Subgrade Stabilization Using Nano Chemicals

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Abstract- *Stabilization of soil using various techniques for modifying the Geotechnical and Engineering properties of a soil to improve its engineering performance is available. Road construction on soils with poor engineering properties necessitates adoption of stabilization techniques. This research work investigates the effects of treating a soils having poor geotechnical properties with Nano chemicals and effectively used for subgrade material. Nano chemicals are found to improve the Geotechnical and Engineering properties of road sub grade and thus performance of roads. The Nano chemicals used in this study are Zycobond and Terrasil from Zydex industries. To evaluate the effect of these Nano chemicals, they were treated with varying dosages such as 0.06%, 0.07%, 0.08%, 0.09%, 0.1%. CBR, unconfined compressive strength and compaction were done on soil with the additive at various curing periods.*

Keywords- Nano chemical, Subgrade, Terrasil, Zycobond

I. INTRODUCTION

For improving strength and durability there are a number of chemical additive both organic and inorganic which are commonly used. Among which Nano chemicals are the material which are recently used for the purpose of stabilization in various engineering fields. For the construction of roads which are the main parts of a city the subgrade should be strong enough so that it should not allow ingression of water, long durability, resistance to deformation under loadetc. The main problems associated with the easy damaging of roads are weak subgrade. By this study it involves by treating a weak red soil from the site and treating the soil with Nano chemicals in various percentages such as 0.06, 0.07, 0.08, 0.09, and 0.1 % upon various curing periods such as 0,3,5,7 and 14 days. The optimum dosage is found from various tests like CBR, unconfined compressive strength, compaction etc.

II. MATERIALS

The materials used in the study are as follows.

A. Soil

The soil (fig 1) is collected from Kazhakuttom, Trivandrum, Kerala. The properties of the soil is as recommended in Table 1

Table 1 Properties of soil

PROPERTIES	VALUES
Specific Gravity	2.62
Liquid Limit (%)	35
Plastic Limit (%)	24.47
Shrinkage Limit (%)	16
IS Classification	CI
Clay %	57
Silt %	24
Sand %	19
OMC %	17
Dry Density (ken/m³)	1.7
Ucc (kN/m²)	33.23

Fig 1 soil collected from Kazhakuttom

B. Nano chemicals

Nano chemicals are materials that are manufactured at a scale that is 10 thousand times smaller than the size of human hair. The Nano chemical used here is Zycobond and terrasil from zydex industries private Ltd, Gujarat. These are added in the soil by diluting it in 100 ml of water.

Zycobond nano materials are Nano polymer that chemically binds soil particles together into a flexible cross-linked network. The chemical binding and Nano size of the polymer leads to improved load bearing capacity and flexibility of the soil base, water-soluble, reactive soil

modifier. It can reduce water permeability of soil bases, whilst maintaining 100% vapour permeability.

Terrasil is easy to apply as soil modifier that permanently eliminates infiltration of water in to soils. Terrasil is a reactive soil modifier that permanently modifies the soil surface, making it hydrophobic. It chemically converts water absorbing hydroxyl groups to water resistant alkyl groups. It is a no leachable and safe chemistry, and works with all soil types. It is designed to be utilised with ZycoBond. Terrasil treated soil bases remain significantly dry throughout periods of rain and allows the escape of any trapped water in the soil base in the form of vapour. lt also reduces expansiveness by up to 90 % and improves the ease of compaction.

Fig 2 Zycobond sample from Zydex industries

Fig 3 Terrasil sample

III. RESULT AND DISCUSSION

Variation of strength of soil with Nano chemicals

Soil is added with varying percentages of Nano chemicals such as 0.06%, 0.07%, 0.08%, 0.09%, and 0.1% by mixing the required quantity in 100 ml of water. This soil additive mix is kept for curing for 0, 3, 5, 7, 14 days in an airtight plastic bags. Strength of various mix found from unconfined compressive strength values at various curing periods. The variation is given in chart 1

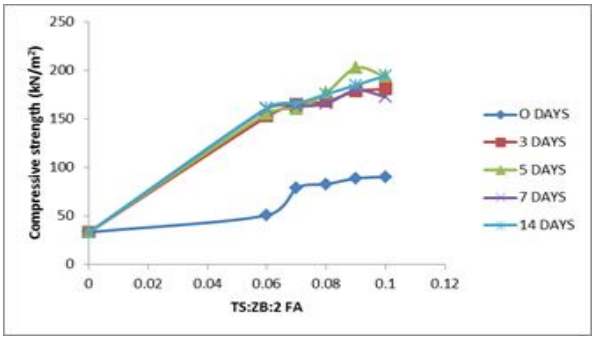

Chart 1 Variation of strength with various percentages of Nano chemicals

From chart 2, 0.09 % of Nano chemical with 2% in soil 2 gave maximum value of 209 ken/m^2.5 days curing was the optimum.

Variation of maximum dry density

Samples for conducting experiment is prepared same as like us test. Proctor compaction test is done to determine the maximum dry density and optimum moisture content. Variation is as in chart 2

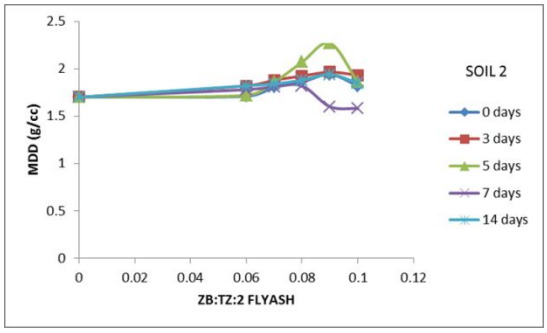

Chart 2 variation of MDD with % of Nano chemicals

From chart 3 it is clear that MDD of soil 2 was maximum at 0.09% with 5 days of curing. MDD of soil 2 increased by 31.1 %. MDD decreased after 0.07 % nano chemical due to the replacement of soil solids by nano chemical.

Variation of optimum moisture content.

Chart 3 shows variation of optimum moisture content.

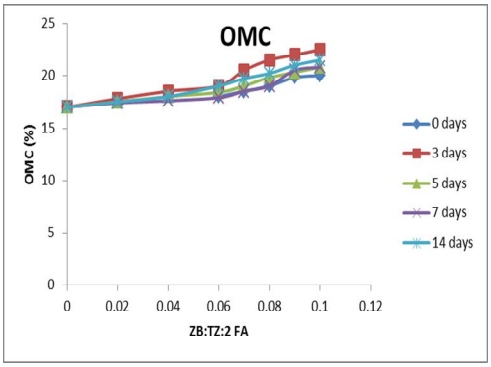

Chart 3 Variation of optimum moisture content with % of nano chemicals

Optimum moisture content increased for soil 2 with increase in curing period may be due to easy drying up of the surface of treated soil. With the increase in chemical content there was a difficulty for compacting therefore OMC increased.

CBR variation

The variation of soaked CBR value is shown in chart 4

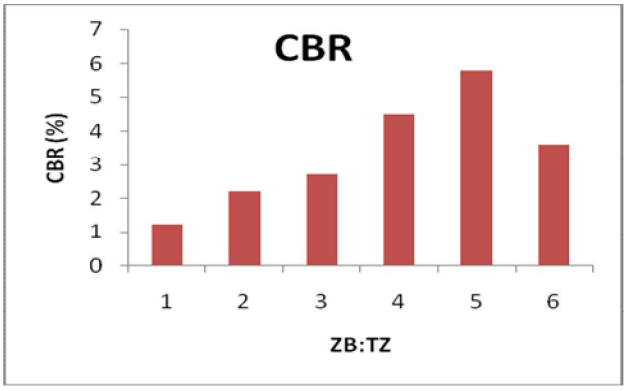

Chart 4the variation of CBR

There is an increase in CBR value for 0.09% additive which is equal to 5.8%.

IV. CONCLUSION

Optimum dosage for soil is 0.09:0.09 percentages. With the addition of Nanochemical mix maximum dry density increased. CBR value increased to 112% hence can be used for subgrade construction. Due to increased value of CBR, thickness of pavement can be reduced. The problem encountered due to pot holes in pavement can be reduced by the addition of Nano chemicals

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