© 2016 IJSRSET | Volume 2 | Issue 5 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Soil Stabilization by Utilization of Hypo Sludge and Lime

Ankit Kumar*[1], S. S. Gupta[2]

*[1]M. Tech. Student, Department of Civil Engineering, G. B. Pant University of Agriculture & Technology Pantnagar, Udham Singh Nagar, Uttarakhand, India
[2]Professor, Department of Civil Engineering, G. B. Pant University of Agriculture & Technology Pantnagar, Udham Singh Nagar, Uttarakhand, India

ABSTRACT

Soil stabilization is the process to improving the geotechnical properties of soil. In various countries like India road network are growing up each year for transportation facilities. In the design of road construction site engineers faces the problem of low strength of soil, due to which settlement and failure of road pavement occurs. For improving the strength of soil pavement Hypo Sludge and Lime can be utilized to the soil. In present studies a series of laboratory experiment performed to determine optimum percentage of these two additives. 6% Hypo Sludge or 8% Lime is observed optimum mix of additive for soil stabilization.

Keywords: Soil Stabilization, Hypo Sludge, Lime, Standard Proctor Test, Unconfined Compressive Strength Test.

I. INTRODUCTION

Soil stabilization development is a process to increased strength of soil pavement. The simplest method for developing strength of soil to drained out water after compaction of the soil. The other method is adding binder like fly ash, lime, bituminous and cement etc material to the weak soils for improving geotechnical properties of soil. Mechanical and chemical analyses are two major areas for improving soil strengthening properties. In which mechanical process is a physical method like vibration and compaction imparted to soil. In chemical method different percentage of binding material having cementitious properties added to the soil. In present study Hypo Sludge and Lime added to the soil and conduct a series of test.

Hypo Sludge is industrial waste material collected from paper mill industries. Hypo Sludge generates continuously throughout the operating year and it behaves like a clayey material consisting of short fiber, ink and other impurities. Due to presence of some hydrated lime (Cao: Calcium hydroxide) with other chemical impurities to the Hypo Sludge is also called Lime Sludge. It is found that high percentage of moisture content is available in the Hypo Sludge after de-inking and re-pulping process in the paper industries. It dried up in the presence of sun before conducting a series of laboratory test for the proposed study.

Lime is used in large quantities as building and engineering materials. Lime manufactured in the industries resulting of cut, crushed or pulverized lime stone or chalk. Lime is purchased from market for present study work.

II. METHODS AND MATERIAL

A. METHODS

a) **Particle Size Distribution:** The percentage of particle i.e. clay, silt and sand (fine grained or coarse grained) in the soil was found after conducting laboratory experiments as per IS: 2720 (Part V) – 1985.
b) **Atterberg Limit:** Liquid limit, plastic limit, plasticity index and shrinkage limit was determined as per IS: 2720 (Part IV) – 1985 in the laboratory.
c) **Specific Gravity:** Specific gravity of soil is obtained as per IS: 2720 (Part III) – 1980 with the help of pycnometer method.
d) **Standard Proctor Test:** The standard procedure of standard proctor test is followed as per IS: 2720 (Part VII) – 1980 to determined optimum moisture content and maximum dry density of soil.
e) **Unconfined Compressive Strength test:** This test is conducted as per IS: 2720 (Part X) in Laboratory to find compressive strength of soil.

B. MATERIALS

a) **Soil :** Soil is collected from Sitarganj, Udham Singh Nagar, Uttarakhand (India).

Figure 1: Sample of Soil

b) **Hypo Sludge :** Hypo Sludge is collected from Century Paper Mill, Lal Kaun, Udham Singh Nagar, Uttarakhand (India).

Figure 2: Sample of Hypo Sludge

c) **Lime :** Lime purchased from market of Udham Singh Nagar, Uttarakhand (India).

Figure 3 : Sample of Lime

III. RESULTS AND DISCUSSION

A. Geotechnical Properties of Soil

A series of laboratory test performed to determine the basic engineering properties of soil. The geotechnical parameters of soil are presented in Table1.

TABLE-1: GEO-TECHNICAL PROPERTIES OF SOIL

S. No.	Geo-technical Properties of Soil	
	Parameter	**Results**
1.	Grain size distribution a) Clay size fraction b) Silt size fraction c) Sand size fraction Soil type as per IS: 1498 – 1970	 15.30 61.40 23.30 ML – CL
2.	Liquid limit (%)	26.08
3.	Plastic limit (%)	19.18
4.	Shrinkage limit (%)	19.47
5.	Plasticity Index (%)	6.90
6.	Specific gravity	2.52
7.	Maximum dry density (KN/m^3)	17.06
8.	Optimum moisture content (%)	16.00
9.	Unconfined compressive strength (KN/m^2) a) 0 days b) 7 days c) 14 days	 242.00 298.00 315.00

B. Standard Procter Test

The standard proctor tests tests were carried out on the soil with varying percentages of Hypo Sludge and Lime. The results are reported as an average value of three tests conducted on same mix. Optimum moisture content (OMC) and maximum dry density (MDD) of the Soil are calculated and summarized in Table 2**.**

a). Comparison of 2% Hypo Sludge & 2% Lime: From Fig. 4, the maximum dry density of soil is observed 16.71KN/m^3 (for 2% Hypo Sludge) and 16.21KN/m^3 (for 2% Lime).

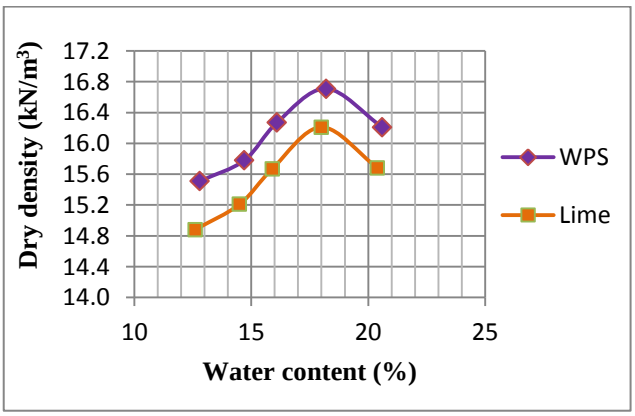

Figure 4: Comparison of 2% Hypo Sludge & 2% Lime

b). Comparison of 4% Hypo Sludge & 4% Lime: From Fig. 5, the maximum dry density of soil is

observed 16.30KN/m^3 (for 4% Hypo Sludge) and 15.51KN/m^3 (for 4% Lime).

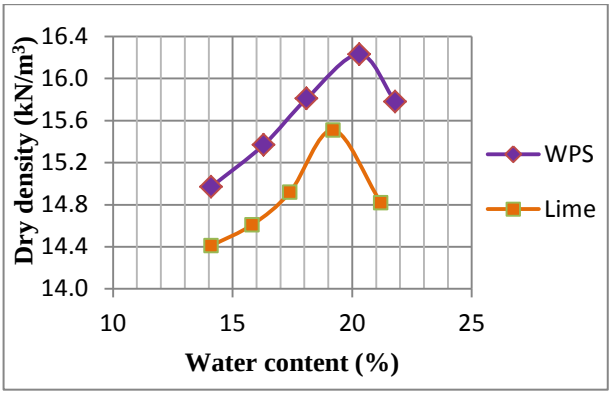

Figure 5: Comparison of 4%Hypo Sludge & 4% Lime

c). Comparison of 6% Hypo Sludge & 6% Lime From Fig. 6, the maximum dry density of soil is observed 15.91KN/m^3 (for 6% Hypo Sludge) and 15.21KN/m^3 (for 6% Lime).

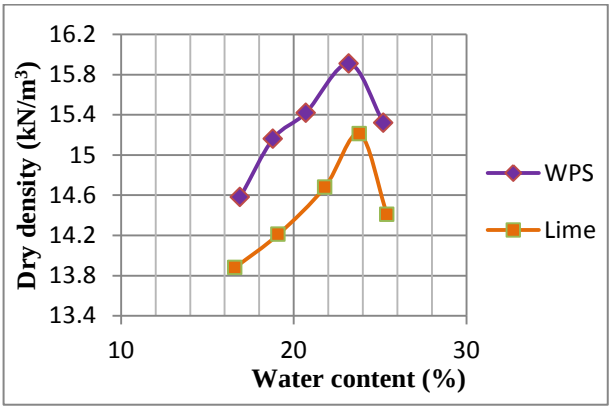

Figure 6: Comparison of 6% Hypo Sludge & 6% Lime

d). Comparison of 8% Hypo Sludge & 8% Lime: From Fig. 7, the maximum dry density of soil is observed 15.47KN/m^3 (for 8% Hypo Sludge) and 14.61KN/m^3 (for 8% Lime).

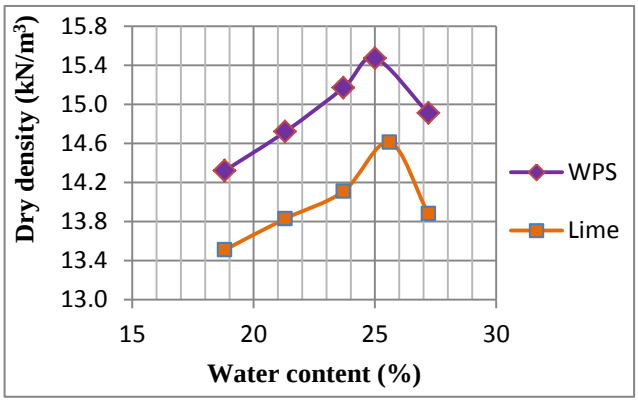

Figure 7: Comparison of 8% Hypo Sludge & 8% Lime

e). Comparison of 10 % Hypo Sludge & 10 % Lime: From Fig. 7, the maximum dry density of soil is observed 14.97KN/m^3 (for 8% Hypo Sludge) and 13.98KN/m^3 (for 8% Lime).

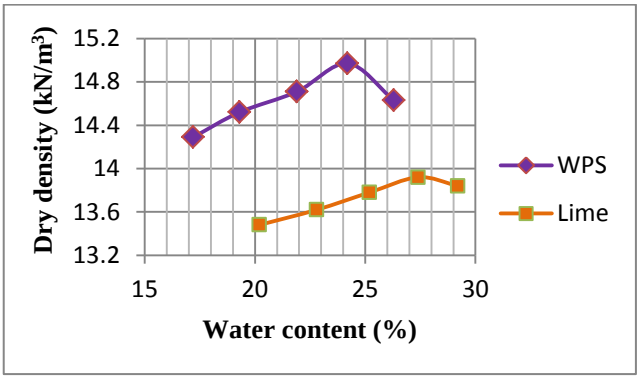

Figure 8: Comparison of 10 % Hypo Sludge & 10 % Lime

TABLE-2: COMPARISION OF PROCTOR TEST

S. No.	Mixed Used	Standard Proctor Test			
		Hypo Sludge		Lime	
		OMC (%)	MDD (KN/m^3)	OMC (%)	MDD (KN/m^3)
1.	Soil+ 2 % Hypo Sludge	18.2	16.71	18.0	16.21
2.	Soil+ 4 % Hypo Sludge	20.3	16.30	19.2	15.51
3.	Soil+ 6 % Hypo Sludge	23.2	15.91	23.8	15.21
4.	Soil+ 8 % Hypo Sludge	25.0	15.47	25.6	14.61
5.	Soil+ 10 % Hypo Sludge	24.2	14.97	27.7	13.98

C. Unconfined Compressive Strength Test

It is the load per unit area at which an unconfined cylindrical specimen of soil will fail in the axial compression test. The unconfined compressive tests were conducted on soil added with different percentages of Hypo Sludge and Lime. The stress–strain behaviour recorded during the unconfined compressive tests for soil with different percentage of Hypo Sludge and Lime. The unconfined compression strength value summarized in Table-3 and 4 for 0, 7 and 14 days cured sample.

TABLE-3: VALUE OF UCS FOR for WPS

S. No.	Unconfined Compressive Strength Test			
	Mixed Used	UCS (KN/m^2) for WPS		
		0 days	7 days	14 days
1.	Soil + 2 % Hypo Sludge	251	316	444
2.	Soil + 4 % Hypo Sludge	272	331	480
3.	Soil + 6 % Hypo Sludge	288	363	507
4.	Soil + 8 % Hypo Sludge	281	354	496
5.	Soil + 10 %Hypo Sludge	261	321	432

TABLE-4: VALUE OF UCS FOR LIME

S. No.	Unconfined Compressive Strength Test			
	Mixed Used	UCS (KN/m^2) for Lime		
		0 days	7 days	14 days
1.	Soil + 2 % Hypo Sludge	257	333	453
2.	Soil + 4 % Hypo Sludge	279	353	489
3.	Soil + 6 % Hypo Sludge	297	386	531
4.	Soil + 8 % Hypo Sludge	301	401	547
5.	Soil + 10 % Hypo Sludge	281	389	513

IV. CONCLUSION

- Maximum dry density followed a decreasing trend with increasing the percentage of Hypo Sludge or Lime.
- Optimum moisture content increased with increasing the percentage of Hypo Sludge or Lime up to optimum mixed.
- Compressive strength of soil is maximum i.e. 507KN/m^2 for 6% Hypo Sludge mixed to the soil.
- And 8% Lime produced higher strength to the soil i.e. 547KN/m^2.

V. REFERENCES

[1] J. Pitroda, L. B. Zala and F. S. Umrigar, "Hypo Sludge Management: Opotunities for Developing Low Cost Concrete with Glass Fibers", International Global Research Analysis, Dec 2012 Volume – 1, Issue – 7, ISSN: 2277 - 8160.

[2] L. Mari, R. Salome and O. Cesar, "Paper Mill Sludge as Fiber Additive for Ashphalt Road Pavement", Philippine Journal of Science – 2009. 138 (1): 29 – 36, ISSN: 0031 - 7683.

[3] P. Kaur and G. Singh, "Soil Improvement With Lime", ISSN: 2278-1648, Volume – 1, Issue 1 (May-June 2012), PP 51 – 53.

[4] S. Kawade, M. Mapari and S. Sharanappa, "Stabilization of Black Cotton Soil with Lime and Geo-grid," International Journal of Innovative Research in Advanced Engineering (IJIRAE), Volume 1, Issue 5 (June 2014).

[5] S. Kumar and S. M. Jawaid, "Paper Mill Sludge Utilization in Ground Improvement", IJBSTR Research Paper, Volume-1, Issue 8, ISSN: 2320 – 6020.

[6] S. Kawade, M. Mapari and S. Sharanappa, "Stabilization of Black Cotton Soil with Lime and Geo-grid," International Journal of Innovative Research in Advanced Engineering (IJIRAE) Volume 1 Issue 5 (June 2014).

[7] U.S. Department of Transportation, Federal Highway Administration, "User Guidelines for Waste and By-product Materials in Pavement Construction, Coal Fly Ash",Publication Number: FHWA-RD-97-148.