International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 6, September-October 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Characterization of Red Mud as a Construction Materials Using with Natural Soil

Sourabh Gupta[1], Dr. Anil Kumar Saxena[2]

[1]PG Student, [2]Associate Professor,
[1,2]Department of Civil Engineering Lakshmi Narain College of Technology, Bhopal, Madhya Pradesh, India

ABSTRACT

Soil is very important in civil engineering constructions. The poor engineering properties of the local soils may present many difficulties for construction and therefore need to improve their engineering properties. Stabilization techniques can be used to improve the properties of soil. Soil stabilization improves various engineering properties e.g. bearing capacity, compressibility, strength, and various other properties of soil. In this study the impact of Red Mud to improve the strength of soil.

The soil was stabilized with Red Mud in stepped concentration of 5%, 10%, 15%, 20%, 25% and 30% by dry weight of the soil individually. All stabilized soil samples were also cured for 96 hours for CBR test in fully saturated condition. The test results indicate that the addition of Red Mud enhances the percentage of grain size distribution, but with addition of Red Mud till 20% the LL, PL,PI and decreases, while these parameters further increases in this limit beyond

i.e. 20% to 30% of Red Mud, but in the case of The optimal percentage of Red Mud at which maximum CBR is achieved is selected, Specific gravity value of Natural Soil is 2.57, but as of Red Mud is increases, specific gravity value decreases gradually from 2.57 to 2.44 with increase in percentage of Red Mud from 0 to 30% and value of raw soil is achieved as 1.85 gm/cc at OMC of 13.65%. It got increased to 1.93 gm/cc at OMC of 12.30 % when Red Mud is increased from 0 to 20% is effective beyond also there is decreasing in MDD from 1.93 gm/cc at OMC of 12.30% to 1.89 gm/cc at OMC of 13.20% when Red Mud is increased from 20 to 30%. The CBR value increases with the addition of Red Mud till 20%, while it decreases beyond the limit 20% to 30% with addition of Red Mud. For both soaked and unsoaked condition.

KEYWORDS: *Red Mud, OMC, MDD, Un-Soaked CBR, Soaked CBR, Stepped concentration*

How to cite this paper: Sourabh Gupta | Dr. Anil Kumar Saxena "Characterization of Red Mud as a Construction Materials Using with Natural Soil" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-6, October 2021, pp.49-51, URL: www.ijtsrd.com/papers/ijtsrd46355.pdf

IJTSRD46355

INTRODUCTION

Soil is the basic construction material. It supports the substructure of any structure and in case of pavement structures; sub-grade soil is an essential component as it supports the sub- base/base. However, in many situations, soils in natural state may not possess adequate geotechnical properties so as to be used as foundation layers, pavement layer or as a construction material. This may be due to the fact that the existing soil at a particular location exhibits poor bearing capacity and higher compressibility. Also, soils with significant plasticity may shrink and swell substantially with changes in moisture conditions. The repeated cycles of swelling or shrinkage of soil, further cause deteriorations and distresses on the structures if these are supported in these types of soil, This necessitates the improvement/stabilization of soil at a site as an indispensable activity, due to rising cost of the land and a huge demand for infrastructure development in developing countries like India. Soil stabilization is a technique introduced with the main purpose to modify the geotechnical properties of the soils making them capable of meeting the requirements of the specific engineering projects. The most common improvements achieved through stabilization include better soil gradation reduction of plasticity index or swelling potential and increases strength and durability. Various stabilizers such as lime, cement and calcium chloride are traditionally used for the stabilization of expansive soils However,

the over dependency on the utilization of such industrially manufactured soil stabilizing additives may significantly increase the cost of construction.

In order to make poor soils useful and meet geotechnical engineering design requirements, efforts are to be made to explore the potential of cost effective materials that are locally available from industrial (e.g. fly ash, red mud) and agricultural waste (e.g., Rice Husk ash, Sugarcane Bagasse Ash, Groundnut Shell Ash and coconut coir fibre) which exhibit cementitious value in stabilization of such soils. Incidentally, the production of large quantity of such Industrial/Agricultural wastes all over the world faces serious problems of handling and disposal. The disposal of these wastes creates a potential negative impact on the environment causing air pollution water pollution finally affecting the local ecosystems. Hence safe disposal of such wastes becomes challenging task for the engineers. Thus, use of such waste products for improving the weak soil will give dual benefits such as possible reduction in the cost of construction as well as reduction or elimination of the environmental hazards caused by such waste.

Subgrade layer is the lower most layers in the pavement structure underlying the base course or surface course, depending upon the type of pavement. Generally, subgrade consists of various locally available soil materials that sometimes might be soft and/or wet that cannot have enough strength/stiffness to support pavement loading. It has been the common observation and experience that roadbeds made up of such soils when subjected to changes in moisture content due to seasonal wetting and drying or due to any other reason undergo volumetric changes leading to pavement distortion, cracking and general unevenness. A pavement constructed either on in-situ soil or on compacted black cotton soil shows several types of damages to pavement structures, and in many instances the pavement may even become unserviceable. Due recognition of the problems of swelling and shrinkage at the design stage, is required so that counter measures could be devised and incorporated in the pavement structure. A proper design incorporating the following measures may considerably minimize the problems associated with expansive soils.

1. Realignment of the road around the deposits.
2. Excavation of clay and replacement with non-expansive backfill materials.
3. Limiting expansion of the clays by replacement of surcharges of non-expansive fills over these deposits.
4. Precluding variations in moisture content of clays so that the soil does not undergo any alternate cycles of expansion and contraction.
5. Treatment of clays with red mud which reacts with the clay minerals to produce stable compounds which are not affected by moisture content changes and

A sound knowledge of performance of the subgrade soil under prevailing in-situ condition is necessary prior to the construction of the pavement. The better the strength/stiffness quality of the materials the better would be the long-term performance of the pavement. Hence, the design of pavement should be focused on the efficient and effective use of existing subgrade materials by stabilizing it with some stabilizing agents to optimize their performance. The present entire practice of major road construction over deep layer of black cotton soil subgrade appears to be conservative lacking technical and financial optimization. It is

A. Chemical and Mineral Compositions of Red Mud

Chemical analysis shows that red mud contains silicium, aluminium, iron, calcium, titanium, sodium as well as an array of minor elements namely K, Cr, V, Ba, Cu, Mn, Pb, Zn, P, F, S, As, and etc. The variation in chemical composition between red mud worldwide is high. Typical composition of red mud is given in Table 1.1

Table 1.1 Typical composition of red mud

S. no.	Composition	Percentage
1	Fe2O3	30-60%
2	Al2O3	10-20%
3	SiO2	3-50%
4	Na2 O	2-10%
5	CaO	2-8%
6	TiO2	trace-25%

Methodology

Table 1.2 - Grain Size Analysis of Natural Soil

Sieve No.	Mass of sieve	Mass of Sieve + soil	Mass of soil Retained	Cumulative mass of soil	Cumulative % of soil	% of finer (Passing)
(1).	(2)(gm)	(3) (gm)	(2)-(3)=(4)	(5) (gm)	(6).	100 - (6)
10.00 mm	418	520	102	102	10.20	89.80
4.250 mm	450	565	115	217	21.70	78.30
2.000 mm	375	460	85	302	30.20	69.80
0.850 mm	354	526	172	474	47.40	52.60
0.425 mm	358	638	280	754	75.40	24.60
0.150 mm	336	552	216	970	97.00	3.00
0.075 mm	350	362	12	982	98.20	1.80
Pan	272	290	18	1000	100.00	0.00

Conclusions

The conclusions drawn from these studies are as follows:-

1. The consistency indices value of the Natural soil reduces with mixing of Red Mud.
2. Initially the LL, PL and PI values of raw soil are 37.00 %, 26.40 % and 10.60
3. % respectively which on mixing Red Mud in ranges from 5 % to 30 % gradually decreasing in liquid limit from **37 to 24%,** Plastic Limit from **26.60% to 17.80%** and Plasticity Index from **10.60% to 6.20%** when Red Mud is increased from 0 to 20% is effective beyond also there is a increase in liquid limit from **24% to 32%,** Plastic Limit from **17.80 to 21.20%** and Plasticity Index from **6.20 to 10.80%** when Red Mud is increased from 20 to 30%
4. Specific gravity value of Natural Soil is **2.57**, but as percentage of Red Mud is increases, specific gravity value decreases gradually from **2.57 to 2.44** with increase in percentage of Red Mud from 0 to 30%.
5. In Compaction Test, the MDD value of raw soil is achieved as **1.85 gm/cc** at OMC of **13.65%**. It got increased to **1.93 gm/cc** at OMC of **12.30 %** when Red Mud is increased from 0 to 20% is effective beyond also there is decreasing in MDD from **1.93**

REFERENCES

[1] Gowtham and V. Janani (2017).”Study on Red Mud on The Expansive Soil International Journal of Civil Engineering and Technology”, 8(5), 2017, pp. 378– 385.

[2] Arora K. R, “Soil mechanics and Foundation Engineering”. Indian Road Congress (IRC-37-2012).

[3] Basta, N. Ribeiro, D. V., Labrincha, J. An., and Morelli, M. R. (2011). Potential utilization of common red mud as pozzolan for Portland bond. Materials Research, 14(1), 60– 66.

[4] Defeat S., Sahoo T. what's more, Das S.K. (2012). “Utility of Red Mud as an Embankment Material”. Bury National Journal of Earth Sciences and Engineering. ISSN0974-5904, Volume 05,No.06, 1645-1651.

[5] Desai, M. V. G., Herkel, R. N., (2010). “Red Mud Bricks – An elective Low Cost Building Material”. sixth International Congress on Environmental Geotechnics, New Delhi, India.

[6] IS: 2720 (Part III)

[7] IS: 2720 (Part V)

[8] IS: 2720 (Part VII)

[9] IS: 2720 (Part XL)

[10] IS: 2720 (Part XVI)

[11] Kalkan (November 2006).” Utilization of red mud as an adjustment material for the planning of mud liners” 87(3):220-229.

[12] Kar B, Kar S, and Satpathy BK (2019).” Red mud: a potential binder for fabrication of fly ash based pervious concrete”. In: Proceedings of 7th international conference and exhibition on aluminium, Bhubaneswar.

[13] Khan, J., Amritphale, S. S., Chandra, N., and Patel, M. (2012).” A novel folio free and energyefficient process for making fired tiles utilizing red mud and sericitic pyrophyllite”. Indian Journal of Chemical Technology, 19(6), 420