Bala Sai Kumar Reddy, 2021, 9:4
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

Index and Engineering Properties of Lime Activated Flyash with GGBS as an Admixture

Bala Sai Kumar Reddy, Asst. Prof. P. Hanuma
Civil Engineering
Sri Sunflower College of Engineering & Technology, Challapali

Abstract- An exceptionally fine side-effect created through coal ignition measure at nuclear energy stations is known as fly ash and a piece of debris tumbles down at the lower part of the kettle is known as base debris. Out of the complete creation of waste fly ash produced is around 80% though base debris created is 20% (by weight of all out produced squander). In India, the absolute creation of fly ash was 184.14MT in the time of 2014-2015. Out of which absolute use of fly ash was 102.59MT or 60.94% and in the extended period of 2015-16, the creation of fly ash was 176.74MT. Out of which complete usage of fly ash was 107.77MT or 60.97%. Here it very well may be seen that the creation and use both are expanding yet there is as yet 40% of fly ash that delivering as a waste. The fly ash that stayed unused will stored as landfills and brings ecological issues. From these landfills, a portion of the substantial metals like mercury, cadmium and boron and the extremely fine particles of fly ash filter to groundwater and cause the ground water tainting. And furthermore unused fly ash is the significant reason for air contamination. To improve the properties of the fly ash, it was In the current review, an attempt has been made for successful use of fly ash as a geo designing material. Material that has been utilized in the review was class-F fly ash and raised from Adhunik Metaliks Limited, Sundergarh. The geotechnical properties like explicit gravity, OMC, MDD, and UCS strength has been assessed, of this virgin fly ash. blended with lime and slag at various extent. Lime was blended in with fly ash at 0%, 2%, 4%, 8% and 12% while slag was blended at 0%, 5%, 10%, 15%, and 20%. Various blends of fly ash, lime, and slag have been made for testing. The light compaction test has been done to decide the OMC and MDD of various blends of fly ash-GGBS-lime. In all out 25 quantities of compaction test has been led to discover the OMC and MDD of the above blends. Further UCS test has been finished with various blends of fly ash-GGBS-lime compacted to their particular MDD at OMC. These examples were relieved under a normal temperature of 28°C with tests fixed in wax for restoring times of 0, 7, 14 and 28 days and the UCS not really settled In the hydrometer examination, it was tracked down that the flyash particles are consistently evaluated and the size of the particles lies between fine sand to sediment size. Still up in the air was low at higher OMC. After treatment of fly ash with lime and slag, the OMC diminished and MDD expanded. Not really settled for virgin fly ash was extremely less and when treated with lime, it expanded promptly hardly. UCS for the lime treated fly ash tests were expanded with expansion in restoring period. UCS for the slag-treated fly ash tests was exceptionally low when tried quickly and with expanding relieving periods the UCS esteems expanded dependent upon some degree. The strength of fly ash treated with lime and slag was observed to be most elevated when relieved for 28 days of restoring period.

Keywords: Fly ash, GGBS, UCS .

I. INTRODUCTION

Fly ash is generated from coal combustion process as a by-product and it is a material having properties nearly same as in volcanic ash. When coal is burning at thermal power plants the temperature reaches to 2800F.

In this temperature, the non- combustible minerals that are formed due to combustion of coal are bottom ash and fly ash. The fly ash is carried out with flue gasses and collected whereas the bottom ash is light in weight and falls bottom at the boiler. In India, the production of fly ash was around 176.74MT in the year of 2015-16. And the utilization was 107.77MT or 60.97%.

The rest of waste is dumped into the ground which will cause the environmental issues either in the form of polluting the air or contaminating the ground water.

II. PROPERTIES OF FLY ASH

Fly is a fine product produced from coal combustion at power plants. It is also known as pulverized fuel ash. Its particle size generally ranges from fine sand to silt size. Silica is the main constituent followed by alumina and ferrous oxide. The pozzolanic activity of fly ash is described as the reaction of Ca(OH)2 with the main components of fly ash.

When SiO2 and Al2O3 present in fly ash, coming contact with the Ca(OH)2 then it forms CSH and CAH. The main pozzolanic reaction will take place between Ca(OH)2 and SiO2, but reaction between Al2O3 and Ca(OH)2 will also be considerable.

III. CLASSIFICATION OF FLY ASH

In the thermal power plant when the coal is burnt, the non-combustible mineral from the coal is collected from the combustion air stream, which is called fly ash. Pozzolan is defined as the material which contains minerals like siliceous or siliceous and aluminous material, which shows little or no cementing properties.

But when it comes in contact with calcium hydroxide at normal temperature then they form the compounds that possess cementing properties. Generally, the fly ash is classified into two types: lass-C fly ash and class-F fly ash. The most of the fly ash formed from the combustion of coal process is class-F flash. It mostly contains silica, alumina, and iron greater than 70% and a very less amount of lime mostly under 15%.

As class-F fly ash contains a lesser amount of lime, so to possess the pozzolanic activity additional amount of lime is required class-C fly ash naturally contains a higher amount of lime usually more than 30%. So it naturally shows pozzolanic activity without any requirement of an additional amount of lime.

IV.EXPERIMENTAL PROGRAM

When fly ash gone through the compaction than it gain some strength but when it became saturated than it will lose its strength immediately. So a proper stabilization technique is must to use for using fly ash as a construction material. In the current project, fly ash is stabilizing with lime as the main constituent. But as the lime is an expensive material GGBS is using as a stabilizer.

But to activate GGBS, the addition of lime was required. So in the study, an attempt has been made to stabilize the fly ash and enhance its physical and chemical properties to use it as a geo engineering material by adding lime and GGBS in proper proportion.

The different mixes of fly ash, lime, and slag were gone through light compaction test to check the OMC and MDD and UCS has been done to check the strength of different mixes at different curing period. In this chapter, a detail on the material used, sample preparation and testing procedure has been given.

V. MATERIALS USED

- Fly ash
- Lime
- Slag

1. Determination of Index Properties:

- Determination of Specific Gravity
- Determination of Grain Size Distribution

2. Determination of Engineering Properties:

- Moisture Content Dry Density Relationship

- Determination of Unconfined Compressive Strength

VI. RESULTS AND DISCUSSION

- Specific Gravity
- Grain Size Distribution
- Compaction Characteristics

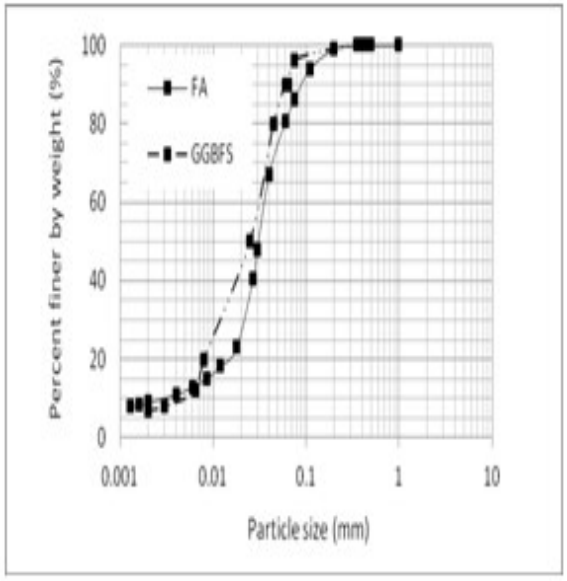

Fig 1. Grain size distribution curve of class-F fly ash.

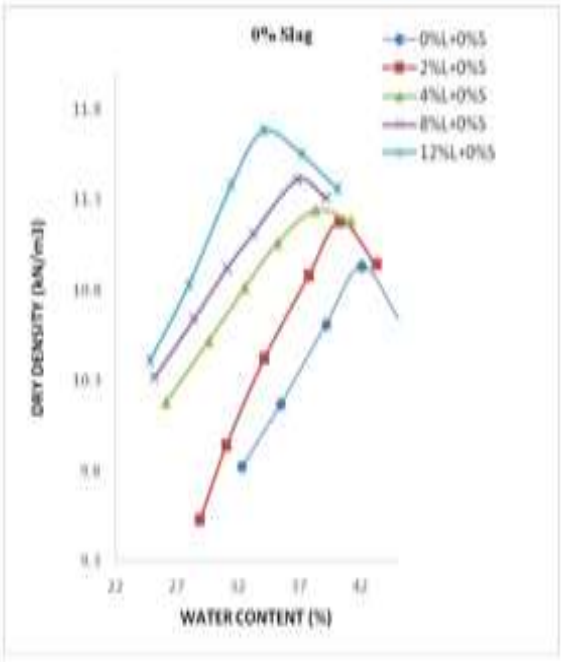

Fig 2. Compaction characteristic of fly ash at 0% slag and 0%, 2%, 4%, 8% and 12% lime content.

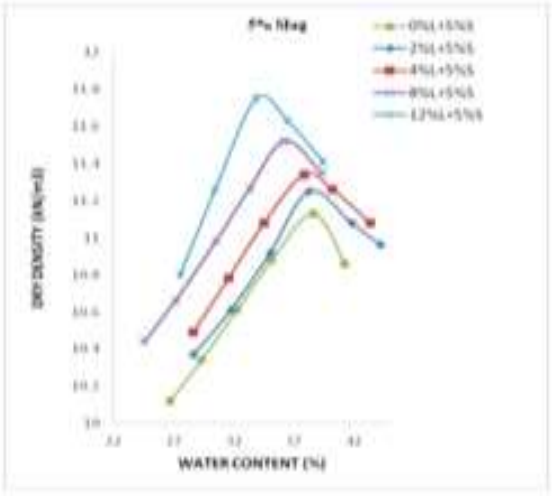

Fig 3. Compaction characteristic of flyash at 5% slag and 0%, 2%, 4%, 8% and 12% lime content.

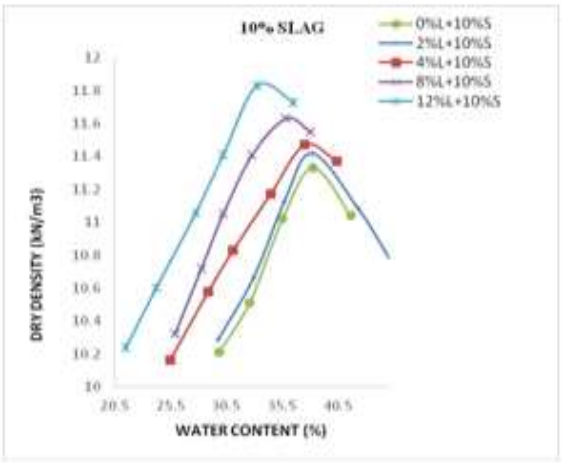

Fig 4. Compaction characteristic of flyash at 10% slag and 0%, 2%, 4%, 8% and 12% lime content.

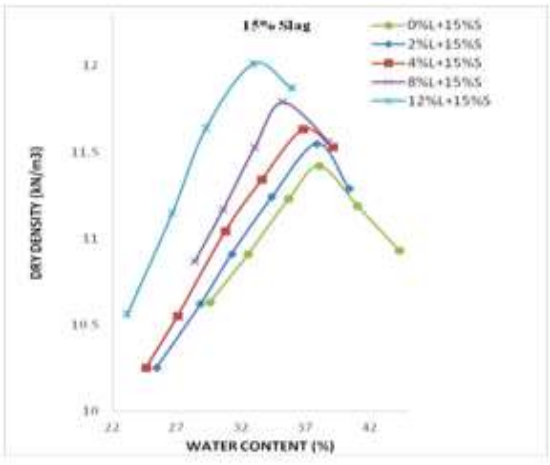

Fig 5.Compaction characteristic of flyash at 15% slag and 0%, 2%, 4%, 8% and content.12% lime.

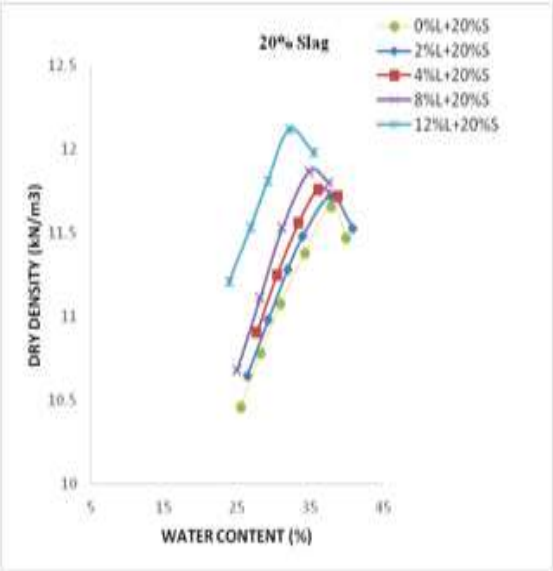

Fig 6. Compaction characteristic of slag and flyash at 20% 0%, 2%, 4%, 8% and 12% lime content.

VII. CONCLUSIONS

In the gradation analysis, it was found that the fly ash passing through 75μ was 86%. And the particles were mostly in between fine sand to silt size. The coefficient of curvature and coefficient of uniformity were found to be 1.26 and 5.66 respectively indicating a well-graded material within its size range.

The standard Proctor test was used to determine OMC and MDD at an energy of 595KJ/m3. The OMC and MDD for virgin flyash were found to be 10.93kN/m3 and 42.12% respectively. It can be stated that a virgin flyash possess a low MDD at higher OMC.

The flyash was mixed with 0%, 2%, 4%, 8% and 12% of lime and the highest MDD was found to be 11.68kN/m3 with an OMC of 34.12% at 12% lime. From the above results, it can be stated that the addition of lime results in a decrease of OMC value whereas MDD value increased.

A combination of slag and lime with fly ash has been made and OMC and MDD were determined for each combination. The mixture with 20% slag and 12% lime with flyash possess highest MDD 12.12kN/m3 at lowest OMC of 32.23%. So it can be stated that with the addition of lime and slag MDD increases whereas OMC decreases.

UCS has been done with sample size 76mm in height and 38mm in diameter, compacted to corresponding OMC and MDD determined by light Compaction test. The UCS for virgin fly ash was found to be 0.24Mpa UCS value for fly ash treated with lime at 0%, 2%, 4%, 8% and 12% was determined and it was found that the maximum UCS value was 1.22MPa at 12% lime.

The effect of curing period has also been studied and the samples were cured to 0, 7, 14 and 28 days of curing period. The maximum UCS value was found to be 5.75MPa at 12% lime and 28 days of curing period.

UCS value for fly ash treated with slag at 0%, 5%, 10%, 15% and 20% was determined and it was found that the maximum UCS value was 0.25MPa at 20% slag determined immediately.

The samples were cured for 7, 14 and 28 days of curing period. The maximum UCS value was found to be 1.39MPa at 20% slag and 28 days of curing period that indicates a substantial increase in UCS value of virgin fly ash with the addition of slag alone.

According to "GUIDELINES FOR DESIGN OF FLEXIBLE PAVEMENTS" by IRC: 37-2012, UCS for sub-base should be 1.5 to 3MPa and for base course UCS should be 4.5 to 7MPa. The result obtained by the current project was found to be more than the requirements. So in future, it can be used as a sub-base or base course of pavement.

REFERENCES

[1] Al-Rawas, Amer Ali, et al. "A coMParative evaluation of various additives used in the stabilization of expansive soils." (2002): 199-209.

[2] Hardjito, Djwantoro, et al. "Factors influencing the compressive strength of flyash- based geopolymer concrete." civil engineering dimension 6.2 (2004): pp-88.

[3] 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.

[4] 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.

[5] 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.

[6] Chithiraputhiran, Sundara Raman. Kinetics of Alkaline Activation of Slag and Flyash-Slag Systems. Arizona State University, 2012.

[7] 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.

[8] 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.

[9] Pani, Aparupa. Effect of Curing Temperature on the Strength of Lime Stabilized Flyash. Diss. National Institute of Technology, Rourkela, 2014.

[10] Singh, S. P., and A. Sharan. "Strength characteristics of compacted pond ash." Geomechanics and Geoengineering 9.1 (2014): 9-17.

[11] Singh, S. P., Swaraj Chowdhury, and Partha Narayan Mishra. "An Experimental Investigation on Strength Characteristics of Alkali Activated Flyash." Procedia Earth and Planetary Science 11 (2015): 402-409.

[12] Hussain, Rounak. "A Study on Properties of Bottom Ash-Ggbs Geopolymer Concrete For Paver Blocks."

[13] Phanikumar, B. R., and Ravideep Singla. "Swell-consolidation characteristics of fibre-reinforced expansive soils." Soils and Foundations 56.1 (2016): 138-143.