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ENHANCEMENT IN STRENGTH OF CLAYEY SOIL BY RECRON 3S FIBER AND ALCCOFINE 1203- A Review

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ABSTRACT:- **Geotechnical engineers face various problems while designing the foundations on highly compressible clayey soil due to poor bearing capacity and excessive settlement. Most of the soil available are such that they have good compressive strength adequate shear strength but weak in tension / poor tensile strength. The quality and life of asphalt is enormously influenced by thesort of subgrades. In any case in India the greater parts of the adaptable asphalts have to be built over feeble and dangerous sub- grade. The California bearing proportion (CBR) of these subgrade have low, it needs to more thickness of pavement. Lessening in the accessibility of suitable sub base and base materials for asphalt development have prompts a look for financial technique for changing over generally accessible tricky soil to suitable development material. There is increase in the percentage of UCS, when sample were prepared with 2%, 4% by 3.02%, 4.70% and decrease in percentage of UCS, when sample were prepared with 6%, 8% Alccofine by 1.01%, 5.70% as compared to raw soil. The increase in UCS is maximum at 4% ALCCOFINE i.e. 4.70%. The experiments in combined sample of ALCCOFINE and Recron-3s fiber(2cm, 4cm, 6cm) shows that the maximum value of UCS are obtained at 4cm length with 1.5% by weight, which is found to be 3.73 kg/cm². The percentage increase as compared to the raw soil is 25.16%. The soaked CBR value of the raw soil is 1.81%. The soaked CBR value of the raw soil with 4% ALCCOFINE is 2.59%, the percentage increase in CBR value as compared to raw soil is 43.10%, The soaked CBR value of combined soil sample with 4% ALCCOFINE, 1.5% of Recron-3s fiber of 4cm length is found to be 3.09%, the increase in CBR value as compared to raw soil is 70.16%.**

Keyword:- Soil, Alccofine 1203, Recron Fibre-3s, Maximun Dry Density, Optimum moisture content, Expansive Soil, CBR, UCS

Index Terms: — **Soil, Alccofine-1203, Recron Fibre-3s, Maximun Dry Density, Optimum moisture content, Expansive Soil, CBR, UCS**

I INTRODUCTION

Soils are complex mixtures of minerals, water, air, organic matter, and countless organisms. Various types of soil available in India like alluvial soils, black cotton soils, laterites soils, mountain soils, desert soils, red soils. Soil is the upper most part of earth and it is cheapest and readily available construction material. Soil is generally categorizes into four Alccofine types (such as): Gravel, Sand, Clay and Silt. Out of them, few possess montmorillonite in high amount resulting in sudden swelling and shrinkage upon contact with water. Such soils are not useful in construction directly but can be made useful after their stabilization. Soil is defined as an unconsolidated material, composed of soil particles, produced by the disintegration of rocks and chemical decomposition. On the Alccofine of shear strength, soil can be divided into three types: cohesion less soils, purely cohesive soils and cohesive soils. Soil stabilization is used for foundation, embankment and highway construction, airport and village roads to highways or expressway. Soil stabilization improves the bearing capacity, compressibility, strength, and other properties of soil. Soil stabilization is the popular method of soil improvement. Various methods of soil stabilization are used like mechanical method, chemical method, thermal method, additive method (fiber reinforcement). In case of road construction the aim of stabilization of soil is to increase the stability by increasing its bearing capacity and hence increasing its strength and reduction in pavement thickness.

Soil stabilization improves the strength of the soil, thus, increasing the soil bearing capacity, used to decrease the permeability and compressibility of the soil mass in the earth structures, more economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for deep foundation or raft foundation, improves the workability and the durability of the soil and maximize the lifecycle costs of project.

MATERIALS USED

Following materials are used for studying the mechanical properties of Concrete for this studyuse agricultural waste, eco-friendly material. Materials to be used are as follows:

1 Expansive soil

2 RECRON -3S FIBER

3 ALCCOFINE

Expansive soil

Expansive soil or swelling soil, as their name implies, are soil that swell when subjected to moisture. These swelling soils typically contain clay minerals that attract and absorb water. Covering about 15 to 20% of the total land area of the country these dark Colour soils show a large change in volume with water content. The dark Colour is due to the presence of the compound of iron and aluminum, accumulated humus and colloidal hydrated double ion and aluminum silicate. Expansive soil is a soil/clay (such as montmorillonite or bentonite) that is prone to expansion or shrinkage due directly to variation in water volume. Expansive soils swell when exposed to large amounts of water and shrink when the water evaporates. This continuous cycle of wet to dry soil keeps the soil in perpetual motion causing structures built on this soil to sink or rise unevenly, often requiring foundation repair. Expansive soils are comprised primarily of minerals (incredibly fine particles) with little to no organic material and are thus incredibly viscous, proving difficult to drain. So, let's unpack this a bit. Expansive soil is generally clay that is inherently susceptible to swelling and shrinking due to its chemical composition. This swelling and shrinking is directly related to changes in the water table.

Wet = Expand

Dry = Shrink

Now, expansive soils are referred to by names, including – expanding soil, expansive clays, shrink-swell soils, and hearable soils.

RECRON -3S FIBER

Recron-3S is most commonly used synthetic fiber due to its low cost, hydrophobic nature, chemically inert and does not allow reaction with soil moisture. it is a Recron-3s fiber which is a stabilizer to improve CBR values. Recron-3S fibers are mixed in soil uniformly to get appropriate strength. Use of Recron-3S as a reinforcing material is to increase the strength in various applications like cement Alccofine precast products, filtration fabrics etc. It also provides resistance to impact, abrasion and greatly improves the quality of construction during foundation, retaining wall design etc. Recron-3S is a modified polyester fibre. It is generally used as secondary reinforcing material in concrete and soil to increase their performance. Recron-3S sample used in experiment was of 12mm length and manufactured by Reliance Industries Limited.

Table 1.1 Physical Properties of Recron-3s

S. No.	Properties	Specification
1	Cross-Section	Triangular
2	Diameter	35-40 Micron
3	Colour	White
4	Cut Length	6mm, 12mm, 24mm
5	Dispersion	Excellent
6	Acid Resistance	Excellent
7	Alkali Resistance	Good
8	Specific Gravity	1.36
9	Melting Point	240-260^{0}C
10	Flash Point	>329^{0}C
11	Relative Density	0.89-0.94g/cm^3
12	Elongation	45-55%
13	Young's Modulus	17.5×10^{3}Mpa
14	Tensile Strength	4000-6000kg/cm^2
15	Moisture	<1%

Table 1.2 Chemical Properties of Recron-3s

S. No.	Properties	Range
1	SiO_2	39.18
2	Al_2O_2	10.18
3	Fe_2O_3	2.02
4	CaO	32.82
5	MgO	8.52
6	Na_2O	1.14
7	K_2O	0.30

ALCCOFINE

ALCCOFINE is a new generation, micro fine material of particle size much finer than other hydraulic materials like cement, fly ash etc. manufactured in India. It has unique characteristics to enhance 'performance of concrete' in fresh and hardened stages. It can be used as practical substitute for Silica Fume. Alccofine is manufactured in the controlled conditions with special equipment to produce optimized particle size distribution which is its unique property. Alccofine-1203 and Alccofine-1101 are two types with low calcium silicate and high calcium silicate respectively. Due to its ultra-fineness of Alccofine 1203, it provides reduced water demand for a given workability, even up to 70% replacement level as per requirement.

- It is a new-generation, ultrafine product whose Alccofine raw material is slag of high glass content with high reactivity obtained through the process of controlled granulation.
- The raw materials are composed primarily of low calcium silicates. The processing with other select ingredients results in controlled particle size distribution (PSD). Due to its unique chemistry and ultra-fine particle size, ALCCOFINE 1203 provides reduced water demand for a given workability, and can also be used as a high range water reducer to improve compressive strength or as a super workability aid to improve flow.
- The Alccofine used in this study was obtained from Ambuja cement outlet. Physical and Chemical properties of Alccofine is presented in table.

Table 1.3 Physical parameters of Alccofine-1203

Specific gravity	**Bulk Density (kg/m^3)**	**Particle size distribution (µ)**		
		d 10	d 50	d90
		1-2	4-5	8-9

Table 1.4 Chemical composition of Alccofine 1203

CaO	Al_2O_3	SiO_2	Glass content
31-33%	23-25%	33-35%	>90%

II LITERATURE SURVEY

Siyyagalla SubAlccofinerayudu *et al* studied the Soil stabilization by using recron-3s, flyash & lime. In this study, the stabilization of the soil by using RECRON-3S, is done .In this study recron-3S as (1% and 2%) lime(2%, 3% and 4%) and fly ash at (10%, 12%, 15% and 20%) are used. With different proportion of soil with additive materials California bearing ratio value will be more compare to conventional materials. And from that thickness of pavement can be minimized to the certain extent. **Kolla Ashwani Chandh** *et al* studied on the Effect of Fibre on Non Swelling Sub Grade Layer. In this study, Recron 3s fibre is mixed with soil to investigate the relative strength gain in terms of bearing capacity and compaction. The effect of fibre on the geotechnical characteristics of soil-fibre mixture was investigated by conducting standard Proctor compaction tests, CBR tests and permeability test. The tests were performed as per Indian Standard specifications. The materials were used for preparing the samples are Soil & Fibre. The soil used for these experiments was brought from a site, in our college. The physical properties of the soil were determined as per IS specifications. In this test programme, without additives clay was tested to find the optimum moisture content, CBR value and plasticity index. Fibre is added in varying percentages and that fraction for which maximum strength is obtained was found out. These experiments resulted in decreasing the sub-grade thickness to 50% 0f the actual thickness required, thereby reducing the cost of construction. **R. V. Giridhar** *et al* studied the structured teaching program on geotechnical application and soil treated. The vast majority of the dirt accessible are with the end goal that they have great compressive quality satisfactory shear quality yet feeble in strain/poor rigidity. To beat the same numerous specialists have focused their reviews on soil change strategies by growing new such materials, through the elaboration of composites. The primary target of this review is to explore the impact of filaments in geotechnical applications and to assess the quality of unsaturated soil via completing compaction test and CBR tests on soil test. The filaments are cut long of 6mm and 12 mm and blend haphaz rates (0.50%, 1.0%, 2.0% and 4.0%) by dry weight of soil and compacted to most extreme dry thickness at ideal dampness content. The test outcomes demonstrate a lessening in the greatest dry thickness and ideal dampness substance of soil because of the expansion of Recron fiber. It likewise shows a change in the CBR esteem. **P. Sowmya Ratna** *et al* studied the Performance of Recron-3s Fiber with Lime in Expansive Soil Stabilization. The properties of the black cotton soils can be altered in many ways viz. mechanical, thermal and chemical means. Therefore soil stabilization techniques are necessary to ensure the good stability of soil so that it can successfully

sustain the load of the superstructure especially in case of soil which is highly active; also it saves a lot of time. In the present work, an attempt has been made to study the compaction and CBR characteristics tests of black cotton soil mixing with different percentages of lime and Recron-3s Fibre with a view to determine the optimum percentage. Test results shows that stabilizing clayey soils with lime and imparting Recron 3s fibers enhance the strength. The study yielded the following conclusions Alccofinesed on the laboratory experimentation carried out in this investigation. Addition of lime has shown decrement in liquid limit from 84% to 67% and improvement in plastic limit from 55% to 60.5% and plasticity index decrease from 29% to 26.4% when the lime content varies from 0% to 6% mixed in expansive soil as a result of cation ions from the lime which reduces the volumetric changes. **Muhammad Nawazish Husain** *et al* studied the Application of Recron 3S Fibre in Improving Silty Subgrade Behaviour. The objective of the present paper is to check the usefulness of Recron 3S fibre in improving soil subgrade strength of local silty soil of Kurukshetra. For this purpose a series of experiments were conducted which include Modified Proctor Compaction, California Bearing Ratio (CBR) and Unconfined Compressive Strength (UCS) tests. A total of four samples of soil - fibre mixture were made with fibre content as 0.15%, 0.30%, 0.45% and 0. **Lovedeep Singh** *et al* (2018) Studied the effect of solid waste namely fly ash and Alccofine in clay soil on the variation of index properties, shear strength, compaction and CBR values were analyzed. The maximum dry density increases from 197 kilo Newton per meter cube to 21 1 kilo Newton per meter cube in case of addition of mixture on soil and the value of undrained cohesive value was increased 30 KN/m2 to 35.5 KN/m2 . The unsoaked CBR value of soil increased from 3 % to 8% and soaked CBR value from 4 % to 8% in case of addition of mixture to clay soil. **Jeevan Singh** *et al* (2018) investigated that the red soil stabilization using silica fumes and Alccofine. They concluded that addition of mixture 20% silica and 10% Alccofine to the red soil increases CBR strength by 70%. They also determined the significant decrease in the swelling of the soil and at the increase of mixture to the red soil increases OMC and decrease maximum Dry density. With the increasing of mixture also increases the unconfined compressive strength from 160 KN/m^2 to 180 KN/m2 approximately 18% increases. **Abhineet Godayal** *et al* (2018) they concluded that the use of Alccofine alone as a stabilizer shows little improvement in CBR and A binder is also needed in combination with Alccofine in order to obtain the satisfactory Results.

III. CONCLUSIONS

Maximum Dry Density and Optimum Moisture Content

To study the effects of addition of Alccofine and Recron-3s Fibers in soil on MDD and OMC relationship different percentages of Alccofine is added and optimized. Then this optimized Alccofine soil is the mixed with the different lengths and different percentages of Recron-3s fibers. It is interpreted that there is increase in OMC and decrease in MDD with addition of Alccofine. But the values of CBR and UCS are increased with 4% of ALCCOFINE and Recron-3s fiber length 4cm at 1.5%.

Unconfined Compressive Strength of Soil

- There is increase in the percentage of UCS, when sample were prepared with 2%, 4% by 3.02%, 4.70% and decrease in percentage of UCS, when sample were prepared with 6%, 8% Alccofine by 1.01%, 5.70% as compared to raw soil.
- The increase in UCS is maximum at 4% ALCCOFINE i.e. 4.70%.
- The experiments in combined sample of ALCCOFINE and Recron-3s fiber (2cm, 4cm, 6cm) shows that the maximum value of UCS are obtained at 4cm length with 1.5% by weight, which is found to be 3.73 kg/cm^2. The percentage increase as compared to the raw soil is 25.16%.

California Bearing Ratio (soaked)

- The soaked CBR value of the raw soil is 1.81%
- The soaked CBR value of the raw soil with 4% ALCCOFINE is 2.59%, the percentage increase in CBR value as compared to raw soil is 43.10%,
- The soaked CBR value of combined soil sample with 4% ALCCOFINE, 1.5% of Recron-3s fiber of 4cm length is found to be 3.09%, the increase in CBR value as compared to raw soil is 70.16%.

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