International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
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STUDY ON GEO POLYMER CONCRETE FOR INCRESE THE HIGH STRENGTH AND SORPITIVITY

[1]GOTTUMUKKALA.PRUTHVI RAJ, [2]AMISIGADDA SAI NAGA MANIKANTA
[1]M-TECH, DEPT OF CIVIL, KAKINADA INSTITUTE OF TECHNOLOGICAL SCIENCES, RAMACHANDRAPURAM, ANDHRAPRADESH, INDIA, 533287
[2]ASSOCIATE PROFESSOR, KAKINADA INSTITUTE OF TECHNOLOGICAL SCIENCES, RAMACHANDRAPURAM, ANDHRAPRADESH, INDIA, 533287

ABSTRACT:
During this study, the water absorption and sorptivity properties of fly-ash based geopolymer concrete were studied in detail. Geopolymer concrete is one among the steps taken towards sustainable construction. It has a lower greenhouse footprint than traditional concrete. The effect of accelerated corrosion on geopolymer concrete was also studied and the results were compared with control concrete. It was concluded through the study that geopolymer concrete is less porous and has a lesser linear curve as compared to control concrete.
Keywords: Geopolymer, sorptivity, Flyash concrete, water absorption, high level concrete.

1. INTRODUCTION:

Concrete usage round the world is second solely to water. Normal hydraulic cement (OPC) concrete is that the most well liked and wide used building materials, attributable to convenience of the raw materials everywhere the globe, its ease in preparation and fabrication altogether forms of conceivable shapes. About 1.5 a lot of raw materials is required within the production of each ton of OPC, at identical time regarding the quantity of CO2 free throughout the producing of normal hydraulic cement (OPC) attributable to the calcinations of rock and combustion of fuel is within the order of 1 ton for each ton of OPC created. On the opposite hand, the extensive convenience of ash worldwide creates. Opportunities to utilize this by-product of burning coal, as a substitute for OPC to manufacture Concrete. It's essential to seek out alternatives to form atmosphere friendly concrete. An alternate to form environmentally friendly concrete is that the development of Inorganic alumina- salt compound, referred to as Geopolymer, synthesized from materials of geologic origin or by-product materials like ash that's made in chemical element and atomic number 13. In step with Davidovits, geopolymerization is age of synthesis that with chemicals integrates materials containing chemical element and atomic number 13. Throughout the method, chemical element and atomic number 13 atoms square measure combined to create the building blocks that square measure with chemicals and structurally love those binding the natural rocks. By exploitation the ash primarily based geopolymer concrete reducing the 2 environmental connected

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problems i.e. the high quantity of free to atmosphere throughout production of OPC and utilization of ash. In this study, style mixture of M25 grade was used for the tests. Factors like alkalescent liquid to ash quantitative relation =0.4, soluble glass to hydrated oxide quantitative relation =2.0, Morality=M14, set temperature =750C, set Time = 24hours, relief = 1day, Admixture indefinite quantity =2% were unbroken constant throughout the tests. The most objective of the study was to compare the water absorption capability and sorptivity of management and geopolymer concrete.

2. RELATED STUDY:

Concrete is the most commonly used construction material, its usage by the communities across the globe is second only to water. The worldwide demand for Ordinary Portland Cement (OPC) would increase further in the future. OPC production is a major contribution to carbon dioxide emissions. The global warming is caused by the total green house emission to the earth atmosphere contributing greatly to the global warming. Many efforts are being made in order to reduce or replace the use of OPC in concrete. These efforts are being made to utilization of supplementary cementitious materials such as fly ash, GGBS, silica fume and rice-husk ash etc. In terms of reducing the global worming the geopolymer technology could reduce the CO2 emission to the atmosphere cause by cement about 80%. The word Geopolymer introduced to the world by Davidovits in year 1980s, proposed that binders could be produced by a polymeric reaction of alkaline liquids with the Silicon and the Aluminum in source materials of geological origin or by-product materials such as fly ash and GGBS, he termed these binders as "Geopolymer". The temperature during curing is very important, and depending upon the source materials and activating solution, heat often must be applied to facilitate polymerization, although some systems have been developed that are designed to be cured at room temperature 2&3. The necessity of Geopolymer Concrete, the Constituents, Properties, Applications and Limitations are discussed in detail in this paper. Construction is one of the fast growing fields worldwide. As per the present world statistics, every year around 260,00,00,000 Tons of Cement is required. This quantity will be increased by 25% within a span of another 10 years. Since the Lime stone is the main source material for the ordinary Portland cement an acute shortage of limestone may come after 25 to 50 years. More over while producing one ton of cement, approximately one ton of carbon di oxide will be emitted to the atmosphere, which is a major threat for the environment. In addition to the above huge quantity of energy is also required for the production of cement. Hence it is most essential to find an alternative binder.

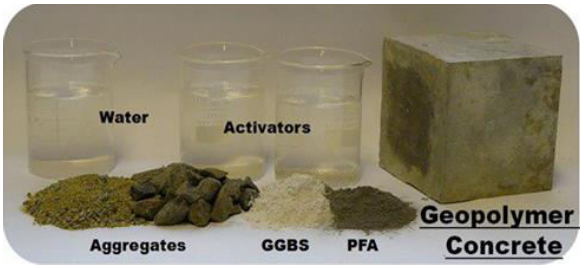

Fig.2.1. Aggregates of geopolymer concrete.

The reaction of Fly Ash with an aqueous solution containing Sodium Hydroxide and Sodium Silicate in their mass ratio, results in a material with three dimensional polymeric chain and ring structure consisting of Si-O-Al-O bonds7. Water is not involved in the chemical reaction of Geopolymer concrete and instead water is expelled during curing and subsequent drying. This is in contrast to the hydration reactions that occur when Portland cement is mixed with water, which produce the primary hydration products calcium silicate hydrate and calcium hydroxide. This difference has a significant impact on the mechanical and chemical properties of the resulting geopolymer concrete, and also renders it more resistant to heat, water ingress, alkali–aggregate reactivity, and other types of chemical attack 3&5. In the case of geopolymers made from fly ash, the role of calcium in these systems is very important, because its presence can result in flash setting and therefore must be carefully controlled 5. The source material is mixed with an activating solution that provides the alkalinity (sodium hydroxide or potassium hydroxide are often used) needed to liberate the Si and Al and possibly with an additional source of silica (sodium silicate is most commonly used).

3. METHODOLOGY AND ANALYSIS:

Geopolymer concrete is concrete which does not utilize any Portland cement in its production. Rather, the binder is produced by the reaction of an alkaline liquid with a source material that is rich in silica and alumina. Geopolymers were developed as a result of research into heat resistant materials after a series of catastrophic fires The research yielded non-flammable and non-combustible geopolymer resins and binders Geopolymer is being studied extensively and shows promise as a greener alternative to Portland cement concrete. Research is shifting from the chemistry domain to engineering applications and commercial production of geopolymer. It has been found that geopolymer concrete has good engineering properties. The use of fly ash has additional environment advantages. The annual production of fly ash in Australia in 2007 was approximately 14.5 million tonnes of which only 2.3 million tonnes were utilized in beneficial ways; principally for the partial replacement of Portland cement Development of geopolymer technology and applications would see a further increase in the beneficial use of fly ash, similar to what has been observed in the last 14 years with the use of fly ash in concrete and other building materials.

Fly Ash:

The fly ash used in the production of geopolymer concrete at Curtin University is Class F fly ashsourced from the coal fired power station approximately 200 km south of Perth, Western Australia. The results of X-ray fluorescence testing (XRF) are shown in Table 1 for the fly ash used in the research program. The class F fly ash is characterized by high silicon and aluminum contents and low calcium content, and a loss on ignition of 0.46.

Alkaline solutions:

Sodium based alkaline solutions were used to react with the fly ash to produce the binder. Sodium-silicate solution type A53 was used

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for the concrete production. The chemical composition Sodium hydroxide solution was prepared by dissolving sodium hydroxide pellets in water. The pellets are commercial grade with 97% purity thus 14 molar solutions were made by dissolving 404 grams of sodium hydroxide pellets in 596 g of water.

Aggregates:

Coarse aggregates with nominal sizes of 7mm, 10mm and 20mm granite and dolerite, were sourced from two local quarries. The aggregates had a particle density of 2.6 tonnes/cubic metre for the granite and 2.63 tonnes/cubic metres for the dolerite. The dolerite aggregate was used in one series of trial mixtures to assess the impact of aggregate type on workability and strength gain of the geopolymer concrete. Fine sand was sourced from a local supplier. The sand has a low clay content (less than 4%)and fineness modulus of 1.99.Previous geopolymer research had been performed with aggregates being prepared to surface saturated dry (SSD) condition, a state of aggregate saturation in which the aggregate will not absorb any further moisture but no surface water is present.

4. EXPERIMENTAL ANALYSIS:

Heat-curing substantially assists the chemical reaction that occurs in the geopolymer paste. Both curing time and curing temperature influence the compressive strength of geopolymer concrete. The effect of curing time is illustrated in Figure 2 . The test specimens were 100x200 mm cylinders heat-cured at 60o C in an oven. The curing time varied from 4 hours to 96 hours (4 days). Longer curing time improved the polymerization process resulting in higher compressive strength. The rate of increase in strength was rapid up to 24 hours of curing time; beyond 24 hours, the gain in strength is only moderate. Therefore, heat-curing time need not be more than 24 hours in practical applications. Figure 1 shows the effect of curing temperature on the compressive strength of geopolymer concrete . Higher curing temperature resulted in larger compressive strength. Heat-curing can be achieved by either steam-curing or dry-curing. Test data show that the compressive strength of dry-cured geopolymer concrete is approximately 15% larger than that of steam-cured geopolymer concrete.

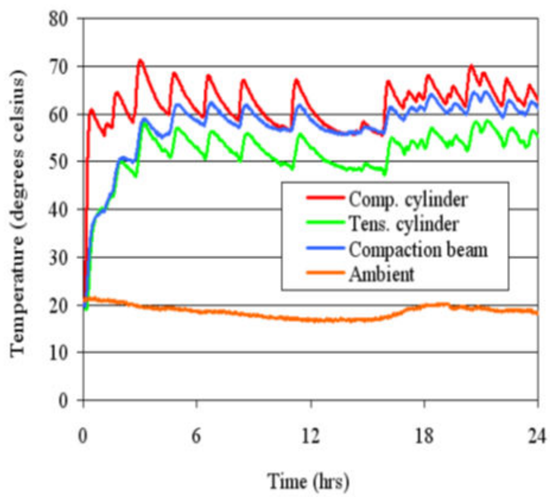

Fig.4.1. Compressive Strength at 28 Days.

The required heat-curing regime can be manipulated to fit the needs of practical applications. In laboratory trials , precast products were manufactured using geopolymer concrete; the design specifications required steam-curing at 60o C for 24 hours. In order to optimize the usage of formwork, the products were cast and steam-cured initially for about 4 hours. The steam-curing was then stopped for some

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time to allow the release of the products from the formwork. The steam-curing of the products then continued for another 21 hours. This two-stage steam-curing regime did not produce any degradation in the strength of the products.

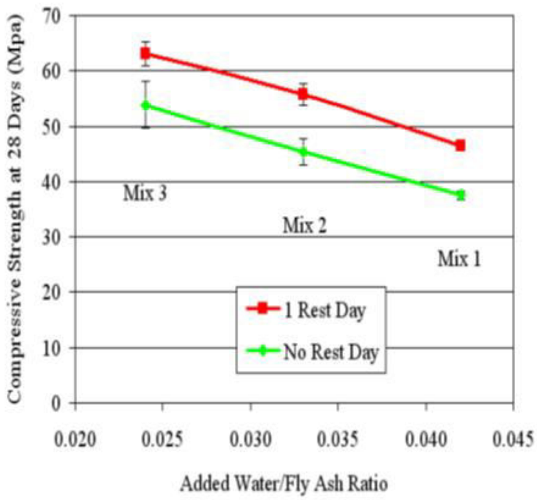

Fig.4.2. With Flyash adding.

After casting, the cylinders were covered with plastic bags and placed under the culvert moulds. A plastic cover was placed over the culvert mould and the steam tube was inserted inside the cover. The culverts and the cylinders were steam-cured for 24 hours. Initially, the specimens were steam-cured for about 4 hours; the strength at that stage was adequate for the specimens to be released from the moulds. The culverts and the remaining cylinders were steam-cured for another 20 hours. The operation of the precast plant was such that the 20 hours of steam-curing has to be split into two parts. That is, the steam-curing was shut down at 11 p.m. and restarted at 6 a.m. next day. In all, the total time taken for steam-curing was 24 hours.

Fig.4.3. Practical implementation models.

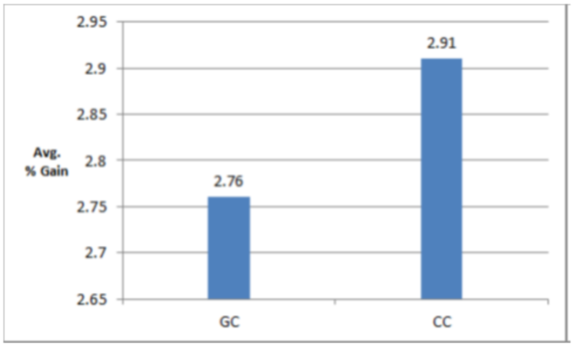

Fig.4.4. Water Absorption of Concrete.

5. CONCLUSION:

The mix style of M25 geopolymer concrete was employed in the study. The results were compared thereto of management concrete. it absolutely was found that The Sorptivity curve is a smaller amount linear as compared thereto of management concrete. Which means the speed of absorption of geopolymer is a smaller amount. Check results of water absorption check shows that the body of geopolymer concrete is a smaller amount as ash is okay than OPC and leads to less water absorption than the management concrete. Accelerated Corrosion check was conjointly performed on cylinders of one hundred fifty millimetre diameters and three hundred millimetre height with chrome steel bar and HYSD bar embedded in it. Affected current technique was adopted with 30V constant power provide. Corrosion resistance was evaluated by amendment in current, 0.5 cell potential meter readings, UPV results and visual examination. The results showed that the corrosion incidence in geopolymer concrete takes longer time than management concrete.

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