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REVIEW ON STRENGTH AND DURABILITY CHARACTERISTIC OF GEOPOLYMER CONCRETE WITH MACRO SILICA, NANO SILICA

M Bala Vinayag[1], M I Abdul Aleem[2], J Thaarrini[3], S Yamini Roja[4]

[1]PG Student, Department of Civil Engineering, Sri Ramakrishna institute of Technology, Tamil Nadu, India.
[2]Associate Professor, Department of Civil Engineering, Sri Ramakrishna institute of Technology, Tamil Nadu, India.
[3] Assistant Professor, Department of Civil Engineering, Sri Ramakrishna institute of Technology, Tamil Nadu, India.
[4] Assistant Professor, Department of Civil Engineering, Sri Ramakrishna institute of Technology, Tamil Nadu, India.

Abstract - : ***Owing to rapid industrial growth the demand of concrete has been increased for various infrastructures. Fly Ash is one of the major waste materials available from thermal power plants. Fly ash based geopolymer concrete has suitable properties for its use as a construction material. So here a review has been carried out about the performance of concrete using fly ash as the major binding material with nanosilica and silica fume. This study revealed the Properties, Performance, and applications of geopolymer concrete in the real world. the geopolymer concrete can be used as a building material in a effective ways and it is one the way to reduce the dumping of fly ash waste in environment.***

Key Words: *Geopolymer Concrete, Fly Ash, Strength, Curing, Applications*

1. INTRODUCTION

Ordinary portland cement (OPC) has been traditionally used as the binding agent in concrete. However, it is also necessary to search for alternative low-emission binding agents for concrete to reduce the environmental impact caused by manufacturing of cement. Geopolymer, also known as inorganic polymer, is one such material that uses by-product material such as fly ash instead of cement. fly ash based geopolymer concrete has suitable properties for its use as a construction material.[1] In 1978, Davidovits et al proposed that an alkaline liquid could be used to react with the silicon (Si) and the aluminium (Al) in a source material of geological origin or in by- product materials such as fly ash and GGBS to produce binders.[2] Therefore ,the objective of this paper is to review the study of the different strength properties of geo-polymer concrete and mix proportion of Geo-polymer concrete with fly ash, silica fume and nanosilica.

2. REVIEW OF LITERATURE

2.1 GEOPOLYMER CONCRETE

V.Bhikshma et.al (2012) this demonstrates that range of NaoH molarity of the NaoH range the 8 to 16 were done and standard cubes of 150*150*150 mm size were cast and tested for the compressive stress at the age of 28 days of their casting the test result of the trial mixes the experiment has been taken. Totally 5 mix proportions with chemical ratio's range from 0.30 to 0.15 were adopted. The compressive strength of the concrete is found to be ranging from 25.00 Mpa to 30Mpa. Splitting tensile strength of concrete is found to be ranging from 4.00 mpa to 5.00 mpa. Similarly the flexural strength of the concrete is ranging from 5.00mpa to 6 .00 mpa. It's higher the concentration of sodium hydroxide solutions results in higher compressive strength of the fly ash based geopolymer concrete[16].

Raijiwala.d et.al (2011) reported in this paper that an attempt is made to study strength properties of geopolymer concrete. Compressive strength of geopolymer concrete increase over controlled concrete by 1.5 times. The split tensile strength of geopolymer concrete increased over controlled by 1.45 times and flexural strength of gpc increased over controlled concrete by 1.6 times. In durability test, there is decrease in weight loss by 10 times (at 56 days % loss in weight has reduced from 5.66% to 0.66%). Good structural properties can be achieved with increase in polymerization temperature along with prolonged curing period in oven [17].

Joseph davidovits (1991) discussed the result of an the ceramic material like in their structure and properties. These materials can polycondense just like organic polymers, at temperature lower than 1000 c geopolymerization of the chemical reaction alumina-silicate oxides(A13+in iv-fold co ordination) with alkaline polysilicates,yielding polymeric si-o-a 1 bonds the amorphous to semi –crystalline three dimensional silico-aluminate structure are of the policy(sialate) type(-si-o-ai-

o-) the poly (sialate-silioxo) type (-si-o-ai-o-si-o-) the poly (sialate –disiloxo) type (-si-o-ai-o-si-o-si-o-)[18].

2.2 FLY ASH

Franitisek Skvara et.al investigated strength affected substantially by macro pores(103 nm and more) formed in result of the air entrained into the geopolymer. The presence of ca-containing additives (slag, gypsum) reduces the porosity because of the co-existence of the geopolymer phase with the C-S-H one. A concrete can be prepared by using the geopolymer binder. No shrinkage due to hydration (typical for the cement –based concretes) takes place in the concrete[3].

Nalloydet.al(2010) conducted research on strength parameter of geopolymer concrete. It has a excellent properties due to this, it is well –suited to manufactured precast concrete products that are needed in rehabilitation and retrofitting of structure after a disaster. It is focusing on the durability of geopolymer in aggressive soil condition and marine environment[4].

S.E. Wallah et.al(2006) discussed the result of an attempt is made to study strength properties of heat –cured fly ash –based geopolymer concrete. It undergoes low creep.The specific creep, defined as the creep strain per unit stress .After one year ranged from 15 to 29*106 Mpa for the corresponding compressive strength 67 mpa to 40 mpa. The test result demonstrate that heat-cured fly ash –based geopolymer concrete has an excellent resistance to sulfate attack .There is no damage to the surface of test specimen after exposure to the surface of test specimen after exposure to sodium sulfate solution up to one year.There are no significant change on mass and compressive strength[5].

Jaydeepet.al(2013) discussed the result of an various properties that the compressive strength is increased with the increase in molarity of sodium hydroxide .After 3days of curing the increase in the compressive strength is not significant. Compared to hot air oven curing and curing by direct sun light oven cured specimens gives the higher compressive strength but sun light curing is convenient for practical condition[6].

2. 3 SILICA FUME

Rajesajeswari et.al(2014) presence the influence of various proportion of silica fume. The effect of al/sf ratio and effect of age on concrete. From the experimental investigation it was found that out of 3 different ratio of Na2 Sio3/NaoH, 3 different ratio of al/sf ratio and four different age of silica fume based geopolymer concrete al/sf =0.25 and Na2 Sio3/NaoH=0.5 yielded better gain in compressive strength thermal curing temperature of 60oc for curing period 56 days[22].

Debabrata dutta et.al(2010) discussed the results of an experimental investigation and compare on the properties of different silica fume concentration. In geopolymer concrete admixture silica fume added in the range of 2.5%to 5% .addition of silica fume to fly ash based geopolymer mortar specimen improve the total porosity. Water absorption value were found directly related to total porosity of specimens for paste specimens water absorption gradually increase with introduction of silica fume into mix. They decreasing trend in water absorption will increase silica fume content [23].

Hisham m khater (2013) discussed about the alkaline activation of alumino silicate waste in the presence of silica fume and metakalin using sodium hydroxide and sodium silicate in the ratio 3.3 wt% of dry weight leads to the formation of an alumino silicate geopolymer that posses an enhancement in both mechanical and micro structural properties. Silica fume addition up to 7% greatly enhances the geopolymerization process with the form well. Further increase SF content leads to decrease in mechanical characteristic [24].

2.4 M-SAND

M.I Abdul Aleem et.al(2013) concluded the experimental investigation, the normal sand is fully replaced by Manufacturing Sand (M Sand), having high content of Silica which activated the production of inorganic molecules, producing good bonding among the materials in the Geopolymer Concrete. The reaction of chemical constituents of Fly Ash and M- sand with mixture of sodium silicate and sodium hydroxide form Sodium Aluminium Silicate with formulation (NaAlSi3O8)5, which is mainly responsible for the bonding strength of geopolymer concrete. The new compound formed is found to belong with polymer containing poly sialate. It is also proved that the geopolymer concrete has a very high compressive strength, its hardness and ease of factory curing it may be a suitable substitute for conventional concrete in the precast industries.

Janani et.al(2015) presented the influence of the various properties of normal river sand has replaced with m-sand .The strength parameter for geopolymer concrete with

varying proportion of m-sand is tested. The test result of compressive strength shows that there is 9% increase in strength when m-sand is fully replaced by river sand. The test result's of tensile strength shows that there is 12% increased strength when m-sand is fully replaced by river sand[8].

T.G.Ushaaet.al (2015) this paper presents an experimental investigation on flexural response of self compacting geopolymer concrete beam by partial replacement of fly ash by GGBs and various replacement of river sand by m-sand under two point loading. Which has 100% m-sand and 0%river sand gives the best result and 100% river sand 0% m-sand has give low workability then 0% of river sand 100% m-sand has high workability[9].

2.5 CURING

Satpute manesh b et.al (2012) this paper presence the study of effect of duration and temperature curing on compressive strength of fly ash based of geopolymer concrete. Cube of size 150mm*150mm*150mm were made at solution to fly ash ratio 0.35 with 16 mole concentrate sodium hydroxide solution. All the specimen were cured in oven at 600c, 900 c and 1200c for 6,12,16,20 and 24 hour's duration more than 60mpa strength can be achieved by fly ash based geopolymer concrete in just 24 hours of curing[19].

P.Nath et .al presented the result of an experimental impact on gpc. Here geopolymer concrete cube are curing with ambient temperature slag in the fly ash based geopolymer mixture decreased the setting time and increased the compressive strength. Adding slag up to 30% of total binder achieved compressive strength up to 55 MPa at 28 days. Setting time reduced rapidly with the increasing amount of slag in the mixture. Increase of alkaline solution activator solution in the mix from 35% to 45% of total binder the setting time increased. Compressive strength decreased[20].

Shankar H.sanni et.al (2013) summarized the impacts on curing of gpc. Geopolymer concretes are curing with ambient, steam and oven curing here making with M-40,M-50,M-60 concrete with 12 molar concentration hot oven and steam curing the specimen curing with 600C. An combination of alkaline solution ratio from 2.5. The average compressive strength heat cured specimens were 34% and68% higher than that of stream curing and ambient curing respectively [21].

N.A Lioyd et.al(2012) this demonstrates that the basic mixture proportions characterized by 75% aggregate to total mass, alkaline liquid to flyash of 0.35(analogous to water to cement ratio) and elevated temperature curing result in a high strength geopolymer concrete. When steam curing is placed on concrete the steam vents (or) hoses are cover from thermocouples that's more important. They resulted in elevated compressive strengths of the order of 20% [13].

Jindalbharat bhushan this paper concluded that fly ash based geopolymer is better than normal concrete in many aspects such as compressive strength exposure to aggressive environment, workability and exposure to high temperature and this study shows that geopolymer concrete is more resistant to corrosion and free, has high compressive and tensile strength and its gain its full strength quickly. It also shrinks less than standard concrete. Thus owing to these structural advantages it may be concluded that in near future geopolymer concrete may find an effective alternate to standard cement concrete[14].

Mohd.mastafa al bakri et.al(2011) has revealed many facts about compressive strength. It is increased with the increasing of fly ash fineness and thus the reduction in porosity can be obtained fly ash based geopolymer also provided better resistance against aggressive environment and elevated temperature compared to normal concrete [15].

3. CONCLUSIONS

It is concluded that by producing geopolymer concrete with micro silica & nano silica an high strength concrete can be achieved, though which the use of cement shall be reduced. And geopolymer concrete with m-sand, micro silica and nano silica is attained that required strength. The durability chacteristics of geopolymer concrete with m-sand ,micro silica and nano silica also increased.

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