

# PREPARATION AND CHARACTERIZATION OF FLYASH BED MADE BY USING GGBS AS ADMIXTURE

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**Abstract:-** Talking about production in India, about 184.14 metric tons was produced only in 2014-15. And in this number, the amount that was used was only about 102.59 metric tons which accounts of about 61 percent of the year 2015-2016, where the generated flyash accounted 176.74 metric tons. In this, only about 107.77 metric tons or about 60.97 percent was used. We can see that the flyash is getting increasingly produced and used but almost 40 percent of the substance comes put as waste. This unused flyash will either go down as a landfill and will cause ecological issues. Based on the landfills, a few heavy metals like boron, mercury and cadmium with finest particles of this substance get fileted into ground water and lead to contamination of ground water. Even air pollution is caused due to he flyash that emerges as a waste. This study tries to make effective and efficient use of flyash that can be used as geo-engineering material. Products utilized in this study were flyash of F-class and emerged out Adhunik Metalics Limited in Sundergarh. Properties relating geo-techniques such as UCS strength, specific gravity, MDD, and OMC were found out for the flyash. To augment flyash features, it was amalgamated with a slag and lime in distinct proportions. A quantity of line was added to flyash in different percentages such as 0 percentage, 5 percentage, 10 percentage, 15 percentage and 20 percentage. Also, quantities of amalgamations of slag, flyash and lime were mixed for the test. The process that too place was light compaction test and this brought forward MDD and OMC in distinct proportions of flyash mixed with GGBS and lime. The samples were then cured by keeping the average temperature at 28 degrees C and the models were wax-sealed with curing period varying between 0 days, 7, 14 days and 28 while the determination of UCS takes place. While the samples were tested using a hydrometer, flyash was found to be graded consistently while the particles size was found to lie somewhere between silt and fine sand. At high OMC, the determined MDD was less. When the flyash was treated with slag and lime, MDD was enhanced and reduction of OMC took place. For virgin flyash, the value of UCS was too low but after getting lime treatment it enhanced quickly but in a bit. For flyash solution treated with lime, UCS was augmented while the curing period increased as well. The value of UCS for flyash solution treated with slag was quite less when quick testing was done and while the enhancement in periods of curing took place, the value of UCS enhanced quite a bit. Flyash strength due to treatment with slag and lime tend to be the most when it was cured for about 28 days.

**Keywords:-** GGBS, Slag, Fly ash, Lime, specific gravity, Moisture Content Unconfined Compression System

## 1. INTRODUCTION

Fly ash emerged due to the combustion of coal and is a kind of waste material which has features quite similar to ash emerging from volcanoes. While coal burs in thermal power plants, the highest temperature can be recorded at 2800 degrees F. In the environment, the materials that are not combustible while emerging from burning or coal are fly ash & bottom ash. Fly ash emerged with the help of flue gasses and contained. Against this, the lighter bottom as is collected from boiler's floor. Power plants produce a very fine powder known as fly ash that emerges out due to burning or coal. You may also call it pulverized fuel ash. The size of its particles can be anywhere between silt and fine sand. Apart from ferrous oxide and alumina, the major element that forms this is silica. The activity of pozzolanic that entails the  $\text{Ca}(\text{OH})_2$  reaction with major elements of fly ash sample. While  $\text{Al}_2\text{O}_3$  and  $\text{SiO}_2$  are a part of the fly ash, this includes  $\text{Ca}(\text{OH})_2$  to give out CAH and CSH. Different pozzolanic reactions taking place with  $\text{Ca}(\text{OH})_2$  &  $\text{SiO}_2$  while the reaction between  $\text{Al}_2\text{O}_3$  &  $\text{Ca}(\text{OH})_2$  was also taken into account.

## 2. MATERIALS AND METHODS

### Materials

- **Fly ash:-**This study saw the use of fly ash of class F. As already stated, it emerged out of Adhunik Metaliks Limited in Sundergarh. Prior to its use, the sample was tested through the 2mm IS sieve to keep away the vegetative materials and foreign samples. The received sample was garnered and mixed well and placed in the oven for a period of a day at temperature ranging between 105 degrees and 110 degrees. The sample was then placed in an airtight jar for future uses.

- **Lime:-**The lime employed in this test was a commercial product that was carried out of Rourkela market and ensured to have cleared 150 $\mu$  sieve test. Then it was maintained in some container that was airtight for future uses.
- **Slag:-**The granulated blast in a ground form of furnace slag emerged out of Shiva Cement Rourkela. Following this, it was trampled, dried in an oven, cleared a 300 $\mu$  sieve test and preserved in a container for future needs.

### Methodology

If fly ash underwent some compaction, it could increase in strength a bit but when it turns saturated, it would at once lose all its strength. Therefore, proper stability methods are needed in order to employ this fly ash as a material for construction. This project will see fly ash being stabilized with the help of lime as the major material. But while it takes some extra cost for lime, we can use GGBS as a stability agent. However, we need to activate GGBS as well and this needed some lime addition. So this study deals in making the fly ash a stable material with an increment in chemical and physical properties to employ it like a geo-engineering product by addition of GGBS and lime in regular composition. Distinct mixtures of slag, fly ash and lime underwent some light compaction test in order to find strength of product with different mixing and the curing period was also different. This chapter sees quite some detail of used materials, preparation of the sample and procedure for testing.

Initially the physical properties as well as chemical properties are to be determine of the material that were used in the present research work i.e. fly ash. Afterword's engineering properties was determine in which moisture content along with dry density was determined by the help of standard proctor test and various combination were studied in different ratio.

Furthermore unconfined compressive strength was determined for this maximum dry density was calculated on fly ash by finding optimum moisture content by standard proctor test. The cylindrical sample was prepared with height of 76mm and dia of 38mm. axial strain were also performed for 1.25 mm per minute. To determine the efficacy of curing, these specimen were preserved for 0, 7 days, 14 and 28 days according to the curing period. For every combo of GGBS, fly ash and lime with distinct periods of curing, 3 similar test specimens were taken into account and their average value was determined.

### 3. RESULTS

#### UCS (MPa) at 0% slag.

Lime %	Unconfined compressive strength in MPa			
	Immediate	7 Days	14 Days	28 Days
0	0.23	0.23	0.23	0.23
2	0.64	0.65	0.71	0.79
4	1.06	2.01	2.92	3.01
8	1.07	2.99	3.02	4.63
12	1.30	3.09	3.61	5.86

UCS (MPa) at 5% slag.

Lime %	Unconfined compressive strength in MPa			
	Immediate	7 Days	14 Days	28 Days
0	0.10	0.20	0.29	0.32
2	0.74	1.42	1.68	1.72
4	0.92	1.9	2.41	2.92
8	0.98	3.08	3.10	4.91
12	1.02	3.62	5.33	5.44

UCS (MPa) at 10% slag.

Lime %	Unconfined compressive strength in MPa			
	Immediate	7 Days	14 Days	28 Days
0	0.21	0.42	0.45	0.59
2	0.35	0.91	1.80	2.97
4	0.45	1.50	3.05	3.40
8	0.58	2.02	3.19	3.81
12	0.61	3.22	3.30	4.89

UCS (MPa) at 15% slag.

Lime %	Unconfined compressive strength in MPa			
	Immediate	7 Days	14 Days	28 Days
0	0.22	0.48	0.62	0.95
2	0.80	1.31	1.89	3.11
4	0.86	2.10	3.49	3.59
8	0.90	2.22	3.69	4.07
12	1.00	3.88	4.32	5.10

UCS (MPa) at 20% slag.

Lime %	Unconfined compressive strength in MPa			
	Immediate	7 Days	14 Days	28 Days
0	0.28	0.62	1.20	1.40
2	0.89	3.00	3.59	3.70
4	0.92	3.27	4.60	5.31
8	0.95	5.41	6.90	7.31
12	1.18	5.80	8.00	8.45

#### 4. CONCLUSIONS

- Talking about gradation analysis, we found that flyash that passed out of 75 $\mu$  was about 86 percent and the size of the particles varied between silt size and fine sand. The curvature coefficient and uniformity coefficient were determined and their value was 1.26 & 5.66 that indicated that the materials were well-graded according to the range of the size.
- Standard Proctor test was employed to establish the MDD and OMC values with energy taken as 595kJ per m<sup>3</sup>. The value of OMC for flyash was 10kN per m<sup>3</sup> and the value of MDD was found to be 42.12 percent. It truly states that the virgin flyash contains less MDD with more OMC value.
- Flyash was adulterated with 0 per-cent, 2 per-cent, 4 per-cent, 8 per-cent, and 12 per-cent lime content and the highest value of MDD turned out to be 11.68kN per M<sup>3</sup> while the OMC of the products varied from 34.12 per-cent with 12 per-cent of lime. The above results found the conclusion that adding lime in the solution can lessen the value of OMC while the value of MDD was enhanced.
- Flyash was added to 0 per-cent, 5 per-cent, 10 per-cent, 15 per-cent and 20 per-cent slag where the most value of MDD turned out to be 11.66kN per m<sup>3</sup> while the OMC being 34.16 percent at about 20 percent of slag. The value of MDD increased while that of OMC lessened.
- A mix of lime and slag using even the flyash was prepared and the value of MDD and OMC were established for each comb. It was found that mix with 20 per-cent of slag and 12 per-cent of lime in association with flyash contains the most MDD at 12.12 kN per m<sup>3</sup> and the least OMC at 32.23 per-cent. It can be concluded that adding slag and lime in flyash enhances the MDD value while it lessens the OMC.
- UCS was performed by taking a sample size that was 76mm high and a dia of 38mm, which was compressed to adjacent MDD and OMC that were established with the use of light compaction test. The value of UCS in virgin flyash was about 0.34MPa.

#### References

- Al-Rawas, Amer Ali, et al. "A coMParative evaluation of various additives used in the stabilization of expansive soils." (2002): 199-209.
- Hardjito, Djwantoro, et al. "Factors influencing the compressive strength of flyash-based geopolymer concrete." *civil engineering dimension* 6.2 (2004): pp-88.
- Kim, Bumjoo, Monica Prezzi, and Rodrigo Salgado. "Geotechnical properties of fly and bottom ash mixtures for use in highway embankments." *Journal of Geotechnical and Geoenvironmental Engineering* 131.7 (2005): 914-924.
- Phanikumar, B. R., and Radhey S. Sharma. "Volume change behavior of flyash-stabilized clays." *Journal of materials in Civil Engineering* 19.1 (2007): 67-74.
- Reddy, BV Venkatarama, and K. Gourav. "Strength of lime-flyash coMPacts using different curing techniques and gypsum additive." *Materials and structures* 44.10 (2011): 1793-1808.
- Chithiraputhiran, Sundara Raman. *Kinetics of Alkaline Activation of Slag and Flyash-Slag Systems*. Arizona State University, 2012.
- Rajesh, D. V. S. P., et al. "Performance of alkali activated slag with various alkali activators." *International Journal of Innovative Research in Science, Engineering and Technology* 2 (2013): 378-386.
- Saride, Sireesh, Anand J. Puppala, and Srujan R. Chikyala. "Swell-shrink and strength behaviors of lime and cement stabilized expansive organic clays." *Applied Clay Science* 85 (2013): 39-45.
- Pani, Aparupa. *Effect of Curing Temperature on the Strength of Lime Stabilized Flyash*. Diss. NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA, 2014.
- Singh, S. P., and A. Sharan. "Strength characteristics of coMPacted pond ash." *Geomechanics and Geoengineering* 9.1 (2014): 9-17.