

Study on Strength Characteristics of Hypo Sludge Stabilized Lithomarge Soil

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Abstract

In this study we used Hypo sludge as additive for soil stabilization of Lithomargic soil. Hypo sludge is an industrial waste collected from paper mill. Hypo sludge which is waste collected from paper industries acts like a clayey material possess short fibre, ink, and other chemical impurities. Lithomargic soil is very problematic soil for engineering activity. Its strength is high in dry condition and reduction occurs with excess moisture content. The present study experimentally investigates the effect of hypo sludge on index properties, compaction and strength characteristics of Lithomargic soil. In this present study, experimentally determining the effect of hypo sludge on CBR and unconfined compressive strength characteristics at different percentages such as 2%, 4%, 6%, 8% and different curing period such as 7th day, 14th day, 21st day and 28th day. It is found that 2% Hypo sludge treated with Lithomargic soil shows significant increase of UCS value for period of 7 days of curing. The addition of Hypo sludge results in increase in CBR value for both soaked and unsoaked condition compared to untreated control sample.

Keywords: CBR, Hypo sludge, Lithomargic soil, Soil stabilization, UCS.

Introduction

Soil stabilization is a procedure in which the engineering properties of the soil are altered and enhanced to increase its suitability for construction purposes. Soil stabilization improves the physical and chemical properties of soil. It enhances the strength and durability of soil. They are different methods used. The first is dewatering, the second is compaction and the third is by mixing additives to the soil. The last method is the most effective of all the methods, In terms of the ease of application, the time consumption and also reduces the cost. Additives like fly ash, wood ash, glass powder, lime, Hypo sludge can be used. Additives are used to increase the strength and stability of soil. Since the costs of stabilisers are increasing in recent times there is need of

finding new stabilising agents. In the present study an attempt is made to improve the Geotechnical properties of Lithomargic soil by addition of Hypo sludge, it is industrial waste which is obtained from paper mill.

Lithomargic soil is locally known as Shedi soil, which is found in shallow depth usually under the lateritic soil. It is usually found on western and eastern coasts of India. It is very sensitive to water and loses a greater part of its strength when saturated. When it is mixed with different admixture for stabilising the soil properties can be absorbed.

Hypo sludge produced in a large amount as by product of paper industry. It is a by-product obtained by deinking and re pulping of paper and its disposal is in the form of land spreading. Hypo sludge mainly contains low calcium and maximum calcium chloride and minimum amount of silica. Lime sludge behaves like cement because of silica and magnesium properties. It is a major economic and environmental problem for the paper and board industry. The laboratory investigations have been carried out on Lithomargic soil by using 2%, 4%, 6% and 8% of Hypo sludge.

Materials and Properties

Lithomargic soil: Soil is collected from Vidyanagar which is 2 Km from Surathkal, Dakshina Kannada (District), Karnataka (India).



Figure 1: Lithomargic soil

Table 1: Physical Properties of lithomargic soil

Grain size distribution (%) (IS-2720-PART-4-1985)	
Gravel size fraction	37.85
Sand size fraction	59.7
Silt and clay	2.45
Specific gravity (IS-2720-PART-3-1980)	2.4
Consistency limits (%)	
Liquid limit (IS-2720-PART-5-1985)	55
Plastic limit (IS-2720-PART-5-1985)	20
Plasticity index	35
Compaction test (Standard Proctor Test) (IS-2720-PART-7-1980)	
OMC (%)	20.5
MDD(g/cc)	1.66
Shear test (UCS test) (IS-2720-PART-10-1991) (kN/m ²)	116.28

Table 3: Chemical properties of hypo sludge

Chemical composition (IS 1760-1991)	
Silicon Dioxide (SiO ₂)	5.88%
Calcium Oxide (CaO)	47.51%
Magnesium Oxide (MgO)	2.99%
Sulphur Trioxide	<0.05%
Aluminium Oxide (Al ₂ O ₃)	0.53%
Ferric Oxide (Fe ₂ O ₃)	0.67%
Loss on Ignition	42.05%
Specific gravity	2.8

Results and Discussion

Standard Proctor Test

In the present study, compaction characteristics were determined using the standard proctor apparatus by compacting soil in 3 layers with 25 blows by using rammer per layer. Figure 3 shows compaction curves obtained for Lithomargic soil without Hypo sludge. From this compaction curve OMC obtained was 20.5% with maximum dry density (MDD) 1.66 g/cc.

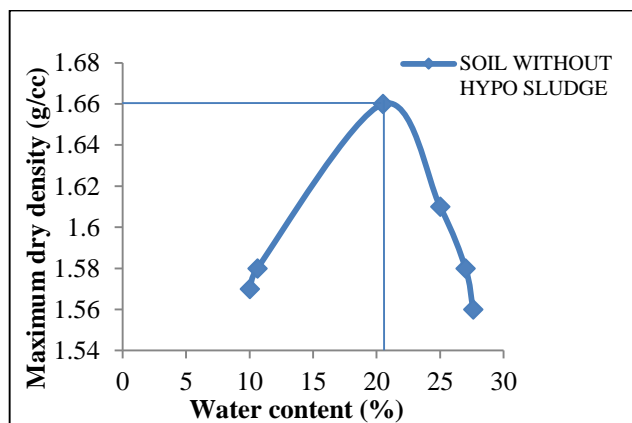


Figure 3: Compaction curve for lithomargic soil without hypo sludge

Hypo sludge

Hypo sludge is collected from Mysuru paper mill industry.



Figure 2: Hypo sludge

Properties of Hypo sludge

Table 2: Physical properties of hypo sludge

Color	White
Form	Amorphous
Grain size	90 Micron

Compaction characteristics were studied by adding 4 different dosages of Hypo sludge which is designated as 2%, 4%, 6% and 8%. The graph is plotted for values obtained water content (%) vs. dry density (g/cc).

Table 4: MDD and OMC for different dosages

DOSAGES (%HYPOSLUDGE)	MDD(g/cc)	OMC (%)
Soil + 0% Hypo sludge	1.66	20.5
Soil + 2% Hypo sludge	1.62	24.09
Soil + 4% Hypo sludge	1.65	21.19
Soil + 6% Hypo sludge	1.69	21.91
Soil + 8% Hypo sludge	1.62	22.54

Compaction curve of different dosages of Hypo sludge indicated that 6% dosage of Hypo sludge shown maximum increase in MDD and reduction in OMC is observed when compared to other dosages.

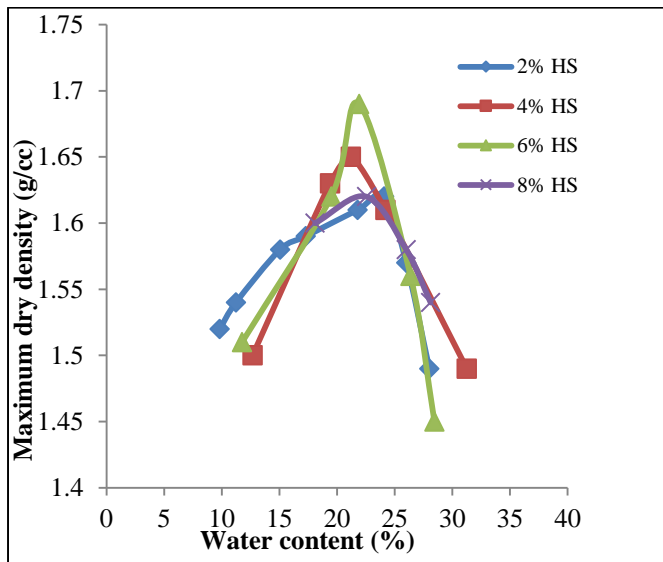


Figure 4: Compaction curves for different hypo sludge dosages for lithomargic soil

Unconfined Compressive Strength Test

Soil passing through IS 425 μ sieve is used. Considering optimum dosage obtained from compaction results, the soil specimens were prepared with or without Hypo sludge for different dosages such as 0%, 2%, 4%, 6% and 8%. The soil specimens were kept in air tight covers and placed in desiccators for a curing period of 0, 7, 14, 21 and 28 days. The peak value of stress was obtained from these stress-strain curves which are designated as Unconfined Compressive strength (UCC).

Table 5: UCS of lithomargic soil at different dosages and different curing period

DOSAGES	q (kN/m ²)	q (kN/m ²)	q (kN/m ²)	q (kN/m ²)	q (kN/m ²)
	0 day	7 days	14 days	21 days	28 days
0%	116.28	-	-	-	-
2%	137.7	149.47	122.05	112.07	98.31
4%	134.69	96.46	94.47	85.18	72.3
6%	131.54	76.62	92.95	94.72	61.21
8%	98.97	70.25	86.44	69.27	71.04

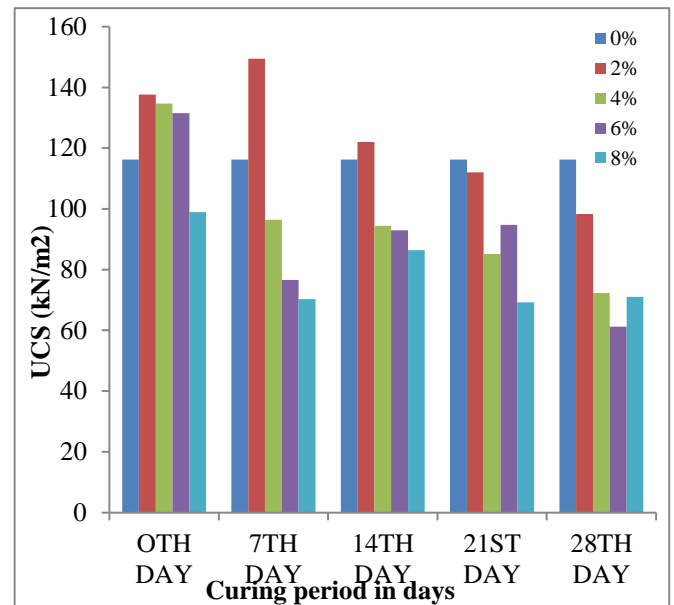


Figure 5: Variation of UCS at different hypo sludge dosages for lithomargic soil

It can be seen that the strength at 7 days was maximum for 2% dosage of hypo sludge. However, it is observed that as the dosage and curing period increases further, the UCS strength goes on decreasing.

California Bearing Ratio Test

The CBR is a method of measuring shearing resistance of the soil under controlled moisture. Test is conducted for two conditions such soaked and unsoaked condition. The soil sample is soaked for minimum 4 days for soaked condition.

Table 6: CBR values of Lithomargic soil at different dosages and different condition

	Soaked (%)	Unsoaked (%)
Soil without Hypo sludge	4.81	2.89
Soil+2% Hypo sludge	7.803	3.468

The Lithomargic soil stabilized with 2% of Hypo sludge was found to be increased in CBR value for about 1.2 times compared to untreated sample for unsoaked condition and 2.7 times for soaked condition.

Conclusion

On the basis of present experimental investigation of Hypo sludge stabilized lithomargic soil, the following conclusions are drawn.

- The hypo sludge dosage has significant effect of improving strength of Hypo sludge stabilized Lithomargic soil.
- The studies on compaction characteristics using different levels of Hypo sludge dosage has indicated that 6% dosage of Hypo sludge shown maximum increase in MDD and reduction in OMC.
- Further increment of Hypo sludge beyond 6% results in decrease in MDD and increase in OMC.
- Maximum increase in UCS strength was found to at 7 days of curing for 2% dosage of Hypo sludge.
- The lithomargic soil stabilized with 2% of Hypo sludge increases CBR value for about 1.2 times compared to untreated sample for soaked condition and 2.7 times for unsoaked condition.

References

- [1] K.Mahendran and N.P.Vignesh, "Utilization of Hypo Sludge for the Stabilization of Red Soils along with Cement and Molasses" Indian Journal of Science and Technology, Volume 9(2) January, 2016.
- [2] Ankit kumar and S.S.Gupta, "Soil Stabilization of Hypo Sludge and Lime" IJSRSET, Volume.02, Issue 5, 2016
- [3] P.Kaur and G.Singh, "Soil Improvement With Lime", Volume-1, Issue 1 (May-June 2012), 51-53
- [4] Mrs.M.Usha, "Soil stabilization for pavement using lime and Hypo Sludge", IJARTET Volume-3, Issue 2, March 2016.
- [5] S.Kumar and S.M.Jawaid, "Paper Mill Sludge Utilization in Ground Improvement", IJBSTR Research Paper, Volume-1, Issue 8, and ISSN: 2320-6020.
- [6] Relevant parts of IS: 2720, Indian Standards codes for testing soil.