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ENHANCEMENT IN STRENGTH OF CLAYEY SOIL BYRECRON 3S FIBER AND ALCCOFINE 1203

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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 the sort 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) showsthat 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 inCBR value as compared to raw soil is 43.10%, The soaked CBR value of combined soil sample with 4% ALCCOFINE, 1.5% ofRecron-3s fiber of4cm 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*

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 stabilisation. 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 stabilisation is used for foundation, embankment and highway construction, airport and village roads to highways or expressway. Soil stabilisation improves the bearing capacity, compressibility, strength, and other properties of soil. Soil stabilisation is

the popular method of soil improvement. Various methods of soil stabilisation 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 stabilisation 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.

Material Used

1 Expansive soil

2 RECRON -3S FIBER

3 ALCCOFINE

1. Expansive soil

Expansive soil or swelling soil, as their name implies, are soil that swell when subjectedto 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 betonies) 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 toswelling and shrinking due to its chemical composition. This swelling and shrinking is directly related to changes in the water table.

Wet = ExpandDry = Shrink

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

2. 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 Alccofinesed 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.

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%

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

3. 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.

Types of Alccofine

Alccofine	Alccofine-1203	Low Calcium Silicate
	Alccofine-1101	High Calcium Silicate

- It is a new-generation, ultrafine product whose Alccofinesic 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.

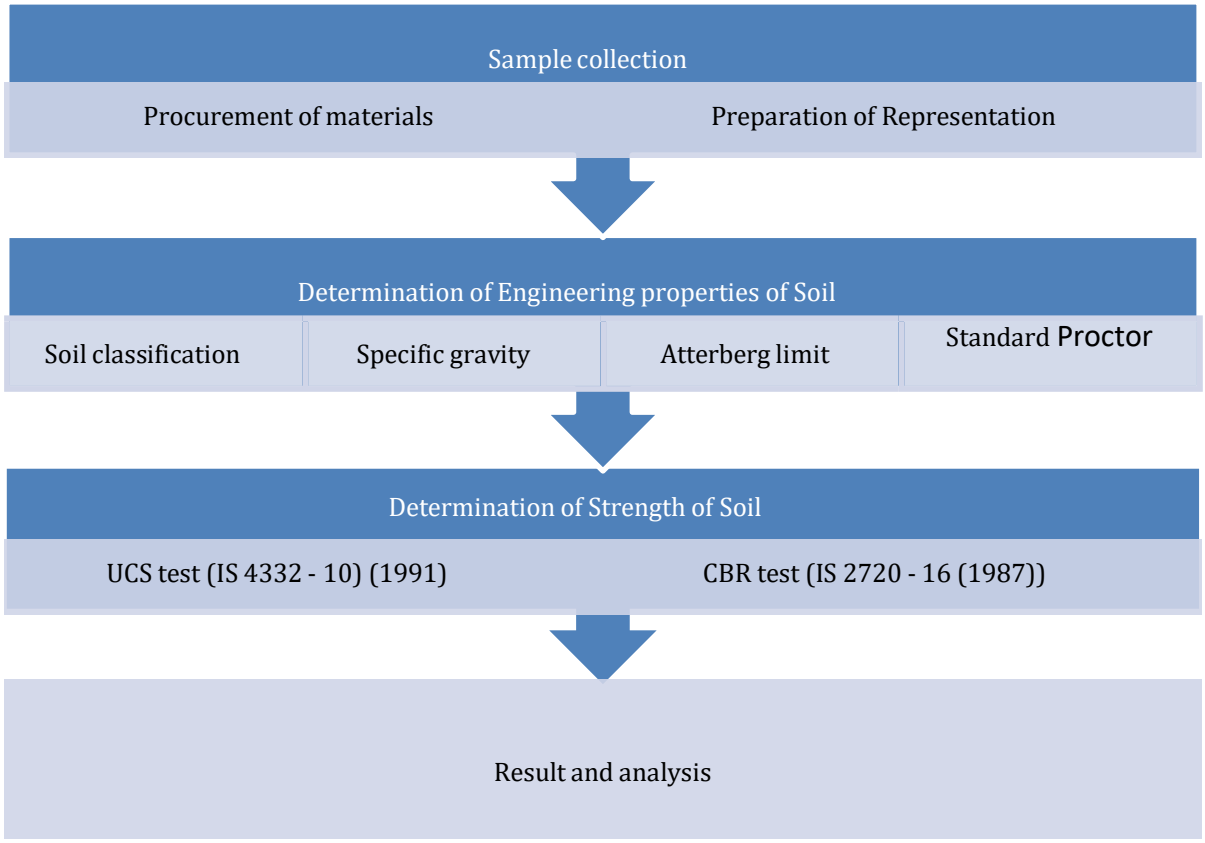
Physical parameters of Alccofine 1203

Specificgravity	**Bulk Density (kg/m³)**	**Particle size distribution (µ)**		
		d 10	d 50	d90
		1-2	4-5	8-9

Chemical composition of Alccofine 1203

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

METHODOLOGY



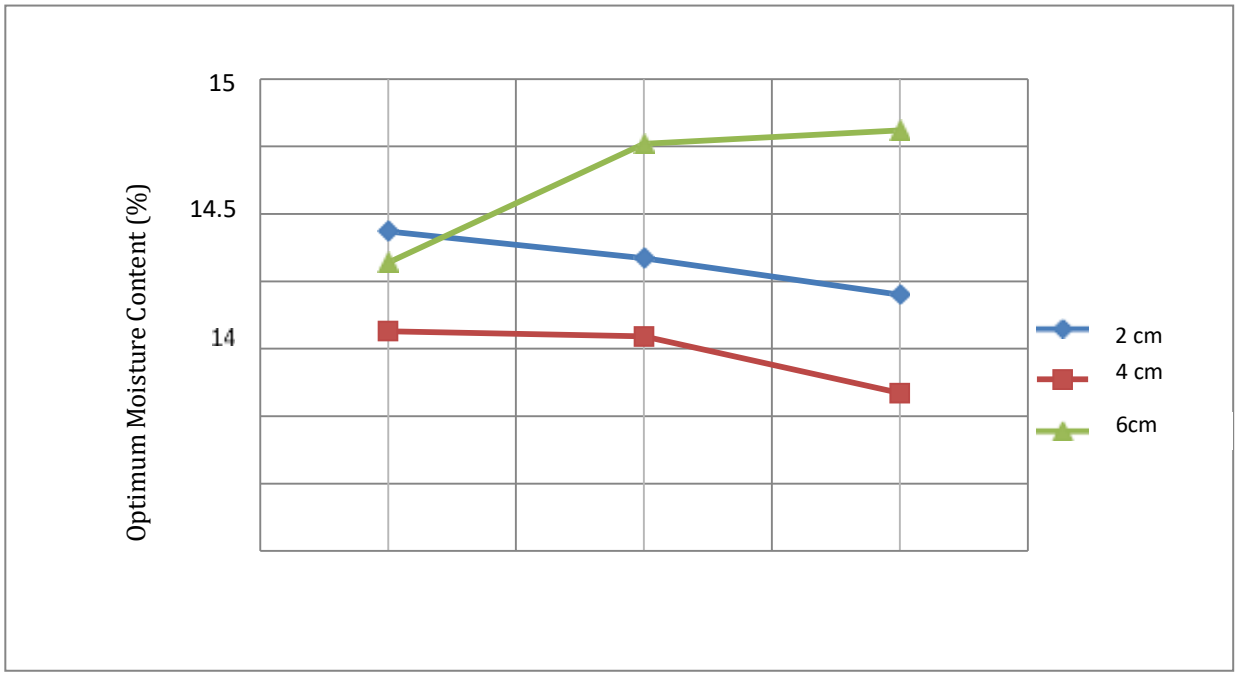
RESULTS

Maximum Dry Density and Optimum Moisture Content

The clayey soil samples blended with Alccofine and reinforced Recron-3s fibers have been tested by using Light compaction test at different values of moisture content for the analysisof MDD and OMC as shown below.

MDD and OMC for Soil with 4% ALCCOFINE reinforced Recron-3sFiber

S. No.	Percentage of RECRON=1%		Percentage of RECRON= 1.5%		Percentage of RECRON= 2%	
	MDD g/cc	OMC %	MDD g/cc	OMC%	MDD g/cc	OMC%
Length of RECRON 2cm						
1	1.81	13.87	1.81	13.67	1.79	13.4
Length of RECRON 4cm						
2	1.87	13.13	1.86	13.09	1.85	12.67
Length of RECRON 6cm						
3	1.83	13.64	1.82	14.52	1.81	14.62



Variation of OMC for Soil with 4% ALCCOFINE reinforced Recron-3sFiber

Unconfined Compressive Strength Test

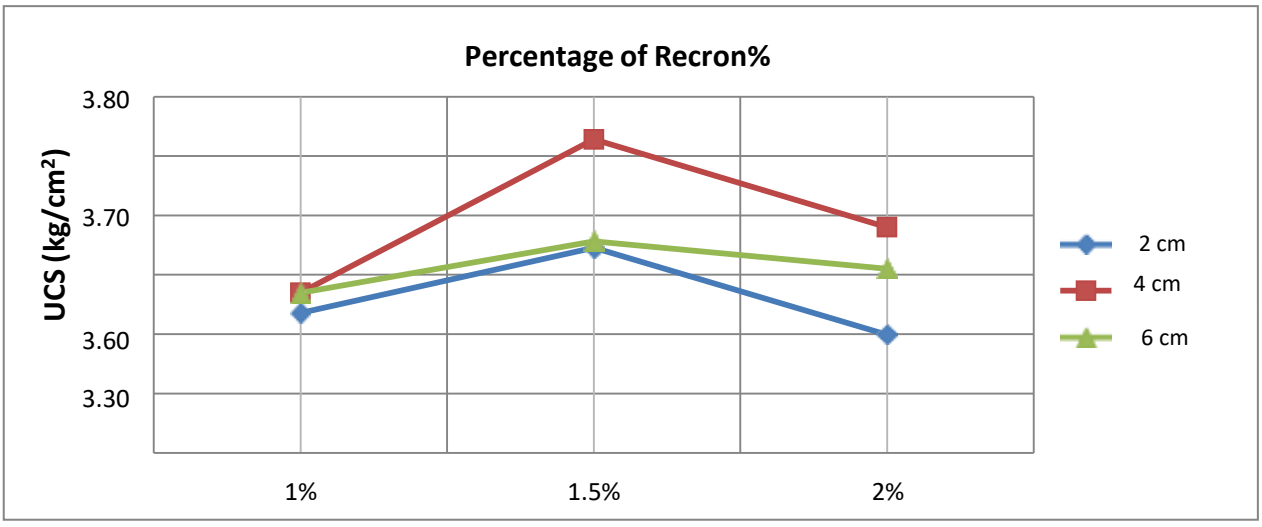
The Exensive soil samples blended with Alccofine and reinforced with Recron-3s fibers have been tested by using UCS test at different percentages and length of fibers for the analysis of California Bearing Ratio as shown below.

UCS of Soil with different percentage of ALCCOFINE

S. No.	Percentage of ALCCOFINE %	UCS (kg/cm²)
1	0	2.98
2	2	3.07
3	4	3.12
4	6	2.95
5	8	2.81

S. No.	Percentage of Recron %	Length of Recron		
		2cm	4cm	6cm
		UCS (kg/cm²)		
1	1	3.44	3.47	3.47
2	1.5	3.55	3.73	3.56
3	2	3.40	3.58	3.51

UCS for ALCCOFINE Soil reinforced with Recron-3s Fiber



UCS for ALCCOFINE Soil reinforced with Recron-3s Fiber

California Bearing Ratio (soaked)

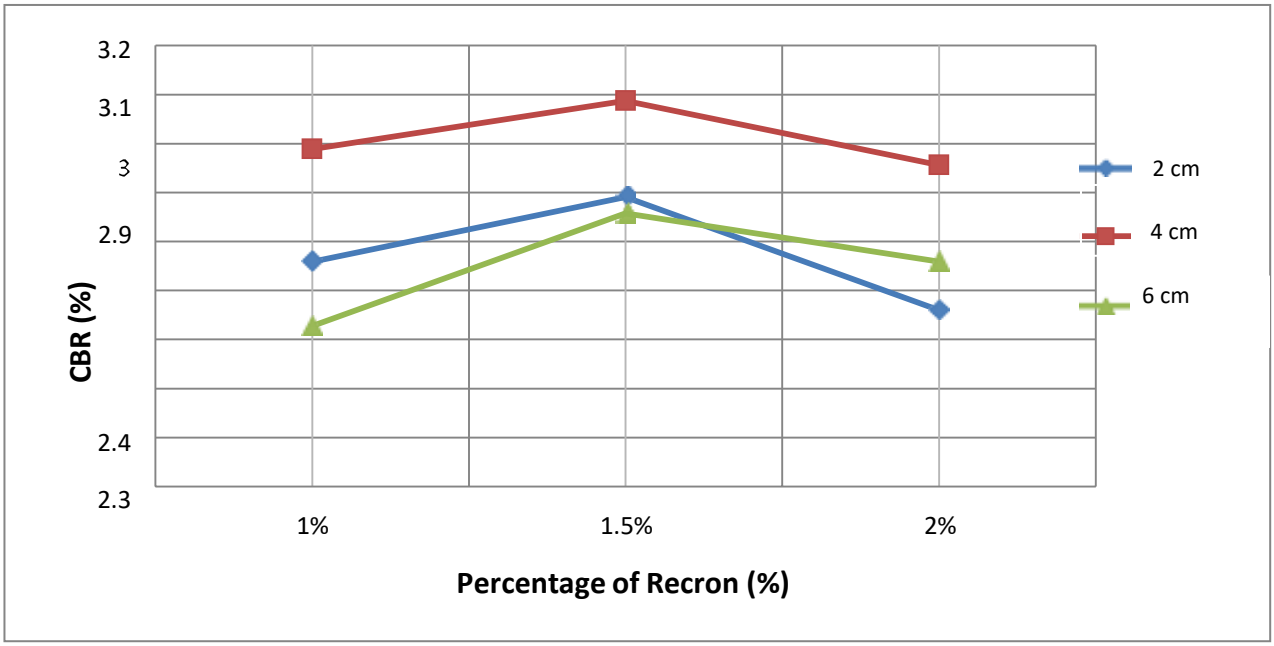
The Expensive soil samples blended with Alccofine and reinforced with Recron-3s Fibers have been tested by using CBR test at different percentages and length of fibers for the analysis of California Bearing Ratio as shown below.

CBR of Soil with different percentage of ALCCOFINE

S. No.	Percentage of ALCCOFINE %	CBR %
1	0	1.81
2	2	2.04
3	4	2.59
4	6	2.36
5	8	2.30

CBR for ALCCOFINE Soil reinforced with Recron-3s Fiber

S. No.	Percentage of Recron-3s fiber (%)	Length of RECRON		
		2cm	4cm	6cm
		CBR (%)		
1	1	2.76	2.99	2.63
2	1.5	2.89	3.09	2.86
3	2	2.66	2.96	2.76



CBR for ALCCOFINE soil reinforced with Recron-3s fiber

CONCLUSIONS

Alccofinesed on analysis and interpretation of experimental investigations followingconclusions are drawn.

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 are 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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