

Review on Stabilization of Soil using Coir Fibre

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Abstract— Soil is that the major and most typically used material within the field of engineering. Wherever it's used construction, foundation, bricks, pavements it ought to give respectable strength for the soundness of the structure. There are varied varieties of soil within the earth relying upon the fabric property, size, texture, varied properties. There in clay soil is one in its entire group A fine-grained natural rock or soil material that mixes one or additional clay minerals with traces of metal oxides and organic matter. Relying upon the fabric composition clay conjointly possess varied properties. It's slow to empty, quickly to harden, and tough to use for love or money owing to its finer particle size. Black cotton soil may be a quite expansive soil within which it expands in its volume in wet condition and shrinks in dry condition. Some things construction on the clay soil isn't avertable one so soil stabilization is one in all the foremost usually used ways to extend the engineering properties of the soil, as a results of soil stabilization, the bearing capability of the inspiration of the structure is raised and its strength, water tightness, resistance to washout. The essential ways of stabilization are cementation, bituminization, silicification, resinification, ways victimization chemical science or thermal action, and artificial state change. These ways will cause some effects on the atmosphere. Within the context of property development the natural atmosphere, the utilization of natural Fibres like fibre in geotechnical applications is fascinating. Reinforcing the soil with fibre Fibres/coir geotextiles may be a price effective resolution to the ground/soil improvement issues. This experimental study deals with the utilization of coconut Fibre for soil stability. The study includes the properties of fibre Fibre and clay and experimental workouts like tri-axial take a look at, Stress state throughout a tri-axial take a look at, California bearing magnitude relation, unconfined compression take a look at, direct shear take a look at.

Key words: Soil, Coir Fibre

I. INTRODUCTION

Soil is an accumulation or deposit of earth material, derived naturally from disintegration of rocks or decay of vegetation that may be excavated without delay with power instrumentation within the field or disintegrated by light mechanical means that within the laboratory. The supporting soil to a lower place pavement and its special beneath courses is named sub grade. Undisturbed soil to a lower place the pavement is named natural sub grade. Compacted sub grade is that the soil compacted by controlled movement of significant compactors. Sub grade soils square measure a necessary element of pavement structures and inadequate sub grade performance is that the reason for several premature pavement failures. Clay sub-grades specially could give inadequate support, significantly once saturated. Soils with vital physical property may additionally shrink and swell considerably with changes in wetness conditions. These changes in volume will cause the pavement to shift or

heave with changes in wetness content, and should cause a discount within the density and strength of the sub grade, fast pavement deterioration. Pavement style relies on the premise that minimum nominative structural qualities are going to be achieved for every layer of fabric within the pavement system. Every layer should resist cutting, avoid excessive deflections that cause fatigue cracking among the layer or in superimposed layers, and forestall excessive permanent deformation through concentration.

As the quality of a soil layer is enlarged, the flexibility of that layer to distribute the load over a bigger space is mostly enlarged in order that a discount within the needed thickness of the soil and surface layers is also allowable. The foremost common enhancements achieved through stabilization embrace higher soil gradation, reduction of physical property index or swelling potential, and will increase in sturdiness and strength. In wet weather, stabilization may additionally be wont to give a operating platform for construction operations. These forms of soil quality improvement square measure noted as soil modification or soil stabilization. The soil should initial be classified as either a sub grade class or base class material so as to be classified as a base material the subsequent criteria should be met:

- 1) A most of 25 % of the soil mass passes the No.200 sieve (0.074 millimetre or 0.003 in.),
- 2) No more than forty % of the soil mass passes the No. forty sieve (0.42 mm or 0.0165 in.),
- 3) A most physical property index of twelve %, and (4) a most liquid limit of forty %.

Otherwise, it's classified as a sub grade material for stabilization functions. The definition of modification and stabilization is ambiguous. During this document modification refers soil improvement that happens within the short term, throughout or shortly when mixes (within hours). This modification reduces the physical property of the soil (improves the consistency) to the required level and improves short strength to the required level (short-term is outlined as strength derived right away among regarding 7-days of when compaction). Although no vital pozzolanic or cementitious reaction happens, the textural changes that accompany consistency enhancements unremarkably end in measurable strength improvement. Stabilization happens once a big, longer-term reaction takes place. This longer-term reaction is as a result of association of metallic element-silicates and/or calcium aluminates in cement or category C ash or as a result of pozzolanic reactivity between free lime and soil pozzolans. A strength increase of 350 kPa or bigger (of the stable soil strength compared to the untreated soil strength beneath a similar conditions of compaction and cure) may be a cheap criterion for stabilization.

II. COIR FIBRE

Soil being the most cost effective and pronto offered construction material, has been fashionable the civil Engineers, although it being poor properties. It's been the constant endeavour of analysis staff to place forth innovative ideas to enhance its mechanical properties to suit the necessities of engineering students. the development of road imposes an important pressure on restricted resources like appropriate earth, stone aggregates binders etc. For property development use of domestically offered materials, waste product ought to be inspired so as to save lots of the natural resources for future generation. There are many varieties of waste product found in Bharat like coal ash, stone quarry, plastics, recycled combination, geo-synthetic materials and synthetic resin baggage etc. however coconut fibre is employed during this analysis paper. In future several roads and highways are created close to the Chandigarh. Coconut fibre is also utilised in these highways comes. fibre or coconut Fibre belongs to the cluster of arduous structural Fibres. it's a very important industrial product obtained from the husk of coconut. The fibre is elastic enough to twist while not breaking and it holds a curl like for good waved. Shorter pad Fibres are separated from the long bristle Fibres that are successively a waste within the fibre business. Thus this fibre waste is employed in stabilization of soil and so it is effectively disposed of. The inclusion of Fibres had a big influence on the engineering behaviour of soil-coir mixtures. The addition of haphazardly distributed plastic Fibres resulted in considerably reducing the consolidation settlement of the clay soil. Length of Fibres has Associate in nursing insignificant impact on this soil characteristic, whereas Fibre contents verified additional influential and effective. Addition of Fibre resulted in decrease in malleability and increase in hydraulic conduction. As a result there has been a growing interest in soil/Fibre reinforcement. The work has been done on strength deformation behaviour of Fibre strengthened soil and it's been established certainly that addition of Fibre in soil improves the engineering performance of soil. Fibre mixed with soil has been employed in several countries within the recent past and more analysis is on-going for several hidden aspects of it. Fibre mixed with soil is effective altogether kinds of soils (i.e. sand, silt and clay). the most advantage of fibre material is that this it's domestically offered and is incredibly low cost. this is often perishable and thus don't produce disposal drawback in atmosphere. This analysis presents the influence of fibre on the UCS and cosmic background radiation price of soil from Industrial space, panchkula, India. the {amount the quantity} of unsoaked and soaked cosmic background radiation price and UCS tests are conducted on soil and soil mixed with varied amount of fibre (0.25, 0.50, 0.75, and 1.0%). The UCS and cosmic background radiation values of soil-coir are compared thereupon of unmixed soil. Historically, oir has been processed into a variety of merchandise like yarns for the assembly of floor coverings, mats and matting, cordage and nets, bristle Fibres for brooms and brushes, and to be used with domestic pad and fabric industries. These markets are dwindling in recent years thanks to robust competition from artificial merchandise. However, there's a firm trend within the industrial countries towards the assembly and use of

additional environmentally benign merchandise and systems, which can facilitate to mitigate the adverse ecological effects of current production ways. the consequences of chemical industries, atmospherically degradation, warming, fast-declining natural resources base, deforestation, waste production, pollution and similar international problems have enlarged the demand for environmentally benign merchandise.

III. SOIL STABILIZATION

A. Mechanisms of Stabilization

The stabilization mechanism might vary wide from the formation of latest compounds binding the finer soil particles to coating particle surfaces by the additive to limit the wet sensitivity. Therefore, a basic understanding of the stabilization mechanisms attached every additive is needed before choosing an efficient stabilizer suited to a selected application. Chemical stabilization involves intermixture or injecting the soil with chemicals active compounds like hydraulic cement, lime, fly ash, Ca or binary compound or with elastic materials like hydrocarbon. Chemical stabilizers is generally divided in to a few groups: ancient stabilizers like calcium hydroxide, hydraulic cement and Fly ash; Non-traditional stabilizers comprised of sulfonated oils, salt, enzymes, polymers, and metal compounds; and By-product stabilizers that embrace cement oven mud, lime oven mud etc. Among these, the foremost wide used chemical additives area unit lime, hydraulic cement and ash. though stabilization with ash could also be additional economical when put next to the opposite 2, the composition of ash is extremely variable. The mechanisms of stabilization of the normal stabilizers area unit elaborated below.

B. Traditional Stabilizers

Traditional stabilizers typically have confidence pozzolanic reactions and ion exchange to change and/or stabilize. Among all ancient stabilizers, lime in all probability is that the most habitually used. Lime is ready by mouldering sedimentary rock at elevated temperatures. Lime-soil reactions area unit advanced and primarily involve a 2 step method. the first reaction involves ion exchange and flocculation/ agglomeration that give birth to fast textural and physical property changes. The altered clay structure, as a results of action of clay particles because of ion exchange and short-run pozzolanic reactions, ends up in larger particle agglomerates and additional friable and feasible soils. though pozzolanic reaction processes area unit slow, some quantity of pozzolanic strength gain might occur throughout the first reactions, ion exchange and flocculation/agglomeration. Extent of this strength gain might vary with soils looking on variations in their mineralogical composition.

C. By-Product Stabilizers

Like ancient stabilizers, pozzolanic reactions and ion exchange area unit the first stabilization mechanisms for several of the by-product stabilizers. Lime oven mud (LKD) and cement oven mud (CKD) area unit by-products of the production of lime and hydraulic cement, severally. Lime oven mud (LKD) commonly contains between regarding thirty to forty p.c lime. The lime could also be free lime or combined with pozzolans within the oven. The supply of

those pozzolans is possibly the fuel wont to offer the energy supply. LKDs could also be somewhat pozzolanically reactive attributable to the presence of pozzolans or they will be altogether non reactive because of the absence of pozzolans or the quality of the pozzolans contained within the LKD. Cement oven mud (CKD) is that the byproduct of the assembly of hydraulic cement. The fines captured within the exhaust gases of the assembly of hydraulic cement area unit additional possible (than LKD) to contain reactive pozzolans and so, to support some level of pozzolanic reactivity. CKD typically contains between regarding thirty and forty p.c CaO and regarding twenty to twenty five p.c pozzolanic material.

D. Non Ancient Stabilizers

The mechanism of stabilization for non-traditional stabilizers varies greatly among the stabilizers. Asphalt might or might not be sorted as a conventional stabilizer looking on perspective. Asphalt isn't a "chemical" stabilizer within the sense that it doesn't react with chemicals with the soil to provide a product that alters surface chemistry of the soil particles or that binds particles along. Instead asphalt waterproofs combination Associate in Nursing soil particles by coating them and developing an adhesive bond among the particles and therefore the asphalt binder.

E. Soil Classification

Soil could be a broad term utilized in engineering applications which incorporates all deposits of loose material on the earth's crust that area unit created by weathering and erosion of underlying rocks. though weathering happens on a geological scale, the method is continuous and keeps the soil in constant transition. The physical, chemical, and biological processes that type soils vary wide with time, location and environmental conditions and end in a good vary of soil properties. Physical weathering happens because of temperature changes, erosion, alternate temperature reduction and thawing and because of plant and animal activities inflicting disintegration of underlying rock strata whereas chemical weathering decomposes rock minerals by chemical reaction, reduction, hydrolysis, chelation, and suffusion. These weathering processes, separately or together.

F. Components of Stabilization

Soil stabilization involves the utilization of helpful agents (binder materials) in weak soils to boost its geotechnical properties like softness, strength, porosity and sturdiness. The parts of stabilization technology embrace soils and or soil minerals and helpful agent or binders (cementitious materials).

G. Soils

Most of stabilization has got to be undertaken in soft soils (silty, clayey humate or organic soils) so as to realize fascinating engineering properties. per Sherwood (1993) fine-grained granular materials area unit the simplest to stabilize because of their massive area in relevance their particle diameter. A clay soil compared to others includes a massive area because of flat and elongated particle shapes. On the opposite hand, loose materials is sensitive to hard currency in wet and, therefore, might prove troublesome throughout stabilization .Peat soils and organic soils area

unit wealthy in water content of up to regarding 2000%, high consistency and high organic content. The consistency of humate soil will vary from muddy to fibrous, and in most cases, the deposit is shallow, however in worst cases, it will reach many meters below the surface. Organic soils have high exchange capability; it will hinder the association method by holding the Ca ions liberated throughout the association of Ca salt and Ca compound within the cement to satisfy the exchange capacity.

H. Stabilizing Agents

These area unit hydraulic (primary binders) or non-hydraulic (secondary binders) materials that once connected with water or within the presence of pozzolanic minerals reacts with water to make cementitious composite materials. The ordinarily used binders are:

- Cement
- Fly ash
- Blast furnace slag
- Lime
- Stone dust

IV. LITERATURE REVIEW

A. Coir Fibre

The outer covering of fibrous material of a matured coconut, termed coconut husk, is that the reject of coconut fruit. The fibres are usually 50–350 millimeter long and consist primarily of polymer, tannin, cellulose, cellulose and alternative water soluble substances.(Hejazi,et. al,2012) Coconut palms are primarily cultivated within the tropical regions of the globe and also the product from the palm is applied in food and non-food product, that sustains the keep of individuals everywhere the world. The coco includes of a meat that contains a total p.c by weight of twenty eight enclosed by a protecting shell and husk that contains a total p.c by weight of twelve and thirty five severally. The husk from the coco includes of half-hour weight of fibre and seventieth weight of pith material. The fibre are extracted from the husk by many strategies like retting, that may be a ancient manner, decortications, mistreatment bacterium and fungi, mechanical and chemical change , for the assembly of building and packaging materials, ropes and yarns, brushes and cushioning of mattresses so on. (Pillai, 2003) fibre or coconut fibre belongs to the cluster of arduous structural fibres. The fibre is elastic enough to twist while not breaking and it holds a curl like for good waved. The inclusion of fibres had a big influence on the engineering behaviour of soil-coir mixtures. The addition of haphazardly distributed plastic fibres resulted in considerably reducing the consolidation settlement of the clay soil. Length of fibres has AN insignificant result on this soil characteristic, whereas fibre contents tested additional authoritative and effective. Addition of fibre resulted in decrease in malleability and increase in hydraulic physical phenomenon. As a result there has been a growing interest in soil/fibre reinforcement. The work has been done on strength deformation behaviour of fibre strengthened soil and it's been established definitely that addition of fibre in soil improves the general engineering performance of soil. Fibre mixed with soil has been employed in several countries within the recent past and additional analysis is current for

several hidden aspects of it. Fibre mixed with soil is effective all sorts of soils (i.e. sand, silt and clay). The fibre is one among the toughest fibre offered as a result of its high content of lignin; fibre is way additional advantageous in several Application for erosion management, reinforcement and stabilization of soil and is most well-liked to the other natural fibres. (Singh and Mittal, 2014). Due to its high polymer content, fibre degradation takes place rather more slowly than in alternative natural fibres. So, the fibre is additionally terribly long lasting, with parcel of land service lifetime of 4–10 years. The water absorption of that's regarding 130–180% and diameter is regarding zero.1–0.6 mm. fibre retains a lot of of its enduringness once wet. it's low purpose however the elongation is way higher. The degradation of fibre depends on the medium of embedment, the climate and is found to retain eightieth of its enduringness when vi months of embedment in clay. Mainly, fibre shows higher resilient response against artificial fibres by higher constant of friction. proportion| the share the proportion} of water absorption will increase with a rise within the percentage of fibre. enduringness of fibre reinforced soil (oven dry samples) will increase with a rise within the proportion of coir. (Hejazi et al, 2012)

B. Advantages of Coir Fibre

- 1) It's a renewable resource and CO2 neutral material.
- 2) The fibre is abundant, non-toxic in nature, biodegradable, low density and very cheap.
- 3) The fibre has a high degree of retaining water and also rich in micronutrients.
- 4) The fibres instead of going to waste are explored for new uses, which in turn provide gainful employment to improve the standard living condition of individuals.(Pillai,2003)

C. Physical properties of coir fibre (Source: T.Subramani, D.Udayakumar et al, 2016 ISSN 2319 - 4847)

Length in inches	-	6-8
Density (g/cc)	-	1.40
Tenacity(g/Tex)	-	10.0
Breaking Elongation%	-	30%
Diameter in mm	-	0.1 to 0.5
Rigidity of Modulus	-	1.8924dyne/cm2

D. Chemical properties of coir fibre: (Source:Ravi Shankar et al, 2012)

Lignin	-	45.84%
Cellulose	-	43.44%
Hemi –Cellulose	-	0.25%
Pectin's and related Compound	-	3.0%
Water soluble	-	5.25%
Ash	-	2.22%

E. Coir Fibre in Soil Stabilization and the Results on the Strength:

Singh associated Mittal (2014) conducted an experimental study on clayey soil mixed with varied share of fibre. Soil samples for unconfined compression strength (UCS) and California bearing quantitative relation (CBR) tests are ready at its most dry density love its optimum wetness content within the cosmic background radiation mould while not and with fibre. the proportion of fibre by dry weight of

soil is taken as zero.25%, 0.50%, 0.75% and one hundred and twenty fifth and love every fibre content unsoaked and soaked cosmic background radiation and UCS tests ar conducted within the laboratory. Tests result indicates that each Unsoaked and soaked cosmic background radiation price of soil will increase with the rise in fibre content. Soaked cosmic background radiation price will increase from 4.75% to 9.22% and unsoaked cosmic background radiation price will increase from 8.72% to 13.55% of soil mixed with one hundred and twenty fifth fibre. UCS of the soil will increase from 2.75 kg/cm² to 6.33 kg/cm² upon addition of one hundred and twenty fifth indiscriminately distributed coconut fibre. Adding of coconut fibre ends up in less thickness of pavement owing to increase in cosmic background radiation of combine and scale back the price of construction and thence economy of the development of road are going to be achieved. this can be due to composite impact of fiber changes the brittle behavior of the soil to ductile behavior. Tiwari and Mahiyar (2014) have tested individual behavior of FlyAsh Crushed Glass & Coconut fibre with soil, that shows that for adding 100%, 15%, 20%, twenty fifth & half-hour solfa syllable with soil produces highest cosmic background radiation useful four at grievous bodily harm twenty fifth, at that time curve height decreases step by step. equally on adding third, five-hitter & seven-membered they obtained highest cosmic background radiation useful three .1 at seven-membered CG once curves falls down hugely. additionally for adding zero.25%, 0.5%, 0.75%, 1% & 1.25%.of CCR we tend to obtained grievous bodily harm curve height at cosmic background radiation price of three.6 at that time curve ought to sequent depletion. thence they determined from experimental results for mixtures created for 25%FA, seven-membered & 1%CCF to line vary for combination for this forty eight trial samples are created. throughout this trial C.B.R, curve attains highest price at five.2 and falls down two.2 and once more it goes to three.8, for various set of combination. Dr.T.Subramani and Er.D.Udayakumar have been also tested some on the coir fibre as well as on the other type of the stabilizers. Some important results as per the highway construction are very useful for the researchers. The test result of the permeability test is as follow the table Table shows the Permeability test result

% of coir fibre	Initial Head (H1)	Final Head (H2)	Time coff. Of permeability	permeability
Normal soil	72	58	5	0.2199
0.25 % of coir	78	58	5	0.3017
0.50 % of coir	83	48	5	0.5570
0.75 % of coir	88	52	5	0.5350
1.0 % of coir	94	82	5	0.1390

Table 1:

Chapale and Dhattrak (2013) targeted on impact of fibre on bearing capability and settlement of footing with parameters like thickness of strengthened layer (B, B/2, B/4) with zero.25%, 0.5%, 0.75% & 1.0% of fibre victimization the laboratory model tests on sq. footings

supported on extremely compressible clayey soil strengthened with indiscriminately distributed fibre fibre. Provision of fibre strengthened layer will increase bearing capability quantitative relation up to one.5 to 2.66. there's vital increase in bearing capability of clayey soil with the inclusion fibre fibres. At twenty five metric linear unit depth of fibre strengthened soil (B/4) and zero.50% fibre content the SBC is most. there's no got to place the fibre strengthened soil throughout the depth because the soil is affected to a major depth {of two of two} to 2.5 times the dimension of footing. only 1 fourth dimension of footing (B/4) is comfortable for increasing the SBC. In general, the results shows that the supply of fibre strengthened layer, reduces the settlement and improves the bearing capability , that found to be economical techniques among varied sorts of bearing capability improvement techniques. H.P. Singh (2013) studied the influence of fibre fibres on shear strength parameters (c and ϕ) and stiffness modulus (σ_d / ϵ) of ash. within the gift investigation, samples of ash compacted to its most dry density at the optimum wetness content were ready while not and with indiscriminately distributed fibre for triaxial compression tests. The fibre fibre were taken as zero.25 %, 0.5 %, 0.75 attempt to I Chronicles by dry weight of ash and also the shear strength parameters (c and ϕ) and stiffness modulus (σ_d / ϵ) of strengthened ash for every fibre content was firm within the laboratory. Finally these strength parameters (c , ϕ and σ_d / ϵ) of strengthened ash were compared thereupon of unreinforced ash. Tests results indicate that on inclusion of fibre fibre, the shear strength parameters and stiffness modulus of ash will increase. it had been additionally determined that on increasing the fibre content, the values of those strength parameters more will increase and also the improvement is substantial at fibre content of I Chronicles. Thus there's a major improvement within the strength parameters of ash owing to inclusion of fibre. Singh and Gill (2012) studied the impact of geo-grid reinforcement on most dry density (MDD), Optimum wet Content (OMC), Calif. Bearing quantitative relation (CBR) of sub-grade soil. The clayey sort of soil and one sort of geo—grid were elite for this study. From the study it's clear that there's goodish improvement in Calif. Bearing quantitative relation (CBR) of sub-grade attributable to geo-grid reinforcement. just in case of while not reinforcement (Geo-grid) the soaked cosmic microwave background radiation price was two.9% and once geo-grid was placed at zero.2H from the highest of the specimen the cosmic microwave background radiation will increase to nine.4%. Vaidya et. al, The stabilization of the ash with cement alone or in conjunction with plastic fibres is effective so as to boost the either strength parameter-compression likewise as durability. The strengths (UCS likewise as BTS) increase up to a quarter fibre altogether the mixes and thenceforth, it decreases. the worth of the strengths (UCS and BTS) will increase with increase in activity amount. the speed of gaining the strength in most of the cases square measure fast throughout initial section of activity, i. e., up to fourteen days activity. the worth of strengths (UCS likewise as BTS) in respect of un- soaked sample is over that just in case of soaked sample. At higher activity amount like fourteen days thought-about within the gift study, the sturdiness of stable ash gets improved attributable to formation of pozzolanic reaction with the

addition of cement. each the strengths- compressive likewise as tensile- is found to be higher {in case just in case} of two hundredth cement contents and appreciate a hundred and twenty fifth fibre in case of either samples, i.e., unsoaked and soaked, indicating the optimum performance of the combination with two hundredth cement contents and a hundred and twenty fifth fibres. Karthika et.al (2011) have stable the soil with fibre geotextile. For acting the cosmic microwave background radiation take a look at, the geotextile was placed at a middle depth of the mould whereas compacting. within the field simulation take a look at for the mensuration of rut depth, a layer of geotextile was provided at a depth of 15cm and higher than that the soil was compacted in layers to create the subgrade and cosmic microwave background radiation of soil strengthened with geotextile is redoubled to twelve the troubles. cosmic microwave background radiation of soil stable with five per cent ash and a pair of 0.5 per cent cement and strengthened with geotextile is found to be glorious and involves 27.5% per cent.

V. CONCLUSION

Coir fibre could be a helpful use waste that improves strength and stiffness of every kind of soil fiber employed in totally different {completely different} proportion and different lengths have an effect on the soil properties. additional work is done on degradation of fiber waste.

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