UTILIZATION OF FOOD WASTE TO IMPROVE SOIL STABILITY

Mr.Sanjay Kumar[1], Mr. Satayanarayan Khaliya[2]

[1]M.Tech Scholar, Manda Institute of Technology, Bikaner, Bikaner Technical University, Sanjay
[2]Head of Department, Manda Institute of Technology, Bikaner, Bikaner Technical University

---

Abstract - *With the quick advancement of urbanization, expanded interest for common assets and produced customer products has squeezed the climate. Around 33% of waste is directly described as Urban Waste. On another way, a tremendous amount of waste is generated per year that causes many problems and increases cost and man force. In India, around 378 million people generate approximately sixty-two million tons of garbage.*

Various tests are carried out to check the soil properties without food waste and variation in food waste. In this study, three types of waste are collected from the the household, office and restaurant. Each waste's interpretation is studied 5%, 7.5% ,10% and 12.5% replacement of food waste with soil. To determine the strength direct shear test is determined. A basic structure was utilized to coordinate these discoveries as to municipal food waste in India.

Second part of this study is carried out on 1 km starch to optimize the cost after adding the food waste.

Key Words: Food waste, Proctor Test, CBR Test, Direct Shear Test.

1.INTRODUCTION

Nearly 43 million tons of waste is collected from this amount, roughly seventy per cent of destruction. In which 12 million tons is treated, and thirty million tons is used as landfill. In this study, urban waste as soil stabilization is carried out to reduce the hazard generated from it—the main objective is to prepare the food to utilize within a specified period. [1]

Various researcher carries out this study but the use of waste within the specified period is limited. In this study different supplement is used as soil stabilization and checked as per Indian standard for fertilizer and other natural decomposition. Furthermore, one out of nine of the worldwide populations is experiencing food hunger issues. The line between consumption or waste of food is changing from time to time.

1.1 The food waste issue

As indicated by the Asian populace prospects, the total populace is extended to 9.7 billion by 2050, hoping that urbanization will increment from the current 50% to 70% in 2050 (DESA, 2019). An expansion of 70% in food creation is needed to take care of the developing populace dependent on the 2010-19 level

2. LITERATURE REVIEW

Sharma et al. (2008) investigated stabilizing expansive soil using ash using a mixture of fly ash, gypsum, and blast furnace slag to stabilize expansive soil. A combination of fly ash, gypsum, and blast furnace ash was discovered. The swelling pressure (S.P.) of the earth was reduced from 248 to 6: 12: 18 by using slag in a 6: 12: 18 ratio kN/m2 to a maximum of 17 kN/m2 and a 300 per cent improvement in unconfined compressive intensity.

Pandian et al. (2014) used a Class–F Fly to stabilize expansive soil; fly ash could be a helpful additive of approximately 20%for improving CBR. a large amount of black cotton soil.

For expanding soil stabilization, Class C fly ash was found to be more powerful, as predicted. The free swell decreased as the curing time progressed. The best results were found. After 28 days of curing, dirt, Class C fly ash, and sand was found to be 75%, 15%, and 10%, respectively.

Satyanarayana al. (2015) investigated the combined impact of fly ash and lime addition. On engineering properties of expansive soil and discovered that the ideal soil proportions are: flutter For road and dam building, the ratio of ash to lime should be 70:30:4. Plasticity, hydraulic conductivity, and hydraulic conductivity.

Phani Kumar and Sharma (2015) stated the dry unit weight of the vast soil fly ash blends decreased as the blends' swelling properties decreased. When the amount of fly ash in the mixture increased, so did its pressure. The resistance of the material to penetrating For a given water content, blends increased dramatically as fly ash content increased. They presented a statistical model for predicting the treated soil's undrained shear power.

Baytar (2013) investigated the use of fly ash and de-sulphonyls collected from thermal power plants to stabilize expansive soils by 0 to 30%. Lime percentages range from 0 to 100%. With the broad soil-fly ash-de-sulphonyls mixture, up to 8%) was applied. Those who have been treated The samples were cured for 7 and 28 days, respectively. The number of people who swelled was found to be lower, and the rate of swelling was found to be lower. Swell was observed to increase as the stabilizer percentage was increased.

Amu et al. (2013) used a block of cement and fly ash mixture. A soil The expansive soil was treated with I 12 per cent cement, (ii) 9 per cent cement + 3 per cent fly ash, and (iii) 9 per cent cement + 3 per cent fly ash. In terms of MDD, OMC, CBR, and shearing resistance, 9 per cent cement + 3% fly ash is superior. When compared to samples stabilized with 12 per cent cement, the value of fly ash was demonstrated. Cement's ability to stabilize expansive soil is being improved, For the stabilization of expansive clayey soils.

Sabates al. (2013) According to the author, fly ash-marble powder will increase the engineering properties of expansive soils and optimal soil proportion: marble: fly ash The ratio of powder to water was 65:20:15.

Punthutaechaet al. (2017) assessed fly ash from class F, bottom ash, and polypropylene. Treatments for fibres, on the other hand, resulted in varying degrees of development. When using a combination of medications, On both soils, the most successful treatment was class F fly ash combined with nylon fibres.

Kumar et al. (2007) studied the effects of fibre inclusions and lime stabilization Geotechnical properties of ash-expansive soil mixtures. Lime and fly ash Added with expansive soil within 1–10% and 1–20%, respectively. The samples of Optimum fly ash and lime content (15% fly ash and 8% lime) based on Added 0, 0.5, compaction, unconfined compression and split tensile power. 1.0,1.5 and 2 per cent polyester fibres by weight.

Buhler and Cerato (2007) investigated the use of lime and Class C to stabilize expansive soils. Fly ash. As compared to other methods, lime stabilization resulted in a more significant reduction in linear shrinkage. Class C fly ash has the same percentage.

Gupta et al. (2002) studied the stabilization of black cotton soil with crusher dust. The waste product from Bundelkhand, India, and optimal crusher dust (quarry dust) Was 40%. Liquid limit decreased (54.10% to 24.2%), swelling pressure decreased and increased shrinkage cap (12.05 to 18.7 percent), CBR value (1.91%-8.06%), UCS value (28.1 kN/m2). 30.2 kN/m2) 40% substitution of expansive Crusher-dust dirt.

Stalin et al. (2015) investigated swelling-potential regulation (S.P.)expansive clays with quarry dust and marble powder. The liquid limit and Swelling pressure decreased with quarry dust or marble powder content

Gulsah (2015) investigated the swelling potential of synthesized expansive soil (kaolinite). I was using aggregate waste (quarry dust), rock powder and lime. Waste and rock powder's aggregate was applied to the soil at 0-25% by weight, with lime varying from 0-25% to 9% By combined weight. The swelling capacity was reduced, and the reduction found to Increase with increasing stabilizers and healing days.

Jain and Jain (2017) studied the effect of adding stone and nylon to Black cotton Soil found stone dust mixing 20% with 3% randomly distributed nylon fibres Swelling pressure decreased around 48%. Ultimate capability improved and Settlement fell by fibre inclusion in stone stabilized expansive soil.

3. METHODOLOGY

3.1 General

A soil sample is mixed with urban food that was collected from the city. Following steps are carried out while mixing the fiber to the soil-

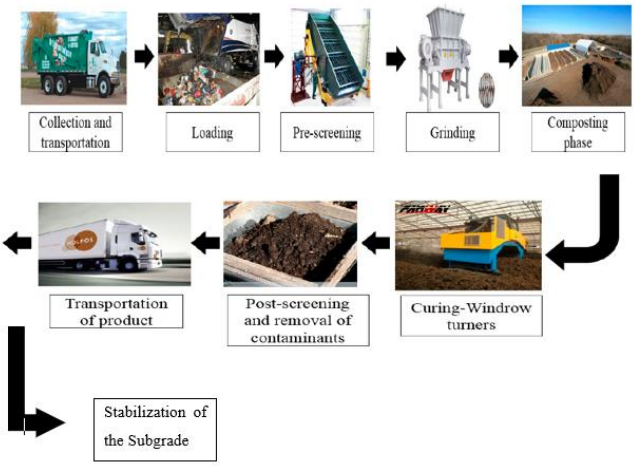

Figure 1 Mix Processing

3.2 Sample Types

- **SAMPLE A:** Waste collected from the household with 5% mixing in soil
- **SAMPLE B:** Waste collected from the household with 7.5 % mixing in soil
- **SAMPLE C:** Waste collected from the household with 10% mixing in soil
- **SAMPLE D**: Waste collected from household with 12.5 % mixing in soil

4. RESULT AND DISCUSSION

4.1 proctor compaction Test

Table 1 Result of Proctor test

Replacement	0%	5%	7.5%	10%	12.5%
MDD(gm/cc)	1.708	1.738	1.762	1.758	1.736
OMC (%)	13.50	12.20	12.00	12.00	11.00

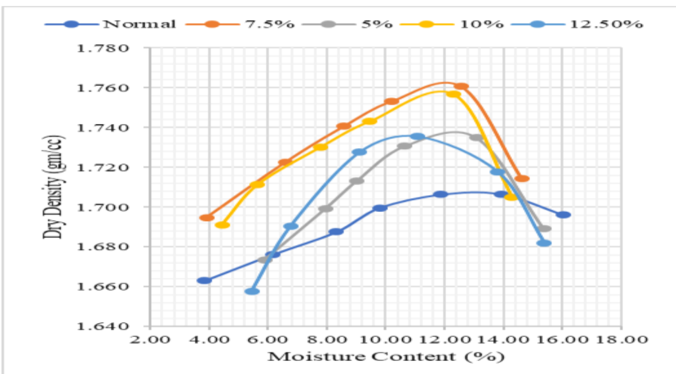

Figure 2 Proctor compaction test

4.2 Liquid breaking point

Table 2 Liquid breaking point result

Replacement	0%	5%	7.5%	10%	12.5%
OMC (%)	27	26.5	28	28.5	29.5

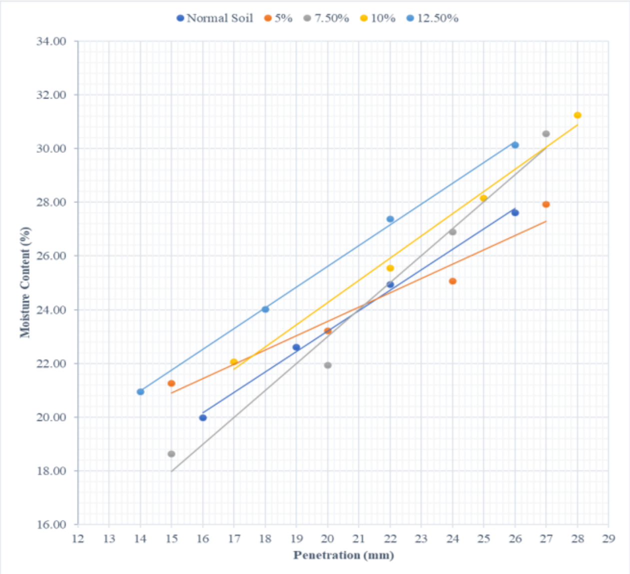

Figure 3 Liquid breaking point result

4.3 4.3 Grain size analysis

Table 3 Grain size analysis result

Mixing	Gravel (%)	Sand (%)	Silt and Clay (%)
Without Mixing	0	88	12
At 5% Mixing	0	89	11
At 7.5% Mixing	0	88.4	11.6
At 10% Mixing	0	89.8	10.2
At 12.5% Mixing	0	90.6	9.4

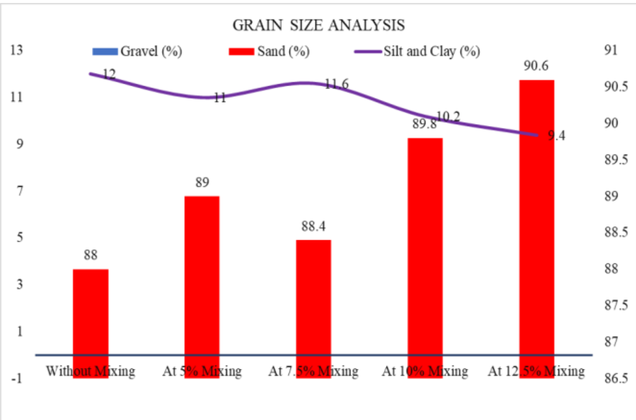

Figure 4 Grain size analysis result

The above graph illustrate about the grain size distribution of soil with mixing of food waste, and it is clearly visible in graph that silt and clay content is decreasing gradually with increasing the mixing of food waste.

Similarly, the sand particle is increasing with mixing and recorded as high as 90.6 at 12.5% mixing of food waste. There is a reason for sand content is increasing due to more granular size of particles availability.

4.4 CBR Test

Table 4 Consolidate CBR value(%)

Replacement	0%	7.5%	10%
CBR VALUE(%)	4.09	9.02	9.92

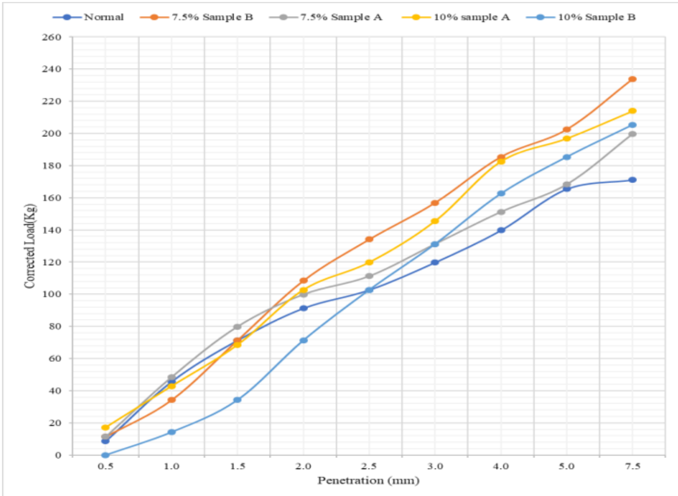

Figure 6 Consolidate CBR value(%)

4.5 Direct shear test

Table 5 Direct shear test Result

Replacement	7.5%	10%
COHESION (kg/cm^2)	0.25	0.21
ANGLE OF FRICTION(φ)	17°57’	18°33’24.84”

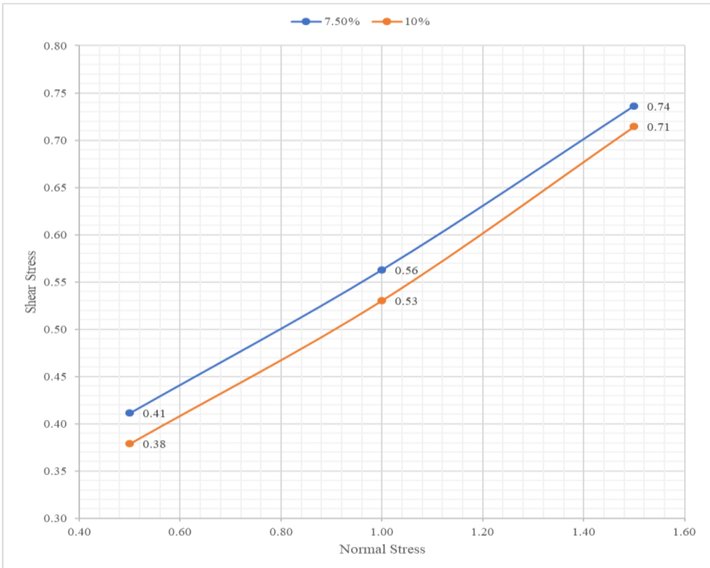

Figure 5 Direct shear test Result

4.6 Economic Analysis

Cost Saving at 7.5% Replacement :-

Total Cost of soil work per km = 10523488.20

Total cost of soil work = 35,02,11,163.8

Total cost of soil without Replacement = 37,86,02,720.44

Cost Difference = 2,82,75,798.30

Total Cost Saving (%) 7.46%

Cost Saving at 10 % Replacement :-

Total Cost of soil work per km = 10239069.60

Total cost of soil work = 34,07,45,997.2

Total cost of soil without Replacement = 37,86,02,720.44

Cost Difference = 2,82,75,798.30

Total Cost Saving (%) 10.00%

The above result shows that there is 7.5% and 10% replacement is useful in pavement stabilization so it can reduce environmental hazards and can overcome the load of dump side. To carry out the full stabilization further research is required.

5. CONCLUSIONS

- The maximum liquid limit is recorded at 12.5% due to high availability of moisture in food waste.
- In the proctor test the maximum dry density is recorded 1.762 at 7.5% food waste replacement
- The optimum moisture content is recorded 13.50% at 0% replacement of food waste.
- The result of the grain size distribution of soil with mixing of food waste, and it is clearly visible in graph that silt and clay content is decreasing gradually with increasing the mixing of food waste.
- Similarly, the sand particle is increasing with mixing and recorded as high as 90.6 at 12.5% mixing of food waste. There is a reason for sand content is increasing due to more granular size of particles availability.
- The maximum value of CBR 9.92 recorded at 10% replacement.
- The maximum cohesion is recorded 0.25 and 0.21 for 7.5% and 10% replacement of food waste respectively.
- Similarly the friction angle is 17°57' and 18°33'24.84'' for 7.5% and 10% replacement of food waste respectively
- Cost is reduced nearly 7.5% to 10% with replacement of food waste.
- Future Scope
- Although, this study has shown that different ash can aid in stabilizing soils by blending.
- Municipal Waste can be used to improve soil stability of fertility.
- Different type of plastic waste also useful in eco-friendly stabilization.
- Some other stabilizing additive like lime, rice bran, sugar mill waste, foundry waste be used.
- Sludge to be added to soil to improve the strength of weak soil with a very low bearing capacity.
- Variation in food waste percent can be carried out.

6. REFERENCES

- Aksan Z, Çelikler D (2012) The Turkish adaptation study of global warming questionnaire. Proc Social Behav Sci 31:681–684
- Amu, O.O., Fajobi, A.B. and Afekhuai, S.O. (2013). "Stabilizing potential of cement and fly ash mixture on expansive clay soil". Journal of Applied Sciences, 5(9), pp.1669-1673.
- Anagnostopoulos CA, Tzetzis D, Berketis K (2014) Shear strength behaviour of polypropylene fbre reinforced cohesive soils. Geomech Geoeng 9(3):241–251
- Baytar, A. (2013). "Effects of fly ash and desu alpha gypsum on the geotechnical properties of çayirhan Soil". A Master of Science thesis submitted to the graduate school of natural and applied sciences Of Middle East technical university.
- Buhler, R.L. and Cerato, A.B. (2007). "Stabilization of Oklahoma expansive soils using lime and class C fly ash". Proceedings of the Conference Geo-Denver 2007, February, Denver,
- Colorado pp. 1-10. Wagh, K.S. (2015). "Improvement in soil properties using industrial wastes". Proceedings of Indian Geotechnical Conference, Warangal, pp. 553—556.
- Cristelo N, Cunha VM, Dias M, Gomes AT, Miranda T, Araújo N (2015) Infuence of discrete fbre reinforcement on the uniaxial compression response and seismic wave velocity of a cement-stabilized sandy-clay. Geotext Geomembr 43(1):1–13
- Dhakal SK (2012) Stabilization of very weak subgrade soil with cementitious stabilizers
- Eisazadeh A (2015) Thermal characteristics of lime-and phosphoric acid-stabilized montmorillonitic and kaolinitic soils. J Therm Anal Calorim 121(3):1239–1246 112. Takemoto K (1980) Hydration of pozzolanic cement.
- Firoozi AA, Taha MR, Firoozi AA, Khan TA (2015) Efect of ultrasonic treatment on clay microfabric evaluation by atomic force microscopy. Measurement 66:244–252
- Gulsah, Y. (2015). "Stabilization of expansive soils using aggregate waste, rock powder and lime". A Master of Science thesis submitted to the Middle East technical university's natural and applied sciences.
- Gupta et al. (2002), A comparative study in soil plasticity of Hall area and lecture complex area of NIT Rourkela" B.tech thesis, NIT,Rourkela.
- Hoover CG, Ulm FJ (2015) Experimental chemo-mechanics of early-age fracture properties of cement paste. Cem Concr Res 75:42–52

•Jain and Jain (2017) ''The behavior of a fibrereinforced cemented soil.'' Ground Improvement, London, 3(1), 21–30.
•Kumar et al. (2007) " Effects of Random Fiber Inclusion on Consolidation, Hydraulic physical phenomenon, Swelling, Shrinkage Limit and Desiccation Cracking of Clays", International Journal of technology, Vol. 6, No. 4, (284-292).
•Le Chatelier H (1919) Crystalloids against colloids in the theory of cements. Trans Faraday Soc 14:8–11
•Ling FN, Kassim KA, Karim A, Tarmizi A (2013) Reaction products of lime zeolite stabilized kaolin humic acid. In: Applied mechanics and materials, vol 372. Trans Tech Publications, Zürich. pp 88–96 .
•Ministry's technical circulars and directives On national highways and centrally Sponsored road and bridge projects volume ii, Ministry of Transport Department of Surface Transport (Roads Wing) Published by the Indian Roads Congress On behalf of the Govt of India, Ministry of Transport Department of Surface Transport (Roads Wing).
•Mitchell JK (1986) Practical problems from surprising soil behavior. J Geotech Eng 112(3):259–289 104. Rajasekaran G (2005) Sulphate attack and ettringite formation in the lime and cement stabilized marine clays. Ocean Eng 32(8):1133–1159
•Pakir FB, Abdul Karim ATB, Ling FN, Kassim KA (2013) Efect of humic acid on geochemistry properties of kaolin. In: Advanced materials research, vol 701. Trans Tech Publications, Zürich. pp 310–313
•Pandian, N. S., Krishna K. C. and Sridharan, A. (2014). "California Bearing Ratio behaviour of soil/fly ash mixtures". Journal of Testing and Evaluation, ASTM, 29 (2), pp. 220–226
•Phani Kumar and Sharma (2007) A study on bearing capacity of randomly distributed fiber-reinforced sand fills overlying soft clay. Geotextiles and Geomembranes 23 (2), 174–183.

BIOGRAPHIES

Sanjay Kumar, M. Tech Scholar Completed his Civil polytechnic diploma and B.Tech. He has 2 years Working Experience in industry. His area of interest is Soil stabilization.

Mr. S. N Khaliya, he is Working as Head of department in civil engineering department and retired from WRE Department Jaipur.