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SUITABILITY OF RED MUD AS A SUBGRADE MATERIAL WITH COMBINATION OF RICE HUSK AND SUGARCANE BAGASSE

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ABSTRACT

Suitability of red mud as a subgrade material with the different combination of industrial waste materials" is a majormotivation of this project is to reduce the storage consumption of vast land. Red mud disposal cost isvery expensive hence safe disposal of red mud isalso economically problematic. The disposal of red mud is a burden for the government as well as aluminum producing company. The land occupied by red mud cannot be used for either constructionsor farming. Thus, this project is deployed to reuse that waste by adding different industrial waste material for various purpose. The industrial wastes are used as basic raw materials to prepare subgrade filling materials.

Keywords: Redmud, Soil Stability, Liquid Limit, Plastic Limit, Plasticity Index, Unconfined Compressive Strength.

I. INTRODUCTION

The hazardous waste known as red mud is produced during the Bayer process of producing alumina from bauxite ore. It is composed of many minor elements, silica, aluminum, iron, calcium, and titanium, as well as a high concentration of residual alkalinity and poisonous heavy metals. Its red color is caused by iron oxides, one of the several oxide compounds that make up its composition. Approximately 1 to 1.5 tons of red mud are created for every ton of alumina produced globally, which is manufactured via the Bayer process, which accounts for over 95% of global alumina production. .Due to this high level of production and the materials high alkalinity .Theyoccupy a vast area of land which does not supportany kind of vegetation because of their hostile nature vegetation growth .Because of the huge volume of The primary negative outcome of these global processes is the creation of enormous amounts of industrial wastes and the issues with proper management and disposal of those wastes. The lack of available land, materials, and resources for ongoing construction projects, including infrastructure, is the second issue. Solid and metallic oxides make up the majority of red mud's chemical makeup. Iron oxides, which can make up to 60% of the bulk, are what give the object its red mud. The mud has a pH between10 and 13, and it is very basic. The titaniumoxide India is the second largest producer of sugarcane in the world. A plentiful byproduct of the sugar and ethanol industries is sugar cane bagasse ash (SCBA). Because SCBA is typically disposed of in landfills or used as fertilizer, environmental concerns have grown. Because SCBA is abundant and has pozzolanic qualities, research on its usage as a building material has mostly concentrated on it in recent years. The fibrous byproduct left behind after sugarcane stalks are crushed to release their juice is known as bagasse. It can be used to makebiomass energy, paper and board, or even biofuels like ethanol. In regions where rice is farmed, one of the readily available materials is rice husk ash (RHA). Around the world, rice is grown in more than 75 nations, with China leading the pack. More than 10% of the 770 million metric tons of rice produced each year is rice husk (Hu et al., 2020). The red mud being generated as a byproduct from the alumina industry it makes them nearly difficult to theDue to its odd location unfavorable climate, and abundance of rice, rice husk has an abnormally high ash level of 20%. RHA is used as a base material to strengthen and prolong the life of concrete by reducing tiny pores and assisting in the breakdown of the geo polymer matrix's cellular structure. RHA has a lower induction period value than several other mineral admixtures. The silica ($SiO2$) content of RHA is high, at around.

II. METHODOLOGY

Tests were carried out for understanding the effect of adding Rice Husk and Sugarcane bagasse on Red mud properties. Initially the Red mud, Rice Husk and Sugarcane Bagasse are tested for their individual characteristics and geotechnical properties. After that the tests were carried out on red mud mixed with Rice Husk and Sugarcane Bagasse. Five combinations of samples by varying the Rice Husk and Sugarcane Bagasse percentage (0%, 2%, 4%, 6% and 8%) were used. The index property tests conducted were Specific Gravity Test and Atterberg's Limits. In engineering properties, Standard Proctor Test, UCS and CBR tests were conducted. Few samples tested in the laboratory are

1. Grain size distribution
2. Specific gravity
3. Liquid limit
4. Plastic limit
5. Plasticity Index
6. Standard Proctor
7. Unconfined Compressive Strength
9. California Bearing Ratio

III. MATERIALS USED

RED MUD

Red mud was collected from Hindalco industrieslimited Belgaum. Red mud waste is used in theconstruction of sub base with the stabilizers like ricehusk and sugar bagges used to impact the strengthin the red mud.

Figure 1: Red mud sample.

RICE HUSK

Rice husk collected from TSR Traders, Hesaragatta main road Bangalore Rice husks ash is a potential material which can be utilized for the improvement of subgrade and rice husk ash contains amorphous silica. This material causes environment threat, whenthis material dumped it causes damage to the land and surrounding area.

Figure 2: Rice husk sample.

SUGARCANE BAGASSE

The sugarcane bagasse are made from reusable sugarcane fibers, which not only a natural source for the material but is also biodegradable. Sugarcane has a lower specific gravity compared to that of the soil. The increase in OMC with increase in sugarcane bagasse implies that more water content is needed in order to compact the soil.

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Figure 3: Sugarcane bagasse sample.

IV. RESULTS AND DISCUSSION

The experiment was performed from both pycnometer method. The specific gravity of different combinations is tabulated in Table 1. From the result, it is clear that with increase in the Rice husk and sugarcane bagasse, the specific gravity decreases however there is no appreciable change found in the specific gravity value.

Table 1. Specific gravity and Atterberg's limits of red mud, Rice husk and Sugarcane bagasse.

Mix Combinations	Specific Gravity	LL	PL	PI
Red Mud + 0% rice husk + 0% Sugarcane bagasse	3.07	49	39	10
Red Mud + 2% rice husk + 2% Sugarcane bagasse	3.02	47	39	8
Red Mud + 4% rice husk + 4% Sugarcane bagasse	2.98	46	39	7
Red Mud + 6% rice husk + 6% Sugarcane bagasse	2.95	48	40	8
Red Mud + 8% rice husk + 8% Sugarcane bagasse	2.91	49	40	9

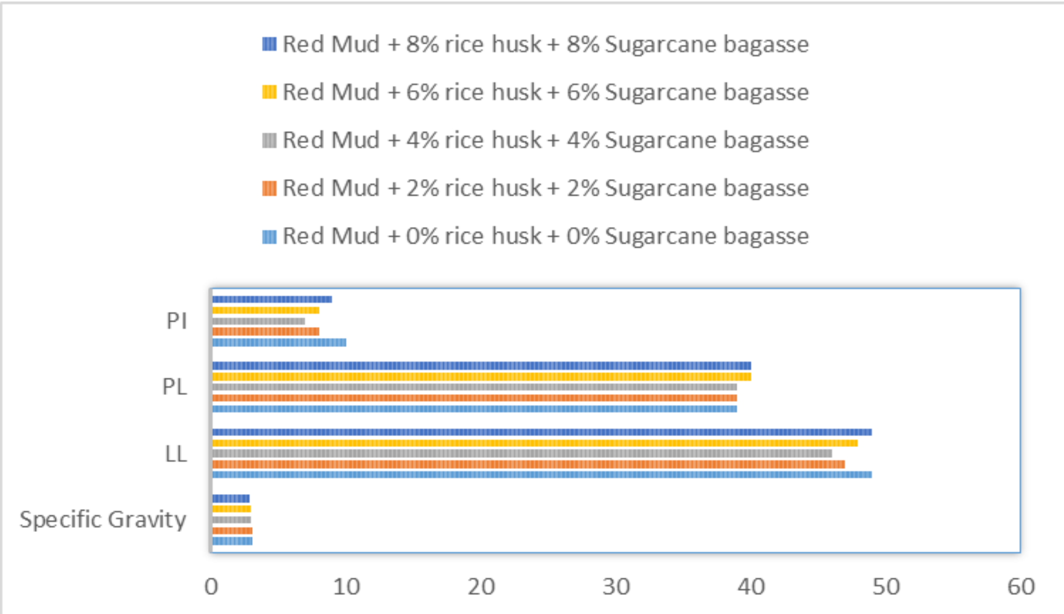

Figure 4: Specific gravity and Atterberg's limits of red mud, Rice husk and Sugarcane bagasse.

Table 1 shows Atterberg's limits for different combinations of red mud, Rice husk and sugarcane bagasse. From the table, it is observed that with increase in the Rice husk and sugarcane bagasse, liquid limit is decreasing up to 4% addition Rice husk and sugarcane bagasse and after that liquid limit is increasing but the plastic limit increases with increase in Rice husk and sugarcane bagasse content. The plasticity index decreases, up to addition of 4% of Rice husk and sugarcane bagasse and after that it increases slightly. It shows that 4% Rice husk and sugarcane bagasse will provide better result and after that there won't be any improvement.

Table 2. OMC, MDD, UCS and CBR values of red mud, Rice husk and Sugarcane bagasse.

Mix Combinations	OMC (%)	MDD (gm/cc)	UCS (Kg/cm2)	Soaked CBR (%)
Red Mud + 0% rice husk + 0% Sugarcane bagasse	32	1.72	2.72	4.5
Red Mud + 2% rice husk + 2% Sugarcane bagasse	29	1.70	3.70	10.5
Red Mud + 4% rice husk + 4% Sugarcane bagasse	27	1.59	4.08	17.2
Red Mud + 6% rice husk + 6% Sugarcane bagasse	28	1.57	4.40	23.5
Red Mud + 8% rice husk + 8% Sugarcane bagasse	31	1.52	4.72	28.9

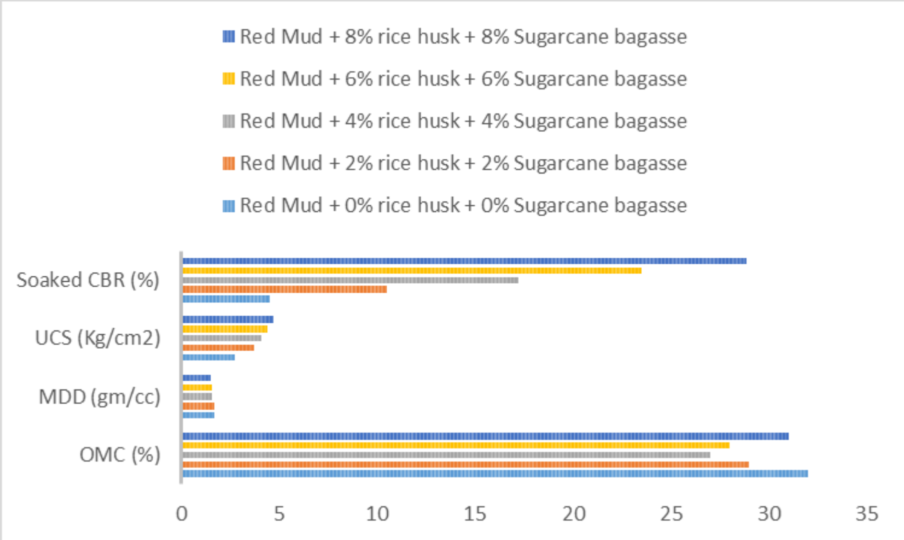

Figure 5: OMC, MDD, UCS and CBR values of red mud, Rice husk and Sugarcane bagasse.

Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) obtained from standard proctor test are presented in Table 2. It was found that as the Rice husk and Sugarcane bagasse content is increased the dry density at OMC decreases. The unstabilized red mud is having dry density 1.72 gm/cc at optimum moisture content of 32%, it decreases to 1.59 gm/cc at 27% OMC with 4% of Rice husk and Sugarcane bagasse. At 6% and 8% of Rice husk and Sugarcane bagasse content there is further decrease in MDD values. There is no appreciable change in OMC values with higher doses of stabilizer.

The samples of sizes 38 mm diameter and height of 76 mm were prepared by static compaction method to achieve maximum dry density at their optimum moisture contents. Unconfined compressive strength tests were conducted at a strain rate of 1.25 mm/min. The results obtained are tabulated in Table 2. The obtained value of unconfined compression strength (UCS) for raw red mud is 2.72 kg/cm2 for 3 days curing. By adding 2% Rice husk and Sugarcane bagasse, the UCS strength increased to 3.70 kg/cm^2. For 4% of Rice husk and Sugarcane bagasse, the strength increased to 4.08 kg/cm^2. Maximum strength value is obtained at addition of 8% Rice husk and Sugarcane bagasse to red mud. The UCS test is conducted for 3 days curing of sample. Further increase in the curing period, may cause increase because the material Rice husk and Sugarcane bagasse takes time for attaining strength.

This test was conducted as per IS: 2720 (Part XXXI). It is common tendency while reading the CBR value we give more importance to the soaked condition. The sample was kept for soaking for 4 days with surcharge. The test results are shown in the Table 2. Here it is found that the CBR value increases continuously with increasing the Rice husk and Sugarcane bagasse.

V. CONCLUSION

Based on the experimental results obtained it can be concluded that the red mud, a hazardous waste, can be successfully stabilized with Rice husk and Sugarcane bagasse and the stabilized red mud can be used as subgrade material in pavement construction. The specific gravity of raw red mud is 3.07. By stabilization, there is a slight decrease in specific gravity which is obvious because of low specific gravity value of Rice husk and

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Sugarcane bagasse. The liquid limit of raw red mud is 47, which by stabilizing it with Rice husk and Sugarcane bagasse up to 4%, decreases to 46. The plastic limit value of raw red mud increases with addition of Rice husk and Sugarcane bagasse. Due to the decreasing LL value and increasing PL value, the plasticity index decreases up to 4% addition. It shows the effectiveness of the stabilizer. The standard proctor test shows that the MDD value decreases continuously with addition of Rice husk and Sugarcane bagasse. The OMC first decreases up to addition of 4% of Rice husk and Sugarcane bagasse and beyond that OMC is increasing. The UCS test results after 3 days curing shows that the strength increases by addition of Rice husk and Sugarcane bagasse. By increasing the period of curing further increase in strength may be possible. The CBR test results show that the bearing capacity of soil increases with increase in stabilizer content.

VI. REFERENCES

[1] Farah Chantit, et., al "Investigation on the reuse of the sugar co-products (Bagasse, Molasses, and Ash) as industrial wastes in the production of Compressed earth blocks", Elsevier- Materials today, Volume 58, Part 4, 2022, pp. 1530-1534.

[2] Thomas Mathew," Utilization of sugarcane bagasse ash and red mud in the manufacture", "International Journal of Advanced Research Trends in Engineering and Technology", Vol. 4, Special Issue 22, December 2017, pp. 6-10.

[3] Deelwalk, Dharavath k and Kulshreshtra M,"Utilization of sugarcane bagasse ash and red mud in the manufacture of compressed earth blocks.

[4] Rameez Ahmad Manto,"A study on use of red mud as a subgrade in road construction", "International Journal of Engineering Research & Technology", Vol. 10 Issue 07, July-2021, pp. 34-36.