GEOPOLYMER CONCRETE USING ADMIXTURES

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Abstract

*Due to increasing environmental concerns of the cement industry alternative technologies have become an area of interest. One such thing is "GEOPOLYMER CONCRETE USING ADMIXTURE". This Project of ours is a comprehensive study conducted on geopolymer concrete using admixtures to strengthen the concrete and other properties of concrete. This fly ash reacts with NaOH and sodium silicate (Na2Sio3) to form a gel and helps in binding the fine and coarse aggregates. The attempt of our project is to find the optimum result of the different admixtures that we have used in our geopolymer concrete. The different admixtures were Super plasticizer, plasticizer, accelerator, retarder, water reducing agents, etc. The concrete cubes of 150*150*150 were casted of M-20 grade of geopolymer concrete using admixtures of varying proportion and test were conducted at 7 and 28 days with and without oven curing. The admixtures that were used are never used before by anyone in the geopolymer concrete. Most of the results that were found to be impressive related to the strength of the concrete. It is a good alternative construction material to the existing P.C.C. On comparing the project with the conventional concrete it is more advantageous, economical and ecofriendly In all there is much to be gained by using geopolymer concrete. The test results presented in this paper show the effects of various properties of geopolymer concrete.*

Key Words: *Geopolymer concrete, Fly Ash, Slaked Lime, Alkaline solution.*

1.INTRODUCTION

This chapter depicts the introductory part of geopolymer concrete what is geopolymer. It also consists of environmental effect of geopolymer concrete with contents and also the use of different type of admixture. It also provides details regarding the previous study conducted on geopolymer concrete.

This chapter also the introduce to the admixture that are being used in the project. Geopolymer concrete products are known for their better durability and strength properties than P.C.C. These properties are investigated properly in laboratory to check durability and strength properties. It also discusses the factors which restrict the use of geopolymer concrete as an alternative to P.C.C. Laboratory tests are conducted on compressive strength, split tensile strength and flexural tests on the concrete blocks on varying proportion of admixture that are kept for curing in oven and natural curing .. The water in a geopolymer mixture plays an important role in the chemical reaction that takes place as it provides workability to the mixture during mixing of concrete. It is similar to the chemical reaction of water in a Portland cement concrete mixture during the hydration process. Geopolymer comes under the group of strong and durable cementitious materials that harden at temperatures below 100°C.

2. LITERATURE REVIEW

Yasir Sofi and Iftekar et.al[1] Gull intended to study the properties of fly ash based Geopolymer concrete. M20 grade GPC can be formed by adopting nominal mix of 1:1.5:3 (fly ash: fine aggregates: coarse aggregates) by varying alkaline liquid to fly ash ratio from 0.3 to 0.45. The compressive strength, tensile strength and flexural strength tests were conducted on geopolymer concrete and parameters that affect it are analyzed and proved experimentally. The durability properties like permeability and acid attack are also studied. From the test results, it was concluded that geopolymer concrete possesses good compressive strength and offers good durability characteristics. With the increase of alkaline liquid to fly ash ratio strength decreases and alkaline liquid to fly ash ratio less than 0.3 is very stiff.

P. K. Jam Dade and U. R. Kawade et.al[2] studied the strength of Geopolymer concrete by using oven curing. In this study Geopolymer concrete is prepared by mixing sodium silicate and sodium hydroxide with processed fly ash. The concrete is cured at different condition and different temperatures i.e. 600C, 900C and 1200C so as to increase the strength of concrete. It was observed that higher curing temperature resulted in larger compressive strength of Geopolymer concrete, even though an

increase in the curing temperature beyond 600C did not increase the compressive strength substantially. Also longer curing time improved the polymerization process resulting in higher compressive strength of Geopolymer concrete.

Arya Aravind and Mathews M Paul et.al[3] carried out research on mechanical properties of Geopolymer concrete reinforced with steel fiber. This study focuses on the compressive strength and split tensile strength of geopolymer concrete reinforced with steel fiber. Experiments were performed using the Box–Behnken experimental design.

Among the waste or by-product materials, fly ash and slag are the most potential source of geopolymer. Several studies have been reported related to the use of these source materials. Cheng and Chiu (2003) reported the study of making fire-resistant geopolymer using granulated blast furnace slag combined with met kaolinite. The combination of potassium hydroxide and sodium silicate was used as alkaline liquids

Van Jaarsveld et.al[4] (1997; 1999) identified the potential use of waste materials such as fly ash, contaminated soil, mine tailings and building waste to immobilize toxic metals. Palomo et. al., (1999) reported the study of fly ash-based geopolymer. They used combinations of sodium hydroxide with sodium silicate and potassium hydroxide with potassium silicate as alkaline liquids. It was found that the type of alkaline liquid is a significant factor affecting the mechanical strength, and that the combination of sodium silicate and sodium hydroxide gave the highest compressive strength.

3. EXPERIMENTAL WORK

The aim of this action was to ease the promotion of this 'new' material later on to the concrete industry. In order to simplify the development process, the compressive strength was selected as the benched mark parameter. This is not unusual because compressive strength has an intrinsic importance in the structural design of concrete structures.

3.1 Material Used

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Fly Ash
In the present experimental work, low calcium, Class F were used.

Aggregate:
Aggregate are used for making geo-polymer concrete are fine aggregate and coarse aggregate having detail s specification as follows Alkaline Activators:

To activate the fly ash, a combination of sodium hydroxide solution and sodium silicate solution was chosen as the alkaline activator. Sodium-based activators were chosen because they were cheaper than Potassium-based activators.

3.2 Mixing and Casting

It was found that the fresh fly ash-based geo-polymer concrete was dark in color (due to the dark color of the fly ash), and was cohesive. The amount of water in the mixture played an important role on the behavior of fresh concrete. When the mixing time was long, mixtures with high water content bled and segregation of aggregates and the paste occurred. This phenomenon was usually followed by low compressive strength result of hardened concrete.
From the preliminary work, it was decided to observe the following standard process of mixing in all future studies.

Mix sodium hydroxide solution & sodium silicate solution together at least one day prior to adding the liquid to the dry materials.

Mix all dry materials in the pan mixer for about 3 min. add the liquid component of the mixture at the end of dry mixing & continue the wet mixing for another 4 to 5 Min approximately.

After the mixture is properly mix the material is collected in the 150×150×150 mm size cubes by using table vibrator .Immediately after casting, the samples are rest for 24 hours specimens were cured in an oven at a specified temperature of 80°C,100°C,120°C for a period of 18 hrs. At the end of curing period the150×150×150 mm cubes are removed from the moulds.

Type of Admixture

1) Zentrament F BV
2) Conplast SP 430 SRV
3) MC- Schnell OC
4) Emceplast BV

4. RESULT AND DISCUSSIONS

The test result chapter shows the compressive strength gained by concrete cubes using different admixtures. The compressive strength is obtained by applying load upto 3000 kN in CTM machine. Each sample is
given different proportion of admixture with oven and natural curing method and their results are compared. The graph also provides pictorial view of the compressive strength with respect to the proportion of admixture.

5. CONCLUSIONS

We have the following observations-
The Zentrament F BV which is super plasticizer gave the best results for 0.8% proportion with natural curing of 28 days than oven curing.
Conplast SP 430 SRV which is super plasticizer gave satisfactory results for 0.9% proportion for a natural curing of 28 days.
The MC Schnell OC which is accelerator gave excellent results for 2% of oven curing for 18hours at temperature 80ºC.
Emceplast BV which is concrete plasticizer gave excellent results by using 1% by the wt of fly ash for oven curing for 18 hours at 80ºC.
CaCl3 which is accelerator had best results by using 1.5% of chemical by the wt of fly ash gave the good results for 7 days without oven curing.

REFERENCES

[1] Yasir Sofi ,Iftekar gull,"Experimental investigations on durability properties of Fly ash based geopolymer concrete" IJETT (2013)

[2] Prof. Jamdade P.K, Prof. Kawade U.R, (2014), Evaluate Strength of Geopolymer Concrete by Using Oven Curing, IOSR Journal of Mechanical and Civil Engineering. 11, 63-66.

[3] Arya aravind and Mathews M paul, "Study of Mechanical Properties of Geopolymer Concrete Reinforced with Steel Fiber" International Journal of Engineering Research and Technology, Vol. 3, Issue 9, ISSN: 2278-0181, 24 September 2014.

[4] Malhotra, V. M., "Making concrete 'greener' with fly ash", ACI Concrete International, 21, 1999, pp 61-66.

[5] McCaffrey, R., "Climate Change and the Cement Industry", Global Cement and Lime Magazine (Environmental Special Issue), 2002 pp. 15-19.

[6] Davidovits, J, "High-Alkali Cements for 21st Century Concretes. in Concrete Technology, Past, Present and Future", Proceedings of V. Mohan Malhotra Symposium, Editor: P. Kumar Mehta, ACI SP- 144, 1994, pp.383-397.

[7] Duxson P, Provis J L, Lukey G C and van Deventer J S J, "The Role of Inorganic Polymer Technology in the Development of Green Concrete", Cement and Concrete Research, 37(12), 2007, pp. 1590.

[8] Gartner E (2004), "Industrially Interesting Approaches to 'Low-CO2'Cements", Cement and Concrete Research, 34(9), 2004, pp.1489-1498.

[9] Davidovits, J, "Soft Mineralogy and Geopolymers", Proceedings of the of Geopolymer 88 International Conference, the Université de Technologie, Compiègne, France, 1988.

[10] Gourley, J. T., "Geopolymers; Opportunities for Environmentally Friendly Construction Materials", Paper presented at the Materials 2003 Conference: Adaptive Materials for a Modern Society, Sydney, 2003.

[11] Gourley, J. T., & Johnson, G. B., "Developments in Geopolymer Precast Concrete", Paper presented at the International Workshop on Geopolymer sand Geopolymer Concrete, Perth, Australia, 2005.

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