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Study of Properties of Geopolymer Concrete

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Abstract – *Concrete is main source of every construction work. Nearly 50% of work and strength of the work is majorly depending on the concrete. At starting stage the ordinary Portland cement is used; after improving studies and experimental investigations the Portland pozzolanic cement concrete and various Portland cement industrial growths was increased. Mainly after development of fly ash study (ASR studies). Generally increasing concrete toughness, energy absorption capacity purpose the fiber reinforced concrete used like pozzolona material. The demand of the concrete usage increase while increasing the infrastructure construction increase. The amount of CO2 increase while increasing the concrete usage. After automobile industry the concrete only release large amount of CO2. To rectify this problem purpose the geopolymer concept was developed in theoretical as well as experimental investigation. Normally many type of geopolymer based concrete was developed. This paper contain geopolymer concrete development as well as the behavior for various experimental investigation. To increase the silica and alumina content in the concrete generally referred as geopolymer concrete. The silica and alumina content increase purpose the pozzolona materials used.*

Key Words: geopolymer, ASR, pozzolona content, flyash

1.INTRODUCTION

Concrete is the most commonly used as a construction material in the worldwide. However, it shows poor tensile and flexural properties when compare to the steel reinforcement. One way to overcome this problem is using various fibers in concrete, resulting in fibre reinforced cementitious composites (FRCC) the property of the concrete was improved. The addition of fibres improves its toughness and energy absorption capacities for example using FRCC in bridging the cracks. The mechanisms is during loading, bridge the cracks and improve the toughness and reduce the crack width. However, the FRCCs are mostly manufactured by cement rich binder with limited use of supplementary cementitious materials (SCM) as partial replacement of cement. The CO2 production in high on the normal concrete members. The geopolymer mainly used to decrease production of CO2. The geopolymer contain high amount of silica and alumina content. The presence of high amount of silica content mainly increases the denoted property. To convert this concrete into high strength concrete purpose the various slag like copper was added or replaced by any material.

$$n(Si_2O_5,Al_2O_2) + nSi_2 + nH_2O \xrightarrow{NaOH,KOH} n(OH)_3 - Si - O - \underset{\underset{(OH)_2}{\downarrow}}{\overset{-}{Al}} - O - Si - (OH)_3 \quad (A)$$

$$n(OH)_3 - Si - O - \underset{\underset{(OH)_2}{\downarrow}}{\overset{-}{Al}} - O - Si - (OH)_2 \xrightarrow{NaOH,KOH} (Na^+,K^+) - \left(\underset{O}{\overset{|}{Si}} - O - \underset{O}{\overset{|}{Al}} - O - \underset{O}{\overset{|}{Si}} - O-\right) + nH_2O$$

Geopolymerization involves a heterogeneous chemical reaction between solidaluminosilicate oxides and alkali metal silicate solutions at highly alkaline conditions. The above are general reaction of geopolymerization.

2. NECESSITY OF GEOPOLYMER CONCRETE

While producing 1 ton of cement, approximately 1 ton of carbon di oxide will be ejected to the atmosphere, which is a major problem 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.

The Cement production generated carbon di oxide, which pollutes the atmosphere. The Thermal Industry produces a waste called flyash which is dumped on the earth, occupies larges areas. The waste water from the Chemical Industries is discharged into the ground which pollutes the ground water. By producing Geopolymer Concrete all the above mentioned issues shall be solved by rearranging them. Geopolymer concrete doesn't use any cement, the production of cement shall be reduced and hence the pollution of atmosphere by the emission of carbon di oxide shall also be minimized.

3.OBJECTIVE

The main target of this study is to analyze the carbon dioxide free cementitious material, various properties and their effects on Geopolymer concrete. .

4. CONSTITUENTS OF GEOPOLYMER CONCRETE

The following are the constituents of Geopolymer concrete

1. Fly Ash- rich in Silica and Aluminium
2. Sodium Hydroxide or Potassium Hydroxide
3. Sodium Silicate or Potassium Silicate

5. PROPERTIES OF GEOPOLYMER CONCRETE

The superior properties of Geopolymer concrete, based on Prof. B. Vijaya Rangan and Hardijito, are

1. sets at room temperature
2. non toxic, bleed free
3. long working life before stiffening
4. impermeable
5. higher resistance to heat and resist all inorganic solvents
6. higher compressive strength
7. Compressive strength of Geopolymer concrete is very high compared to the ordinary Portland cement concrete.
8. Geopolymer concrete also showed very high early strength. The compressive strength of Geopolymer concrete is about 1.5 times more than that of the compressive strength with the ordinary Portland cement concrete, for the same mix.

6. LITERATURE REVIEW

S. V. Joshi and M. S. Kadu thought about the Fly slag with mix of acid neutralizers like sodium hydroxide and sodium silicate can convey confining material depending on the characteristics of these fixings. The probability of eco-obliging usage of locally available flyfiery stays with financially open salts in the headway of feasible folio and the effect of various parameters on the compressive nature of geo-polymer concrete is examined in the present paper. The lab examinations under encompassing and grill dry relieving conditions suggested that locally available low calcium fly-searing garbage is suitable for headway of geo-polymer concrete and the compressive nature of geo-polymer concrete is a component of mass extent of fundamental liquid to fly-ash, mass extent of sodium silicate to sodium hydroxide and molar gathering of sodium hydroxide. Correspondingly the Geopolymer Concrete demonstrated great functionality as of the customary Portland Cement Concrete.

M.I. Abdul Aleem and P.D. Arumairaj thought about that Geopolymer solid uses a substitute material including fly soot as limiting material set up of bond. This fly searing remains reacts with solvent game plan (e.g., NaOH) and Sodium Silicate (Na2SiO3) to shape a gel which ties the fine and coarse sums. Since Geopolymer concrete is the creating field, the guidelines from the Bureau of Indian Standards are yet to be point by point. An undertaking has been made to find a perfect mix for the Geopolymer concrete. Strong 3D states of size 150 x 150 x 150 mm were orchestrated and relieved under steam restoring for 24 hours. The compressive quality was found at 7 days and 28 days. The results are thought about.The perfect mix is Flyash: Fine total: Coarse aggregate (1:1.5:3.3) with an answer (NaoH&Na2SiO3 solidified together) to fly searing remains extent of 0.35. High and early quality was gained in the Geopolymer strong mix.

Yasir Sofi and Iftekar 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. Jamdade and U. R. Kawade considered the quality of Geopolymer concrete by utilizing broiler restoring. In this investigation Geopolymer concrete is set up by blending sodium silicate and sodium hydroxide with handled fly fiery debris. The solid is restored at various condition and diverse temperatures i.e; 600C, 900C and 1200C in order to build the quality of cement. It was seen that higher restoring temperature brought about bigger compressive quality of Geopolymer concrete, despite the fact that an expansion in the relieving temperature past 600C did not expand the compressive quality generously. Likewise longer relieving time improved the polymerization procedure bringing about higher compressive quality of Geopolymer concrete.

Arya Aravind and Mathews M Paul completed research on mechanical properties of Geopolymer concrete strengthened with steel fiber. This investigation centers around the compressive quality and split elasticity of geopolymer concrete strengthened with steel fiber. Examinations were performed utilizing the Box– Behnken trial structure. Box–Behnken exploratory structure is a kind of reaction surface approach. Reaction surface approach is an exact streamlining procedure for assessing the connection between the test yields and factors called X1, X2, and X3. For getting the outcomes for Box Behnken structure, investigation of change has been determined to examine the openness of the model and was conveyed in Microsoft Office Excel 2007. It very well may be reasoned that compressive

quality of geopolymer concrete is bit by bit expanded with delayed relieving period likewise with the expansion of sodium silicate to sodium hydroxide fluid proportion by mass. Split rigidity of geopolymer concrete expanded as level of steel fiber expanded. Another imperative perception was acquired that restoring under typical daylight yielded quality of 16 N/mm2.

Kamlesh. C. Shah led inquire about on quality parameters and sturdiness of fly fiery debris based Geopolymer concrete. In this investigation, two cement blends are to be worked out; GPC Mix-1 fly powder cement and OPC Mix-2 Concrete blend having OPC proportional to measure of cementitious material utilized in GPC Mix-1. Diverse parameters were utilized, for example, soluble fluid to fly fiery debris proportion of 0.40 ,0.45 and 0.50, proportion of NaOH to Na2SiO3 2.0 and 2.5, molarities of NaOH; 10M ,12M, 14M and 16M. Compressive quality test, split tractable test, haul out test and sturdiness test were performed under encompassing temperature relieving conditions i.e; 600C, 900C and 1200C. Higher normal compressive quality, elasticity and haul out quality of 52.25, 4.10 and 10.25 N/mm2 were watched for cement GPC Mix-1 when contrasted with that of cement OPC Mix-2. The test outcomes demonstrated that broiler restored fly slag based geopolymer concrete have a brilliant protection from sulfate assault, salt assault and corrosive assault when contrasted with surrounding relieving. Minor increment in the mass of solid examples of blend has been seen due to the assimilation of the sulfate, corrosive and salt for solid Mix-1.

S. Jaydeep and B. J. Chakravarthy arranged an ideal blend for Geopolymer solid utilizing admixtures. Solid 3D shapes of size 150×150×150mm were set up to discover compressive quality at 7 and 28 days. Results demonstrated that the expansion of sodium silicate answer for the sodium hydroxide arrangement as an antacid activator upgraded the response between the source material and arrangement. Stove relieved example gives the higher compressive quality ascompared to coordinate daylight restoring. It was likewise seen that geopolymer concrete is increasingly worthwhile, prudent and ecofriendly strategy when contrasted and regular cement.

Shankar H. Sanni and R. B. Khadiranaikar completed examination on the variety of basic arrangement on mechanical properties of geopolymer concrete. The evaluations favored for the examination were M30, M40, M50 and M60; the blends were intended for 8 molar. The antacid arrangement utilized was the mix of sodium silicate and sodium hydroxide arrangement with the fluctuating proportion of 2, 2.5, 3 and 3.5. The test examples were 150x150x150 mm solid shapes and 100x200 mm chambers heat-relieved at 60°C in a broiler. The outcomes uncovered that the serviceable stream of geopolymer concrete was in the scope of 85 to 145mm and was reliant on the proportion by mass of sodium hydroxide and sodium silicate arrangement. The naturally arranged geopolymer blends were durable and their functionality expanded with the expansion in the proportion of basic arrangement. It was reasoned that the quality of geopolymer cement can be improved by diminishing the water/authoritative and total/restricting proportions. Compressive quality and split elasticity got were in the scope of 20.64-60N/mm2 and 3-4.9 N/mm2.

Benny Joseph and George Mathew done the impact of total substance on the designing properties of Geopolymer concrete. Impact of different parameters, for example, restoring temperature, time of relieving, proportion of sodium silicate to sodium hydroxide, proportion of soluble base to fly cinder and molarities of sodium hydroxide were additionally examined. In light of the investigation completed, it very well may be presumed that a geopolymer concrete with legitimate proportioning of all out total substance and proportion of fine total to add up to total, alongside the ideal estimations of different parameters, have preferred building properties over the relating properties of common bond concrete. Contrasted with conventional bond concrete, 14.4% upgrade in modulus of flexibility and 19.2% improvement in Poisson's proportion could be accomplished in geopolymer concrete.

Aminul Islam Laskar and Rajan Bhattacharjee researched the variety of functionality of fly fiery remains based Geopolymer concrete with the variety of lignin based plasticizer and poly-carboxylic ether based superplasticizer. It has been seen that there exists a basic estimation of molar quality of sodium hydroxide past which superplasticizer and plasticizer have unfriendly impact on usefulness of fly slag based geopolymer concrete. There is an expansion in droop beneath the basic molar quality of sodium hydroxide. Lignin based original plasticizer indicates better execution as far as functionality over third era superplasticizer underneath the basic estimation of molar quality. It was likewise seen that here is a decent connection between's the rheological parameters and droop for fly fiery debris based geopolymer concrete consolidating plasticizer and superplasticizer.

Steenie Edward Wallah utilized low-calcium fly cinder as its source material, soluble activators and totals regularly utilized for Ordinary Portland bond concrete. Four arrangement of test examples with various compressive quality were set up to investigation the drying shrinkage of this solid. Results got were contrasted and the determined aftereffects of drying shrinkage as anticipated by Gilbert Method which is typically utilized for Ordinary Portland bond concrete. Results demonstrated that the warmth relieved fly powder based geopolymer concrete experiences exceptionally low drying shrinkage. The drying shrinkage resist one year as determined utilizing Gilbert Method was a lot higher, around five to multiple times, contrasted with the deliberate drying shrinkage strain.

7. Limitations

• Geopolymer concrete did not harden immediately at room temperature as in conventional concrete.
• Geopolymer concrete specimens took a minimum of 3 days for complete setting without leaving a nail impression on the hardened surface. These two limitations of geopolymer concrete mix was eliminated by replacing 10% of fly ash by OPC on mass basis with alkaline liquids resulted in Geopolymer Concrete Composite and are considered as drawbacks of this concrete to be used for practical applications

3. CONCLUSIONS

From the past research thinks about, it very well may be continuation that:
The diminished CO2 emanations of Geopolymer concretes manufacture them a decent option in contrast to Ordinary Portland Cement. Geopolymer bond delivers a substance that is practically identical to or superior to customary bonds as for generally properties. Higher convergence of sodium hydroxide arrangement results in higher compressive quality of geopolymer concrete. Geopolymer concrete includes fantastic properties inside both corrosive what's more, salt situations. Low calcium fly slag based geopolymer concrete has superb compressive quality, presentation to forceful condition, usefulness, introduction to high temperature and is appropriate for auxiliary applications.

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