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# Soil Stabilization using Pro-base Technology

Dr. Sanjeev Kumar Gupta[1] and Gurmeet Singh[2]
[1]HOD, Civil Engineering Department, Government College of Engineering and Technology, Jammu, Jammu & Kashmir, INDIA
[2]Assistant Professor, Department of Civil Engineering, Government College of Engineering and Technology, Jammu, Jammu & Kashmir, INDIA

Corresponding Author: gurmeet.b.tech@gmail.com

**ABSTRACT**

**Roads are the lifeline of the nation and hence a road must be of better quality which could make effective land access possible. According to a research conducted in Sri Lanka, if you want to rescue a village from poverty, 10-20 years of educational subsidy might not work, but if the same amount of money is funneled on road infrastructure development, you can see results within 2 years. An effective road network ensures efficient delivery of goods and transportation of people, directly contributing to the economic growth of the region. Due to economic reasons in developing nations like India, it is not possible to make paved roads especially in rural areas. These areas are mostly connected by the use of unpaved roads called as earth road or soil roads. But there are many problems associated in building these roads particularly like deterioration of the surface usually by rutting and formation of potholes, dusty in dry state and muddy during wet state. The basis of this report is to make aware about the non-traditional soil stabilization technique using Probase SH-85 Soil Hardener for hardening soil of any type and TX-85 Soil Stabilizer & Strengthener for stabilizing unstable soil and at last sealing it by spraying with Probase PB-65 Soil Sealant on soil surface. The Probase Road System ensures making soil road no longer dusty and muddy. These products are free from toxins and are environmental friendly unlike bitumen, soil-cement, lime and asphalt roads. Probase soil stabilizer will hence not only help in stabilizing the soil but will also reduce maintenance and construction cost, along with ensuring that the roads remain open and well operational in rainy season and dust-free in dry season that is to make it an all-weather road.**

***Keywords*--** Probase PB-65 Soil Sealant, Probase SH-85 Soil Hardener, Probase TX-85 Soil Stabilizer & Strengthener, OMC, UCS, MDD, CBR

## I. INTRODUCTION

The stability of the underlying soil determines the total performance of the pavement. The structural quality of each layer has the inner ability to provide support and helps in distributing superimposed load. Since the available earth does not have the appropriate properties to serve the engineering purpose and therefore needs to be substituted by effective materials to modify and improve their properties. It is not always efficient to import good quality material to the construction site and therefore locally available material has to be modified for engineering purposes. This is usually done by physical or chemical stabilization. Soil stabilization means to alter any property of soil to improve its engineering and structural performance permanently. Engineering properties of soil depends upon different soil composition, different geological deposits and physical/chemical interaction of soil particles. Due to all these differences it is necessary to do its site specific treatment for stabilization. It is important to consider various engineering aspects before stabilization to have effective and efficient solution. Stabilization can be done by various means such as electric, thermal, mechanical and chemical. Mostly mechanical and chemical stabilization are adopted. Mechanical stabilization also known as compaction is done by densification of soil by applying mechanical energy. It occurs when air is expelled out of the soil voids without much affecting the water content. It is more suitable for cohesion-less soil as compared to cohesive soil as cohesion force and inter-particle bonding interferes with particle rearrangement during the process of compaction. Hence physio-chemical(Physical & Chemical) properties of fine grained soil by using chemical stabilizers/modifiers is most efficient stabilization than densification in fine grained soil. It is always advised to before applying any technique/method for soil stabilization it is important to study it in the laboratory.

## II. OBJECT & SCOPE OF INVESTIGATION

The objective of this work is to evaluate additive of Eco-Green Road system (SH-85 and TX-85) as a soil stabilizer for flexible pavement and characterization of soil sealant (PB-65). To assess the efficacy of the additive, the following laboratory experiments were carried out:

- Geotechnical characterization of soil.
- Study of modification of soil by additives of Eco-Green road system.
- Strength and durability assessment of soil

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stabilized with additives of Eco-Green road system.
- Characterization of soil sealant.

## III. RESEARCH METHODOLOGY

The whole study and investigation was done to find the change in the strength of soil (taken from **SIROFATI** road) after adding admixtures like **SH-85 & TX-85.** The study consists of various tests like sieve analysis, liquid limit test, plastic limit test and proctor test on the natural soil deposits (without adding admixtures) & UCS and CBR were done on the samples made from both the natural soil and soil with admixtures. In the given below table the various properties of SH-85 & TX-85 are listed below.

**Table 1: Product Specifications for TX-85 Soil Stabilizer & Strengthener**

| Parameters | Test Methods/ Test Equipment | Requirements |
|---|---|---|
| Calcium, %w/w | Test by AAS | 0.1 - 0.5 |
| Sodium, %w/w | Test by AAS | 3.5 – 6.5 |
| Silica, %w/w | By Colorimetry + Gravimetry | 15 - 24 |
| Specific Gravity | By Hydrometer (At Ambient Temp.) | 1.28 – 1.35 |
| Particle Charges | By pH meter | ( - ) negative |

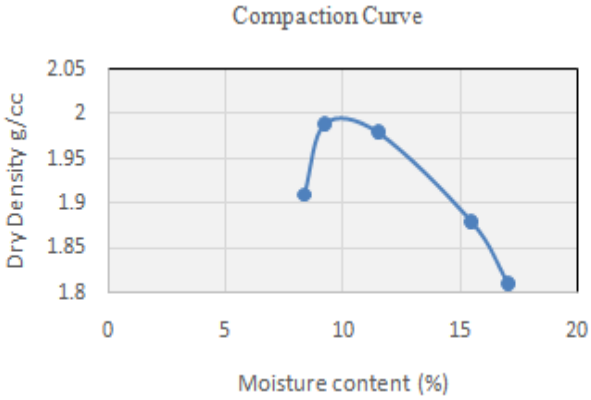
**TABLE 2: Product Specifications for SH-85 Soil Hardener**

| Parameters | Test Methods/ Test Equipment | Requirements |
|---|---|---|
| Bulk Density, kg/L | By Gravimetry | 0.65 – 0.80 |
| Iron, %w/w | Acid Digestion – AAS | 0.6 – 1.0 |
| Calcium, %w/w | Acid Digestion – AAS | 1.0 – 2.5 |
| Aluminium, %w/w | Acid Digestion – ICP-OES | 1.0 – 1.5 |
| Sulphur, %w/w | Acid Digestion – AAS-OES | 0.3 – 0.6 |
| Silica, %w/w | By gravimetry + Colorimetry | Minimum 65 |

### *3.1 Specimen for Testing*

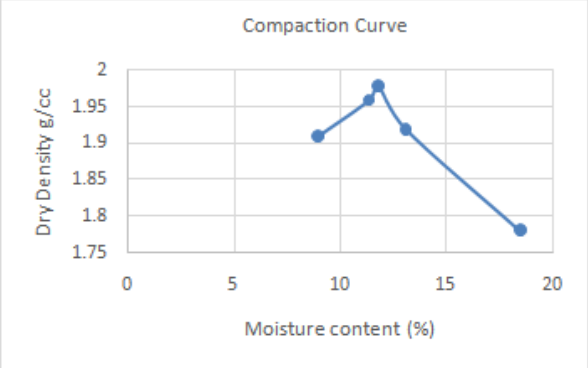
The Proctor test determines the optimum water content for the compaction of that particular soil. Compaction test was done as per IS: 2720 (Part 8). To see the change in OMC and MDD value, the proctor test of natural soil with additives was also done The samples for UCS & CBR were prepared at OMC and MDD which were predetermined through proctor tests. The OMC and MDD is taken as average of all the samples. The OMC and MDD for different samples taken are given as follows:

**Figure No. 1**



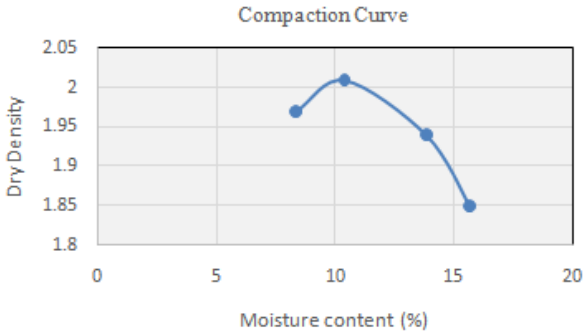

**SAMPLE NO. 1: OMC= 9.27, MDD= 1.99**

**Figure No. 2**




**SAMPLE NO. 2: OMC= 11.78, MDD= 1.98**

**Figure No. 3**




**SAMPLE NO.3: OMC= 10.43, MDD= 2.01**

The various moulds used were as follows:

- **UCS:** Cylindrical split type mould having internal dia. 2inch &height 4inch.UCS test determines the very unconfined compressive nature, which actually means the soil is supported by itself by means of internal bonding and strength of clayey soil. The test is strain controlled as when the soil

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sample is loaded rapidly the pore pressures (water within the soil) undergo changes that do not have enough time to dissipate. Unconfined compressive strength may be defined as the load per unit area at which an unconfined cylindrical specimen of soil will fail in shear in the axial compression test. It was done as per IS: 2720 (Part 10). UCS test was done on both unmodified and modified soil. The samples were prepared at OMC and MDD. Test samples were kept in desiccators to retain moistures of the sample

- **CBR:** Cylindrical mould having internal diameter 150mm and a height of 175mm which is provided with a detachable collar 50mm height.CBR test is a penetration test for evaluation of the mechanical strength of road sub grade and bases. Test involves the measure of pressure required for penetration of standard plunger into soil sample. CBR is defined as ratio of pressure required to penetrate a standard plunger into soil sample to the pressure required to achieve an equal penetration on a standard crushed rock material. Higher CBR value represents the higher bearing capacity of soil. The test was done as per IS: 2720 (Part 16). CBR (four day soaked) test was done on both modified and unmodified soil.

**Figure No. 4**

**Unconfined Strength Testing Machine**

**Figure No. 5**

**CBR Mould**

## IV. RESULTS AND DISCUSSION

The test results obtained are shown below. From the following table it can be seen that on addition of SH-85 & TX-85 the mechanical strength of the soil is increased.

| Different dose of additives(0.165% TX-85) | CBR% | UCS (kg/cm$^2$) |
|---|---|---|
| Natural soil 14 days curing | 0.74 | 0.297 |
| 2% SH-85,14 days curing | 3.5 | 0.193 |
| 3.5% SH-85, 14 days curing | 5.6 | 0.329 |
| 5% SH-85, 14 days curing | 7.8 | 0.607 |
| 2% SH-85,10days curing 4 days soaking | 2.3 | 0.163 |
| 3% SH-85,10days curing 4 days soaking | 5.5 | 0.23 |
| 5% SH-85,10days curing 4 days soaking | 12.5 | 0.59 |

## V. CONCLUSION AND FUTURE SCOPE

Based on laboratory studies, it was concluded that soil treated with **5 % SH-85 and 0.165% TX-85** additives of Ecogreen Road system can be considered for stabilization of subgrade for low volume traffic roads i.e. less than 1 msa traffic. The roads of rular areas where it is

quite difficult to stabilize the roads with other techniques can be easily treated with probase technology by the addition of SH-85 and TX-85. As such roads have low traffic volume and density such roads can withstand various loads by the use of SH-85 and TX-85. These stabilizers can further be used with other solvents with utmost care and only after proper testing. in India the probase technology is generally used in far flung areas or the roads which are under the scheme of PMGSY like that in Udhumpur side of Jammu. SH-85 and TX-85 can also be used with PB-65 for further improvement in the soil stabilization technique. It should be kept in mind that not so much research has been done on this topic because of the nature of the technology as it is restricted to be used in rular areas. Also it should be noted down that the results may vary from place to place as the nature of the soil itself changes or varies accordingly. This technology can also be used in the stabilization of steep slopes so as to prevent them from sliding or overturning.

## REFERENCES

[1] www.ncbi.nlm.nih.gov/pmc/articles/PMC4756670/.
[2] www.sciencedirect.com/topics/engineering/soil-stabilization.
[3] iopscience.iop.org/issue/1755-1315/220/1.
[4] A C S V Prasad & C.N.V. Satyanarayana Reddy. (2015). Strength characteristics of cement stabilized well graded gravel. In: *50th Indian Geotechnical Conference*, *Pune*, India.
[5] civilengineer.co.in/wp-content/uploads/2017/03/IS-2720-PART-10-1991-INDIAN-STANDARD-METHODS-OF-TEST-FOR-SOILS-DETERMINATION-OF-UNCONFINED-COMPRESSIVE-STRENGTHSECOND-REVISION.pdf.
[6] geotechnicaldesign.info/bs5930-2015/g46-4.html.
[7] www.solidbasemalta.com/materials.html.
[8] www.ncbi.nlm.nih.gov/pmc/articles/PMC5008773.