A Review on using Geopolymer Mortar as Repair Mortar

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Abstract— Geopolymer mortar is an eco-accommodating material. Be that as it may, for the present, the quick development in the improvement and research identified with geopolymer folios has demonstrated that the use of geopolymer mortar is exceptionally advantageous. In this examination, it will investigate geopolymer mortar as a repair material because of which squander material is utilized. The principle key is to decrease contamination and to utilize material or mortar as repair mortar. The correlation of business mortar ought to be finished with our repair mortar. In this manner the outcome demonstrates the quality of repair mortar is higher than the business one. The greater part of the material utilized is squander and however would be temperate.

Key words: GPC, OPC, GGBFS

I. Introduction

Geopolymer concrete (GPC) is a potential material for assistant application as a choice of standard portland bond OPC concrete. It can accept a basic part in green strong advancement by taking out bond and utilizing diverse outcome materials for instance fly searing flotsam and jetsam and effect warmer slag. Studies drove throughout the latest decades indicated potential points of interest of fly red hot stays based geopolymer over OPC concrete. It has been represented that low calcium fly blazing stays based geopolymer concrete achieved splendid mechanical and quality properties when cured in high temperature. geopolymer is a paste aluminosilicate surrounding by stomach settling agent institution of alumina and silica as starting materials at temperature to some degree higher than room temperature. These acid neutralizer started materials are coordinated of tetrahedral silicate and aluminate units strengthened in a three-dimensional structure by covalent securities. The materials used for geopolymerization are isolated into two segments: a responsive aluminosilicate material for instance fly red hot remains or calcined muds and solvent base activator plan.

The geopolymer mortar is inorganic normally some mud and materials that shape long-broaden non-crystalline frameworks and covalently sustained. Obsidian is a sort of regularly happening geopolymer material. In any case made geopolymers may be used for warmth and flame resistant bond and coatings high temperature stoneware creation restorative applications there are a couple of folios for warm verification fiber composites and new bonds for concrete and radioactive waste encapsulation. Various properties and jobs of geopolymers are by and by being explored in various organizations and creation inquire about places for instance physical science the colloid science mineralogy current science geology and in various types of outlining strategy and advancements. geopolymers are the genuine bit of polymer science and moreover development that structures one of the essential genuine districts of materials science. Polymers are of two sorts for instance common material for eg carbon based and inorganic polymer for eg. silicon based. the normal polymers involve trademark polymers like flexible cellulose produced common polymers are material strands films plastics elastomers and consistent biopolymers for instance science sedate store medicine unrefined materials that are used as a piece of the amalgamation of silicon based polymers are for the most part shake forming minerals of land source.

II. Literature review

Arie Wardhono et al. (2015) discussed the use of fly ash and slag to the replacement of cement, to reduce the emission of carbon dioxide (CO_2). The recent researches have found that it is possible to use slag and fly ash as a sole binder in concrete by activating them with alkali components through a polymerization process. The main issue of use of fly ash as a replacement material for cement is the need of heat curing regime to achieve structural integrity and lower standard deviation which means improved stability of AASF mortar specimens.

B. Singh et al. (2015) shows that geopolymeric binders are discussed with respect to fresh hardened state, interfacial transition zone between aggregate and geopolymer, make bond with steel reinforcing bars and are resistant to elevated temperature. The durability of geopolymer mortar and concrete is highlighted in terms of their deterioration in various aggressive environments. Research and development works was carried out on heat and ambient cured geopolymers at CSIR-CBRI (Central Building Research Institute) for 4 months. Research findings revealed that geopolymer concrete exhibited comparative properties to that of OPC concrete which has potential to be used in civil engineering applications.

David Wiyono et al. (2015) focuses on improvement of surface durability of pozzolan concrete by applying geopolymer coating on it. The two different types of materials used i.e. class- F fly ash and calcinated volcanic mud with different particle sizes. The alkali solution has a combination of NaOH and sodium silicate solution. Concrete samples are exposed to 10% sulphuric acid solution by applying the wet-dry cycles to accelerate the damage process and to chloride solution to evaluate its penetration depth. Compressive tests concluded that at the age of 28 days, 56 days and 90 days increases. This increase shows better durability of concrete with geopolymer coating due to reduced decomposition rate. The result shows that applying the alkaline solution and geopolymer coating thus increases the durability of pozzolan concrete.

H.Y. Zhang et al. (2015) presents the characterization of bond strength of geopolymers at ambient and elevated temperatures. The bond strength of 18 different formulations of metakaolin (MK)/fly ash (FA) based geopolymers is evaluated through double shear tests in 20–300°C temperature range. The test parameters include fly ash content, SiO_2/K_2O ratio, solid-to-liquid ratio and Si/Al ratio. The data from these tests show that geopolymer exhibit slightly lower bond strength than that of epoxy resin at room temperature. However geopolymers have much higher bond strength in 100-300ºC range.

J.G. Sanjayan et al (2015) discussed about the properties of lightweight geopolymer specimens aerated by aluminium powder. Different specimens were made by changing sodium silicate to sodium hydroxide and alkali activator to fly ash weight ratios. Substitution of fly ash with aluminium is done with a percent 1.5, 3 and 5 wt.% in different mixes. The result shows that substituting fly ash with aluminium powder and sodium silicate with a ratio of 0.35 and 2.5 causes best foam specimen with lower density. Compressive strength is in range of 0.9-4.35 MPa, which is suitable for using as bricks, fire resistant panels and so on. Microstructure analysis shows fast reaction between Al powder and alkali activator. Aerating of geopolymers causes damages in stoichiometry of alkali activator and incomplete geopolymerization of fly ash.

Masimawati Abdul Latif et al. (2015) explained that LKD is used as a cementitious material in mortar. LKD is replaced by Portland cement (OPC) up to 60% by weight. This shows that addition of LKD reduces the strength of mortar. A strength of above 50 MPa for 28 days can be achieved by replacing cement with 50% LKD by weight. Water demand increases with increase of LKD. Thus further results shows that the final and initial setting time is accelerated due to addition of LKD. This reduces the density of mortar. It also concluded that there is a good potential for the use of LKD as a cementitious material with accelerated hydration rates.

M. Lassinantti Gualtieri et al. (2015) discussed geopolymers from laterite, laterite from togo (Africa) was used to prepare geopolymers using both phosphoric acid and alkaline sodium silicate solution. Microstructural properties were calculated by scanning electron microscopy, X-ray powder diffraction and mercury porosimetry, whereas thermal properties were evaluated by thermal analysis. The setting and hardening time required a calcination step of the raw material, after which the amount of metakaolinite was about 30 wt%. The flexural strength and elastic moduli were in the ranges 3.3-4.5 MPa and 12-33 GPa. X-ray absorption spectroscopy (XANES) evidenced a change in chemical and structural environments of iron following thermal treatment of geopolymers. These changes indicate interaction between the geopolymer structure and iron is likely to connect and to be observed thermally activated redox behavior.

M.M. Hossain et al. (2015) explained the durability of mortar and concrete. It is generally used to reduce the emission of a huge amount of carbon dioxide (CO2). In order to reduce the CO2 emission researchers both in academia and industry both working on replacement of cement with pozzolan such as slag, fly ash, palm oil fuel ash, metakaolin, rice husk etc. to investigate the water absorption, porosity, sorptivity, chloride penetration, carbonation, acid resistance and drying shrinkage of mortar or concrete. Most of the researchers have observed complex properties. Some have reported a superior durability mortar and concrete containing activated-alkali binder (AAB) with various activators. Effective reuse of pozzolanic materials can have many advantages such as reduction of cement consumption, construction cost and CO2 emission. At last the disposal problem can be minimized by their effective consumption.

M. Talha Junaid et al. (2015) show the systematic approach for selecting mix proportions for alkali activated fly ash-based geopolymer concrete (GPC). The proposed mix design process is developed for low calcium Class F fly ash activated geopolymers using sodium silicates and sodium hydroxide as activator solutions. The literature review reveals that there is no published comprehensive approaches in designing mixes for GPC. The characteristics of GPC mix are identified. The researchers consider the water to geopolymer solid and alkaline liquid to fly ash ratios as direct measure of strength and workability. Most importantly, relationships have been established between these important parameters in order to achieve a certain level of strength together with desired workability.

Partha Sarathi Deb et al. (2015) discussed about fly ash geopolymer concrete. In this review the shrinkage behavior of geopolymer concrete mixtures in which class F fly ash was replaced with 10 or 20% GGBFS and sodium silicate to sodium hydroxide ratio was 1.5 or 2.5. Shrinkage of 4 geopolymer and 1 ordinary Portland cement concrete mixtures cured at room temperature was studied. Some comparisons are made between the shrinkage behavior of geopolymer concretes with different mixture proportions. The shrinkage of geopolymer concrete up to the age of 180 days was found comparable to that of (OPC) ordinary Portland cement concrete of similar compressive strength. Thus, shrinkage of geopolymer concrete measured at 28th day were higher than the design shrinkage.

Pradip Nath et al (2015) experimented on low calcium fly ash. Setting time, workability and compressive strength were studied. OPC and $Ca(OH)_2$ were used at a rate of 2 – 10% of total binder. At 23ºC fly ash geopolymers blended with GGBFS, OPC or CH which reduce the setting time comparable to OPC. The results shows the decreased workability in flow of mortar due to presence of additives and faster setting time. Compressive strength increases with increase of binder content for fly ash blended with 10% of OPC. The 28th day strength increased from 26 MPa to 56 MPa when the binder content is increased from 450 kg/m^3 to 730 kg/m^3. Best results are calculated when binder content was in range of 550 to 650 kg/m^3. Thus fly ash geopolymers blended with small percentages of GGBFS, OPC or CH that can be a suitable binder.

III. CONCLUSIONS

1) Compressive and tensile strength of the mortar increases with adding the fly ash and GGBFS, especially at early ages.
2) In this study, materials that are used are mainly waste product.
3) Repair mortar should be compared with commercial mortar for better results.
4) Finally, repair mortar or geopolymer mortar is economical.

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