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STABILIZATION OF FLYASH WITH RED MUD & CEMENT

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ABSTRACT

Red mud is an industrial waste material which is obtained from the refining of bauxite into the form of Aluminium oxide called alumina. In the present study for the use of Red mud with Fly Ash in geotechnical application with various percentages of cement were added. Tests like compaction, grain size distribution analysis, unconfined compressive strength, permeability were conducted to study the interaction of Fly Ash , Red mud and cement particles. Unconfined compressive strength were determined for the curing periods 3, 7, 28days with various combinations of Fly Ash and Red Mud mixed with various percentages of cement (0, 2, 4, 6, 8, and 10). From the test results it is identified that as the percentage of cement increases compression strength increases and maximum values attained at 28 days curing periods. Hence Flyash- Red mud- cement stabilized material can be used in the Geo technical applications like Embankments and Liners..

Keywords*: Red Mud, Fly Ash, cement, Unconfined compressive strength, Embankments.*

I. INTRODUCTION

Disposal of residual waste is increasing day by day because of the manufacturing industries. Red mud is one of the bi-products obtained during refining process of Bauxite (ore of Aluminium Al2O3). The PH value of the RedMud is greater than 11 due to because of large amount of caustic soda presenting in it and because of that the disposal is problematic and it is hazardous to environment. In order to overcome this problem it has to be reused in various fields like agricultural, gas treatments and civil engineering such as Bricks preparation, Road pavements, Embankments and for Landfill liners

Being one of the basic elements for setting up strong and healthy infrastructure, Cement plays a crucial role in economic development of any country. Having more than a hundred and fifty years history, it has been used extensively in construction of anything, from a small building to multipurpose project. Cement is the glue that holds the concrete together, and is therefore critical for meeting society's needs of housing and basic infrastructure such as bridges, roads, water treatment facilities, schools and hospitals.

During the production of electricity a fine, glass powder is obtained by the burning of coal is FlyAsh. At present about 35%-40% Flyash is utilized in ash dyke construction, land filling and in other construction industries is very much in contrast with 80% or more Flyash used in developed countries for the manufacture of bricks, cellular concrete blocks, road construction, landfill application, ceramics, agriculture, insulating bricks, recovery of metals and dam constructions etc. Highway engineers are utilizing bulk quantities of Flyash into embankment and road construction. Flyash settles very negligible amount during construction period and not afterwards. Its lesser density is suitable for high embankments. Lime stabilized Flyash gains cementation properties due to formation of silicates and aluminate hydrates at the time of Puzzolanic reaction. Due to cementation properties, lime stabilized Flyash gain in strength which is the better alternative for stable sub-grade or sub-base.

Manoj Bhaskar et al.,(2014) observed that when clay is replaced with RedMud the water absorption is less. **Sawante et al., (2013)** observed that when they add RedMud to the concrete initial setting time decreased so it can be used as accelerator. **DRET (Department of resources, Energy and Tourism)** in Australia carried out a research on reuse of Red mud. This is used in various applications. Some buildings have constructed there by using stabilized Red mud bricks. These bricks are used in construction of low cost structures.

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II. MATERIAL

Red mud
In the present study Redmud was collected from NALCO (National Aluminium Company) which is located at Damanjodi in Orissa. The Geotechnical properties of Red mud are provided in table 1.

Flyash
In the present study FlyAsh was collected from NTPC (National Thermal Power Corporation Limited) which is located in paravada Vishakhapatnam. The Geotechnical properties of FlyAsh are provided in table 2.

Cement
Cement used in this work is OPC (53-grade) cement. The manufactures of the cement used is Jaypee. OPC means Ordinary Portland Cement. The physical properties of cement are provided in table 3

Table: 1 The Geotechnical properties of Redmud

Name of Property	*Value*
Appearance	Mud
Colour	Red
Odour	Slightly pungent
Specific Gravity	2.9
Liquid Limit (%)	32
Plastic Limit (%)	24
Plasticity Index	08
Grain Size Distribution	
a. Fine sand (%)	05
b. Silt (%)	89
c. clay(%)	06
OMC (%)	22
MDD (g/cc)	1.78
UCS(Kg/cm^2)	1.49
CBR	4.00
Permeability (cm/s)	$4.3x10^{-6}$

TABLE: 2 GEOTECHNICAL PROPERTIES OF FLYASH

Name of Property	*Values*

Sand (%)	28
Silts (%)	72
Liquid Limit (%)	28
Plastic Limit (%)	NP
Specific Gravity	2.10
OMC (%)	210
MDD (g/cc)	1.28
Angle of Shearing Resistance (deg)	34
CBR (Soaked condition (%)	4.00
Compression Index	0.16

Table: 3 physical properties of cement

Name of property	***Values***
Standard consistency (%)	32
Weight per bag (kg)	50
Initial setting time (min)	128
Final setting time (min)	279
Specific gravity	3.12
Fineness (%)	2.50
Percentage of passage (%)	97.5

III. TESTS AND RESULTS

Compaction Characteristics For Fly Ash + Red Mud + Cement:

To study the compactness of Red mud-Fly Ash-cement mixes IS heavy compaction (Modified proctors) test was performed on various percentages of Red mud and Fly Ash at various percentages of cement such as 0,2,4,6,8,10 respectively as per IS 2720. OMC and MDD values were obtained at various percentages of cement and the results are obtained on the table.

Table: 4 Compaction Characteristics For Fly Ash (90%) + Red Mud(10%) + Cement(%):

Cement(%)	***OMC (%)***	***MDD(g/cc)***
0	21.2	1.3
2	21.5	1.32
4	21.8	1.35
6	22.2	1.38
8	22.6	1.42
10	23	1.44

Table: 5 Compaction Characteristics Table For Fly Ash (80%) + Red Mud (20%) + Cement (%):

Cement(%)	***OMC (%)***	***MDD(g/cc)***
0	21.4	1.33
2	21.6	1.36
4	21.7	1.39
6	22.3	1.42
8	22.6	1.45
10	22.6	1.47

Table: 6 Compaction Characteristics For Fly Ash (70%) + Red Mud (30%) + Cement (%):

Cement(%)	***OMC (%)***	***MDD(g/cc)***

0	21.6	1.36
2	21.8	1.39
4	22.1	1.42
6	22.4	1.46
8	22.6	1.50
10	22.9	1.52

Table: 7 Compaction Characteristics for Fly Ash (60%) + Red Mud (40%) + Cement (%):

Cement(%)	*OMC (%)*	*MDD(g/cc)*
0	21.8	1.4
2	22.1	1.43
4	22.4	1.46
6	22.7	1.49
8	22.9	1.51
10	23.1	1.53

From the test results as the percentage of cement increases with increase in the percentage of RedMud and decrease in the FlyAsh percentage the OMC and MDD values also increased.

Unconfined Compressive Strength Values For Fly Ash- Red Mud- Cement Mixes:

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. All the prepared samples were cured for 3 days, 7 days and 28 days by maintaining 100% humidity. Unconfined compressive strength tests were conducted after completion of their curing periods at a strain rate of 1.25 mm/min as per IS 2720 (part -10)-1991and the results are shown in table.

Table: 8 UCC values for Fly Ash (90%) + Red Mud (10%) + Cement (%)

Cement (%)	*UCC (Kg/cm^2)*		
	3 days	*7 days*	*28 days*
0	1.9	2.2	2.5
2	4.6	8.4	12.2
4	6.9	14.6	18.8
6	9.8	17.6	24.2
8	11.4	20.7	30.8
10	14.5	24.2	35.8

Table: 9 UCC values for Fly Ash (80%) + Red Mud (20%) + Cement (%)

Cement (%)	*UCC(kg/cm^2)*		
	3 days	*7 days*	*28 days*
0	2.3	2.8	3.4
2	5.4	10.2	14.8
4	8.2	16.2	20.7
6	11.4	19.4	26.3
8	13.6	22.9	32.7
10	15.8	26.1	38.4

Table: 10 UCC values for Fly Ash (70%) + Red Mud (30%) + Cement (%)

Cement (%)	*UCC(Kg/cm^2)*		
	3 days	*7 days*	*28 days*

0	2.6	3.2	3.7
2	6.8	12.4	16.7
4	9.6	18	23.2
6	13	21.6	29.6
8	15.8	24.8	35.8
10	18.4	28.6	41.5

Table: 11 UCC values for Fly Ash (60%) + Red Mud (40%) + Cement (%)

Cement (%)	***UCC/(Kg/cm2)***		
	3 days	***7 days***	***28 days***
0	2.8	3.5	4
2	8.2	14.8	18.5
4	11	20.4	26.9
6	14.8	24.2	33.7
8	17.6	27.6	39.4
10	20.2	31.5	44.6

From the test results as the percentage of cement increases with increase in the percentage of red mud the compressive strength values increases for the curing periods and maximum values were occur for 28 days curing period.

IV. CONCLUSIONS

- Addition of cement to Red mud and Fly Ash increases OMC values and MDD values.
- Early days compressive strengths like 3 days and 7 days are1.9Kg/cm2-20.2Kg/cm2 and 2.2Kg/cm2-31.5Kg/cm2 and their compressive strengths at 28 days are 2.5Kg/cm2-44.6 respectively with different combination of Fly Ash and Red Mud with different percentages of cement. These values are low at lower dosages (2%) and high at 6-10% dosages.
- Fly Ash, Red mud and Cement mixes have obtained high strength values are in the range of the structure of Red mud into thereby increasing the strength of the mixture.
- Gaining of high strength values of Fly Ash-Red mud- cement mixes can be used in various geo technical applications like embankments and liners etc.

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