ENHANCEMENT IN IMPROVEMENT OF CLAYEY SOIL WITH ADDITION OF CALCIUM CHLORIDE, RICE HUSK ASH AND POLYPROPYLENE FIBRE

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ABSTRACT:- *In India, a major portion of total land area is covered by clayey soil. Of this, a large portion is expansive soil. Structures constructed over this expansive soil may be severely damaged due to its high swell shrinkage behavior. So such soil needs to be stabilized to increase its strength, durability and to prevent erosion. As Soil stabilization is the technique used to improve the geotechnical properties of soil and has become the major practice in construction engineering Expansive soils are not stable during all moisture conditions due to swelling and shrinkage properties. Hence they are stabilized properly to reduce extensive damage to the structures. Utilization of industrial waste materials in improving the soil properties is cost effective and environmental friendly method. The present study is carried out to establish the viability of using the combination of rice husk ask and calcium chloride and polypropylene fiber in stabilizing expansive soils. In experimental evaluation, the observations are made for different mixes like soil-rice husk ash, soil-rice husk ash- calcium chloride and polypropylene fiber at different proportions. Rice husk ash was as constant for all mixes to obtain the base line values and calcium chloride at 1%, 2%, 3% was added to untreated soil and polypropylene fiber at 0%, 0.5%, 1%, !.5%. Test specimens were subjected to unconfined compressive tests at 1, 3, 7, 14 and 28 curing days. Free swell index test and Atterberg limit test were conducted at 28 days curing. It was observed that mixes with calcium chloride exhibited high strength, low plasticity index and low free swell index at 28 day curing.*

KEYWORDS*: Soil, rice husk ash, calcium chloride, polypropylene fiber, Clayey Soil, Water cement ratio, Dry Density.*

INTRODUCTION

Soil stabilization is an effective and reliable technique for altering important soil properties. Several reinforcement methods are available for stabilizing expansive soils such as stabilization with chemicals additives, rewetting, soil replacement, compaction control and moisture control, surcharge loading and thermal methods. These techniques have wide application in areas like construction of road, slope stabilization, railway embankments, and so on. Soils are generally stabilized. Certain types of clayey soils subjected to excessive compression, heave, collapse, low shear strength and low bearing capacity. Due to the presence of water in air voids, expansive clays are subjected to large volume changes undergo huge variation in dry and wet conditions, deep cracks occurs in dry condition and expand in wet condition . This consequence makes a severe damage to lightly loaded structures like foundations, canal beds, canal linings, pavements and poses a great problem for civil engineers. Soil stabilization occurs by improving the bearing capacity of soil with introduction of additives as binders. In the process of stabilization cementitious materials are formed to improve the

engineering properties of virgin soil. Utilization of industrial waste material in improving soil properties is an environmental friendly and cost effective method. Various ashes are involved in improving the bearing capacity of soil. Portland cement, bitumen, hydraulic lime and industrial by-products such as blast furnace slag, Rice husk ash, rice husk ash (RHA), and cement kiln dust (CKD) have been used as soil stabilizers to improve the properties of untreated soil). Infrastructure projects such as highways, railways, water reservoirs, reclamation etc. requires earth material in very large quantity. In urban areas, borrow earth is not easily available which has to be hauled from a long distance [1]. Quite often, large areas are covered with highly plastic and expansive soils, which is not suitable for such purposes.As Rice husk and calcium chloride is freely available from Thermal Power Plants, it can be used for stabilization of expansive soils for various uses. [2] The sample of soil used in the mix will be collected from the fields of R.S.PURA (JAMMU DISTRICT) J&K. It will be combined with rice husk ash and calcium carbonate in different proportion for further analysis. The soil will be pulverized before conducting the tests. Rice husk and calcium chloride is itself an industrial waste which imposes many health and environmental hazards Dumping Rice husk and calcium chloride is not an environmentally suitable measure as it degrades the soil and water quality nearby the dumping area. Consistent infiltration of Rice husk and calcium chloride in the agricultural fields may render the crop area infertile. On similar lines, polypropylene too is an industrial waste which can be utilized in constructional activities. Of late polypropylene has been used in many road works all across the country.[5] Rajagopalan Vasudevan, the 2018 Padma Shri awardee pioneered the art of using plastic in road construction works and through this study we aim to further find what different percentage of polypropylene can be used in road works when mixed with soil.[6]

SOIL STABILIZATION WITH RICE HUSK AND CALCIUMCHLORIDE

Soil is a peculiar material. Waste material Rice husk and calcium chloride may use to make the soil to be durable. Addition of such material will improve the properties of the soil. Soil properties to be improved are shear strength, CBR value, bearing capacity, plasticity index, and liquidity index etc. The aim of this study is to find out the effect of Rice husk and calcium chloride from combustion of coal at thermal power plants in stabilization of clayey sand soils [7]. California bearing ratio (CBR) and other strength property tests were conducted on soil. Plasticity of soil ranging between 5 and 10. Tests were conducted on soils and soil–Rice husk and calcium chloride mixtures prepared at optimum water content of 12% .Addition of Rice husk and calcium chloride resulted in appreciable increases in the CBR of the soil. For moisture contents 12% wet of optimum, CBRs of the soil are found in changing rate to such an extent that 3, 5,6and 9. We will discover ideal CBR estimation of the soil is 7% the increment of CBR esteem is utilized to lessen the thickness of the asphalt and expanding the bearing limit of soil.

SOIL STABILIZATION WITH POLYPROPYLENE FIBRES

The aim of this assesses to acquire and thesis relating to the utilization of waste polypropylene strands as stronghold in the soil by analyzing the execution of exploratory soil test tests. The examination is confined to distributed research reports, diary articles, and gathering procedures. This audit is organized to show the esteem added to establishments by the utilization of geosynthetic support. In particular, the review is intended to outline the advantages got from waste polypropylene fibre support, the conditions under which fortification is great, the polypropylene properties that are most

powerful for this application, and the components in charge of fortification [8]. The finishes of this unit are utilized in this way to assess existing plan systems, to remark on creating application particulars. Polypropylene fibre is hydrophobic, that is they don't assimilate water. The sort of polypropylene fibre suggested by producers for clearing applications is the gathered fibrillated fibre. Producers suggest that the length of the fibre be more prominent than double the distance across of the total. This would be predictable with past encounters with other reinforcing material and furthermore with current hypotheses on fibre scattering and holding".

TYPE OF WASTE MATERIALS USED FOR WORK

Polypropylene fibre

Polypropylene fiber to which does not absorb or respond with soil dampness or leachate. Warm and degree Celsius are different properties. The polypropylene filaments utilized as a part of this examination has physical properties, particular gravity of 0.91 and a normal measurement and length from0.06mm to 20mm individually.

Properties of polypropylene fibre

S. No.	Properties	Range
1	Fibre type	Single fibre
2	Unit weight	0.91 g/cm3
3	Average diameter	0.04 mm
4	Average length	12mm
5	Breaking tensile strength	350Mpa
6	Modulus of elasticity	3500Mpa
7	Fusion point	160 degree
8	Burning point	590 degree
9	Acid and alkali resistance	Very good
10	Dispersibility	Excellent

RICE HUSK ASH

Rice husk ash is in the form of ash which is a solid wasted which is disposed in the empty barren land as a solid waste. Rice Husk Ash is by-product material produced from the process of manufacturing puffed rice, contains large amount of iron oxide and silicate. It has higher density, stay in the top layer and then transported to a water basin with a low temperature for solidification. The end product is a solid, hard material that goes to the crusher for further processing. Annually 60,000 tons of rice husks are produced in India. It is chemically stable and its physical properties are similar to that of natural sand. The high angularity and friction angle (upto 530) of rice husk contribute to excellent stability and load bearing capacity. With specific gravities ranging from 2.8 to 3.8, rice husk aggregates are decidedly heavier than conventional granular material. Rice husk aggregate tend to free drying and are not frost susceptible.

CALCIUM CHLORIDE

Calcium chloride is a product with many beneficial properties. For highway work, its main properties are:

1. It absorbs moisture
2. It dissolves in this absorbed moisture.
3. It retains this moisture for long periods
4. It lowers the freezing point of the moisture.

It is not difficult to determine why this product is beneficial in highway maintenance. Youhave seen unpaved roads that are stable under wet weather conditions, yet they become dusty and show signs of raveling in dry weather; this weakness may eventually cause complete disintegration of the surface. If we can maintain moisture, similar to damp weather conditions, it is possible to hold the surface in a well-compacted state even during the hot summer months. The water absorption and retention properties of calcium chloride aid in supplying a damp condition which will give you a smooth riding dust free surface without excessive floater material that is a definite hazard to safe driving.

Comparison of the California Bearing Ratio of the plain soil with the stabilized soil

S. No.	Sample	CBR (%)	Comparison
1.	Virgin soil	3.15	-
2.	Soil+1%RH & CC	3.84	21.9%
3.	Soil+2%RH & CC	3.61	(+)14.60%
4.	Soil+3%RH & CC	4.00	(+)26.98%
5.	Soil+4%RH & CC	3.84	(+)21.90%
6.	Soil+3%RH & CC+0.5% PPF	4.13	(+)31.11%
7.	Soil+3%RH & CC+1% PPF	4.34	(+)37.77%
8.	Soil+3%RH & CC+1.5% PPF	4.20	(+)33.33%

Comparison of the OMC and MDD of virgin soil with reinforced soil

S. No.	Sample	Cohesion ($kg/cm^{2)}$	Comparison (%)	Angle of internal friction (φ)	Comparison (%)
1	Virgin soil	0.309	-	20.15°	-
2	Soil+1%RH & CC	0.44	42.39	23.83°	18.26
3	Soil+2%RH & CC	0.453	46.60	24.70°	22.58
4	Soil+3%RH & CC	0.537	73.78	23.83°	18.26
5	Soil+4%RH & CC	0.483	56.31	25.16°	24.86
6	Soil+3%RH & C+0.5%PPF	0.52	68.28	26.1°	29.53
7	Soil+3%RH & CC+1%PPF	0.532	72.16	27.2°	34.99
8	Soil+3%RH & C+1.5%PPF	0.57	84.46	30.75°	52.61

CONCLUSIONS

Based on the laboratory tests conducted for this study the following conclusions are given below.

1. The Optimum Moisture Content (OMC) and Maximum Dry Density values obtained from virgin soil were 12% and 1.965 g/cc respectively.
2. Through Standard Proctor Test, it was concluded that maximum dry density and optimum moisture content were obtained at 3% Rice husk and calcium chloride mixed in soil. Compared to virgin soil, a marginal 8.22% increase in Maximum Dry Density was observed.
3. At 1% polypropylene fibre mixed with 3% Rice husk and calcium chloride content, a marginal increase of 4.88% in MDD value was observed. At 3% Rice husk and calcium chloride content, MDD was found to be further improved as compared to just Rice husk and calcium chloride mixed with soil.
4. In comparison to virgin soil (Clayey Sand – SC group) the soil mixed with 3%Rice husk and calcium chloride gave a substantial increment of 26.98% in CBR value. Thus it was concluded to fix the percentage of Rice husk and calcium chloride a 3% to further analyses effect of polypropylene in the soil mix.
5. As compared to soil mixed with 3% Rice husk and calcium chloride, 1% polypropylene mixed with 3% Rice husk and calcium chloride gave CBR value of 4.33. Thus 8.25% increase in CBR value was observed.
6. In comparison to virgin soil, an overall gain of 37.46% of CBR value was obtained with 3%Rice husk and calcium chloride and 1% polypropylene fibre mix.
7. When virgin soil (Clayey Sand) mixed with 3%Rice husk and calcium chloride gave a substantial increment of 73.78% in Cohesion value and 18.26% in Angle of Internal Friction. Thus it was concluded to fix the percentage of Rice husk and calcium chloride a 3% to further analyses effect of polypropylene in the soil mix
8. The shear quality parameters of clayey sand soil were determined by coordinate shear test delineates the value of cohesion enhanced for soil admixed with 3% Rice husk and calcium chloride and various polypropylene fibre

reinforcement of 0.5%, 1% and 1.5% are 68.28%, 72.16% and 84.46% respectively. The increment of the internal angle of friction (φ) was observed to be 29.53%, 34.99% and 52.61% individually. Thus, a net increase in the cohesion and the internal angle of friction φ were seen to be 84.46%, from 0.309 kg/cm2 to 0.57 kg/cm2 and 52.61%, from 27.82 to 30.75 degrees.

9. The fibrous mix develops resistance towards sudden failure by improvising upon grain contact of the overall mix.
10. With overall gain of 37.46% of CBR thickness of subgrade reduced to around 25 mm in rural roads as per IRC: SP 72-2007.

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