS2720-part 4 |
| 2 | Modified Proctor | Is2720-par t8 |
| 3 | Free Swell Index | Is2720-Part 2 |
| 4 | Atterberg's Limit | Is2720 |

Table 2.1: Various Type of Soil with IS Codes

### A. *Various Test of Soil*

#### 1) *Sieve Analysis*

a) Objective

Determination of quantitative size distribution of particles of soil down to fine-grained fraction.

b) Apparatus

1) Set of sieves (4.75mm), B
2) Balance (0.1g accuracy),
3) Drying oven, Rubber pestle, Cleaning brush,
4) Mechanical shaker.

Fig. 2.1.1:

#### 2) *Modified Procter Test*

a) Objective

To determine moisture content and dry density relationship using heavy compaction or modified compaction method.

b) Apparatus

1) Metal mould (volume = 1000 cm3)
2) Balance (capacity = 10 kg, least count = 1g)
3) Oven (105 to 1100C)
4) Sieve (19 mm)
5) Metal rammer (weight = 4.9 kg)

 

Fig. 2.2.2:

*3) Free Sweel Index*

a) Objective

Free swell index, is the increase in volume of soil without any external constraint when to submergence in water.

b) Apparatus

1) Sieve (425 micron IS sieve)
2) Glass Graduated Cylinders- Two, 100-ml capacity

Fig. 2.3.3:

*4) Atterberg's Limit*

a) Objective

The method of taste covers the procedure for determination of liquid limit and plastic limit of soil.

The liquid limit of soil is the water content, expressed as a percentage of the weight of the oven dried soil. At the boundary between liquid and plastic state of consistency of the soil that corresponds to the moisture content of a paste which would give 25mmpenetration of cone.

The plastic limit of the soil is the water content, expressed as percentage of the weight of oven dry soil. At the boundary between the plastic and the semi solid states of consistency of the soil. It is the percentage of moisture content at which 3mm dia. Thread crumbled.

b) Apparatus

The app. Required for the test is as follows:

1) Uppal's cone penetrometer
2) Oven (Maintain the temp. betn. 105- 110*C
3) Balance (cap 210gm, accuracy 0.01gm)
4) 3mm dia. Steel rod
5) Nickel Crucible

*5) Atterberg's Limit*

a) Liquid Limit

1) Take oven dry soil sample passing throughout 425 micron sieve.
2) Make a paste by required distilled water and transfer it to the cylindrical cup such thatthere is no air bubble.
3) Adjust the moisture content such that penetration reading is in between 16-26 mm.
4) Determine moisture content.

*6) Plastic Limit*

1) Make paste by adding required distilled water.
2) Make a thread of 3mm dia.
3) When 3mm dia. Thread starts crumbling, collect representative solid thread in crucible.
4) Determine moisture content.

## III. PRESENT VIEW ON NANOTECHNOLOGY

In the present, it is observed that the behavior of soil changes with the addition of nanomaterials.

The amount of stabilizer required for appreciable stabilization depends on the characteristics of soil.

Nanomaterail based stabilizers will works well with the combination of cement and makes the soil stiff, So that in low traffic area stabilized gravel road can be constructed.

From economy point of view, benefit associated with the utilization of nanomaterials with cement is attractive and supports the sustainable development in road construction.

## IV. PROBLEM IDENTIFICATION

Fig. 4.1.1:

Fig. 4.2.2:

 

Fig. 4.3.3:

Unpaved roads may generate a lot of dust during dry periods. This dust can alter roadside vegetation, and has been considered to harm human health.

Dirt roads may only be passable by trucks or four-wheel drive vehicles especially in wet weather.

*A. Dust Problem in Unpaved Road*

a) roadway safety problems due to impaired visibility,
b) reduced roadway longevity due to a loss of surfacing/binding materials,
c) Reduced vehicle life, and environmental health issues due to the many negative impacts of particulate matter in the atmosphere.
d) Dust and drainage problem effect the human body and environment.

## V. CONCLUSION

Water permeability, erosion control and other properties are also improved for use of nanomaterials.

The nano materials utilised, attractive and supports for the sustainable development in road construction.

Nanomaterials are used to increase the durability of soil, subgrades and implement the technology on the rural roads.

Nanomaterials used to resistance to soil erosion and dust control.

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