International Journal For Technological Research In Engineering
Volume 4, Issue 12, August-2017 *ISSN (Online): 2347 - 4718*

EXPERIMENTAL STUDY ON PERFORMANCE COMPARING OF FERRO CEMENT AND GEOPOLYMER OF STEEL MESH

D. Bhagya Bharathi[1], Ch. Vinodh Kumar[2], K. Bhanuji Rao[3], G. Himala kumari[4]
[1]P.G.Student , Department of Civil Engineering, GITAS,JNTU Kakinada, A.P, India.
[2]Assistant Professor, Department of Civil Engineering, GITAS,JNTU Kakinada, A.P, India.
[3,4]Assistant Professor, Department of Civil Engineering, SSCE, JNTU Kakinada, A.P, India.

Abstract: ***Cement is most important component in construction field. Cement has various uses and provides strength to the construction. But recently cement has become most expensive component of concrete and also releases CO2 in atmosphere. Emission of CO2 is a serious factor for the environment which increases the global temperature and leads to climatic change. The reason for climatic changes is not only global warming but also global dimming due to the pollution in the atmosphere. This effect is due to the decreasing in the content of sunlight reached to the surface of earth. From this aspect, the global warming become a serious issue and need to reduce the effect. The carbon dioxide emitted from cement causes global warming. Apart from the environmental friendly nature, Ordinary Portland cement binder offers early strength and resistance against sulphate and acid attacks. Researchers developed amorphous to 3-dimensional silico-aluminate which is called as geo polymer. This is a new polymer in which cement is replaced by an activated and low calcium fly ash by alkaline solutions. So, we need to make concrete more environmental friendly with the help of other cementitious or industrial materials such as fly ash. Geo polymer is the recent development in the mortar world. Here we replace with fly ash and cement is activated by alkaline solutions which act as a binder in the concrete mixture. Various investigations are carried out to examine the compressive strength and split tensile strength of geo polymer and Ferro cement mortar and their relationship by increasing volume in percentage and specific surface of steel mesh. In the experimental work, we maintained the ratio of activated liquid to fly ash is 0.60 by mass. The values of SiO2, H2O, sodium silicate solution with Na2O and sodium hydroxide solution were maintained throughout the experiment . In this experiment we use cylinders of geo polymer mortar with dimensions of 150x300mm.These cylinders are casted and placed at 900C for the duration of 8 hours. The result shows that the effect of different volume fraction percentage of steel mesh on split tensile strength and compressive strength of geo polymer mortar and Ferro cement. Following values of percentages of sodium silicate solution with other solutions are 16.36%, 34.36%, 49.28% of Na2O, SiO2 and H2O respectively. These values must be constant throughout the experiment. In this experiment, we evaluate the compressive strength, split tensile strength, comparison of geo polymer mortar and Ferro cement.***

Key words: Concrete mix, Compressive Strength, Spilt tensile Strength .

I. INTRODUCTION

The behavior of geo polymer mortar is almost similar to the ordinary Portland cement mortar. The combination of potassium hydroxide or sodium hydroxide and potassium silicate or sodium silicate produces alkaline liquid which is used in geo polymerization. Researchers examined that when samples are immersed in 5% of hydrochloric acid and sulphuric acid solution geo polymer has low mass loss. In this experiment the result shows that the effect of different volume fraction percentage of steel mesh on split tensile strength and compressive strength of geo polymer mortar and Ferro cement. Geo-polymers are a type of inorganic polymer that can be formed at room temperature by using industrial waste or by-products as source materials to form a solid binder that looks like and performs a similar function to OPC. Geo-polymer binder can be used in applications to fully or partially replace OPC with environmental and technical benefits, including an 80 - 90% reduction in CO2 emissions and improved resistance to fire and aggressive chemicals. Geo polymer cement is made from aluminum and silicon, instead of calcium and silicon. The sources of aluminum in nature are not present as carbonates and therefore, when made active for use as cement, do not release vast quantities of CO2. The most readily available raw materials containing aluminum and silicon are fly ash and slag – these are the -materials that Zeo bond uses to create its low carbon emission binder. The main process difference between OPC and geo polymer cement is that OPC relies on a high-energy manufacturing process that imparts high potential energy to the material via calcinations. This means the activated material will react readily with a low energy material such as water. On the other hand, geo polymer cement uses very low energy materials, like fly ashes, slag and other industrial wastes and a small amount of high chemical energy materials (alkali hydroxides) to bring about reaction only at the surfaces of particles to act as glue. This approach allows the use of measured amounts of chemicals to tailor the product to specification, rather than using an amount of very high-energy material required for OPC, regardless of whether the material is used to build strength (such as the inside of particles). This approach results in a very large energy saving in the production of geo polymer cement. The properties of geo polymer cement, when used to make concrete, have been repeatedly and independently shown to be equivalent to other cements in terms of the structural qualities of the resulting concrete. Indeed, the fire resistance of has been tested to be well in excess of double that of traditional concrete. This is a highly significant

technical benefit and will drive wide scale adoption in high-rise construction in the near term, including in some government department buildings.

II. MATERIALS AND THEIR PROPERTIES

Raw materials required for the concrete use in the present work are :

- Cement
- Fine Aggregate
- Water
- Admixture
- Mortar Mix
- Reinforcing mesh
- Skeletal Steel

Cement :

S. No	Property	Test results
1	Normal consistency	28%
2	Specific gravity	3.10
3	Initial setting time	92 minutes
4	Final setting time	195 minutes

Table 2.1 Cement properties

Fine Aggregate :

S. No	Property	Value
1	Specific gravity	3.08
2	Fineness modulus	2.28
3	Bulk density: Loose Compacted	 14kN/m^3 15kN/m^3
4	Grading	Zone-II

Table 2.2 Fine aggregate properties

Sieve analysis

Sieve size	Retained	% retained	Cumulative % retained	%passed
4.75	-----	----	-----	100
2.36	6.5	0.65	0.65	99.3
1.18	80.5	8.05	8.7	91.3
600	149	14.9	23.6	76.4
300	733	73.3	96.9	3.1
150	15	1.5	98.4	1.6
Pan	16	1.6	100	0

Fineness Modulus =2.2

Table 2.3 Sieve analysis

Steel mesh:

For the experiment we use steel mesh with the measurements of diameter 0.15 cm and spacing of 1.5cm with yield strength of 40600 N/cm2 and tensile strength of 51200 N/cm2 as reinforcement.

Percentage of steel	Specific Surface area (mm^2)	Weight of required steel (gm)	Size of steel mesh (mm X mm)
0.5	1.32	209	280 X 384
1	2.68	414	280 X 765
1.5	4.05	625	280 X 1150
2	5.32	833	280 X 1530

Table 2.4 percentage of steel

III. PREPARATION OF SPECIMENS

Mixing :

The fly ash is mixed with sand which is graded by using sieve analysis in a bowl .The bowl is taken with the capacity of 6 kg. Mix the content until the homogeneous mix was obtained in the bowl by using trowel as shown in the figure above. Take a steel plate and spread the dry mix in thick layer. The prepared solution is added to the mix and thoroughly mixed. It was viscous, dark in color and cohesive. The behavior of fresh mortar is depends on the amount of water in the mixture. This homogeneous mix was checked for workability by flow table apparatus.

Casting :

Take 48 samples of cylinders are casted and the dimensions of the moulds are 150x300mm. The sample is casted in 3 layers with 0.50 %,1.0%,1.50% and 2.0% steel mesh. Another 12 samples of cylinders are casted without steel mesh. Depends on the volume fraction percentage, steel mesh is placed in cylindrical form in the mould.

Figure 3.1 Steel reinforcement

IV. TEST RESULTS

Compressive strength:

The compressive strength of a material is that value of uni-axial compressive stress reached when the material fails completely. The compressive strengths of concrete has been evaluated by testing cubes of size 15cm*15cm*15cm. The compressive strength is determined by the ratio of failure load to the cross sectional area of the specimen..

Surface of Reinforcement :

The specific surface of reinforcement is defined as the ratio of total surface areas of reinforcement and the volume of composite.

S.No	Percentage of steel	Ferro Cement Mortar	
		Average compressive strength (N/cm^2)	Average split tensile strength (N/cm^2)
1	0	2172	154
2	0.5	2342	183
3	1.0	2648	281
4	1.5	2759	309
5	2.0	2781	327

Table 4.1 Strengths for Ferro Cement Mortar

S.No	Percentage of steel	Geo polymer Mortar	
		Average compressive strength (N/cm^2)	Average split tensile strength (N/cm^2)
1	0	2459	254
2	0.5	2893	297
3	1.0	3342	473
4	1.5	3631	540
5	2.0	3912	559

Table 4.2: Strengths for Geo polymer Mortar

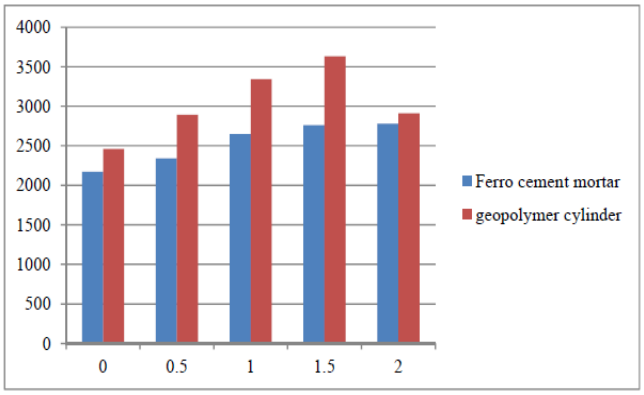

Figure 4.1: Comparison between compressive strengths

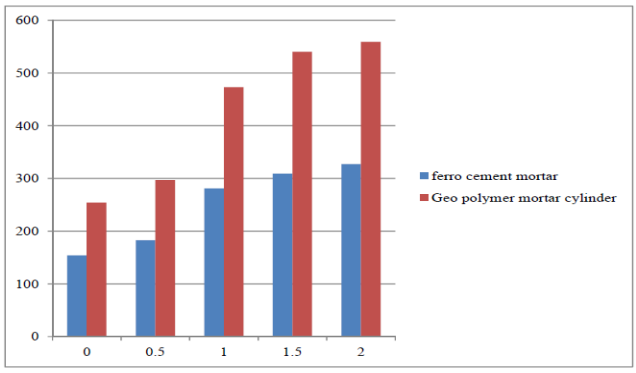

Figure 4.2: Comparison between split tensile strengths

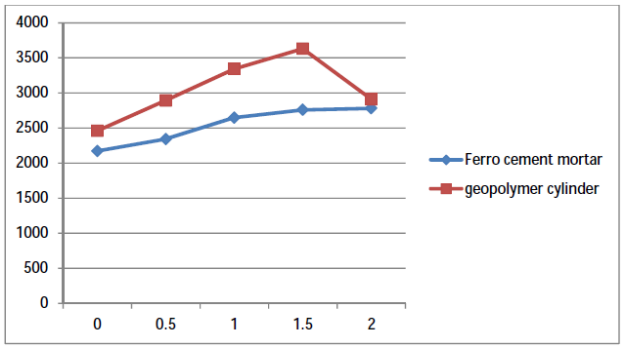

Figure 4.3: Comparison between compressive strengths

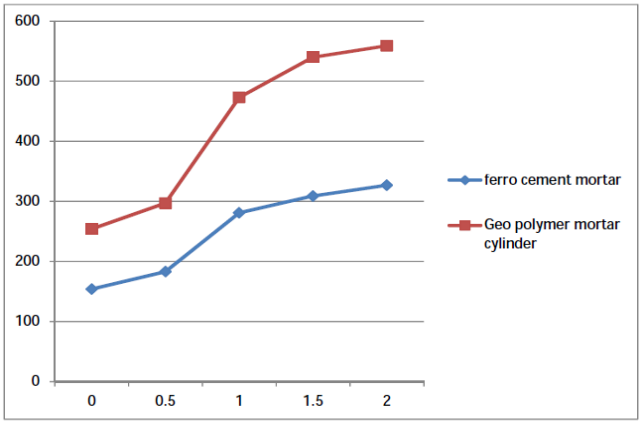

Figure 4.4: Comparison between split tensile strengths

V. CONCLUSION

From this thesis experiment, we can consider the following conclusions

With the increase of percentage of volume fraction of steel mesh, the compressive and split tensile strength increases. When we use 0.5% steel mesh, it provides more split tensile strength and compressive strength. When we double the percentage of volume fraction of mesh with same size by 100% of specimen with specific surface and there is an increase of 27% in compressive strength and 200% of increase in specific surface and there is an increase of 33%.Additional increase of 300%, corresponding tensile strength of geo polymer mortar by 42% than Ferro cement mortar.

There is an increase of split tensile strength of 27%, when we doubles the volume fraction of same size of mesh of specimen increased by 100% .Further increase of specific surface up to 200% improves compressive strength by 32%. Additionally increase by 300% i.e. using 2%, corresponding tensile strength of geo polymer mortar by 71% than Ferro cement mortar. Volume of different percentages may also influence the specific surface. Here specific surface is increased by the multiple of percentages of wire mesh. geo polymer mortar produces binder material by using industrial waste in concrete.

So it can be considered as an eco-friendly material and provides high strength more than Ferro cement mortar. There are too many environmental issues linked with the manufacturing of ordinary Portland cement and reason for some of the emission of CO2 therefore there must be a substitute for ordinary Portland cement. To make a good alternative to ordinary Portland cement, reduce the emission of carbon dioxide from geo polymer mortar.

REFERENCES

[1] Bozorgnia, Yousef; Bertero, Vitelmo E. (2005). Earthquake Engineering: From Engineering Seismology to Performance-Based Engineering.

[2] Berg, Glen V. (1984). Seismic Design Codes and Procedures.

[3] Bapat J.B., "Performance of Concrete with Blended Cement", Two days seminar on Advances in concrete technology at Bharati Vidypeeth, Pune, 16-

16 January 2004, pp. 24-30.

[4] Bertero, Anderson E & Krawinkler . Performance of steel building structures during the Northridge earthquake. Report No UCD/EERC-94/09. Berkeley, California: Earthquake Engineering Research Center, University of California at Berkeley. 1994.

[5] Christy C Freeda and Tensing D. "Greener building ", Asian journal of Civil Engineering(Building and Housing),2012, Vol. 12, No.1, pp. 88-105.Carola Edvardsen and Karsten Tollose, "Environmentally Green Concrete Structures", FIB-Symposium on Concrete and Environment in Berlin, October 2003, pp.179-193.

[6] Canadian Standard Association, 2004, "Handbook of Steel Construction," Seventh Edition, Canadian Institute of Steel Construction, Willowdale.

[7] Devidovi ts Joseph, "Geoplymeric Reaction on the Economic future of cements and concretes: World Wide Mitigation of carbon dioxide Emission" Proceedings of the Second International Conference Geopolymère 98, France, 30 June to 02 July 1999, pp111-121.

[8] Davidovits Joseph,"geopolymers: Inorganic Polymeric New materials", Journal of Thermal Analysis, 1993, Vol.36, No.1, pp

[9] Davidovits Joseph, " Chemistry Of Geopolymeric Systems, Terminology", Proceedings of the Second International Conference Geopolymer 98, France, 29 June to 03 July 1998, pp. 10-3865

[10] E. Ghobarah and V. Said. 2003. Shear strengthening of beam-column joints. Engineering Structures, Vol. 24, No. 7, pp. 880- 888.

[11] E. Ghobarah and V. Said 2001 Seismic rehabilitation of beam-column joints using FRP laminates. Journal of Earthquake Engineering, Vol. 5, No. 1, pp. 113-12

[12] Joseph Davidovits,Luigi Buzzi,Philippe Rocher, Domingo, Jimeno, Carlo Marini and sandro, Tocco, "Geopolymeric Cement Based on Low Cost Geologic Materials.Results from the European Reasearch Project Geocistem",Procedings of the second internation conference geopeolymere-99,Freance,29 June to 3 July 1998 pp 84- 97.

[13] Joseph Davidovits"Environmentally Driven Geopolymer Cement Application", Procedings of the third international conference geopeolymere 2004, Melbourne, Australia, 28-30oct2003, pp224-237

[14] Kharrazi, M.R.J., 2005, "Rational Method for Analysis and Design of Steel Plate Walls," Ph.D. Dissertation, University of British Columbia, Vancouver, Canada,

[15] Kharrazi, M.F.J., 2006, "Rational Method for Analysis and Design of Steel Plate Walls," Ph.D. Dissertation, University of British Columbia, Vancouver, Canada,

[16] Malhotra V. M. and Ramezanianpour A. A., "Fly ash in Concrete", Canada Centre for Mineral and Energy Technology (CANMET) September 1993, pp.1-254.

[17] neesit (2006-11-16). "Shaking Table Test on Conventional Wooden House (1)".

[18] Omori, R. (1901). Seismic Experiments on the Fracturing and Overturning of Columns. Publ. Earthquake Invest. Comm. In Foreign Languages, N.3, Tokyo

[19] Patankar S.U., Ghugal Y.N., Jamkar S.C., "Mix Proportioning of fly ash based Geopolymer concrete" ACI Materials Journal 17July 2015. 66

[20] Patankar S.S. and Jamkar S.G., "Effect Of Various Parameters In Activation in Fly Ash Based Geopolymer Mortar", Proceedings of International Conference on Advances in Concrete and Construction, ICAEC-2006 7-8 Feb, 2009, Hyderabad, India pp 271-278.

[21] Rangan B.K., Djwantoro Hardjito. steenie H Wallah and DodyM.G. Sumajouw,"Studies on fly-ash based Geopolymer concrete", Proceedings of the Geopolymer; Green chemistry and Sustainable Development Solutions, World Congress Geopolymer 2006,pp132-137

[22] Sure S.C., "Fly Ash based Innovative building products for construction -Part-II", CE and CR, January 2013, pp135-143.

[23] Seismology Committee (2000). Recommended Lateral Force Requirements and Commentary. Structural Engineers Association of California.

[24] Timler etl., 1999 and Agelidis and Mansell, 1982

[25] Zos in A. P., Priimak T.Y. and Avsaragov Kh.T, "Geopolymer materials Based on Magnesia-Iron Slags for Normalization and Storage of radioactive wastes " Atomic Energy, 1997, Vol 86,No. 2, pp 510-513.

