iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** IV **Month of publication:** April 2020

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue IV Apr 2020- Available at www.ijraset.com

Improvement in the Engineering Property of Locally available Soil using Silica Fume

Ramakant Sharma[1], Dr. M. K. Trivedi[2], S.S. Kushwah[3]
[1]*P.G. Student,* [2, 3]*Professor, Department of Civil Engineering MITS Gwalior, Madhya Pradesh, India*

Abstract: ***In this research paper we study the effect of adding silica fume to locally available soil in order to improve its engineering properties. Silica fume has been added in different percentages 0%, 2.5%, 5%, and 7.5% by weight of soil. The experimental investigations reveals that the addition of silica fume reduces the liquid limit, plasticity index, specific gravity, optimum moisture content, free swell % and increases plastic limit, unconfined compression strength with increasing California bearing ratio.***

Keywords: Locally available Soil, Silica Fume (SF), California Bearing Ratio (CBR), Atterberg's Limit.

I. INTRODUCTION

Soil plays an important part for the base of the structure to be strong. So for good foundation we should know about the properties of the soil around it. If the soil is week or don't have the required properties then it will produce severe damage to the structure build on it. Soil which expand always create problem for the lightly weighted structure because it changes volumetrically along with the seasonal moisture variation. It results in the decrement of engineering properties of the soil. Hence in order to attain the desirable amount of strength modification in the properties of the soil is needed The present study comprises of characterization and stabilization of locally available soil with the help of silica fume waste .This waste is being dumped off in low laying area causing dumping issues as well as hampering the fertility of the soil.

A. Materials And Properties

In this study, silica fume is used for stabilizing and considering its effects on the locally available soil.

1) *Soil:* The locally available soil is used in this research that is collected from MITS Campus Area, Gwalior (M.P.).Locally available soil is used as a base material in this study. It has been partially replaced by silica fume powder by weight of dry soil. The soil sample collected was disturbed. The study tells us that soil is of clayey nature having expansive behavior with high plasticity having Gs = 2.69 with 90% fines. Table 1 depicts the properties of collected sample of locally available soil.

Table1. Properties of Locally available Soil

S.No.	Particulars	Test Results
1.	Grain Size Distribution Sand (%) Silt + Clay (%)	10% 90%
2.	Liquid Limit (%)	64
3.	Plastic Limit (%)	33
4.	Plasticity Index (%)	31
5.	Specific Gravity	2.69
6.	Optimum Moisture Content (%)	19
7.	Maximum Dry Density (KN/m^3)	15.572
8.	Differential Free Swell (%)	45.32
9.	Unconfined Compressive Strength (KN/m^2)	130

2) *Silica Fume:* Silica fume is a by-product which is produced during the reduction of high-purity quartz with coal in electric arc furnaces in the production of silicon and ferrosilicon alloys. The silica fume used in this study was 'Elkem Silica' Grade 920 is a dry silica fume powder. The composition of silica fume is presented in table:

Table2- Chemical and physical properties of silica fume

Property	SiO_2	H_2O	Loss of ignition	Retained on 45 micron sieve	Pozzolanic Activity Index, 7 days	Bulk density
Specified Value (ASTM C1240-14)	Maximum 85%	Maximum 3%	Maximum 6%	Maximum 10%	Minimum 105% of control	500-700 Kg/m^3
Analysis	87.64	0.28	1.20	0.25	124	625

II. TESTING METHODOLOGY

Laboratory tests were performed on locally available soil mixed with silica fume at various percentages i.e. 0%, 2.5%, 5%,7.5% by weight of dry soil are as follows :-

A. Grain size distribution
B. Liquid limit
C. Plastic limit
D. Plasticity index
E. Specific gravity
F. Standard proctor test
G. Differential free swell (DFS)
H. California bearing ratio (C.B.R.)
I. Unconfined compressive strength (UCS)

III. RESULTS AND DECLARATION

The test results obtained from various laboratory investigations are summarized in table:

S.N.	Particulars of tests	Soil + SF 0%	Soil + SF 2.5%	Soil + SF 5%	Soil + SF 7.5 %
1.	Soil Classification	CL			
2.	Liquid Limit (%)	26	24	23	23
3.	Plastic Limit (%)	20	21	22	22
4.	Plasticity Index (%)	6	3	1	1
5.	Specific Gravity	2.61	2.59	2.58	2.57
6.	Optimum Moisture Content (%)	14.30	13.27	12.30	13.50
7.	Maximum Dry Density (kN/m^3)	1.55	1.60	1.72	1.61
8.	Differential Free Swell (%)	32.50	30.20	28.30	26.70
9.	Unconfined Compressive Strength (kN/m^2)	130	145	180	176

Table for California Bearing Ratio (CBR)

S.No.	Penetration	Soil + SF 0%	Soil + SF 2.5%	Soil + SF 5%	Soil + SF 7.5%
1.	2.5 mm	1.98	2.451	4.50	3.50
2.	5 mm	1.98	2.50	2.70	2.80

SF%	SOIL +0% SF	SOIL+2.5% SF	SOIL+5% SF	SOIL+ 7.5%
CU	27.20	33.60	40.30	38.30
Φ	4	17	20	22

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue IV Apr 2020- Available at www.ijraset.com

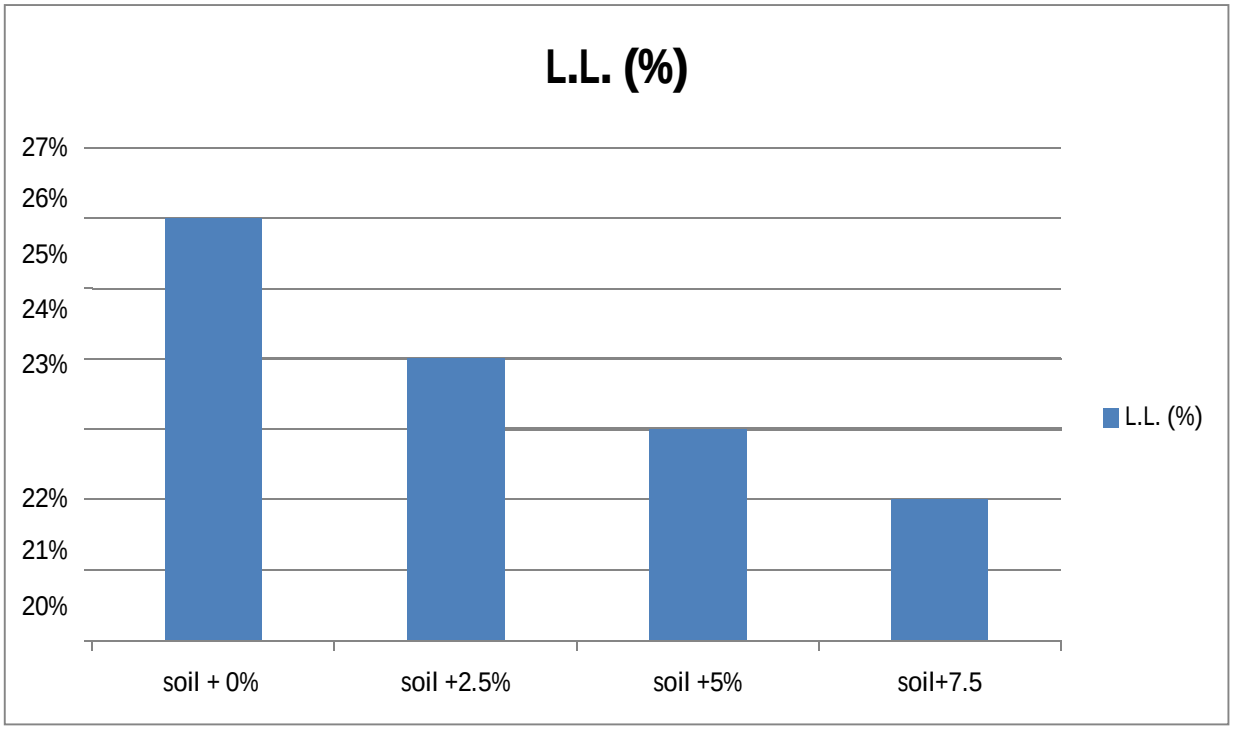


Fig.1. Chart showing the variation in L.L. for mix proportion of soil and silica fume

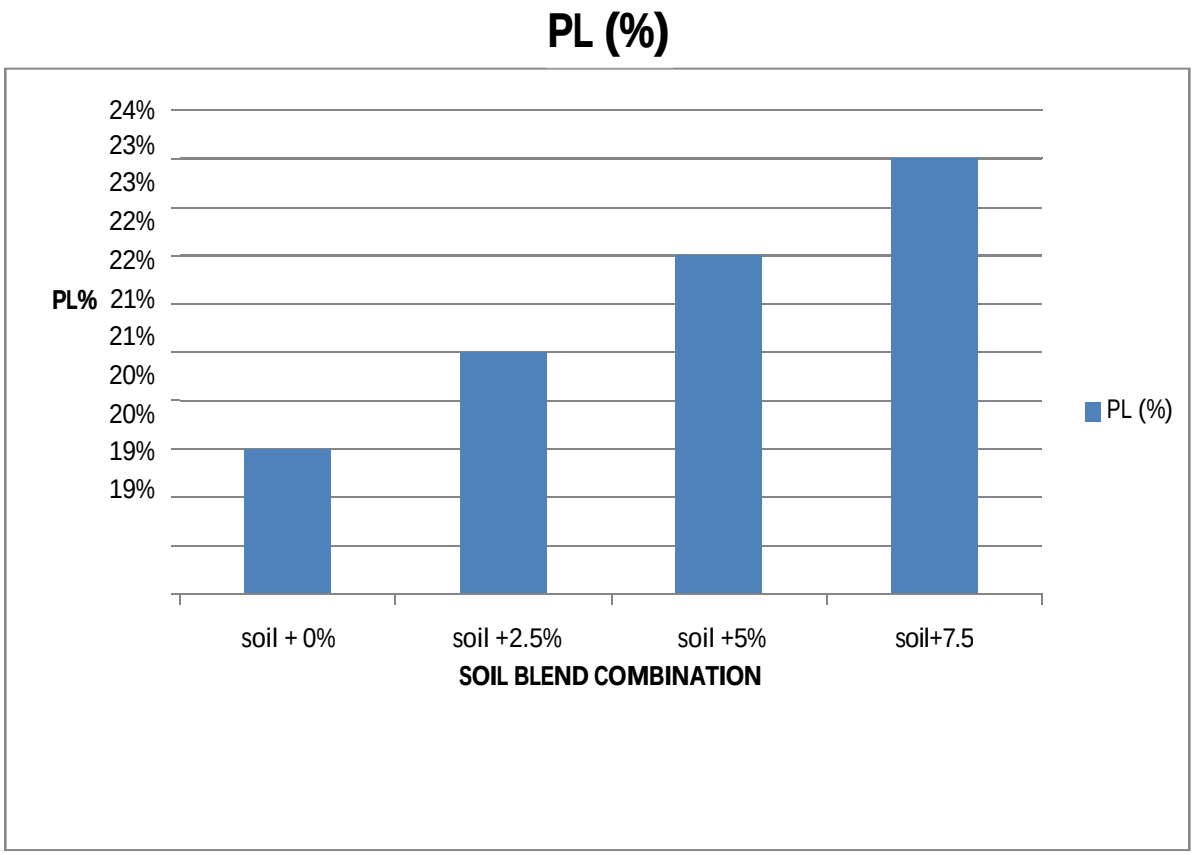


Fig.2. Chart showing the variation in PL for mix proportion of soil and silica fume

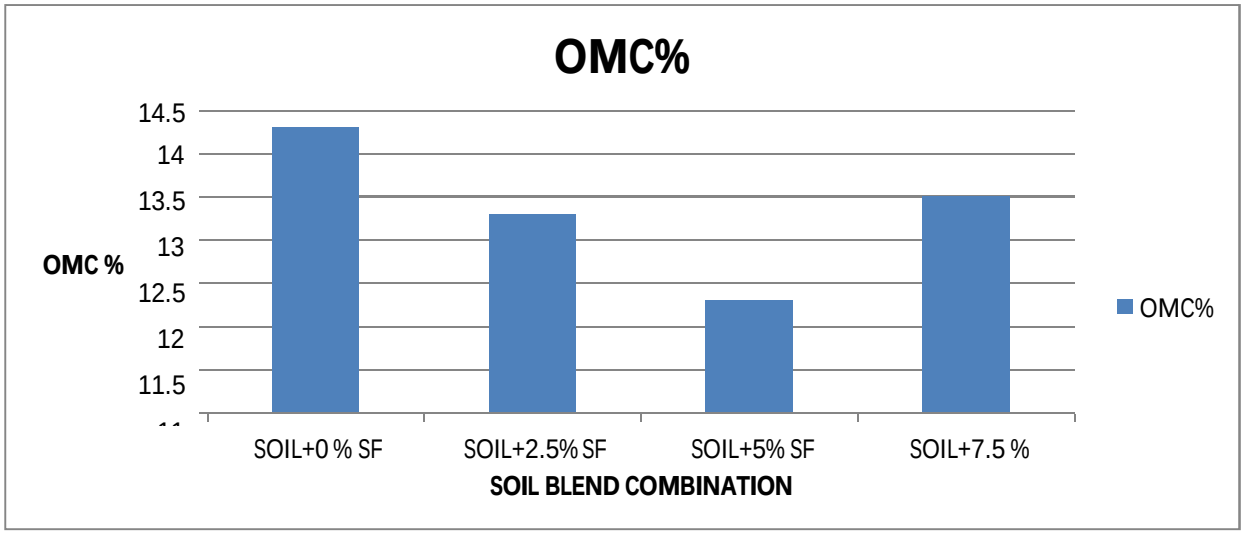


Fig .3. Chart showing the variation in OMC for mix proportion of soil and silica fume

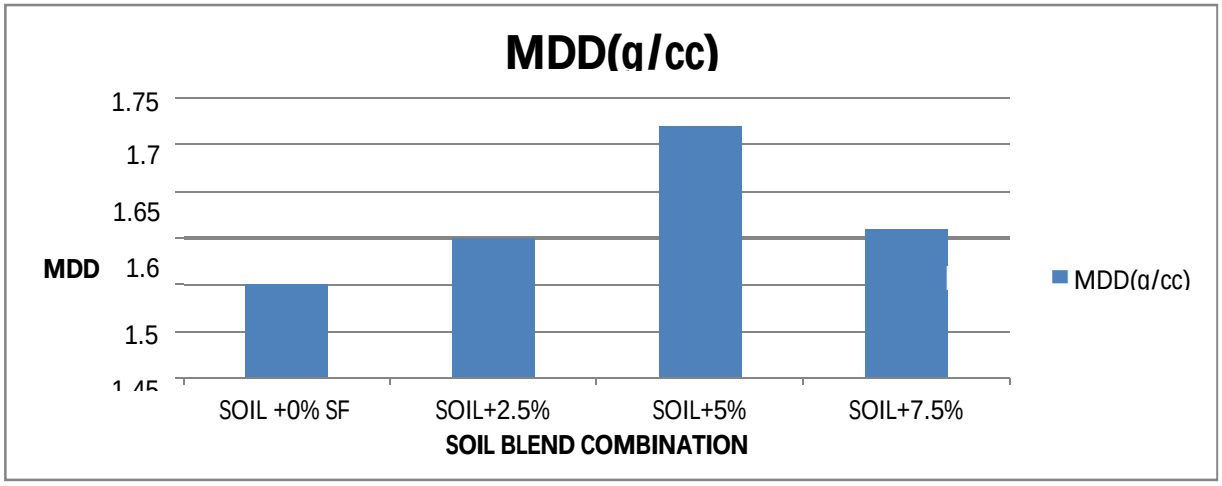


Fig .3. Chart showing the variation in MDD for mix proportion of soil and silica fume

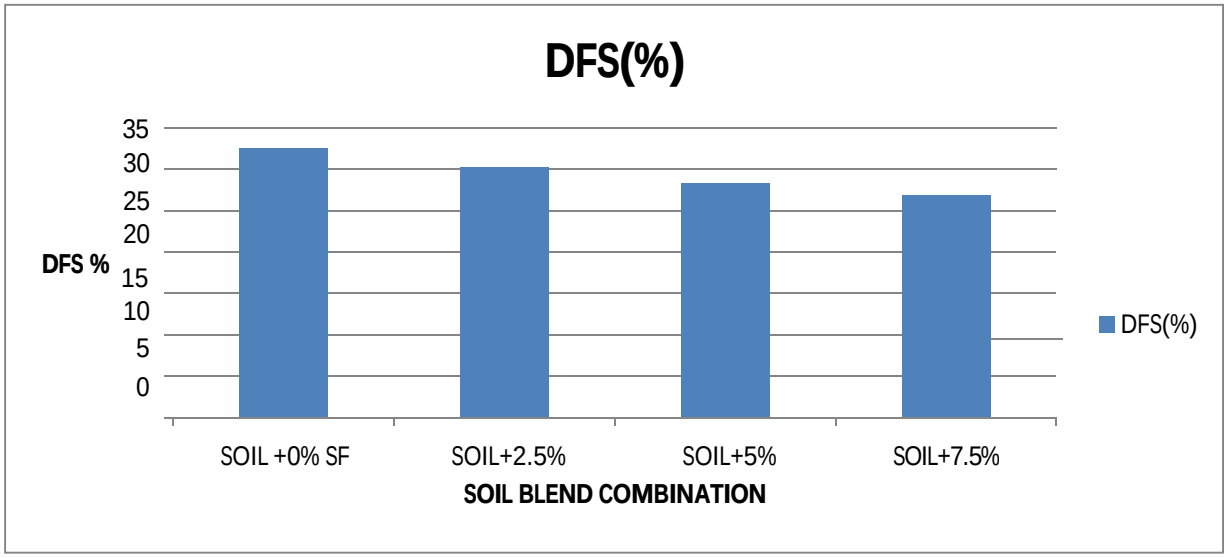


Fig.4. Chart showing the variation in DFS for mix proportion of soil and silica fume

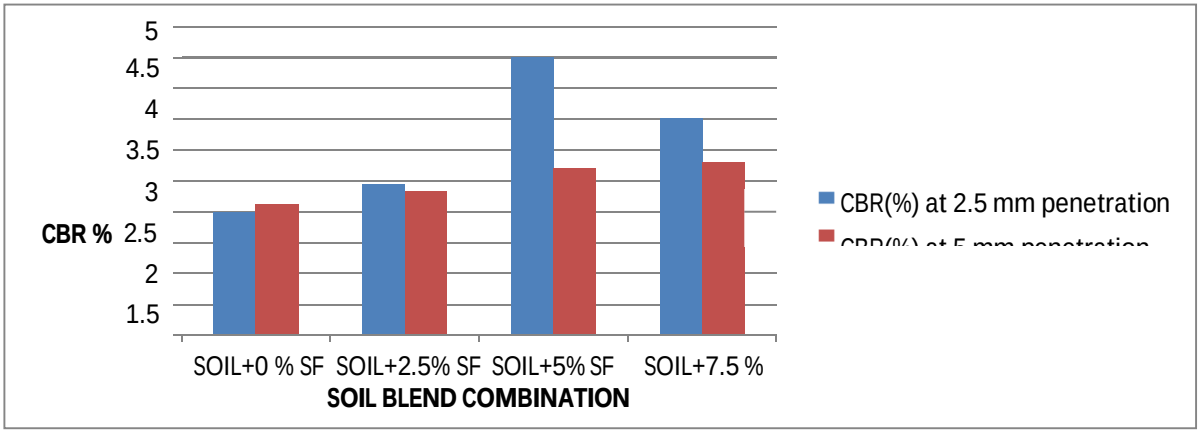


Fig. 5. Chart showing the variation in CBR for mix proportion of soil and silica fume

IV. CONCLUSION

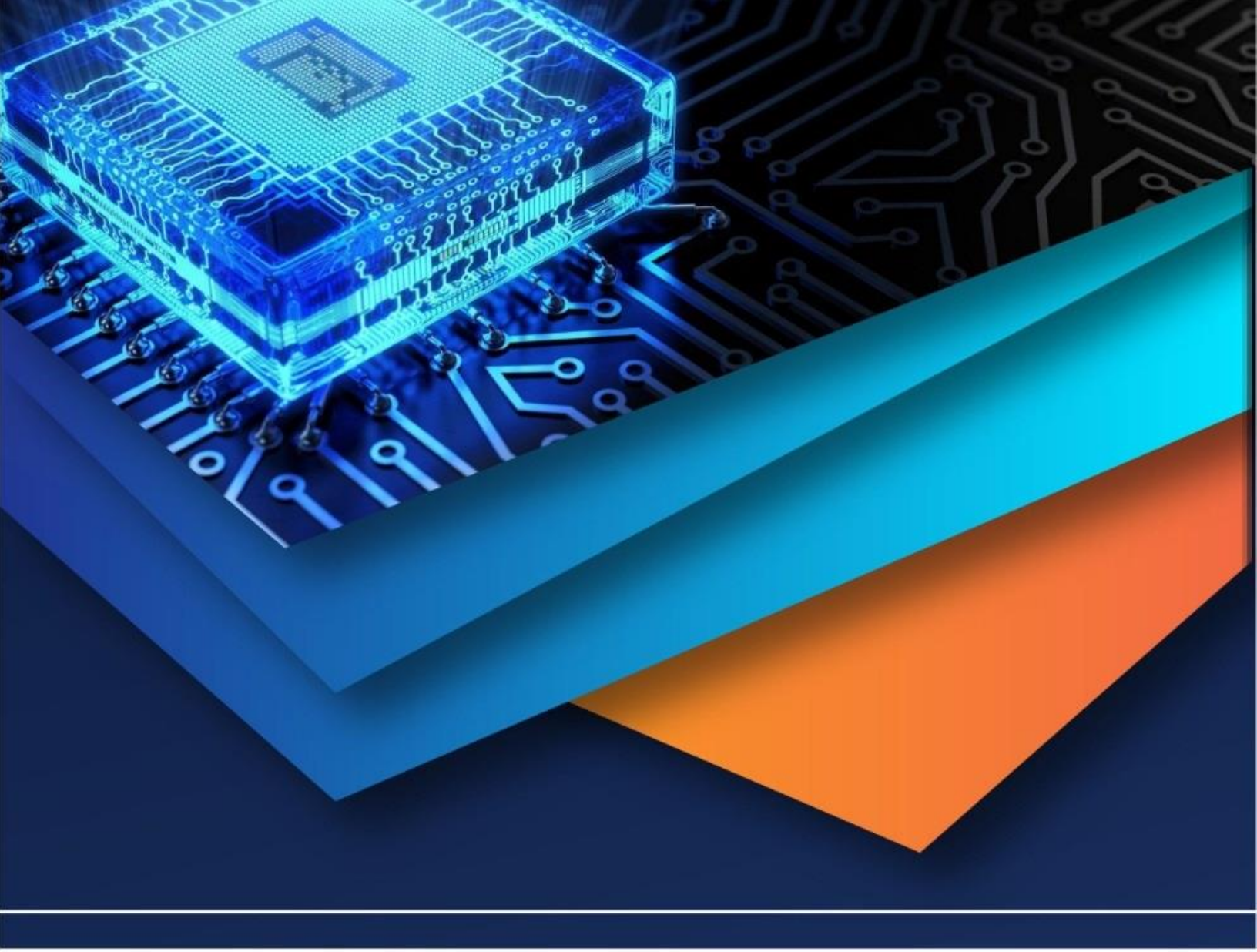
Study reveals that a number of of tests has been performed by blending different percentages of silica fume powder with the soil-samples. It is found that the index properties and swelling properties have been ehanced by addition of different percentage of silica fume. Tests concluded that liquid limit decreased from 26% to 23%, plastic limit increased from 20% to 22%, OMC decreased from 14.30% to 13.50% at 7.5% replacement of silica fume with soil. A slight increase is noted in maximum dry density and high amount of decrement in DFS is observed. CBR value is increased from 1.98% to 3.50% . Thus locally available is soil stabilized with silica fume can be used for the constructions of embankments and pavements in rural roads.

V. ACKNOWLEDGEMENT

I would like thank my guide Dr. M.K. TRIVEDI for guidance and support. This research would not have been possible without his guidance, support and encouragement. All the tests were performed in the Geotechnical lab of MITS College, so I am indebted to lab faculties for their fruitful cooperation.

REFERENCES

[1] Qassun S. Mohammed Shafiqu, Ahmed S. Ali and Haider Naeim Abdul-Hussein Al- Hassany(2015) : Enhancement of Expansive Soil Properties Using Lime Silica-Fume Mixture, IJSER, Volume 6, Issue 10, October-2015
[2] Mohammed Y. Fattah, Aamal A. Al-Saidi, Maher M. Jaber(2014) : Consolidation Properties of Compacted Soft Soil Stabilized with Lime-Silica Fume Mix, IJSER, Volume 5, Issue 7, July-2014
[3] Mohammed Y. Fattah, Aamal A. Al-Saidi, Maher M. Jaber(2015) : Characteristics of Clays Stabilized with Lime-Silica Fume Mix, Societa Geologica Italiana, Roma, Vol. 134, No. 1
[4] R. Bharathan, A. Giridharan, P. Saranya(2017) : Soil Stabilization Using Silica Fume and Cement, SSRG Int. Journal of Civil Engineering, special issue, March 2017
[5] Saranjeet Rajesh Soni, P.P. Dahale, R.M. Dobale(2016) : Disposal of Solid Waste for Black Cotton Soil Stabilization, IJAEST, Vol No. 8, Issue No. 1
[6] S. Srikanth Reddy, A.C.S.V. Prasad, N. Vamsi Krishna(2018) : Lime- Stabilized black cotton soil and brick powder mixture as subbase material, Hindawi, Volume 2018
[7] Chayan Gupta and Ravi Kumar Sharma(2014) : Influence of Micro Silica Fume on Sub Grade Characteristics of Expansive Soil, International Journal of Civil Engineering Research, Volume 5, No. 1
[8] Hassnen Mosa Jafer, Hayder Abbas Obaid, Ahmed Hassan Hadi(2013) : Stabilization of Soft Soil Subgrade Layers By Using Lime-Micro Silica Fume Mixture, Euphrates Journal of Agriculture Science-5 (1)
[9] Masoud Karimi & Ali Ghorbani(2011) : Stabilization of Silty Sand Soils with Lime and Microsilica Admixture in presence of Sulfates, 2011 Pan-Am CGS Geotechnical Conference
[10] Chhaya Negi, R.K. Yadav, A.K. Singhal(2013) : Effect of Silica Fume on Engineering Properties of Black Cotton Soil, IJCER, Vol. 03, Issue 7
[11] Tiza Michael, Sitesh Kumar Singh(2016) : A Survey of Literature on Impact of Silica Fume and Saw Dust on Expansive Soil, IJRASET, Vol. 4, Issue VIII
[12] G Radhakrishnan, Dr. M Anjan Kumar, Dr. GVR Prasad Raju(2014) : Swelling Properties of Expansive Soils Treated with Chemicals and Flyash, AJER, Vol. 3, Issue 4
[13] C.S. Prasad, K.N. Maiti, R. Venugopal(2002) : Effect of silica fume addition on the properties of whiteware compositions, ELSEVIER, Ceramics International 28 (2002)
[14] A.R. Goodarzi, H.R. Akbari, M. Salimi(2016) : Enhanced stabilization of highly expansive clays by mixing cement and silica fume, ELSEVIER, Applied Clay Science
[15] Gulhati & Datta, “Geotechnical Engineering”, Tata MacGraw Hill Publications, New Delhi.
[16] Shivangi.B and Trivedi.M.K. (2016). Impact of Micro Silica Fume on Engineering Properties of Expansive Soil. - International Journal of Science Technologys



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY