March-April 2020
ISSN: 0193-4120 Page No. 6913 - 6919

Performance Evaluation of Expansive Soil Stabilized with Bagasse Ash and Coir Fibres

T. Karthika[1], K. Arumugam[2], R.K. Sangeetha[3] , S.Karthi[4] and T.Anitha[5]
[123]Department of Civil Engneering, Kongu Engineering College, Perundurai-638 060, Tamilnadu, India
[4]Department of Mechanical Engneering, Kongu Engineering College, Perundurai-638 060, Tamilnadu, India
[5]Department of Civil Engneering, Paavai Engineering College, Namakkal-637 018, Tamilnadu, India

Article Info
Volume 83
Page Number: 6913 - 6919
Publication Issue:
March - April 2020

Article History
Article Received*: 24 July 2019*
Revised*: 12 September 2019*
Accepted*: 15 February 2020*
Publication*: 05 April 2020*

Abstract:
Soil is the most important foundation substance which supports loads commencing the overlying structure. Soil stabilization is a course of altering various soil resources by different methods in order to create all the preferred engineering properties. Expansive soils have big volume adjust potentials with water content changes causes issues such as foundation damage and failures and it is challenging to facilities. Immense efforts have been spent on finding appropriate methods to stabilize expansive soils, but these stabilizers all had restrictions. Soil stabilization was a major frequent land enhancement method undertook for developing challenging resources of soil. The study reveals a sequences of evaluation carried for assessing an impact of bagasse ash as well coir fibre inclusion to the engineering and shrink-swell activity of extended soils. The soils used for the investigation were collected from local area: Vellode of Erode district. Bagasse Ash were collected from sugar mill, Tittagudi of Cuddalore district. The coir fibres were collected from Perundurai and Gobichettipalayam of Erode district. To explore the influences of bagasse ash and coir fibre on the engineering activity of extended soil, different percentages of bagasse ash of 1% and 2.0% and coir fibre of 0.25% and 0.75% were studied. Unconfined compressive strength test were conducted for determining the compression strengths of the samples with different healing durations. According to this lab evaluation research, this is concluded; the extended soils can be consistent mixture of baggase ashes as well coir fibres.

Keywords: *Expansive soil stabilized - Bagasse Ash - Coir Fibres.*

I. Introduction

Each year will have terrific rise in manufacturing of industrial drain and the discard of those drain in large amounts causes in natural issues. This control its detrimental effects, some substances could be utilized as geotechnical admixtures. The various admixtures are bagasse ash, coconut fiber, lime, crushed glass and stone dust etc. The employment of the drain goods can be an ecofriendly alternative for soil stabilization in expansive soils (Raju Sarkar et al. 2016). More proportion of clay could include shrink-swell effects and bring variations in moisture proportion. For improving the behaviour of expansive soil, coir fibre binding with soil particles strongly resist the internal swelling pressure (Srikalpa RajguruMahapatra & Rupashree Ragini Sahoo, 2017). Stabilization of soil may be categorized under two most important types: alteration of soil with no including some consistent agent and enhancing soil resources by adding admixtures. Bagasse ash proportion straightly influences the swell-shrink activity of high plasticity of clay soil whereas Ground Granulated Blast Furnace Slag (GGBS) enhance a swelling behavior of clay. Mixing of bagasse ash as well GGBS enhanced swelling behaviour of maximum plastic clay. Free swell index as well swelling pressure decreasing with optimal mixing of bagasse ash and GGBS to untreated large plasticity clay soil . The creation expenditure might significantly reduced through choosing domestic substances which include domestic land for creation of sub-base course. Efficient employment of domestic poor soils by relating supplementary power utilizing stabilizations enables decrease in construction expenditure and improves the performances for infrastructure (Prakash Chavan & M.S.Nagakumar, 2014). Bagasse ash is a byproduct of agriculture of sugarcane bagasse incineration for generating electricity and it inappropriate set down produce a major environmental problem. This stiffness as well strength of smooth soil can be enhanced through including those drainsn with fibers collectively along the chemical agent (Fatahi et al. (2013). For evaluating this reliability of bagasse ash and sisal fiber in stabilization, the use of waste in road construction would significantly decrease the rate of erection and decrease environmental hazards (Ahmed Khan et al. 2019). By adding fibres as soil strength increases the compact power, bearing capacity, stability, decrease lateral distortion, settlement and stops the development of rigid splits in clay soils (Manikandan et al. 2017).

Hydrated lime blending with bagasse fibre reinforcement is increasing the compact power of extended soil depends on healing duration, although the linear diminish of stabilized extended lands decreasing with rising of hydrated lime and bagasse fibre proportions (Liet Chi Dang et al. 2016). This performance of extended soil along the coir pith indicates the optimium benefits when it is combined with lime (Raziya Banu et al. 2015). Hydrated lime with bagasse ash is more effective in expansive soil for governing the consolidation characteristics (Manikandan & Moganraj, 2014). To avoid the adverse health issues and environmental problems, bagasse ash and fly ash can be used in the construction industries with some treatments which increases the engineering properties of soils (Srikalpa Rajguru Mahapatra & Rupashree Ragini Sahoo, 2017). The waste of coir fibre have been employed in consistent of soil that could be successfully disorted. Thus, insertion of fibres have considerable effect on the technical activity of soil-coir mixtures. This accumulation of unsystematic mixed polypropylene fibres caused in decreasing the consolidation arrangement of the clay soil. Extent of fibres have unimportant influence on the soil basic nature in contrast fibre proportions showed most effective as well as influential. Use of natural fibre and waste materials in enhancing soil resource is beneficial as those were domestically obtainable cheap and nature favourable materials. Through current research, the stabilizing impact of baggase ash and natural fibre - (coconut coir) with the expansion soil resources was explored.

II. EXPERIMENTAL STUDY AND INVESIGATION

2.1 Materials used

2.1.1 Soil: The soil samples were collected (Figure 1.) from local sites at Vellode, Erode district at a depth of 1.5 - 2 m by disturbed sampling. The samples gathered through sites were exercised and stocked in a close-fitting repository in laboratory. This initial evaluation was carried for the samples as per to the Indian Standard Code of Practice for examining of soils. The results of virgin expansive soil completed as stated in the trial initiative were mentioned. The liquid limit, plastic limit, specific gravity, free swell index, optimum moisture content, maximum dry density and unconfined compressive strength of expansive soil are 68%, 32%, 2.58, 76.5%, 22.5%, 1.6g/cc and 0.06kg/cm^2 respectively.

Figure 1. Sample of expansive soil

2.1.2 Bagasse ash: Bagasse are pulpy fibrous residue materials which are obtained from sugarcane and sorghum stalks after crushing to extract juice. (Figure 2) Bagasse Ash (BA) are obtained from Shree Ambika Sugar Mill Company Limited, Pennadam, Tittagudi of Cuddalore district in Tamilnadu. The bagasse ash had an average moisture content of 89.50%. The sugarcane bagasse includes about 50% cellulose, 25% hemicelluloses and 25% lignin. The common compound of bagasse ash were: SiO_2 = 78.34%, Al_2 = 8.55%, Fe_2O = 3.61%, CaO = 2.15%, Na_2O = 0.12% and loss in ignition = 0.42%. The dried bagasse ash was cautiously screened and gone between 4.75 mm aperture screen and retained on 300 mm aperture size.

March-April 2020
ISSN: 0193-4120 Page No. 6913 - 6919

Figure 2. Sample of bagasse ash

2.1.3 Coir fibre: The fibre from coconut has more advantage due to local availability, less expense and nature favourable substance. The Coir Fibre (CF) was acquired through coconut husk (Figure 3) also associates to the set of structural fibres. They were collected locally from Perundurai and Gobichettipalayam of Erode district. 0.1 mm diameter of the coir were used for the investigation. The fibres were slit into the length of 5mm and 10 mm for Aspect Ratio (AR) 50 and 100 respectively. The chemical properties of CF and sample of coir fibre are given in Table 2.

Table: 2 Chemical properties of coir fibre

Composition	Percentage
Cellulose	43.44%
Lignin	45.84%
Water solubles	05.25%
Pectin and related compounds	03.00%
Ash	02.22%
Hemi-cellulose	00.25%

Figure 3. Sample of coir fibre

2.2 Experimental program

Soil illustratives with particles dimension lesser than 2.36 mm was developed through combining bagasse ash and coir fibre. The proportions of the materials was completed by blending a soil in various percentages of bagasse ash (1% and 2%) and coir fibre (0.25% and 0.75%) . The evaluation was carried out over the soil samples combined at various percentages – 1% BA: 0.25% and 0.75% CF: 2% BA: 0.25% and 075% CF. The liquid and plastic restrain evaluations was done according to IS: 2720 (Part 5) - 1985. Proctor compaction eavaluation was completed as per IS: 2720 (Part 8) - 1983.

2.2.1 Unconfined compression test

An unconfined compression examination was completed according to IS: 2720 (Part 10 -1991). The extended soil were combined with bagasse ash as well as coir fibre in conventional method. The untreated as well as treated soil samples were tested to find the MDD and OMC. For the MDD and OMC, soil samples of dimensions 3.6 cm diameter and 7.8 cm length were prepared for conventional unconfined compression strength. The samples were cured and tested at 0th, 7th and 14th day. The samples are evaluated and proportions have been studied after the curing. The unconfined compression testing device has fixed at a load rate of 0.75 mm/min, and retained constant for every untreated and treated samples. The unconfined compressive power / axial stresses in unsuccess of the illustratives were determined relies on the axial stress to section area of the samples. For both the treated and untreated samples, the unconfined compressive strength value were acquired as the standard of the three unconfined compressive strength evaluations of all the soil samples.

III. RESULTS AND DISCUSSIONS

The virgin expansive soil were mixed with 1% and 2% of bagasse ash with coir fibre in various proportions: 0.25% and 0.75% with two various strand ratios of 50 and 100. The UCC experiment outcomes for 1% and 2% of bagasse ash and 0.25% and 0.75% coir fibre increases with increase in the curing periods, for the aspect ratio of 50 and 100 are illustrated. (Fig: 4 to 13).

March-April 2020
ISSN: 0193-4120 Page No. 6913 - 6919

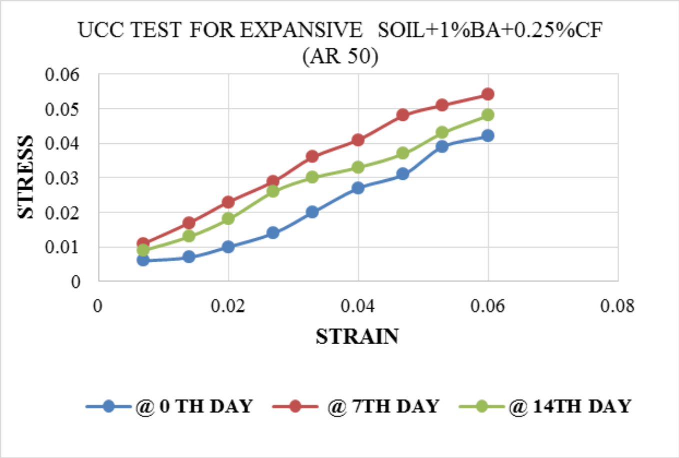

Figure 4. Variation of UCC value with 1BA + 0.25 CF for (AR 50) at 0th, 7th and 14th day

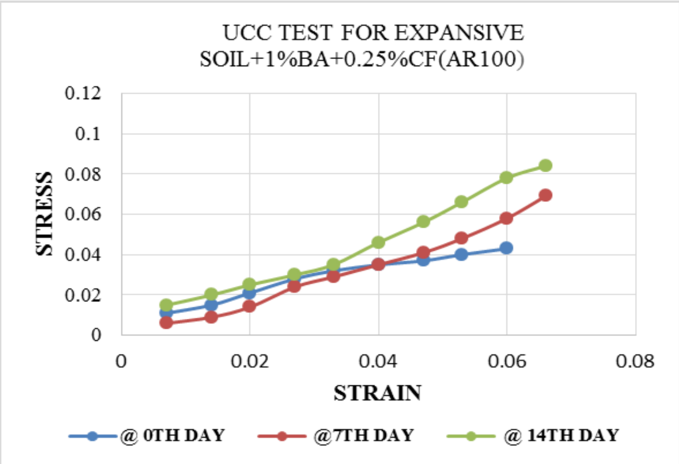

Figure 5. Variation of UCC value with 1BA + 0.25CF for (AR 100) at 0th, 7th and 14th day

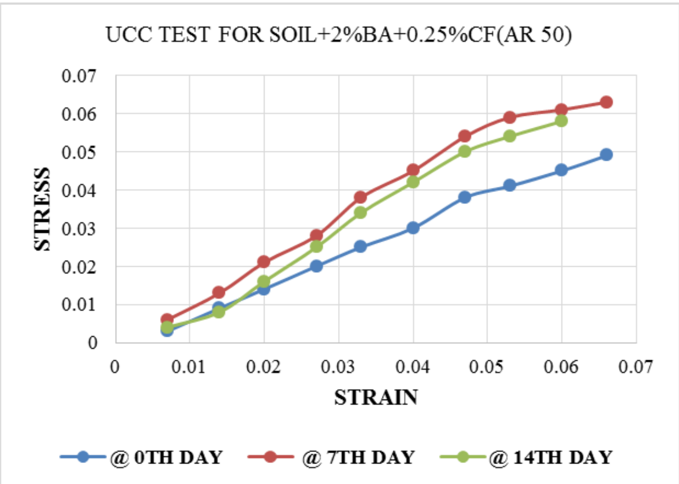

Figure 6. Variation of UCC value with 2BA + 0.25 CF for (AR 50) at 0th, 7th and 14th day

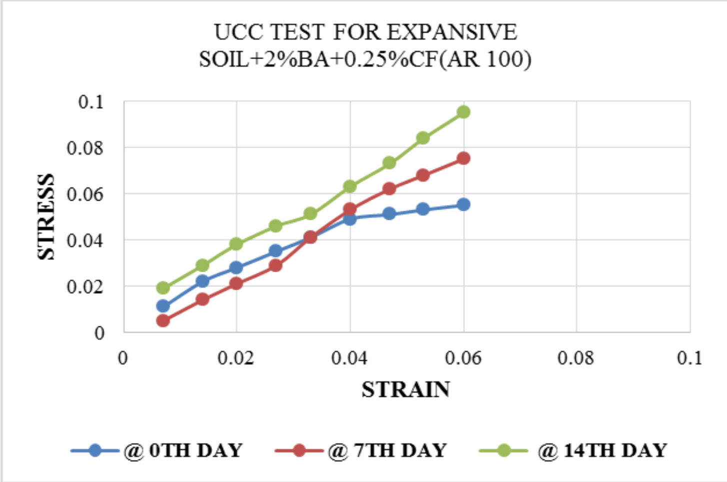

Figure 7. Variation of UCC value with 2BA + 0.25 CF for (AR 100) at at 0th, 7th and 14th day

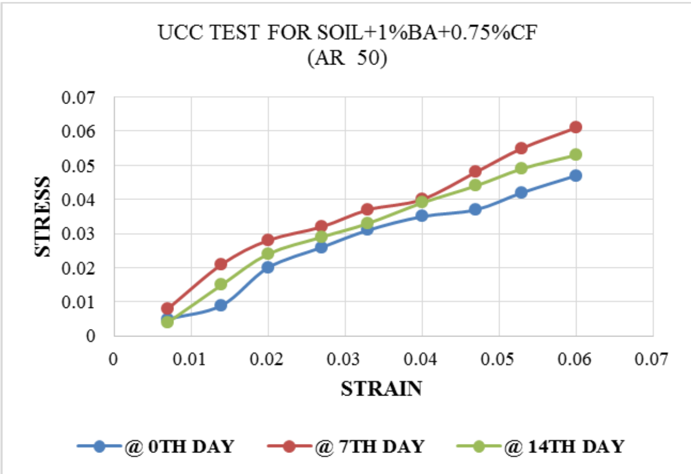

Figure 8. Variation of UCC value with 1BA + 0.75 CF for (AR 50) at 0th, 7th and 14th day

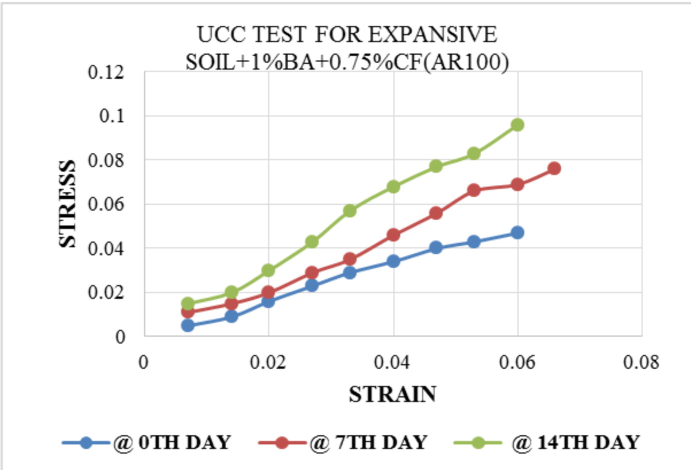

Figure 9. Variation of UCC value with 1BA + 0.75 CF for (AR 100) at 0th, 7th and 14th day

March-April 2020
ISSN: 0193-4120 Page No. 6913 - 6919

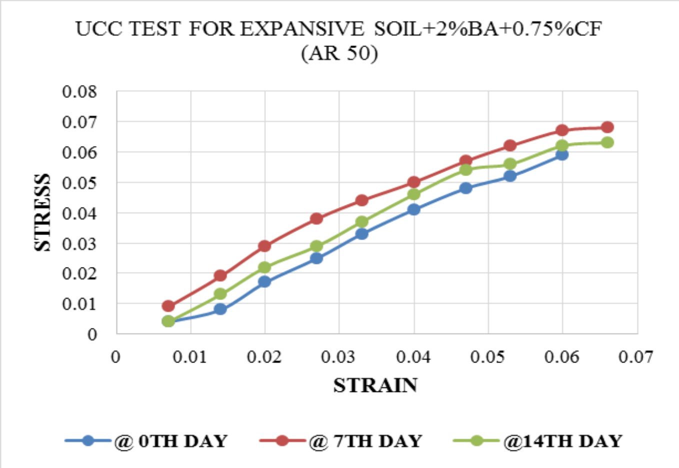

Figure 10. Variation of UCC value with 2BA + 0.75 CF for (AR 50) at 0th, 7th and 14th day

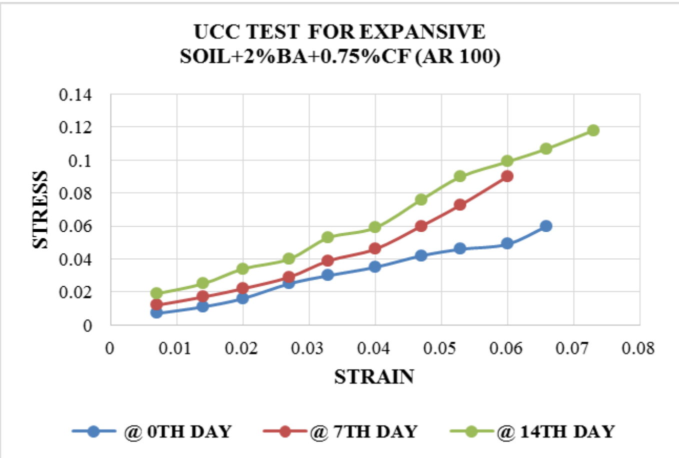

Figure 11. Variation of UCC value with 2BA + 0.75 CF for (AR 100 at 0th, 7th and 14th day

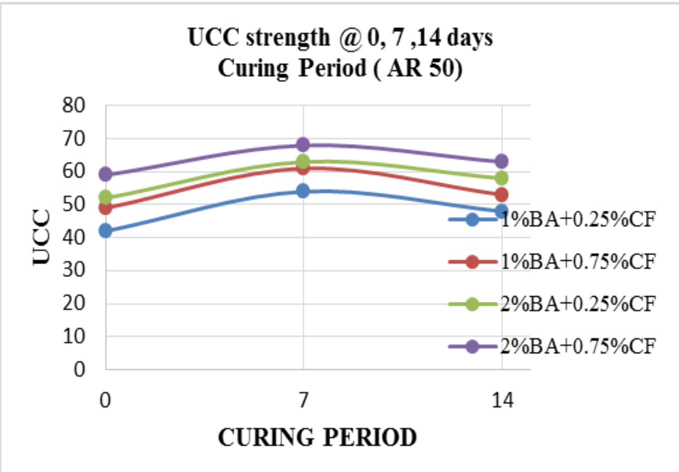

Figure 12. Variation of UCC value with curing period for four mixes (AR 50)

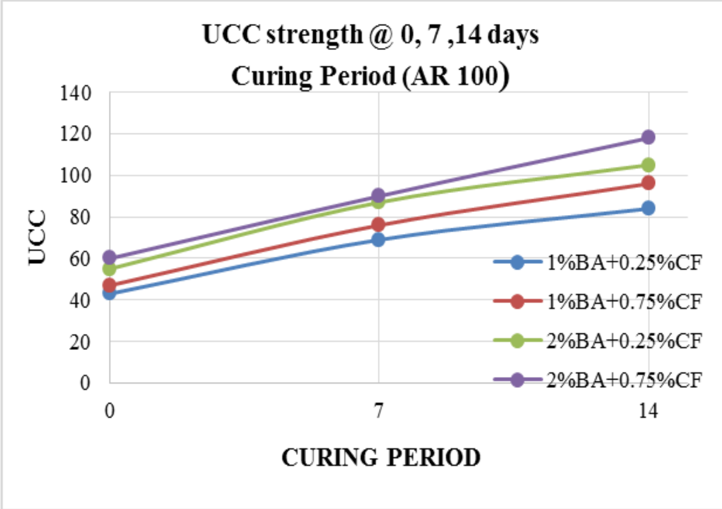

Figure 13. Variation of UCC value with curing period for four mixes (AR 100)

The UCC strength values for the treated sample rises linearly with the growth in percent of coir fibres. The overall movement indicates that the UCC potency of used extensive soil raises in the majority of the instances with the rise in percent of coir fibres both bagasse ash along with coir fibres. The highest values of UCC power were attained at 2% to bagasse ash and 0.75% to coir fibres. The gain in power along the growth in coir fiber material is a result of the growth in addition of water material in the ground and as a result of interlocking of fibre with all the soil matrix. The UCC power for the two samples raised with the growth in healingduration. The highest values have been attained for the healing duration of 14 days as the healing period raises the water content from the soil reduces. Thus, shows the reduction in cohesion as well as enriches the friction involving coir fibre and soil particles. The UCC strength values of used extensive soil were nearly the identical for both the Aspect Ratios (50 and 100) coir fibres. The growth in amount of coir fibres might lead to a finer interlocking procedure, through offering a substantial region of exposure with the soil particles.

IV. CONCLUSIONS

The study concluded that for the aspect ratio 100, the UCC value goes on increasing for 0th, 7th and 14th day curing period. However for aspect ratio 50, the UCC value increased upto 7th day and decreased later on. The strength reduction is due to the rise in extent of coir fibres might cause finer interlocking procedure, through offering a substantial region of exposure with the soil particles. Theis fibre length for aspect ratio 50 is much smaller when compared to aspect ratio 100 which decreased the power of the stabilized ground.

Excessive relative analysis of the already available experiments point out that several admixtures could improve the geotechnical resources of expansive soils. There were several combinations of admixtures in which the characteristics of those expansive soils have been managed. The usage of coir fibre as augmentation in expansive soils causes in 68.25% increase of UCC strength value in comparing to untreated expansive soils. Bagasse ash could be employed along with several fibre goods as a association to additionally purify the geotechnical resources of expansive soils; used bagasse ash (2%) along with coir fibres (0.75%) to gain moderate UCC value of 0.11kg/cm^2.

The conducted studies confirmed that waste products - bagasse ash and coir fibres – have been employed as geotechnical admixture. Inclusion of those admixtures modifies the physical and compaction elements of cohesive soils. This is appraised that bagasse ash and coir fibres combined as admixture in expansion soil stabilization certainly facilitates to hamper the image of drain by products bagasse ash on the environment in line with reducing the building cost.

V. REFERENCES

1. Ahmed khan, MohdFahiem Tahir and Er. Tripti Goyal, (2019), Study on engineering properties of soil using bagasse ash and sisal fiber, International Research Journal of Engineering and Technology, 6(3),1614-1621
2. Fatahi B., Le T.M., Fatahi B. & Khabbaz H. (2013), Shrinkage properties of soft clay treated with cement and geofibers, Geotechnical and Geological Engineering, 31(5), 1421-1435
3. Ige, J. A., and S. O. Ajamu. "Effects of Moisture on Lime-Stabilized Lateritic Soil." IMPACT: International Journal of Research in Engineering & Technology (IMPACT: IJRET) 3.3 (2015): 37-44.
4. Jery, Christina, Et Al. "Effect of coconut shell powder on the strength of soil."
5. Liet Chi Dang, BehzadFatahi, and HadiKhabbaz, (2016), Behaviour of expansive soils stabilized with hydrated lime and bagasse fibres, Advances in transportation geotechnics. The 3rd International conference on transportation geotechnics (ICTG), Procedia Engineering.143, 658–665
6. Manikandan, A. T., and Moganraj, M. (2014), Consolidation and rebound characteristics of expansive soil by using lime and bagasse ash, International journal of research in engineering and technology, volume: 3(4), 403-411
7. Manikandan, A. T., Venkataradha Lokesh, Ibrahim, Y, Dheebikhaa, B. & Kulanthaivel, P. (2017). Study on effect of fibres with cement on engineering properties of soils, International journal of research in engineering and technology, 9 (2), 1-4
8. Prasanna, SC, and T. tamil Selvan. "preparation of al6061-sic-bagasse ash MMCS by using stir casting method and evaluation microstructural, mechanical properties and numerical analysis."
9. Raju Sarkar, AnkurMudgal, Sandeep Bhaskar, Varun Gupta & RiteshKurar, (2016). A review on study on effect of various admixtures on geotechnical properties of expansive soils, Indian journal of science and technology, 9(44), DOI: 10.17485/ijst/2016/v9i44/105295
10. Ramteke, Balwant, and Ak Saxsena. "Improvement in properties of subgrade soil by using rich husk ash and Moorum."
11. Raziyabanu, Lohith, H. G., Danish Ali, M. D. and Ramya, H. N, (2015), Stabilization of black cotton soil using coir pith, International journal of technology enhancements and emerging engineering research, 3(8), 61-66
12. Ramteke, Balwant, And Ak Saxsena. "Strengthening black cotton soil with rha and Moorum for pavement subgrade."
13. Shiva Prashanth Kumar Kodicherla and Darga Kumar Nandyala, (2019). .Influence of randomly mixed coir fibres and fly ash on stabilization of clayey subgrade, International journal of Geo-Engineering, 10:3
14. Shukla Devdatt, Rajan Shikha Saxena A.K, and Jha A.K, (2015). Soil stabilization using coconut coir fibre,. International journal for research in applied science & engineering technology, 3 (9), 305-306
15. Srikalpa RajguruMahapatra & Rupashree Ragini Sahoo, (2017), Strength behaviour of soil stabilized with fly ash and sugarcane bagasse ash,

Research Journal of Engineering sciences, 6(9), 1-5

16. Sharma, Arun Kumar, and Prashant Baredar. "Roof tiles prepared by using fly ash and analyzing mechanical properties."
17. Khushbu, S. Gandhi, Shruti, J., & Shukla. (2019). Durability of commercial waste bagasse ash and ground granulated blast furnace slag stabilized high plastic clay, International Journal of Recent Technology and Engineering, 8(1), 2964-2971
18. Prakash chavan & Nagakumar, M.S. (2014). Studies on soil stabilization by ssing bagasse ash, Nternational Journal of Scientific Research Engineering & Technology, 89-94
19. IS:2720 (Part 5)., “Tests for soils: Determination of liquid and plastic limit”, Bureau of Indian Standards, 2002, New Delhi.
20. IS:2720 (Part 7)., “Tests for soils: Water content-dry density relation using light compaction”, Bureau of Indian Standards, 2002, New Delhi.
21. IS:2720 (Part 10)., “Tests for soils: Determination of unconfinedcompressive strength”, Bureau of Indian Standards, 2006, New Delhi.
22. Sathyamoorthy, G., and S. Raja Narayanan. "Experimental Analysis of Delamination Failure in Jute-Coir Fiber Reinforced Composites." International Journal of Mechanical and Production Engineering Research and Development (IJMPERD) 8.2 (2018):1001-1010
23. Olaniyan, O. S., and V. O. Ajileye. "Strength Characteristics Of Lateritic Soil Stabilized With Terrasil And Zycobond Nanno Chemicals." International Journal of Civil Engineering (IJCE) 7.2 (2018): 1 – 12
24. Gamal, Alnos Hegazy1 Ahmed Mohamady2 Ahmed, and Ayman Salm. "Effect of chemical additives on engineering properties of base and sub-base layers." International Journal of Civil Engineering (IJCE) 5.5 (2016):1-12
25. Prasanna, Sc, and T. Tamil Selvan. "Preparation of al6061-sic-bagasse ash MMCS by using stir casting method and evaluation Microstructural, mechanical Properties AND Numerical Analysis." International Journal of Mechanical and Production Engineering Research and Development (IJMPERD) 8.2 (2018):677-682
26. EL HOUMMAIDI, L. A. L. A., and abdelkader Larabi. "Impact of soil erosion on water quality in the Hatta dam (Dubai emirate)." International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) 9.6 (2019):1–16
27. Hegazy, Alnos Ae. "Chemical analysis of wastewater-contaminated ground soil in arar, Saudia Arabia." International Journal of Civil Engineering (IJCE) 3.2 (2014):15-24
28. Ngwangwa, N. V., C. N. Madubuike, and S. N. Asoegwu. "Predicting hydraulic conductivity of Nigerian Agricultural soils using dimensional Analysis." International Journal of General Engineering and Technology (IJGET) 3.5 (2014):1-12.
29. Rani, k. Saroja, and PVV Satyanarayana. "collapse Behavior of red soils of silty sand nature based on engineering properties." international journal of civil, structural, environmental and infrastructure engineering research and development (ijcseierd) 9.1 (2019):11-14