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Soil Stabilization Using Human Hair and Terrasil For its Potential Use in Sub grade

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ABSTRACT: This research paper deals with the study of humanhair fibre and TERRASIL for stabilization of soil. Human hair fibre and TERRASIL are used as reinforcement material reinforcement toimprove theshear strength parameters of weak soils. clayey soils (Low bearing capacity soils) possess threat for the construction of building due to its low shear strength and high swelling characteristics. In this experimental work, clayey soil is treated with human hair in the proportion of 0.5%,1.2% & 1.5% and TERRASIL in proportion of 0.9%,1.1% &1.3% and then compaction test, unconfined compression test was carried out. Physical properties of soil like Atterberg's limits, compaction characteristics of virgin soil sample were also determined. Human hair fibre is a natural non – biodegradable waste material, which creates environmental problem. Human hair and TERRASIL proved to a worthwhile as well as versatile stabilizers for soils as both the additives enhances almost all-important geotechnical properties of soil.

KEYWORDS: Soil stabilization, Human hair fibre, TERRASIL, compaction, compression, Optimum moisture content (OMC), Maximum dry density (MDD)

I. INTRODUCTION

Soil stabilization is process of altering the engineering properties of soil. Stabilization is used to reduce the permeability and compressibility of soil and toincrease its shear strength and bearingcapacity of foundation soils. the main objective ofsoil stabilizationis to increase the strength of soil and to reduce the cost of making best use of frequently available material. During current times human hair fibre (HHF) is considered as a waste material inTERRASIL 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. A TERRASIL solution (1:200 dilution) when spray applied and mixed can reduce water permeability by a factor of 500 most parts of world and it create many environmental problems however it has many known users like Soils are generally stabilized to increase their strength and durability or to prevent erosion and dust formation in soils. The main aim is the creation of a soil material or system that will hold under the design use conditions and for the designed life of the engineering project. The properties of soil vary a great deal at different places or in certain cases even at one place; the success of soil stabilization depends on soil testing. Various methods are employed to stabilize soil and the method should be verified before applying it on the field.

II. METHODOLOGY

Samples of soil were taken near SSM College of engineering and technology parihaspora Pattan Baramulla Kashmir (India). the various preliminary tests for the index properties and strength parameters were done as per IS code.

Human HairFibre

The hair thread is a natural fibre formed by keratin. Human hair creates environmental problems to minimize that it can be used as reinforcing agent, addition ofhair fibre to the soil sample increases the binding properties. by the addition of human hair to soil itsCalifornia Bearing Ratio (CBR) gets increased. It also helps in decreasing the permeability of soil.

Terrasil

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. Terrasil is a non-leachable and safe chemistry and works with all soil types. It reduces water permeability, reduces expansivity, increases compaction.

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A Terrasilsolution (1:200 dilution) when spray applied and mixed can reduce water permeability by a factor of 500.TERRASIL reduces expansiveness by up to 90% at dosage of 0.5 to 1kg per cubic meter of soils.



Tests

The tests performed on soil samples are specific gravity test, liquid limit test, plastic limit test, proctor compaction test, unconfined compression test and the results are given below.

| S. No. | Property | Value |
|--------|--------------------------|-----------|
| 1 | Specificgravity | 2.23 |
| 2 | Liquid limit | 33.8% |
| 3 | Plastic limit | 24.4% |
| 4 | Optimum moisture content | 11% |
| 5 | Maximum dry density | 1.81 g/ml |
| 6 | Plasticity index | 58.2% |

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III. RESULTS

Result of proctor compaction test with 0.9Terrasil

| Determination no. | Percentage of water | | | | |
|---|---------------------|-------|-------|-------|-------|
| | 4% | 8% | 12% | 16% | 20% |
| Weight of empty mould (Wm g) | 4318 | 4318 | 4318 | 4318 | 4318 |
| Weight of mould +compacted soil (Wg g) | 5770 | 5880 | 5840 | 6025 | 5990 |
| Weight of soil in mould W=Wg- Wm | 1452 | 1562 | 1522 | 1707 | 1672 |
| Wet density (g/cc) | 1.45 | 1.56 | 1.52 | 1.70 | 1.67 |
| Moisture content w% | 21.08 | 21.43 | 23.21 | 25.01 | 27.99 |
| Dry density (g/cc) | 1.199 | 1.220 | 1.235 | 1.365 | 1.306 |
| Void ratio e= | 1.31 | 1.27 | 1.25 | 1.03 | 1.12 |



Result:

optimum moisture content = 25.40% Maximum dry density =1.370 g/cc



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Result of proctor compaction test with 1.1% Terrasil

| Determination no. | Percentage of water | | | | |
|---|---------------------|-------|-------|-------|-------|
| | 4% | 8% | 12% | 16% | 20% |
| Weight of empty mould (Wm g) | 4318 | 4318 | 4318 | 4318 | 4318 |
| Weight of mould +compacted soil (Wg g) | 5845 | 5870 | 5900 | 6055 | 6040 |
| Weight of soil in mould W=Wg- Wm | 1527 | 1552 | 1582 | 1737 | 1722 |
| Wet density (g/cc) | 1.53 | 1.55 | 1.58 | 1.74 | 1.72 |
| Moisture content w% | 18.93 | 22.97 | 24.38 | 27.27 | 28.46 |
| Dry density (g/cc) | 1.284 | 1.262 | 1.272 | 1.365 | 1.340 |
| Void ratio e= | 1.16 | 1.20 | 1.18 | 1.03 | 1.07 |



Result:

optimum moisture content =27.8% Maximum dry density =1.368 g/cc

Result of proctor compaction test with 1.3 Terrasil

| | Percentage of water | | | | |
|---|---------------------|-------|-------|-------|-------|
| Determination no. | 4% | 8% | 12% | 16% | 20% |
| Weight of empty mould (Wm g) | 4318 | 4318 | 4318 | 4318 | 4318 |
| Weight of mould +compacted soil (Wg g) | 5790 | 5840 | 5870 | 5900 | 5990 |
| Weight of soil in mould W=Wg- Wm | 1472 | 1522 | 1552 | 1582 | 1672 |
| Wet density (g/cc) | 1.47 | 1.52 | 1.55 | 1.58 | 1.67 |
| Moisture content w% | 19.55 | 20.48 | 22.10 | 24.31 | 25.59 |
| Dry density (g/cc) | 1.228 | 1.263 | 1.271 | 1.273 | 1.292 |
| Void ratio e= | 1.26 | 1.20 | 1.18 | 1.18 | 1.15 |

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Result

Optimum moisture content = 28% Maximum dry density = 1.320 g/cc

Result of standard proctor test with varying Human Hair Fibre:





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Result of unconfined compression test with varying Human Hair Fibre:



Result of unconfined compression test with varying Terrasil:



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IV. CONCLUSIONS

The physical properties and engineering characteristics of virgin soil is studied, which includes moisture content, specificgravity, Atterberg'slimits, compaction characteristics and unconfined compressive strength. The addition of human hair fibre and Terrasil improved the properties of the virgin soil, making it good for sub- base material.

- 1. It is observed that the maximum dry density decreased from 1.81gm/ml to 1.55 gm/ml,1.38gm/ml and 1.365gm/ml on addition of 0.5%.1.2% & 1.5% human hair fibre respectively.
- 2. It is noticed that the optimum moisture content of the clayey soil increased from 11% to 13.2% and 25.7% on addition of 0.5%,1.2% human hair fibre respectively.
- 3. It is observed that the shear strength of clayey soil increased from 124 kn/m2 to 156.57 kn/m2 on addition of 0.5% human hair fibre but decreased to 92.214 kn/m2 and 91 kn/m2 on addition of 1.2% and 1.5% human hair fibre respectively.
- 4. The optimum values of unconfined compressive strength (shear strength) were achieved at 0.5% human hair.
- 5. it has been observed that maximum dry density of clayey soil decreases with increase in Terrasilcontent. The maximum dry density of parent clayey soil was observed to be 1.437g/cc.with the addition of Terrasil,MDD value starts decreasing.it was found to be 1.320g/cc at Terrasil content 1.3%.the decrease in value of max dry density may be due to formation of new chemical product after reaction between soil and chemical.
- 6. It has been observed that optimum moisture content of parent soil was 23.7%. with the addition of Terrasil, OMC value starts increasing.it was found that OMC value increased from 23.07% to 28% at Terrasil content 1.3%.
- 7. It has been observed that compressive strength of clayey soil increases with increase in percentages of Terrasil in parent soil .1.1% Terrasil content gives the max value of compressive strength.

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