Geopolymer concrete-A solution for cementitious concrete pollution A Review

Mohammad Amin[1], Sandeep Nasier[2]

[1]ME Research Scholar, CED, Chandigarh University
[2]Assistant Professor, CED, Chandigarh University, Punjab, India

---

Abstract - *From environmental aspect, the world is concerning about the Global warming & increase in environmental pollutions, which is caused in engineering field mainly by cement production. While producing cement a huge amount of carbon dioxide is emitted to atmosphere. To overcome this phenomena, either we can partially replace cement with fly ash, GGBS, Rice husk ash etc…or we can use the Geopolymer technology. Geopolymer concrete which can also be called zero cement concrete is an innovative construction material that has alkaline solution i.e. (sodium hydroxide & sodium silicate) and the fly ash as a binding material. Fly ash is a rich source of silica and alumina which react with alkaline solution and produces alumina silicate gel that acts instead of cement in concrete.*

Key Words: **Global Warming, Fly ash, GGBS, Rice husk ash, Geopolymer Concrete, Alumina silicate**

1. INTRODUCTION

Urbanization increases need of concrete, where cement is the main constituent of concrete as a binder material. And production of 1Ton cement emits approximately 1Ton of carbon dioxide to the air which actually causes temperature rise and air pollution. Thus we need to concern about the environment, and partially replacement of cement with mineral admixtures can not solve the problem. So we are supposed to have an alternative construction material, where Geopolymer concrete is a best replacement for conventional concrete.

Geopolymer technology was named and presented for the first time by Davidovits in 1978 to represent a broad range of materials characterized by networks of inorganic molecules (Geopolymer Institute 2010) [1] Geopolymer concrete can be called environment friendly or green concrete by means of no cement in its composition and the usage of industrial byproducts such as fly ash, GGBS , which are harmful to the environment. Geopolymer concrete is nothing but the combination of aggregates, fly ash, and alkaline solution. It has two main limitations which need more exploration such as late initial setting and the heat necessity in curing time to gain strength [2].

2. PROPERTIES OF GEOPOLYMER CONCRETE

Its properties are as follow [1,3]:

- Sets at room temperature
- Non-toxic, bleed free
- Durable and good thermal resistance
- High resistance to corrosion
- Impermeable
- High compressive strength
- Good for hot weather concreting.

3. ALKALINE SOLUTION

Sodium hydroxide and Sodium silicate are used to make alkaline solution with different ratios. And varying molarity of sodium hydroxide can be used such as 8 moles, 10 moles, and 12 moles. The molecular weight of sodium hydroxide is 40. To make 10 molarity solution 400 gr of sodium hydroxide flakes are weighed and they are dissolved in water to form 1 liter of alkaline solution.

4. MIX PROPORTIONS

As there are no code provisions for the mix design of Geopolymer concrete, the density of Geopolymer concrete is assumed as 2400 kg/m^3. The rest of the calculations are done by considering the density of concrete.[4]

5. LITERATURE REVIEW

Ajay Kumar Singh studied strength and durability of Fly ash and GGBS based Geopolymer concrete. The specimens were taken to be tested after 28 days of curing in sun. Then the specimens were immersed in 3% HCL, 3% H2SO4 and 3% HNO3. Results showed greater resistance to acid environment and high compressive strength compared to conventional Portland cement concrete.[5]

K.Prasanna, Arun Kumar, M.Dinesh Kumaran J R and Lakshminarayanan.B investigated Fly ash based Geopolymer concrete with GGBS. Based on results gained from experimental investigation. The Geopolymer concrete gained strength within 24 hours at ambient temperature without water curing and also the strength of Geopolymer concrete was increased with increase in percentage of GGBS in a mix. Low calcium Fly ash (ASTM Class F) was used. Low calcium Fly ash based Geopolymer concrete has excellent compressive strength and is suitable for structural applications.[6]

Satpute Manesh B., Wakchaure Madhukar R., Patankar Subhash V. also had an experimental evaluation of Effects of Duration and Temperature of curing on compressive strength of Geopolymer Concrete. They have tested the

specimens in different curing hours and varying temperature and got that by increasing the temperature in the same curing time the compressive strength of Geopolymer concrete increased in considerable amount. [7]

Chennur Jithendra Reddy and Dr. S. Elavenil researchers wrote GEOPOLYMER CONCRETE WITH SELF COMPACTING: A REVIEW, it is founded that, increasing the dosage of sodium hydroxide molarity leads to decrease in fresh properties, however it increased the compressive strength. The contribution of GGBS helps the SCGC to attain high compressive strength at ambient room temperature. GGBS at ambient curing condition had more compressive strength rather than Fly ash based SCGC.[8]

MR. PRATIK B. SHINDE.1, MR. SWAPNIL A. SURYAWANSHI.2, MR. AMIT D. CHOUGULE.3 investigated light weight Geopolymer concrete and got results as follow: The light weight Geopolymer concrete gain the strength within 24 hours without water curing. The strength of light weight Geopolymer concrete was increased with decreased in molarity of alkaline solution. It was observed that, with a 1M solution the sample gives good compressive strength with achievable density to make it light weight.[9]

6. CONCLUSIONS

- All research papers and review papers show Geopolymer concrete is a best alternative construction material to replace the conventional concrete for reducing the carbon dioxide emission.
- To gain sufficient strength 60 to 90-degree Celsius curing temperature is good without water curing, but still can gain strength in room temperature.
- Increase of molarity of sodium hydroxide increases strength of concrete.
- Low calcium fly ash and increasing GGBS showed increase in strength of concrete.

ACKNOWLEDGEMENT

The author of present review paper work would like to acknowledge Mr. Sandeep Nasier, Assistant Professor at Chandigarh university for his technical assistance, valuable guidance and spirited efforts.

REFERENCES

[1]. M.I Abdul Aleem, P.D. Arumairaj "GEOPOLYMER CONCRETE- A REVIEW 2012 International Journal of Engineering Sciences & Emerging Technologies.

[2]. D.B.Rajiwala,H.S.Patil(2011)"Geopolymer Concrete : A concrete of Next Decade" Journal of Engineering Studies and Research Vol II Issue I.

[3]. Mr.Prashant M.Dhamanage Light- Weight Geopolymer Concrete- AReview. International Journal of Research in Advent Technology 19 March 2016

[4]. L.Krishnan, S.Karthikeyan " GEOPOLYMER CONCRETE AN ECO-FRIENDLY CONSTRUCTION MATERIAL" International Journal of Research in Engineering and Technology volume 03, June 2014.

[5]. Ajay Kumar Singh. Strength and Durability test of fly ash and GGBS Based Geopolymer concrete. Int. Journal of Engineering Research and Application Vol.6, Issue 8, (Part-1) August 2016.

[6]. K.Prasanna, Arun Kumar.M, Lakshminarayanan.B, and Dinesh Kumar.J.R. FLYASH BASED GEOPOLYMER CONCRETE WITH GGBS. International conference on Current Research in Engineering Science and Technology (ICCREST-32016).

[7]. Satpute Manesh B., Wakchaure Madhukar R., Patankar V. Effect of Duration and Temperature of Curing on Compressive Strength of Geopolymer concrete. International Journal of Engineering and Innovative Technology Volume 1, Issue 5, May 2012.

[8]. Chennur Jithendra Reddy and Dr. S. Elavenil GEOPOLYMER CONCRETE WITH SELF COMPACTING: A REVIEW International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 2, February 2017

[9]. MR. PRATIK B. SHINDE.1, MR. SWAPNIL A. SURYAWANSHI.2, MR. AMIT D. CHOUGULE.3 "A Characteristic Study of Light Weight Geopolymer Concrete" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 02 | Feb-2016