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Enhancing Properties of Clayey Soil using Calcium Chloride and Pine Needles

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Abstract: ***Since centuries the practice of stabilization and filaments intensification of soil is done. Plants, thatch and other natural fibers being used for the construction of the houses as reinforced materials, which is helpful to avoid fracture in masonry resources. The size of the particles of clay soil is very small as compared to other varieties of soil because of their size single particle of this soil is not visible by naked eye it is visible under electron micro scope. Therefore at very less space huge amount of particles can exist and the void ratio among them is also very small due to their fineness. Clayey Soil present moderately a few confronts to the geo technical engineer because it impersonate troubles associated to cracks, stability, settlements and swellings. For enhancing the property of this type of soil needles of pines and calcium chloride being used to solve the problem. Different types of test were done on index properties, compaction characteristics and soil reinforced with pine needles and calcium chloride and CBR value of the Parent soil. The observation was that there was reduction in the dry density with the accumulation of pine needles and OMC increases of the parent soil. 1. 92mg/cc was the value of the dry density of parent soil, with the accumulation of 0.7 % of pines it decreases to 1.81mg/cc, with the increase of pine needles from 0.7 % to 1.4 % the value of dry density reduces to 1.75mg/cc and the final with the increase in the value of pines to 2.1 % the dry density was reduces to 1.56 mg/cc. As outlying OMC was worried, the value of it increases with increasing in amount of pines in soil, when the percentage of pine was 0 % OMC was 12.95 and for 0.7 % pines OMC value was 16.20 and at 1.4 % of pines in soil the value of OMC was observed to be 14.45 and at last the value of 2.1 % of pines addition, gives OMC value 11.95. This increase in OMC and MDD be chiefly because of flocculation between clay particles and pine needles, consequently the outcome was of ascend in percentage of pines needles, pore void size also increases, that result in enhanced water holding capacity of soil accumulation and while the outcome there is increase in the moisture content. For preventing the restraint 4 % calcium Chloride be accumulated to soil in adding up to Pine needles. It was observed that optimum percentage meant for soil to stay stable in significance to all its compaction properties like dry density, void ratio, OMC. The optimum percentage of mutually pine and calcium chloride be observed to be 0.7% and 4 % respectively. At 0 % pine needles as well as 4 % Calcium Chloride soil , maximum dry density was equivalent to 1.91 gm/cc as well as optimum Moisture Content was 4.95 gm/cc, with adding 0.7 % lime to this model maximum dry density increased to 2.08 mg/cc and OMT reduces to 5.45%. Various tests were carried out on 1.4 % pines and 4 % calcium chloride and 2.1 % pines and 4 % calcium chloride as it is understood from the fact that the dry density from here on will increase and as a result void ratio be negative which obviously should not happen. Since calcium chloride alone is not effectively sufficient to improve properties of soil. So pines were added beside being economical by reducing earth pressure, pines imparts ductility to soil, which would not have been possible alone by calcium chloride. Also pine alone does not have great impact on compaction properties. Combination of both at 0.7 % pines and 4 % calcium have been found to be best for soil. Beside the above mentioned properties on adding pines to the clayey soil it was found that CBR value increases a little bit but not to a great extent from 6.50 % for unreinforced soil to 7.73% and 8.84 % respectively by adding 0.7 % pines and 1.4%pines respectively. However at 2.1 % pines addition, CBR decreases from 8.84 % to 7.87%clearly indicating that as far as CBR is concerned optimum percentage of pines is 1.4 % by weight of soil after that CBR decreases. So to increase CBR value Calcium Chloride was added and was noted that significant increase in CBR value of Soil takes place that is to 13.52 from 8.84 % at 1.4 % pines and that of 6.50 % for untreated soil. Thus it can be concluded from above discussion it can be concluded that Combination of both calcium chloride and Pine needles in soil improves Both MDD and CBR value at certain percentages, hence this type of soil which is reinforced with these materials can be used for various purposes as various limitations like low strength, Water content in soil swelling properties etc have been encountered.***

Keywords: Calcium chloride, pine needles

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I. INTRODUCTION

A. General

The practice of upgradation and fiber intensification of soil with the help of assorted chemicals and additives has been practiced since prehistoric period. Straw fiber are still universally worn for the reinforcement of the exacting building materials for houses in villages and rural areas and a mixture of chemicals are added for the deprived soil stabilization, adjacent to this by modern techniques for buildings and constructing foundation of the embankment this soil is used. During 1966 Vidal of France was the first person who gave the perception of reinforcement of the soil. In view of the fact that the chief progresses include for preparing in the drafting and building of structures like pavements, foundations, retaining walls, banks, etc. For increasing the strength along with decreasing the deformation in the medium of soil the role of the reinforcements is done. The compensation of randomly dispense fibers are the fantasy of possible planes of error which can build up parallel to slanting reinforcement. The presence of plant roots are the standard ways for integration randomly slanting fiber inclusions in the soils. Since past Various South Asian countries frequently consumes stuff such as coir, jute and bamboo as a reinforcing stuff. Both the factors strength as well as stability of slopes is improved by these reinforced plant fibers in the soil bunch. When a load is applied to the complex material of fiber reinforced soil, the tensile quarrel is drum up by the cooperation of fibers which increases the strength of soil. The advantage of this is that its availability is effortless.

B. Material Used

1) *SOIL:* By the combination of one or more clay minerals with the traces of metal oxides and organic matter with the fine-grained natural material that is a clayey soil. These soil models was collected from surankote about 28 km away from Poonch. The soil models were formed in the Engineering and Technology college BGSB University Rajouri (J&K) in geotechnical engineering laboratory. These diverse groundwork tests for the index properties and strength properties were completed in the lab. For each models sieve analysis were carried out.

Table Properties of soil

S.No.	Soil property	Soil sample
1	Colour of soil	Greyish Brown
2	Nature of soil	Clay type
3	Natural moisture content (w %)	12.80
4	Specific gravity G	2.62
5	Uniformity coefficient Cu	3.98
6	Coefficient of curvature Cc	2.00
7	Liquid limit (%)	56.59
8	Plastic limit (%)	32.65

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2) *Pine Needles:* From the place of lassana in the district poonch of the state Jammu and Kashmir these naturally available Pine needles were gathered from neighboring forest of this region. 12mm to 16mm fibers length wise was sliced from the alienated Pine needles. Below table 3.1 shows the properties of pine needles.

Table: Properties of pine needles

S.No.	Material Properties	Values
1.	Fiber Length	12 mm to 16 mm
2.	Diameter	0.5 mm to 1.1 mm
3.	Colour when dry	Brown
4.	No. of fibers per g	200
5.	Holocellulose content	67.29%
6.	Pentosan	11.57%

3) *Calcium Chloride:* The reduction of water content and the cause of colloidal reaction is due to the Calcium Chloride which is hygroscopic in character. $CaCl_2$ $(H_2O)_x$, (where x = 0, 1, 2, 4, and 6) is the chemical formula of an organic compound namely calcium chloride. The property of these salts are a extremely soluble in water. The deicing and dust control are generally done by this. This chemical also improves maximum dry density of the soil. When the structure of mineral of clayey soil is changed it will makes the clayey soil brawny and less stretchy with the use of Calcium Chloride, and dropping expansion by the addition of calcium chloride. This chemical is effortlessly can be avail and from chemistry lab of university it was taken.

Table: Physical Properties of Calcium Chloride

S. No.	Chemical formula	$CaCl_2$
1	Molar mass	110.98 g·mol^{-1}
2	Appearance	White powder, hygroscopic
3	Odour	Odourless
4	Density	2.15 g/cm^3 (anhydrous)
		2.24 g/cm^3 (monohydrate)
		1.85 g/cm^3 (dihydrate)
		1.83 g/cm^3 (tetrahydrate)
		1.71 g/cm^3 (hexahydrate

II. EXPERIMENTAL PROGRAM

A. *Tests Performed*

1) *Compaction Test:* In order toward finding the optimum moisture contents and maximum dry the part of Study occupied the complete examination in compaction characteristics of the parent soil plus blended model which occupies dissimilar percentage of coal ash and stone dust contents, densities. The samples of Unconfined Compressive Strength test is prepared by the use of obtained optimum moisture stuffing. This test confirms to IS: 2720 (Part 8) 1980.

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2) *California Bearing Ratio (CBR) Test:* The CBR test shows a quantify resistance of a material toward penetration of standard hypodermic underneath proscribed density and moisture situation. This CBR test in the lab can be conducted with re-molded or undisturbed sample. This test is simple and be broadly investigated for field with relation of flexible pavement thickness necessity. For penetrating the pavement constituent substance at 1.25mm/minute the test is done with the help of the cylindrical plunger of several diameter. The loads, for 2.5mm and 5mm were taken. The same as the percentage of standard load assessment at a relevant deformation level to get C.B.R. value will articulate this load. The table contains the values is under.

Table: Standard Load Value at a Respective Deformation to obtain C.B.R. Value

Penetration, mm	Standard Load, kg	Unit Standard Load, Kg/Cm^2
2.5	1370	70
5.0	2055	105
7.5	2630	134
10.0	3180	162
12.5	3600	183

III. RESULT AND DISCUSSION

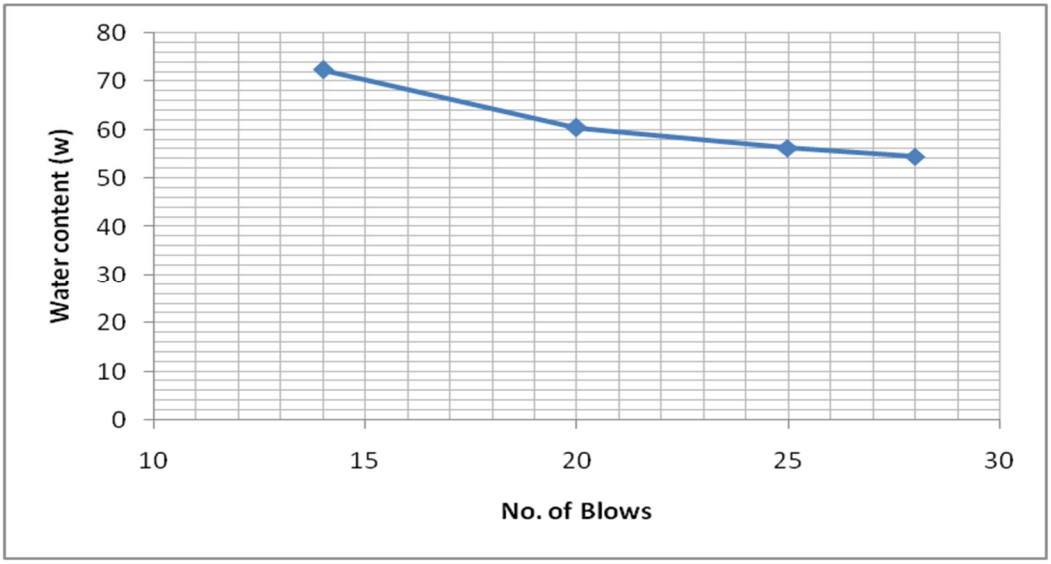
A. *Analysis Of The Soil Sample (Clayey Soil)*

1) *Liquid Limit*

Table : Liquid Limit Determination

Determination No.	1	2	3	4
Number of blows (N)	14	20	25	28
Water content (w %)	72.41	60.45	56.35	54.54

Figure : Liquid limit of parent soil



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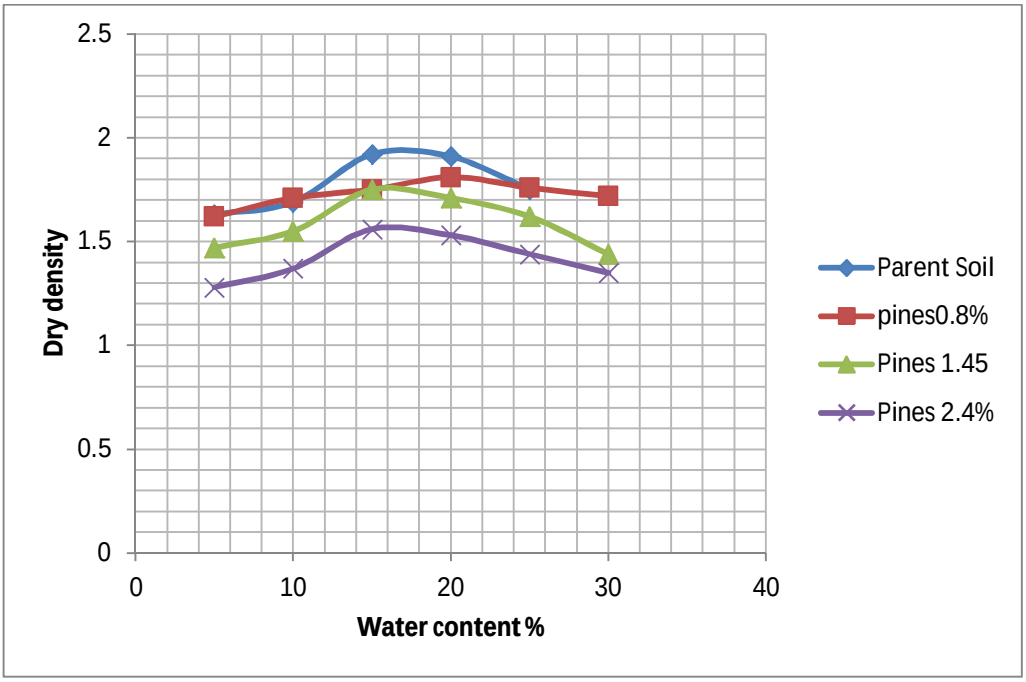
2) Grain Size Distribution Of Soil

Table: Grain size Distribution

Sieve size	Wt. of soil retained (gm)	% Retained	Cumulative % retained	% finer
4.75mm	223.5	22.35	22.35	77.65
2.00mm	343.3	35.33	56.68	43.32
850µ	209.92	22.26	78.94	21.06
600	100.44	10.44	89.38	10.62
300	52.51	5.21	94.59	5.41
250	9.5	0.95	95.54	4.46
212	11.00	1.10	96.64	3.34
150	15.12	1.51	98.15	1.85
75	10.5	1.05	99.20	0.8
Pan	7.5	0.75	99.95	-

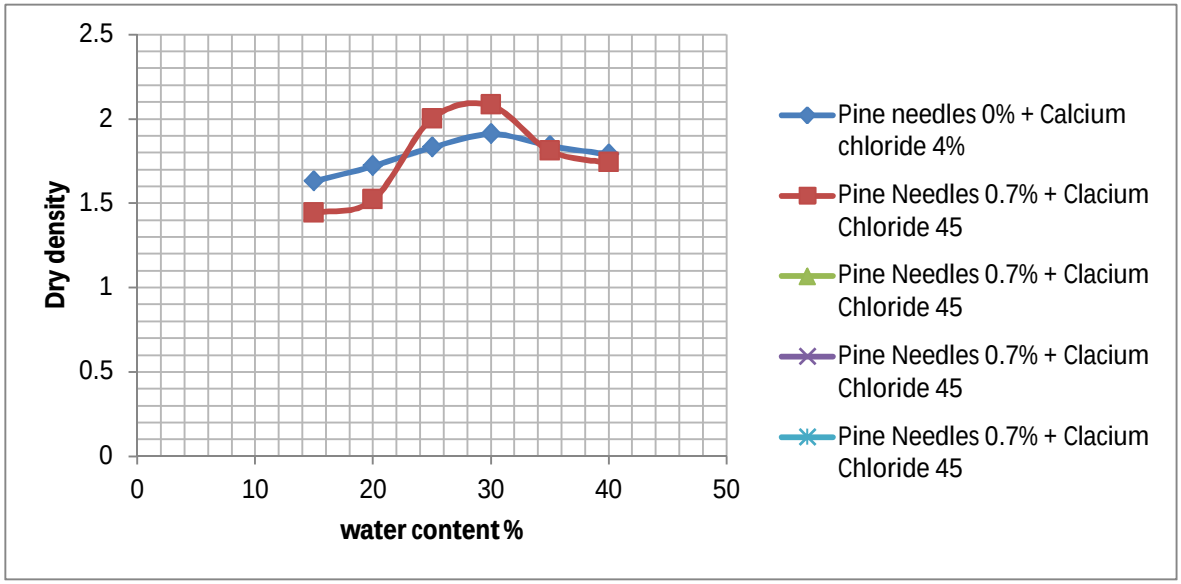
3) Compaction Test

Comparison graph of compaction test results(with pines)



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Comparison graph of compaction test results(with pines and calcium chloride)



4) California Bearing Ratio Test

Table 4.16: Variation of CBR with Reinforcement of Pine needles in clayey soil

S.No.	% of pine needles	CBR (%)
1	0	6.50
2	0.7	7.73
3	1.4	8.84
4	2.1	7.87

IV. CONCLUSIONS

1) The value of the specific gravity of soil was obtained to be 2.62.
2) Liquid limit was found to be 56.59% and Plastic Limit was found to be 32.65%.
3) It institute that by adding of pine needles in the parent soil, there is decrease in dry density and OMC is increased.
4) By the addition of pines there is reduction in dry density, with increasing the percentage of pines from values 0.7% to 1.4% dry density is decreases.
5) When the quantity of pines is increased within soil as outlying as OMC be anxious, it is also increased.
6) Generally because of flocculation within pine needles and particles of clay there was increase in the OMC and MDD, consequently by the outcome of ascend within percentage of pines, there is ascend of magnitude of pore voids, that effects in enhancement of soil mass in water holding capacity furthermore the outcome is increase of the moisture content.
7) For prevailing over this problem calcium Chloride be added to soil for betterment with accumulation to Pine needles. The outcome discovered is that the optimum percentage for soil to remain secure consequence with its every compaction properties like OMC, void ratio, dry density
8) The value of optimum percentage of mutually pine and calcium chloride were initiate to be 0.7% and 4 % correspondingly.
9) For enhancement of this unprocessed soil it has been found that amalgamation of in cooperation at 0.7 % pines and 4 % calcium was best.

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10) In this investigation adjacent to the properties which are discussed we get the value of CBR increased very less not much more by adding pines to the clayey soil.

11) Conversely by adding the pines, evidently CBR value reduces signifying that as outlying as CBR is anxious optimum percentage of pines is 1.4 % by load of soil later than with the intention of CBR reduces.

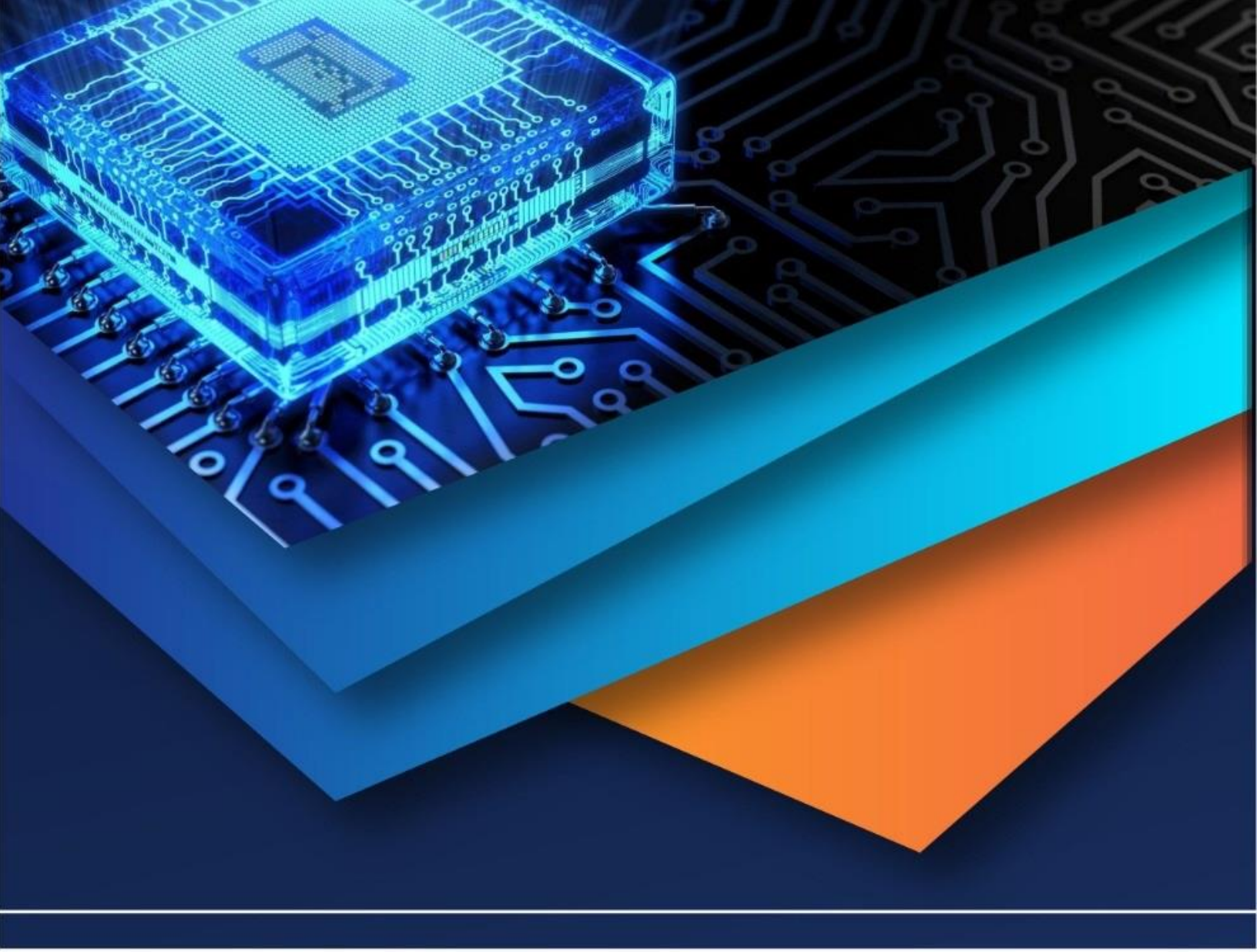
12) Consequently for enhancing CBR value chemical Calcium Chloride be added and distinguished that it considerable enhances in CBR assessment of Soil takes place.

With the help of the above investigation and discussion it be able to accomplished that mutually MDD and CBR can be enhanced with amalgamation in cooperation of both calcium chloride and Pine needles at certain percentages, for this reason the soil that is reinforced with pine needles and calcium chloride are being suitable in use for different engineering purposes because of different restrictions that are water content, low strength and other swelling properties etc are being encountered.

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