IMPROVEMENT OF SUBGRADE SOIL PROPERTIES USING ADMIXTURE (QUARRY DUST) AND WOVEN GEOTEXTILE

[1]AppariAvinash, [2]B SANTOSHI MATHA

[1]Student, [2] Assistant professor
[1]Transprtations
[1]PYDAH COLLEGE OF ENGINEERING, kakinada, india

***Abstract*—The important factor for design and construction of pavement is the behavior of underlying sub-grade. Large deformations in the sub-grade will lead to a continuous deterioration of the paved surface. As the sub-grade soil is too weak to bear the load, engineering solutions such as geo rein for cement using geo-synthetics are additives which are earlier used in sub-grade improvement and such experimental study is carried by previous authors. This paper deals with the sub-grade improvement using geo-textile as a reinforcement sheet and quarry dust as admixtures. In order to increase the strength of the sub-grade the quarry dust is varied with different percentages i.e., 0%, 5%, 10%, 15%, 20% and 25%.In this study, Proctor's compaction tests, and CBR soaked and un-soaked tests are conducted on locally available soil with reinforced material and with admixture. For this study it is identified that the engineering properties of the soil is improved in all conditions. The soil with quarry dust at optimum value is 20% has CBR soaked value is obtained 6.83% and un-soaked value is obtained 7.02% is increased when compared with conventionally soil. The soil, quarry dust at optimum value is at 20% and Geo-textile has CBR soaked value is 6.59% and un-soaked value is 8.95% is increased when compared with conventionally soil and soil with quarry dust.**

***IndexTerms*—Dust, admixture**

I. INTRODUCTION (HEADING 1)

Introduction on Sub grade layer:

Low volume paved and unpaved roads usually serve as access roads to rural areas, towns and districts. They play a very important role in rural economy, resource industries (forest, mining) and transportation to agricultural production areas. When low volume roads are built on poor subgrade soils, large deformations can occur, which increase maintenance cost and lead to interruption of traffic service. Leng (2002) states that in general, deterioration of unpaved and paved roads is faster than road replacement. The increasing material and construction costs, make it important to explore alternative construction methods with longer service life but at the same time cost efficient. The objective of pavement design is to provide a structural and economical combination of materials to carry traffic in a given climate over the existing soil conditions for a specified time interval. In which subgrade is the lower most layer in the earth's surface which is the native material underneath a constructed road, Generally subgrade is compacted before laying a pavement as it is the lower layer and it should have the bearing capacity to sustain the entire pavement.

Geo-synthetics have been found to be a cost effective alternative to improve poor sub- soils in adverse locations, especially in situations where there may be non-uniform quality and/or non-availability of desired soils with applications in almost all geotechnical engineering projects such as airport and highway pavements. In India Ghosal and Som (1989) reported the first major use of a nonwoven fabric in a heavy duty yard in Haldia, it was found to decrease the pavement thickness by 30%.

Geo-grid, a type of geo-synthetic reinforcement is gaining acceptance as an effective way of improving on the properties of naturally occurring soils for road pavement construction. Venkatappa Rao and Banerjee (1997) reported that bi-oriented geo-grids have been successfully utilized in Maharashtra in the State Highways for strengthening road pavements in black cotton soil. Gupta (2009) argues that the purpose of geo-synthetic reinforcement in flexible pavements is to extend a pavement's lifespan or to enable the construction of a pavement with a reduced quantity of base course material without sacrificing pavement performance. The Ghanaian engineering community is in the process of getting acquainted with geo-grids through research work and conferences. In many tropical countries like Ghana, lateritic subgrades are common and often rejected after proof rolling during construction due to poor strength. Cost associated with poor subgrades include relatively larger sub-base and base thicknesses, right-of-way purchases as a result of relocation of road corridors and eventually longer construction periods with associated opportunity costs..

II. TYPE STYLE AND FONTS

IntroductiononSurfaceLayer:

Surface coarse is the top most layer of the pavement which carry the load and transmits to the layers. The purpose of the surface or wearing coarse is to give a smooth riding surface thatis dense. Its resists the pressure exerted by tyres and takes up wear and tear due to the traffic. It also of fersa water tight layer against the surface water infiltration.

TypesofPavements:

Pavements can bedivided into 3 major types:

- Flexiblepavements(upperlayersofasphalt)
- Rigidpavements(upperlayersofconcrete)

- Compositepavements.

Flexible Pavements: Flexiblepavements consistofanumberoflayers.

- ❖ Conventionalflexiblepavements:

Advantages of conventional flexible pavement:

- Adjusts to limited differential settlement
- Easily,quicklyconstructedandrepaired
- Additionalthicknesscan beadded

TypesofAdmixtures:

There are many admixtures which are been use in replacement off in aggregate to increase the strength. Commonly used admixtures are:

1. Quarrydust
2. Flyash
3. Steelslag
4. Brickdust

SHOWING THEPHYSICALPROPERTIESOF QUARRYDUSTANDNATURALSAND

Property	Quarry Dust	NaturalS and	TestMethod
Specific gravity	2.54-2.6	2.6	IS2386(part-III)-1963
Bulk density(kg/m^3)	1720-1810	1460	IS2386(part-III)-1963
Absorption(%)	1.20-1.50	Nil	IS2386(part-III)-1963
Moisturecontent(%)	Nil	1.50	IS2386(part-III)-1963
Fineparticleslessthan0.075mm(%)	12-15	6	IS2386(part-III)-1963
Sieveanalysis	ZoneII	ZoneII	IS383-1970

Showing the Typical ChemicalProperties of Quarry Dust andNatural Sand

Constituents	Quarry Dust(%)	NaturalSand (%)	TestMethod
Sio2	62.48	80.78	IS4032-1968
Al2o3	18.72	10.52	IS4032-1968
Fe2o3	6.54	1.75	IS4032-1968
Cao	4.83	3.21	IS4032-1968
Mgo	2.56	0.77	IS4032-1968
Na2o3	Nil	1.37	IS4032-1968
K2o	3.18	1.23	IS4032-1968
Tio2	1.21	Nil	IS4032-1968
Lossofignition	0.48	0.37	IS4032-1968

Advantagesof QuarryDust:

The Specific gravity depends on the nature of the rock from which it is processed and thevariation is less

DisadvantagesofQuarryDust:

Shrinkage is more in when compared to that of the natural river sand. Water absorption ispresent so that increase the water addition to the drymix

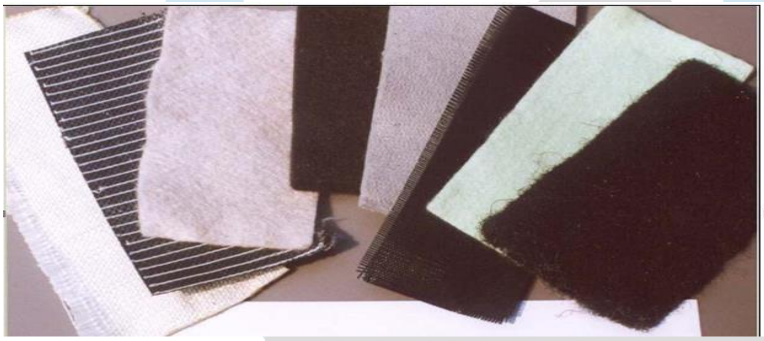
Geo-textileMembranes:

A geo-textile is defined as a permeable geo-synthetic made of textile materials. The Geo-synthetics industry has expanded rapidly in recent years, and the number and types of geo-textiles manufactured with a specific focus in roadway design has increased dramatically. This increase has resulted in many new performance-enhancing and cost-saving design n alternatives for road ways. The use of geo-textiles in pavement applications has addressed five main functions: separation, filtration, drainage, reinforcement, and mitigation of crack propagation.Depending on the type of geo-textile and its location within the pavement system, geo-textilescan performs one or more of these various functions simultaneously as part of an overarching application.The polymersused inthe manufacture ofgeo-textile fibers include the following, listedin order of decreasing use: polypropylene (≈85%), polyester (≈12%), polyethylene (≈2%), and polyamide (≈1%). The most common types of filaments used in the manufacture of geo-textilesinclude monofilament, multifilament, staple filament, and slit-film. If fibers are twisted or spun together, they are knownas ayarn.

NonwovenGeo-textiles:

Nonwoven geo-textiles are manufactured by placing and orienting the filaments or fibersonto a conveyor belt, which are subsequently bonded by needle punching or by melt bonding. The non woven geo-textiles have tremendously different engineering properties than the wovengeo-textiles. The type of polymer will also influence significantly the engineering properties oftheseproducts.

View of differenttypesof Geo-textiles



Separation:

Separation is the introduction of a flexible porous geo-textile placed between dissimilarmaterials so that the integrity and the functioning of both materials remains intact for the life ofthe structure or is improved is the introduction of a flexible porous geo-textile placed betweendissimilar materials so that the integrity and the functioning of both materials remains intact forthe life of the structure or is improved. A geo-textile placed between the aggregate and thesubgrade acts as a separator, minimizingcontamination of the aggregate base bythe subgrade

Pavement without geo-textile showing intrusion into thebase coarse

Pavement without geo-textile showingSub grade reduction of base contamination

Figure1.6: Pavement WithandWithoutGeo-Textile

LITERATUREREVIEW

StudiesofVarious AuthorsImproving StrengthofSoftSubgrade:

LacuotureandGonzalezetal.[1995]He conducted comprehensive study of the Terrazymes oil stabilizer product and its effectivenesson sub-base and sub-grades oils. The reactions of this oils treated with the enzyme was observed and recorded and compared to the untreated controlSamples, the variation in properties was observed over a short period only and it was found thatIncohesivesoilstherewasnomajorvariationinpropertiesduringtheearlydaysbutthesoilshowed improved performance progressively.

Hitam and Yousofet al.[1998] He conducted field studies on improvement of plantation roads.The road was unpaved road and it affects badly due to adverse weather conditions. Terrazyme was treated to 27.2 km of the road and the sections were then monitored on the surface erosionfor two monsoon seasons. No damage was noticed and there searches have concluded thatTerrazymestabilizationcanconverttheroadtoallweatherroadsthathasminimumdestructionin hot and wet seasons.

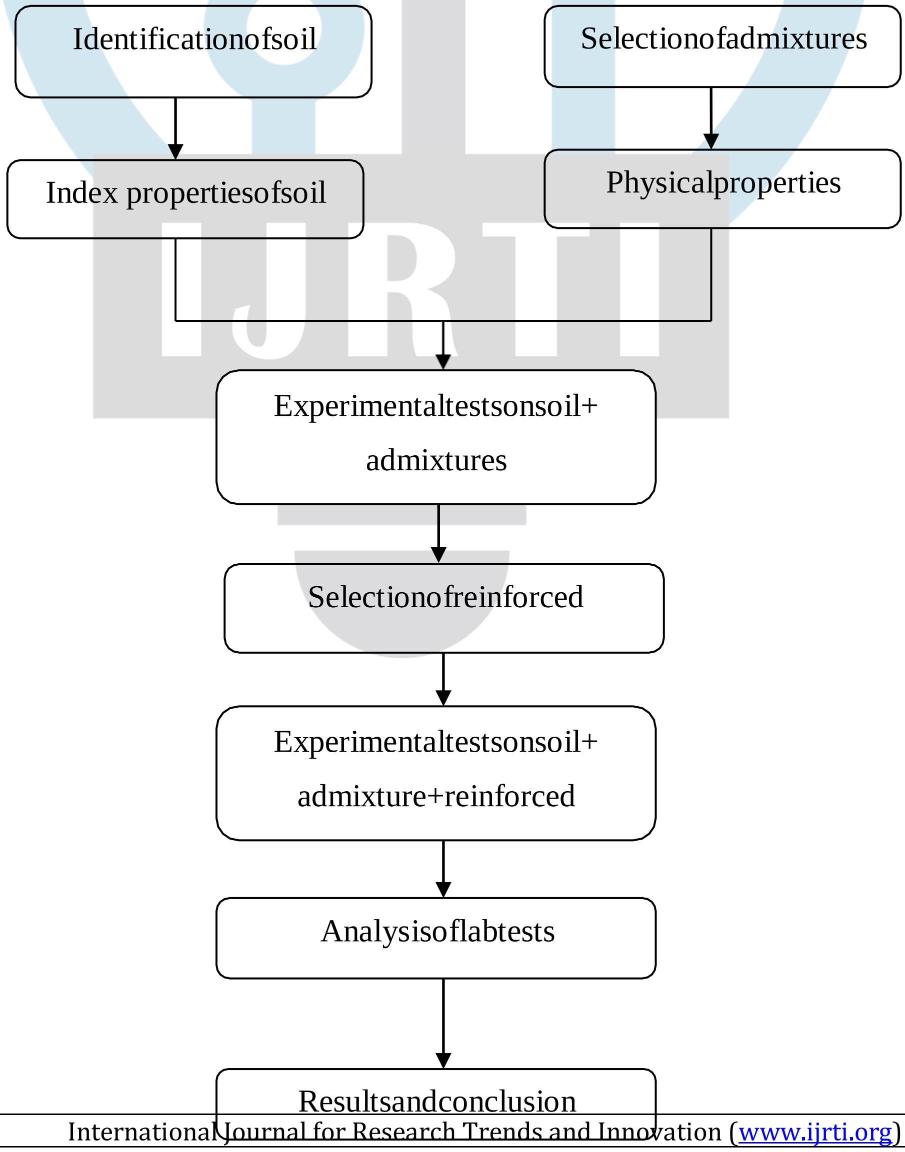
Sharma et al. [2001] He has conducted laboratory studies on use of Bio-Enzyme stabilization ofthree types of soils namely, clay of high plasticity, clay of low plasticity and silt of low plasticity. It was found that soil shows a margin a lima provident in CBR value and substantiates reduction in saturation moisture after four weeks of stabilization. The soil shows a marginal improvement in unconfined compressive strength, direct tensile strength and fatigue strength.

Isaacetal.[2003]He have done experimental studies in the area of Bioenzymatics oil stabilization in the laboratory for different types of soils from Kerala. The soil samples werelaterite, clay and sand. These samples were tested for grain size analysis and Atterberg's limit.The optimum moisture content of the soil was determined from modified compaction test. The soil was treated with different dosage of enzyme. CBR test were conducted on each soil samples at different curing period under soaked condition. From the study they found that Terrazyme

METHODOLOGYANDEXPERIMENTALSTUDY

The following methodology is undertaken and various combinations oftests were conducted for both Un-modified and modified soilin order to complete thetask.

Figure3.1:Methodologyforproject



MaterialStudy:

In this experiment we are evaluating the index properties of soil in which the materialsused are an unmodified Red soil which is collected near Sanketika College, pm palem. Quarry Dust which is collected from Gonnavanipalem quarry. It consists mainly of sand size particles(89%). Geo-textileof 200 GSM woven 1.6mm thick (+1-20%) and holding in position in thefoundation trench in between the sandlayers includingover lappingof 100mm foreveryjoint.

TestsonMaterials:

Thefollowingparameters arestudied in experimental work

- Specific gravityofsoil
- Grainsizedistributionofsoil
- Compactioncharacteristicsofsoil
- Californiabearingratio(CBR)ofsoil.

RESULTSANDDISCUSSION

ResultOnSoilAndAdmixture:

In this experiment we are evaluating the index properties of soil in which the materials usedare an unmodified Red soil which is collected near Sanketika college, pm palem. Quarry dustwhich is collected from Gonnavanipalem quarry.

PresentationofTestResults:

Naturally available red soils are mixed with admixtures like Quarry dust at varyingpercentages to the dry weights of soils. Experiments are conducted on the samples blended withtheseadmixtures to determinethe indexand engineeringproperties of themodified soils

Propertiesof UnmodifiedSoilandAdmixtures:

Properties	**Soil**	**Quarrydust**
Specificgravity	1.9	2.4
WL(%)	21.5	NP
WP(%)	12.01	NP
P.I(%)	9.49	NP
Gravelsizeparticles(%)	2.82	1.78
Sandsizeparticles(%)	22.62	89
Finessizeparticles(%)	71	5
ISCS	CI	SP
γd(kN/m³)	18.94	26.5
WO(%)	14.3	10.6
SC(%)	1.74	-
UC(%)	2.8	-

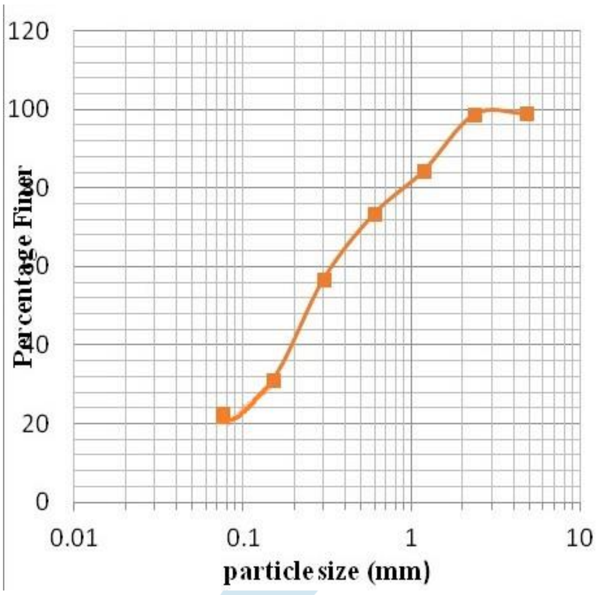


Figure4.1:Grain SizeAnalysisGraph

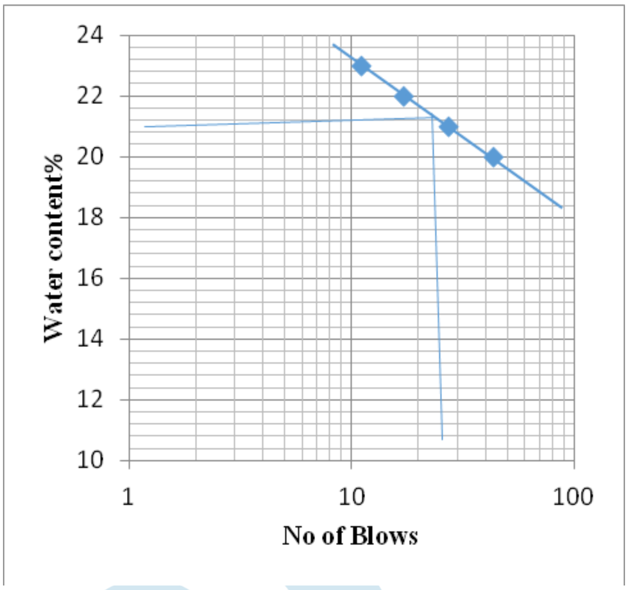


Figure4.2:Atterberg'sLimitGraph

Table5:Atterberg'sLimitofunmodifiedsoilandAdmixtures

Properties	Soil+ (0%)QD	Soil+ (5%)QD	Soil+(10 %)QD	Soil+(15 %)QD	Soil+(20 %)QD	Soil+(25 %)QD
WL(%)	21.5	20.2	19.8	16.5	14.89	14.29
WP(%)	12.01	11.82	11.62	9.56	8.25	8.01
P.I(%)	9.49	8.38	8.18	6.94	6.64	6.28

CONCLUSIONS

Conclusions that are studied from the course of study include the following:

1. The effect of all the admixtures on various properties is significant in general and of geo- textile in particular. Among two admixtures it is observed that workability of geo-textile membrane is better than quarry dust
2. The Liquid limit of soil with quarry dust gradually decreases from 5% to 25% when compared with soil with zero percentage of quarry dust. The decrease in liquid limit is 1.3%, 1.7%, 5%, 6.61% and 7.21%.
3. The plastic limit of soil with quarry dust gradually decreases from 5% to 25% when compared with soil with zero percentage of quarry dust. The decrease in liquid limit is 0.89%, 0.39%, 2.45%, 3.76% and 4%.
4. The plasticity index of soil with quarry dust gradually decreases from 5% to 25% when compared with soil with zero percentage of quarry dust. The decrease in liquid limit is 1.04%, 1.25%, 2.55%, 2.85% and 3.21%.
5. The water content of soil with quarry dust gradually decreases from 5% to 25% when compared with soil with increase in percentage of quarry dust. The optimum moisture content was attained at 15% with 21.66%. The decreases in water content with respect to OMC is 3.36%, 2.05%, 0.69%,till 15% and a gradual increase in water content with respect to OMC is 1.14% and 1.18%.
6. The dry density of soil with quarry dust gradually decreases from 5% to 25% when compared with soil with increase in percentage of quarry dust. The MDD is attained at 20%. The decrease in dry density with respect to MDD is 3.75%, 3.47%, 2.80%, 2.60% and 0.8%.
7. The void ratio of soil with quarry dust is gradually decreasing with a percentage of 5% to 25%. The decrease of void ratio of soil is 0.041%, 0.0876%, 0.1159%, 0.1762%, 0.0199%.
8. The un-soaked CBR value with a modified soil gradually decreases with addition of quarry dust from 5% to 25%, the decrease of CBR value from the figure is 4.22%, 2.1%, 1.41%, 0.13%.

9. The un-soaked CBR value with a modified soil gradually decreases with addition of quarry dust and geo-textile membranes from 5% to 25%, the decrease of CBR value from the figure is 5.35%, 3.93%, 2.97%, 1.83%.

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