Review of Soil Subgrade When Stabilized with Rice Husk Ash

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Abstract— The natural soil behaves like an Expansive soil or cracking soil because these have tendency of shrinking and cracking when moisture content decreases and also have tendency of swelling when moisture content increases. The moisture may come from water leakage or sewer lines, rain, flooding. Soil generally exhibits these properties, when it contains montmorillonite clay minerals. The engineering properties of Natural soil includes plasticity characteristics, compaction properties, volume stability its strength may be enhanced by adding materials such as Rice husk ash, fibres, cement, sodium chloride etc. The changes in properties of these soils primarily depend upon the type and amount of binder, curing conditions, time, organic matter content and the percentage of clay.

Keywords: Soil Subgrade, Rice Husk Ash

I. INTRODUCTION

Soil is basic and important element in Civil Engineering field. Stability of every structure depends on the type and characteristics of foundation which in turn depends on the type of soil. Many problems irrupt if expansive soil, Natural soil is to be used in foundation, because of its shrinkage and swelling properties. There are many methods to make natural soil stable for various constructions. Natural soil is comfortable for road work, compared to other types of soil. There are two ways to enhance the quality of subgrade soil - “Replacement of soil” or “Soil stabilization”. Soil stabilization can be done chemically or mechanically. Chemical stabilization is carried out by adding different chemicals in suitable proportion, while Mechanical stabilization is achieved by addition of admixtures which helps to improve the properties of soil.

A sound knowledge of performance of the subgrade soil under prevailing in-situ condition is necessary prior to the construction of the pavement. The better the strength/stiffness quality of the materials the better would be the long-term performance of the pavement. Hence, the design of pavement should be focused on the efficient and effective use of existing subgrade materials by stabilizing it with some stabilizing agents to optimize their performance.

II. RESEARCH BACKGROUND

Geotechnical properties of natural soil such as soft fine grained and expansive soils are improved by various methods. The problematic soil is removed and replaced by a good quality material or treated using mechanical and/or chemical stabilization. Any of the above method can be used to improve and treat the geotechnical properties of the natural soil(such as strength and the stiffness) by treating it in situ. During the past few decades it has been reported that the use of cement or lime for the stabilization of pavement bases was investigated and developed into practical construction procedures. These practical procedures have been improved and covered periodically by the technical standards for road and traffic. These natural soil do not possess enough strength either in construction or during the service life of the pavement. One of the strategies to achieve this is soil stabilization. Generally, the role of the stabilizing (binding) agent in the treatment process is either reinforcing of the bounds between the particles or filling of the pore spaces. Soil stabilization technique is an open-field of research with the potential for its use in the near future.

Cement contains calcium required for the pozzolanic reactions to occur. Further cement already contains silica thus stabilization with cement is fairly independent of soil properties. The only thing required is water for hydration process to begin and attributes to the improvement of strength and compressibility characteristics of soil. It has a long history of use as an engineering material and has been successfully employed in geotechnical applications.

Strength gain in soils using cement stabilization occurs through the same type of pozzolanic reactions found using lime stabilization. Both lime and cement contain the calcium required for the pozzolanic reactions to occur; however, the origin of the silica required for the pozzolanic reactions to occur differs. With lime stabilization the silica is provided when the clay particle is broken down. With cement stabilization, the cement already contains the silica without needing to break down the clay mineral. Thus, unlike lime stabilization, cement stabilization is fairly independent of the soil properties; the only requirement is that the soil contains some water for the hydration process to begin.Many engineers and scientists work on stabilization of soil, some work on stabilization of the soil is given below:

Leonard and Bailey (1982), Effect of fine Rice husk ash and coarse Rice husk ash on natural soil was studied. The various test conducted for this project like Atterberg’s Limit, Compaction, Triaxial Compression test, Chemical Analysis, Consolidation. The Attempt has been made to proposed use of Rice husk ash, from the compaction test results it was observed that the variation of dry density was irregular at higher moisture contents. Bleeding was initiated at moisture contents resulted in erratic 40% and the bleeding moisture content corresponded to optimum moisture content. From the findings it was proposed that finer ash samples exhibited higher strength as compared to the coarser samples.

Martin et al. (1990), The effect of Rice husk ash on expansive soil was studied, and different experimental programmes were carried out such as Particle size distribution, Compaction test, Permeability, Consolidation. It was investigated that Rice husk ash in partially saturated state displayed an apparent cohesion due to tensile stresses of retained capillary water. Hence, the effective friction angle, Φ’, was considered as the major factor for long term stability analysis. The results of the standard extraction procedure toxicity tests showed low metal leaching characteristics of Rice husk ash.

Raza& Chandra (1995), The effect of (Rice husk ash + geo-fabric) on soil was studied, various tests such as

Compaction, Swelling, CBR & UCS were carried out. These Studies carried out for use of Rice husk ashes to stabilized alluvial soils, so as to use them as sub grade and base course in airfield and road pavements. The tests conducted on Rice husk ash, soil and their mixtures having various Rice husk ashes: soil ratio. This study indicates that soil treated with Rice husk ash gives considerable improvement in CBR value of soil. With incorporation of geofabric CBR value further increased.

Boominathan and Ratnea (1996), The effect of (Rice husk ash + Rice Husk Ash) on soil was investigated, There were various tests conducted for this research work such as Atterberg's Limit, Compaction and UCS. These studies have been carried out to proposed use of Rice husk ash for stabilization of soil with and without Rice Husk Ash incorporate. Addition of Sugarcane bagasse ash to Rice husk ash resulted in flocculation and particle aggregation. It was observed that WL and WP were reduced with the Sugarcane bagasse ash treatment whereas UCS increased by about 25 %. The compressibility of Rice husk ash reduced to almost one fourth of the original value due to Sugarcane bagasse ash treatment. It was concluded that Sugarcane bagasse ash treated Rice husk ash could be effectively used for embankment over soft clays.

Singh et al. (1996), studied the effect of Rice husk ash and Sugarcane bagasse ash on soil. There were various test programme conducted for this research work such as Atterberg's Limits, Compaction, CBR, UCS. The Effects of different proportions mixes of Sugarcane bagasse ash and Rice husk ash on local soil of Varanasi evaluated to propose suitability of Rice husk ash-soil Sugarcane bagasse ash as a base and sub base material for the roads. From this study, it can be concluded that good results were obtained when soil was stabilized with 15 % of Sugarcane bagasse ash and Rice husk ash in the proportion of 1:3. Different proportions enabled an increase in the CBR value from 4.00 % to 20.70 % and the unconfined compressive strength from 134 KN/m^2 to 680 KN/m^2.

Pandian (2002), The effect of two types of Rice husk ashes Raichur Rice husk ash (Class F) and Neyveli Rice husk ash (Class C) on the CBR characteristics of the black cotton soil was studied. The Rice husk ash content was increased from 0 to 100%. Generally the CBR/strength is contributed by its cohesion and friction. The CBR of BC soil, which consists of predominantly of finer particles, is contributed by cohesion. The CBR of Rice husk ash consists of predominantly coarser particles which contributed its frictional components. The low CBR of Natural soilis attributed to the inherent low strength, which is due to the dominance of clay fraction. The addition of Rice husk ash to Natural soilincreases the CBR of the mix up to the first optimum level due to the frictional resistance from Rice husk ash in addition to the cohesion from BC soil. Further addition of Rice husk ash beyond the optimum level causes a decrease up to 60% and then these is an increase up to the second optimum level. Thus the variation of CBR of Rice husk ash-Natural soilmixes can be attributed to the relative contribution of frictional or cohesive resistance from Rice husk ash or BC soil, respectively. There is an increase of strength with the increase in the Rice husk ash content. Here there will be additional pozzolanic reaction forming cementitious compounds resulting in good binding between Natural soiland Rice husk ash particles.

Kanirajand and Gayathri (2003), effect of Rice husk ash & cement analysis was carried out, UCS test Experiments used to evaluate the factors influencing strength of cement Rice husk ash base courses. Stabilizer content was determined by conducting UCS test on stabilized Rice husk ash specimens cured at different curing conditions. It included Six different curing conditions and adopted controlled and ambient conditions in the study. It was reported that, UCS of stabilized Rice husk ash specimens depends on curing, unit weight, and water content in addition to cement content and curing period.

Phanikumar and Sharma (2004), study of Rice husk ash on engineering properties of soil was carried out through an experimental programme. The effect on parameters like free swell index (FSI), swell potential, swelling pressure, plasticity, compaction, strength and hydraulic conductivity of expansive soil were studied. The ash blended expansive soil with Rice husk ash contents of 0, 5, 10, 15 and 20% on a dry weight basis and they inferred that increase in Rice husk ash content .reduces plasticity characteristics and the FSI was reduced about 50% by the addition of 20% Rice husk ash. The hydraulic conductivity of expansive soils mixed with Rice husk ash decreases with an increase in Rice husk ash content. Due to the increase in Rice husk ash content increases in maximum dry unit weight. When the Rice husk ash content increases there is a decrease in the optimum moisture content and as a result the maximum dry unit weight increases. Hence the expansive soil is rendered more stable. The undrained shear strength of the expansive soil blended with Rice husk ash increases with the increase in the ash content.

S. Bhuveneshwari et. al (2005), effect of Rice husk ash on soil was studied, The experimental programme was carried out by Atterberg's Limits, Compaction, UCS, and Core Cutter. Reported improvements in properties of expansive soil treated with Rice husk ash at varying percentages. Both laboratory trials and field tests have been carried out. It was observed that field application is done through mixing of the two materials (expansive soil and Rice husk ash) in required proportion to form a homogenous mixture there. Trial embankment of 30 m length by 6m width by 0.6m thickness constructed and in-situ tests were carried out.

J.N. Jha (2006), effect of (RHA +Sugarcane bagasse ash) on soil was studied, the tests like Compaction, CBR and UCS test were conducted and evaluation of the effectiveness of using rice husk ash as a pozzolanic to enhance the Sugarcane bagasse ash treatment of soil. The Studies carried out to study the influence of different mixed proportions of Sugarcane bagasse ash and RHA on various properties of the soil. The result shows that addition of RHA enhances not only strength developments but also it increases durability of Sugarcane bagasse ash stabilized soils.

Edil et al (2006), effect of Rice husk ash on soil was investigated, various tests were conducted like Atterberg's Limits, CBR test. The effectiveness of self cementing Rice husk ashes from combustion of sub-bituminous coal at electric power plants for stabilization of soft fine grained soils was evaluated. tests were conducted on soil and soil-Rice husk ash mixtures prepared at different water contents. The results indicated that addition of Rice husk ash appreciably increased CBR and resilient modulus of soils.

Purbi Sen. et al (2011), effects of various locally available stabilizing agents like OPC, Sugarcane bagasse ash and Rice husk ash have been studied for strength improvement. Tests like Compaction, Atterberg’s limit, UCS have been used for the purposes. Specimens were prepared by mixing varying proportions stabilizers with clayey soils separately. UCS and Atterberg’s limits of the soils were determined separately after curing specimens for 7 days. 7.5%-8% of Portland cement gives UCS strength is around 28 kg/cm2 which is satisfactory for road use under Indian climatic condition. 7 days peak strength of soil-Sugarcane bagasse ash specimen was found at 7.5% Sugarcane bagasse ash content.

Bahai Louafi and RamdaneBaharin (2013), the effect on performance by addition of sand as stabilizer on swelling soil has been studied. Based on the study undertaken, they found that the addition of sand reduces consistency limits. They have also worked on introducing sand layer into two different configurations and found that these layers effectively reduce the swelling of soil.

Saad Ali Aiban (1994), study to assess the strength properties of stabilized granular soils and to evaluate the behaviour of cement- treated soil. Two types of cementing agents were used: Portland cement and calcium carbonate. The effects of some of the variables encountered in the field such as curing type and time, confining pressure, cementing agent content, density, saturation and reconstitution on the behaviour of stabilized soils, were studied. Test results show that the addition of a cementing agent to a wind-blown sand (cohesion less material) with uniform size distribution produces a material with two strength components, that due to cementation or "true" cohesion and that due to friction. The angle of internal friction for the treated sands is not much different from that of the untreated sand. The results also show that the drying process is essential in the development of cementation, especially when calcium carbonate is used as the cementing agent. Peak strength as well as initial tangent modulus values, increase with an increase in curing period, confining pressure, cement content and density. Residual strength values seem to be independent of all parameters other than the confinement and density; behaviour commonly observed for un-cemented sands.

Kowalski et al. (2007), portland cement is hydraulic cement made by heating limestone and clay mixture in a kiln and pulverizing the resulting material which can be used either to modify or to improve the quality of the soil or to transform the soil into a cemented mass with increased strength and durability. The amount of cement used will depend upon whether the soil is to be modified or stabilized.

Kent Newman and Jeb S.Tingle (2004), did study of previous research efforts. Portland cement was used as the stabilizer control for comparison of properties to the polymers and was used at concentration of 2.75%, 6% and 9%. Previous research work has shown that the addition of inert material(sand) to swelling soil can be a method of stabilization of soil. Roads constructed on poor subgrade soil also require larger thickness of pavement which can be reduced by inclusion of geogrid. This increases the bearing capacity of the subgrade, reduces the differential settlement of the pavement, increases the life of the pavement and also reduces the cost due to saving incurred in the reduction of the special filler material. Geogrid can be placed in one or more layers in subgrade soil. Geogrid reinforcement can be used to prevent or reduce rutting caused by bearing capacity failure of the base or subgrade and by the lateral movement of base course or subgrade material.

Sarika Dhule et.al (2011), reported that weaker soils are generally clayey and expansive in nature which has lesser strength characteristics. Technique of improving the soil with geogrid increase the stiffness and load carrying capacity of the soil through fractional interaction between the soil and geogrid material improving black cotton soil. The experimental work involved modifying the properties of weak subgrade soil by addition of geogrid in different percentage i.e 1%, 2%, 2.5% and 3% separately. Simillarly the studyof improvement in properties of soft murum by adding geogrid was also done and geogrid was used in mix of soil and 2% cement in different proportions to study its effect. Due to the efforts mentioned above, the optimum mixes, which are to be used for further construction to achieve desired stability and economy in construction, were deduced. For this purpose different tests were performed i.e sieve analysis, liquid limit, Plastic limit, Standard proctor test to find its maximum water content and maximum dry density, specific gravity, Laboratory Unsoaked California Bearing Ratio (CBR) and Laboratory soaked CBR test to find resistance to penetration. For different percentage of geogrid with soil, murum and cement economical cost analysis was carried out and suggestion for most economical mix with geogrid was given. Further, it was deduced that the CBR value increases with addition of geogrid. In addition to this work,the effect on CBR value of murrum with 2% cement and different percentage of geogrid was discovered. According to the experimental work CBR value found by addition of 2.5% geogrid is more than any other.

A.K.Choudhary et.al (2011), placed multiple layers of reinforcement horizontally at specified vertical spacing within the subgrade and thereby determining their relative positions for two different types of reinforcement namely geogrid and jute geotextile. The number of reinforcing layers was varied from 1 to 4. He found that the expansion ratio decreases when the soil is reinforced with single layer and goes on decreasing with increase in number of reinforcing layer but this decrease is significant in case of jute geotextile and marginal in case of geogrid which means insertion of reinforcement controls swelling of soil. The CBR tests were conducted with both unreinforced as well as reinforced specimens with varying number of reinforcing layers and reinforcement types and found that the CBR value of the soil also increases with increase in number of reinforcing layers. Further it was found that geogrid offer better reinforcing efficiency than jute geotextile but it can be gainfully exploited in low cost road project.

S.A. Naeini& R. Ziaie Moayed(2009), three types of soil samples with different percentage of bentonite on which CBR tests were carried with or without geogrid reinforcement in one or multilayer. Result shows that increase in plasticity index decreases the CBR value in both soaked and unsoaked condition. CBR can be considerably increased by using geogrid reinforcement in two layers when compared with unreinforced, but less value when compared with single layered reinforcement. By placing geogrid at layer 2 there is a considerable increase in CBR value compared with unreinforced soil in both soaked and unsoaked conditions. By using two layers of geogrid at layer 1 and 3, unsoaked CBR value increases compared with unreinforced soil. However this increment is much less when compared to the case when geogrid is placed at layer 2. Further, the soaked CBR value is higher than the value obtained for both single and no layer of geogrid.

Dr. P Senthil kumar& R. Rajkumar (2012), successful use of geosynthetics is ensured in a given geotechnical application, as it is not only compatible but effective in improving the soil properties when appropriately placed. In his study the performance of woven and nonwoven geotextile, interfaced between soft subgrade and unbound gravel in an unpaved flexible pavement system, is carried out experimentally, utilising the California Bearing Ratio (CBR) testing arrangement. In order to evaluate the performance, the reinforcement ratio is obtained based on the CBR load – penetration relation of both soft subgrade-gravel and soft subgrade-geotextile-gravel, separately, for woven and nonwoven geotextile. The effect of introducing geotextile layer between subgrade soil and base course layer and found that the resistance to penetration increases with the introduction of geotextile layer. The equation given by (Koerner, 2005) for calculating the reinforcement ratio i.e. loads with geotextile to load without geotextile was used and it was found that the reinforcement ratio is more than one throughout the test. Hence it was concluded that the use of geotextile is most advantages in road with soft subgrade at higher penetration. The results are not validated though because of the fact that results were essentially performed on soil of class CH having an MDD of 1.562, the nature of the textile(woven/non-woven) were mentioned but properties like aperture size, thickness and the percentage of geotextile were left unmentioned.

Hossein Moayedi (2009), provides geogrid reinforcement into paved road to improve the performance of the transportation. The experimental work provides a series of two-dimensional finite element simulations carried out to evaluate the benefits of integrating a high modulus geogrid for reinforcement at three different position (i.e. at a distance of 0.5m ,0.25m and at 0.05m from the bottom of the model . Analytical results for three different possibilities of geogrid reinforcement in the paved road layers have been evaluated. It was found that maximum shear stress and normal stress increases when the geogrid is placed at a distance of 0.5m from the bottom. The optimum position was decided based upon the tension stress absorption value, deformation reduce rate and tension cut-off point location. Three types of reinforcing model and one type of unreinforced model of paved road were selected. It was observed that the vertical deflection under the centre of load reduces with the use of geogrid just under the asphalt layer and hence a conclusion made that the effectiveness of geogrid is more pronounced when it is placed at the bottom of the asphalt concrete improved if an effective bending is maintained between the asphalt concrete and geogrid.

Dr .D. S. V. Prasad (2010), prepared a model of flexible pavement consisting of expansive soil subgrade of 0.5m at bottom compacted in 10 layer and gravel subbase laid in two layers each of 0.07m compacted thickness using a layer of different reinforcing material like geogrid, bitumen coated chicken mesh, bitumen coated bamboo mesh for reinforcement with waste plastic and waste tier rubber was mixed uniformly throughout. The sub-base material on which two layers of WBM-II each of 0.075m compacted thickness was laid. To find the best alternative reinforcement in flexible pavement, cyclic plate load test where carried out. It was found that the total and elastic deformation values of the flexible pavement system are decreased by the provision of providing different reinforcing material. The maximum load carrying capacity followed by less value of rebound deflection obtained for geogrid reinforcement is more than any other reinforcement provided.

Omid Azadegan and Gh. R. Pourebrahim (2010), studied the effect of geogrids on compressive strength and Elastic Modulus of Lime. Cement treated soil in order to find out the effect of geogrid applications, on the geotechnical behavior of lime/cement treated soil used as base, sub-base or structural foundation materials. Study has been performed on compressive treated soil sample with or without geogrid layers and found that when there is an increment in modulus of elasticity and the cohesion, produced by pozzolanic reaction of lime and cement, side deformation of the cylinder decreases and therefore the tension produced in reinforcement and the confinement forces would decrease too. To have appropriate interaction the mix design should comprise enough ductility and side deformation for which, L/C ratio should be greater must be selected and total amount of applied cement must be lower than 5 percent. The author has used UCS using cylindrical sample and not correlate with CBR. Moreoverstudy fails to mention about specific mix design of pavement which is the governing factor for the interaction between used of geogrid and stabilized soil.

Dr Sujatha Evangelin Ramani (2012), provide geogrid reinforcement to improve the strength of subgrade and reduce the thickness of the pavement. CBR tests has been conducted on soil with geogrid introduced at different depths within the sample, in single , double and triple layer and found that the best performance in the single layer occurs when geogrid is placed at 2/3 distance from the base. And found that the CBR value of 3 layer of geogrid is lesser than 2 layer but higher than single layer and hence concluded that geogrid increases the strength of subgrade soil in both soaked and unsoaked condition and proved that geogrid reinforcement provided in a single or multilayer to the subgrade increases the strength of the soil and thus reduces the thickness of the pavement.

Pradeep Singh and K.S. Gill (2012), Reinforced soils are often treated as composite materials in with reinforcement resisting tensile stress and interacting with soil through friction. Although there is lot of information and experience with geo-synthetic reinforcement of subgrade soils, many pavement failures still occur. These failures may be due to lack of understanding of how these materials influence the engineering properties of sub-grade soils and what is the optimum position of reinforcement. Therefore a compressive laboratory program is required to study strength characteristics of both reinforced and un-reinforced sub-grade soils also to investigate their behaviors under cycle leading. Study describes the beneficial effects of reinforcing the sub-grade layer with a single layer of geo-grid at different positions and thereby determination of optimum position of reinforcement layer. The optimum position was determined based on California Bearing Ratio(CBR value) and unconfined compression tests were conducted to decide the optimum position of geo-grid. Through his experimental work he found that by providing geogrid reinforcement at 0.2H from top give considerable improvement in CBR value and stress strain behavior of subgrade soil.

Mihai Iliescu and IoanRatiu (2012), for subsoil with insufficient bearing capacity, stabilization and improvement of subsoil characteristics are necessary. The bearing capacity can be increased by excavation and replacement of the soft material, chemical stabilization by using chalk or by using geosynthetics. Placed between the subgrade and base course, or within the base course, the geosynthetic improves the performance of unpaved roads carrying channelized traffic and unpaved areas subjected to random traffic. Study devised a new design methodology for stabilizing a road subgrade using geogrid reinforcement. In the experiments, they found out that geogrids can improve the performance of the subgrade soil. Study has been carried out extensive static and dynamic plate bearing tests on different conditions based on the results of trial and the membrane theory of Giroud&Noiray, they developed design graphs for multifunctional geogrids in unpaved and temporary road.

Rakesh Kumar and P.K. Jain (2013), Different ground improvement techniques have been proposed in the literature to work with this soil and are found to be successful to some degree. The construction of granular piles has been proved successful in improving soft marine clays, which are very poor from strength and compressibility criteria. The technique of granular pile may be applied in expansive soil too. The granular piles derive their load carrying capacity from the confinement offered by the surrounding soil. In very soft soils this lateral confinement may not be adequate and the formation of the granular pile itself may be doubtful. Wrapping the granular pile with suitable geogrid is one of the techniques to improve the performance of granular piles. The encasement by geogrid makes the granular piles stiffer and stronger. The behavior and the mechanism of the granular pile and geogrid encased granular piles are not investigated for expansive soil. The author made an attempt to investigate the improvement of load carrying capacity of granular pile with and without geogrid encasement through laboratory model tests conducted on single granular pile installed in expansive clay bed prepared in controlled condition in small testing tanks. The load tests were performed on single granular pile. Tests were performed with different diameter of granular piles with and without geogrid encasement. The results from the load tests indicated a clear improvement in the load carrying capacity of clay, with granular pile and with encased granular pile. The increase in the load carrying capacity also increases as the diameter of the granular pile increases.Thusit was concluded in study of ground improvement techniques that the construction of granular piles in expansive soil improves the load carrying capacity of the soil.

Prof MayuraYeole and Dr. J.R. Patil (2013), carried out a laboratory CBR test on granular soil with or without geotextile which was placed in one or two layer in the mould. The single layer of geotextile was placed at the depth of (25, 50, 100 mm) from the top of the mould, the maximum CBR obtained was at 25mm and when the geotextile was placed in two layers at {(25 &75 mm),(50 &75 mm), (50 &100 mm)} CBR was increased and it was maximum at 25 & 75mm geotextile layer by 38.21% when compared with the CBR of no geotextile.

Jesna Varghese, Remya.U. R (2009), et al Indicated that reinforced soil with fiber has following properties- The relationship between optimum moisture content and maximum dry density of soil significantly affected by the addition of polypropylene fiber. During the study, MDD increases with decreasing OMC. From unconfined compressive test, it was observed that the unconfined compressive strength value of untreated soil was found to be 15.1 KN/m2 and the strength value increased with increase in addition of polypropylene fiber up to 0.05% and then decreases. There is an increase of strength of about 454.37%.That may be due to increase in interfacial shear strength at 0.05 %.For higher amount of polypropylene fibre it shows reverse trend. The strength is increased in low percentage of PPF addition, it ensures more economical in construction. So finally it was concluded that the polypropylene fiber can potentially stabilize the clayey soil.

N. Vijaya Kumar et al (2010), reported that Wear loss and coefficient of friction of slag composites decreases with the increase in normal loads. Wear loss and coefficient of friction increases with the increase in sliding velocities. The stick-on disc wear testing machine has been used to study the friction and wearbehavior of the polymer composites. The wear loss and coefficient of friction are plotted against the normal loads andsliding speeds. It is noted from the graphical representation of the result that with the increase in load weight lossdecreases and increase in sliding velocity weight loss also increases.

Andrzej K. Bledzki Reported that the feasibility of utilizing of grain by-products such as Rice Husk Ash and rye husk as alternative fillers for soft wood fibre as reinforcement in for composites material. Following conclusions are drawn from their study. Rice Husk Ash thermally stable as low as 235 degreecelcius. Structural proportions (cellulose, starch) contained by Rice Husk Ash are 45% on the other hand 42% contained by soft wood. More carbon rich surface was observed for Rice Husk Ash compared to soft wood fibre. Rice Husk Ash contained more surface silicon than soft wood fibre. Rice Husk Ash composites showed 15% better Charpy impact strength than soft wood composites.

Mona Malekzadeh and HuriyeBilsel (2012), reported that optimum water content is not influenced by polypropylene fiber inclusion, whereas maximum dry density has been reduced. This can be attributed to the reduction of average unit weight of solids in the soil-fiber mixture. Studying the influence of polypropylene fiber on swell characteristics, the overall conclusion is that one-dimensional swell decreases considerably with 1% fiber addition. Unconfined compressive strength increases with polypropylene fiber inclusions. Maximum value of cohesion can be observed with 1% fiber content which is approximately 1.5 times of the unreinforced soil. From the analysis of split tensile strength test, it is observed that the maximum value of the tensile strength obtained for 1% fiber inclusion is 2.7 times of the unreinforced soil. Increase in the ratio of tensile strength to compressive strength indicates that polypropylene fiber reinforcement is more effective in improving tensile than the compressive strength. Thus fiber enhances the ductile behavior of soils, reducing shrinkage settlements during desiccation, hence detrimental damages to structures, such as roads and pavements may be prevented.

III. Conclusion

This paper includes a literature review of the structure of soils and their minerals, especially montmorillonite and kaolinite, they are the predominant clay minerals found in natural soil. In general the problems of expansive clay are also discussed together with natural soil stabilization. Special consideration is given to Rice Husk Ash stabilization, including the general soil-Rice Husk Ash reactions, effect of Rice Husk Ash on compaction characteristics, plasticity, volume stability and strength. The changes which occur in clay soil when Rice Husk Ash is added can be divided into two categories, modification and stabilization. During modification calcium ions are absorbed by clay particles in cation exchange reactions. This process starts immediately and it changes the plasticity of the clay without the formation of any new cementitious materials. In the stabilization process calcium ions attack the clay minerals due to chemical reactions between the clay minerals and calcium hydroxide, and new materials are formed, mainly calcium silicate hydrate, calcium aluminates hydrate and calcium aluminates silicate hydrate (Bell, 1996).The total Rice Husk Ash content required for modification (change in plasticity) is in the range 1-3% by dry weight of soil, while that required for both modification and stabilization is in the range 3-8% by dry weight depending primarily on the clay fraction of soil under investigation and also on the type of the clay minerals (Ingles and Metcalf, 1972; Bell, 1988; Diamond and Kinter, 1964). These aspects are considered in detail below. The structure of soils and clay minerals is critical in an understanding of the process of soil stabilization generally and clay-Rice Husk Ash reaction in particular and this is considered below.

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