IMPROVEMENT OF FINE GRAINED SOIL BY ADDITION OF STONE DUST AND LPDE FIBRE

Lakhvir Singh*, Gurdeepak Singh**

*Research Scholar, Guru Nanak Dev Engineering College, Ludhiana
**Associate Professor, Guru Nanak Dev Engineering College, Ludhiana

ABSTRACT: This research work was conducted with an objective to make soil stable for better soil execution and economical design of structure. There were seven set of experiments (S0 to S6) The Sample S0 represents virgin soil with no addition of Stone Dust and LDPE, sample S1 was prepared by using 4% Stone Dust only and no LDPE. In sample S2 the proportion of Stone Dust was increased to 8% and in sample S3 the fraction of Stone Dust was increased to 12% with no LDPE. In sample S4, S5 and S6, the ratio of LDPE was kept as 1.0%, 2.0% and 3.0% respectively along with optimum value of Stone Dust (9%). Results have shown optimum value of 9% of Stone Dust as stabilizer and then further used in estimating the optimize dose of LDPE

Keyword: Optimum Moisture Content, Maximum Dry Density, CBR and UCS.

Introduction

Soil stabilization is the method of modifying some soil characteristics by diverse techniques, mechanical or chemical to produce a value-added soil material which has all the preferred engineering characteristics. It is generally done for increasing their strength and permanence or to check erosion and formation of dust. Structure building depends on soil bearing capacity, so soil stabilization is required to predict the bearing capacity, to enrich the soil strength, to avoid erosion and to enhance workability and durability of soil. The entire replacement of inferior quality soil is very costly therefore, soil stabilization is the option in such situations. One of the many challenges faced in developing country like India is the issue of waste management. Focus of this current study is to utilize this waste for engineering purpose. Current study analyses comprise the set of practical work on fiber treated highly compressible soil as well as analyze the impact of stone-dust on the physical competency of soil.

Literature review

This section reviews the most noteworthy literature associated to S.D and LDPE. Research has been conducted on different ways to of soil stabilization by using different materials in different proportions. Soil stabilization using S.D and Jute Fibre, is an idea requiring attention as very limited work has been done previously.

Priya S. et.al (2017) worked on stabilization of clayey soil using Low density polyethylene fiber. Fiber & liquid limit is directly proportional to each other. Upon introduction of fiber content up to 1% of fiber, max.dry density rose and then decreased. Therefore 1% of stabilize addition, was taken as optimal proportion of PP fiber. Moreover, soil strength was improved due to fiber addition.

Naale et al. (2016) Present study generalizes on assessment of advantage of stabilization of road pavement sub grade soil. Two types of soil sample are taken for further investigation i.e. CBR of Soil A and Soil B having 1.45 & 4.67 respectively. Stabilizers were used lime, class F Stone dust and synthetic LDPE fiber with aspect ratio of 100. Tests performed on both un-stabilized and stabilized sub grade soil at entirely dissimilar percentages of stabilizers. Lime percentage varied from 1.5, 3.0, 4.5 and 6 %, for Stone dust 5, 10, 15 and 20 % whereas for LDPE fiber it was 0.25, 0.50, 0.75 and 1 % respectively. Maximum value of failure stress is gain at 4.5 % lime, 10 % Stone dust and 0.5 % fiber in both soil-A and soil-B sample. Significant change in plasticity index is observed which is ascribed to the alteration in soil property due to flocculation and agglomeration etc. Optimal value of lime, Stone dust and Low density polyethylene is observed 4.5 %, 10 % and 0.5 % respectively for the reformation of strength features of soil.

Sabat A.K. and Pradhan A. (2014) considered that best proportion of stone-dust for treatment of soil lie beneath 20%. Introduction of 20% of S.D to soil led to 58% rise in U.C.S, soaked CBR rose by 91% and 38 % lower swelling pressure. U.C.S of stone-dust cured soil increases with addition of LDPE fiber by up to 1%.

Maximum value of U.C.S is attained with sample treated with 12 mm fiber length. 70% increase in U.C.S as weigh to S. D treated soil. 170% increase in U.C.S in comparison to untreated soil. Soaked CBR of S. D treated soil rise up to 1% of fiber, thereafter it decreases irrespective of the lengthiness of Low-density polyethylene fiber. Optimal percentage of LDPE fiber is 1% for reinforcement of compressive soil treated with optimal percentage of FA is 20%. From economic point of view there is 7% and 13.6% saving in cost of construction/sqm. Combined use of LDPE fiber & Stone dust increase strength more than as compared to adding fiber & fly ah separately.

OBJECTIVES

1. To study the effect of stone dust and LDPE on compaction characteristics of the soil.
2. To optimize the dose of stone dust by Unconfined Compressive Strength.
3. To optimize the dose of LDPE in the mix of stone dust (optimized value) and soil
4. To determine the improvement in CBR value by addition optimized dose of stone dust and LDPE.

EXPERIMENTAL SET UP

Table 1: Composition of the sample prepared to attain the desired results

Details of samples Sample No.	%age of Stone Dust	Varying percentage of LDPE
S0	0	0
S1	4	0
S2	8	0
S3	12	0
S4	Optimize value	1.5
S5	Optimize value	2.5
S6	Optimize value	3.5

Work was done to improve the geotechnical properties of clayey soil like Compaction Characteristics, California Bearing Ratio (soaked and unsoaked) values with utilization of Stone Dust and LDPE at different proportions. Grain size analysis, wet sieve analysis of soil, specific gravity were calculated. Liquid Limit Test, Plastic Limit Test, Specific Gravity, Standard Proctor Test (SPT) and California Bearing Ratio Test (CBR). The results of all these tests were collected.

Relationship b/w the dry density and the moisture content of the soil was determined by proctor test. It was determined that for Sample, S0, max value of DD was 17.3 kN/m^3 against OMC of 10.5% and for Sample S1, max value of DD is 17.8kN/m^3 against OMC of 10.1 %. Max value of DD is 17.9kN/m^3 against OMC of 9.8% for S2, for S3 Sample, max value of DD is 18KN/m^3 against OMC of 9.6%

Table 2: Test result for OMC and MDD (Using Stone Dust)

S. No.	Stone dust + LDPE (%)	OMC (%)	MDD (kN/m^3)
S0	0+0	10.5	17.4
S1	4+0	10.1	17.8
S2	8+0	9.8	18
S3	**12+0**	**9.6**	**18**

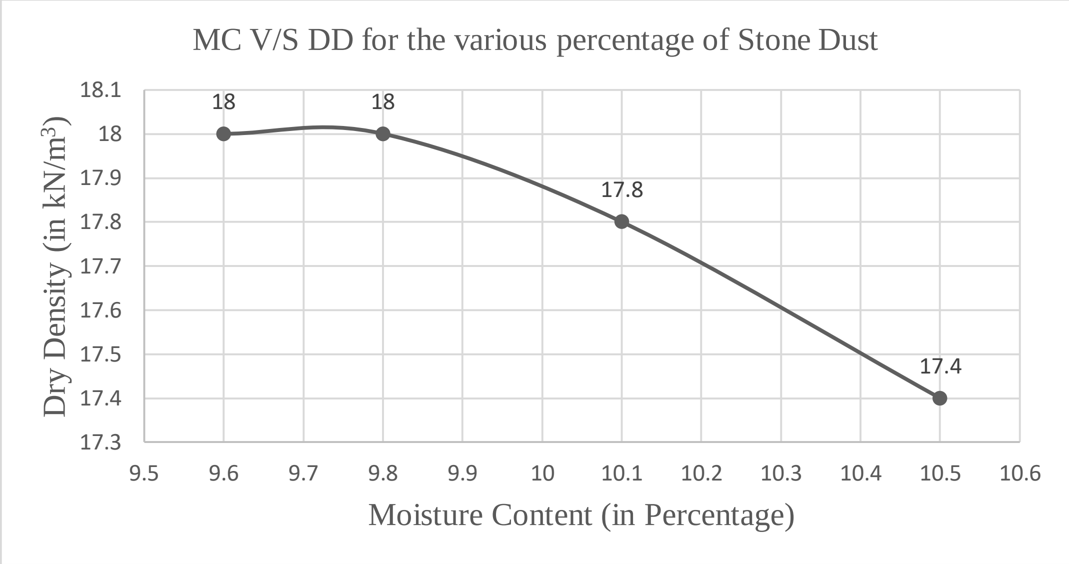

Fig 1–: Determination of optimum moisture content

From the graph, it is clear that *Max value of DD is 18kN/m^3* against *OMC of 9.6%*

Unconfined Compressive Strength (UCS) Variations Using Stone Dust

Table 3: Variation in UCS using stone dust in different percentages

S. No.	Stone dust + LDPE (%)	UCS (kN/m^2)
S0	0+0	173
S1	4+0	300
S2	8+0	351
S3	12+0	349

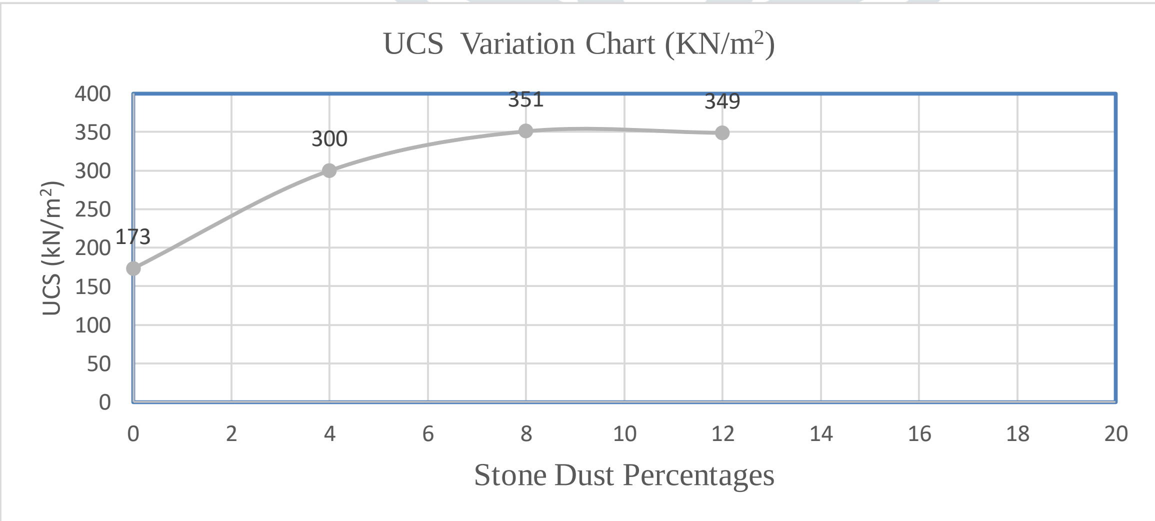

Fig 2**:** Variation of UCS with respect to SD

The graph depicts that m*ax value of UCS is 351KN/m^3* against S*D of 9%*

It was determined that, For S4, Max value of DD is 18.9kN/m^3 against OMC of 9.7%, For S5, Max value of DD is 18.7KN/m^3 against OMC of 9.9% and for S6, Max value of DD is 18.2kN/m^3 against OMC of 11%

Table 4: Test result for OMC and MDD (Using Stone Dust), for samples 4,5 and 6

S.No.	S.D + LDPE (%)	OMC (%)	MDD (kN/m^3)
S4	9+1.5	9.7	18.9
S5	9+2.5	9.9	18.7
S6	9+3.5	11.0	18.2

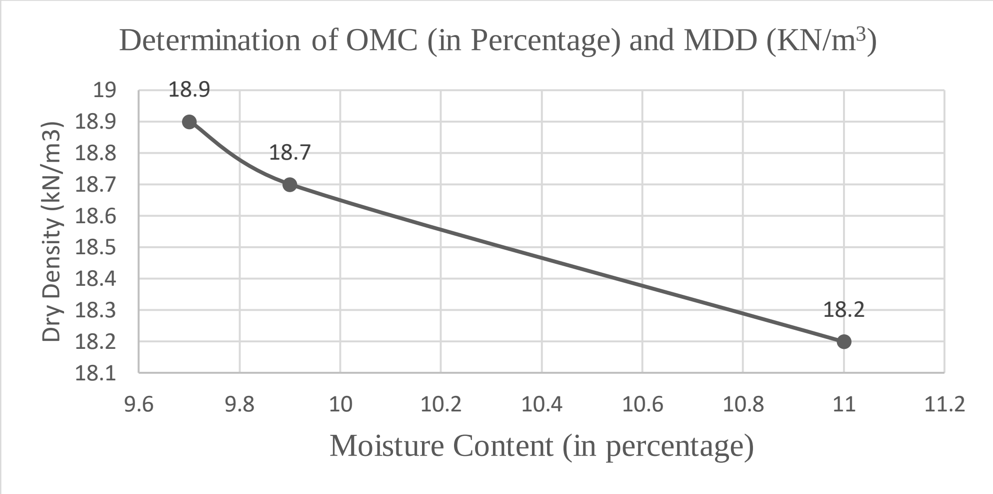

Fig 3**:** Variation of OMC (%) and MDD (KN/m^3) w.r.t. SD and Varying Percentage of LDPE

The graph depicts m*ax value of DD is 18.9KN/m³* against *OMC of 9.7%*

Unconfined Compressive Strength (UCS) Variations Using Optimal Stone Dust and Varying Percentages of LDPE

Table 5: Variation in UCS using optimal stone dust and Varying Percentage of LDPE

S. No.	S.D + LDPE (%)	UCS (kN/m^2)
S4	9+1.5	435
S5	9+2.5	471
S6	9+3.5	456

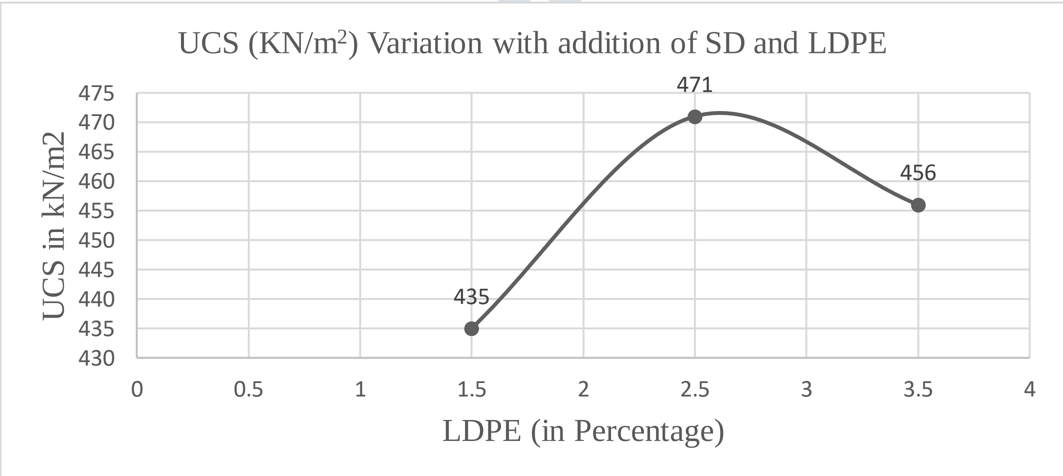

Fig 4**:** Variation of UCS w.r.t. SD and Varying Percentage of LDPE

From the graph, it is clear that *Max value of UCS is 472kN/m³* against 9% SD and + *2.6% LDPE*

CBR TEST RESULT FOR SOIL TREATED WITH S.D + LDPE MIX

Table 6: Test results of Un-soaked and soaked CBR

S.No.	S.D + LDPE (%)	CBR (in Percentage)	
		Un-soaked	Soaked
S0	0+0	4.8	3.6
S3	9+0	7.1	5.6
S5	9+2.6	7.7	6.0

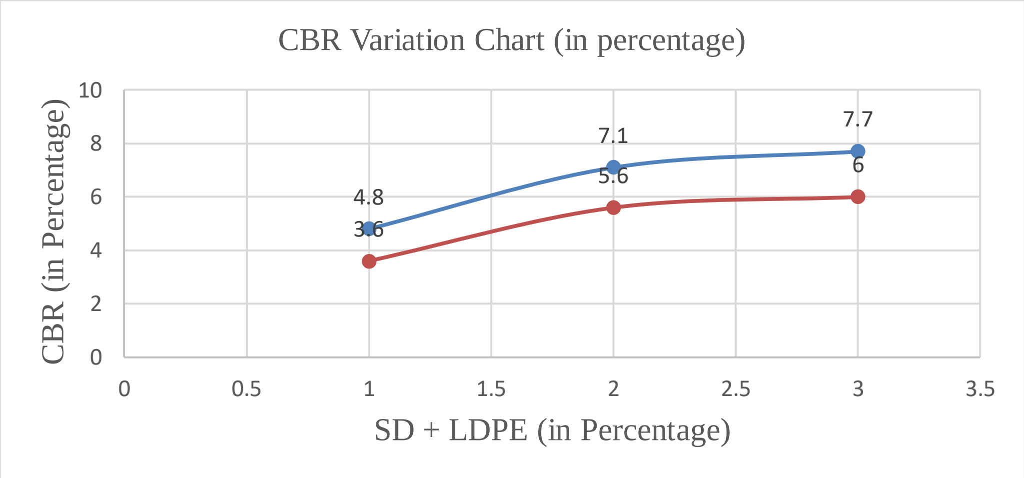

Fig. - 5: showing variation in soil properties when treated with S.D and LDPE

Results

When soil is blended with 9% Stone Dust (Sample S3). (MDD increased by 8.0 percentage higher compared to virgin soil and the Maximum Value of 7.1 percent (Nurture of 48 percent) for un-soaked and 5.6 percent (Nurture of 43.5 percent) for soaked sample, raise of 110 percent UCS compared to the virgin soil UCS value, Combinations of optimum Stone Dust (i.e. 9 %) and LDPE (i.e.2.6%) have shown further more increase of 8 percent as compared to virgin in MDD. Furthermore increase in CBR percentage of 7.7 percent (Nurture of almost 60 percent) for un-soaked and 6 percent (Nurture of almost 50 percent) for soaked sample. UCS increased to 472 KN/m^2, results in raise of 175 percent with respect to virgin soil and 4.2 percent compared to the maximum value of LDPE blend.

Conclusion

The stone dust itself can be considered as a good sub base material. Hence it can be used for construction of road embankment. From the compaction studies out on stone dust, it is found that the maximum dry density and optimum moisture content relationship is fairly flat at peak values. Hence the variation in water content as compared to optimum moisture content leads to marginal change in maximum dry density. Stone dust and LDPE has high specific gravity and the soaked CBR value for standard compaction is more. This indicates that stone dust can be used as an embankment material, backfill material for the lower layer of sub base. Also reuse of this waste material is economically advantages and does not bring any environmental hazards.

References:

- Priya C.M.S, Albert A.B., Deegan A.D. (2017), "Stabilization of clayey soil using Low density polyethylene fiber", IRJET Journal Vol. 4.

- Nagle R.K. (2016): "comparative study of CBR of soil, reinforced with natural waste plastic material" IJESR June 2014/ vol-4 /issue-6/304-308.
- Sabat A.K. and Pradhan A. (2014), "Fiber Reinforced- Stone dust Stabilized Expansive Soil Mixes as Sub grade Material in Flexible Pavement" Electronic Journal of Geotechnical Engineering (EJGE) Vol. 19, PP 5757-5770
- Dhatrak, A.I. and Konmare, S.D, (2015) "Performance of randomly oriented plastic waste in flexible pavement", Int. J. of pure and applied research in Engineering and Technology, Vol.3, Issue No. 9, pp-193-202.
- Fauzi A. Djauhari Z., and Fauzi U.J. (2016) "Soil engineering properties improvement by Utilization of cut waste plastic and crushed waste glass as additive", Int. J. of engineering and Technology, Vol. 8, Issue No. 1, pp.15-18.
- Gawande A., Zamare G., Renge V.C., Tayad S. and Bharsakale G. (2012):" an overview on waste plastic utilization in asphalting of roads" JERS april-june, 2012/vol. 3/issue 2.
- Gumuser C.and Senol A. (Nov. 2013), "Effect of Stone dust and different lengths of Low density polyethylene fibers content on the soft soils" International Journal of Civil Engineering Vol. 12, No. 2,PP 134-145
- Harish, C. and Ashwini, H. M., (2015) "Stabilization of soil by using plastic bottle strips as a stabilizer", Int. Res. J. of Engineering and Technology. Vol.4, pp1877.
- Kalliyath J.V., Remya. U. R and Snigdha.V. K (2016), "The Effect of Low density polyethylene Fibre on the Behaviour of Soil Mass with Reference to the Strength Parameters" International Journal of Engineering Research & Technology (IJERT) Vol. 5, PP 781-784