"FLY ASH BASED GEOPOLYMER CONCRETE"

Ankalkote Avinash R.[1], Bhise Sachin B.[2], Gaikwad Akash P.[3], Latpate Shrikrushna J.[4], Guide-Prof. Ghodke Arjun.[5], Prof. Hake Sandip[6]

[1] UG Student, Civil Engineering, G.H.Raisoni COEM, Ahmednagar, Maharashtra, India
[2]UG Student, Civil Engineering, G.H.Raisoni COEM, Ahmednagar, Maharashtra, India
[3]UG Student, Civil Engineering, G.H.Raisoni COEM, Ahmednagar, Maharashtra, India
[4]UG Student, Civil Engineering, G.H.Raisoni COEM, Ahmednagar, Maharashtra, India
[5]Prof, Civil Engineering, G.H.Raisoni COEM, Ahmednagar, Maharashtra, India
[6]Prof, Civil Engineering, G.H.Raisoni COEM, Ahmednagar, Maharashtra, India

ABSTRACT

Cement industries is the major contributor to GDP. Now a day the demand of infrastructure is increasing. From recent years man is facing problem like increasing population, change in environment and reduction of natural resources. A part from this there is need of infrastructure development. Main part of infrastructure is cement, but it has some environment related problem so t o reduce these kinds of problems there is need of alternate building material like geopolymer concrete, which bring development economically, socially, environmentally. Cost of geopolymer concrete is less than cement concrete and it is also safe to environment, with these views we are attempt to replace the cement. Thus paper presents the study of geopolymer concrete.

Keyword: -*Fly ash (Class 'C'), GGBS (Ground Granulated Blast Furnace Slag), Potassium Hydroxide (KOH),Potassium Silicate (K_2Sio_3), etc…*

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1. INTRODUCTION

1.1 General:

India is a developing country and it is developing in various sectors. Infrastructure is one of the important part of it. For that the construction industry has grown up rapidly. As the number of construction industry increases the use of cement concrete also grown astronomically and it will continue to grow as the result of continuous urban development. Ordinary Portland cement is conventionally used as the primary binder to produce concrete. By comparing the cement concrete with other construction material it have many benefits like easily available material, strength and durability, versatility, affordability, low maintenance, making process is easy etc. Though the cement concrete has such advantages it has some disadvantages also such as low tensile strength, less ductility and it creates environmental pollution. Concrete, as a major construction material, is being used at an ever increasing rate all around the world. Almost all of this concrete is currently made using OPC, leading to a massive global cement industry. Every year the production of Portland cement is increasing with the increasing demand of construction. Therefore the rate of production of carbon dioxide released to the atmosphere is also increasing.The production of cement releases the Co_2 which increases the global warming.Co_2 contributes 65% of global warming(McCaffery,2002).The cement industry is responsible for about 6% of all co_2 emission,because the production of one tonne of portland cement releases one tonne of co_2 into the atmosphere. On the other side, fly ash is the waste material of coal based thermal power plant, available abundantly but pose disposal problem. Several hectors of valuable land is acquired by thermal power plant for the disposal of fly ash. As it is light in weight and easily flies, creates severe health problems like asthma, bronchitis, etc.

The survey shows the total production of fly ash in the world is about 780 million tons per year after 2010. In India more than 100 million tons of fly ash is produced annually, out of which 17 – 20 % fly ash is utilized either in concrete as a part replacement of cement or workability improving admixtures or in stabilization of soil. There are environmental benefits in reducing the use of Portland cement in concrete, and using a by-product cementitious material, such as fly ash, silica fume, ground granulated blast furnace slag, rise husk ash, etc. as a partial substitute. With silicon and aluminum as the main constituents, fly ash has great potential as a cement replacing material in concrete. The concrete made with such industrial wastes is eco-friendly and hence called as "Green concrete". Some fly ash is utilized in the production of Portland pozzolana cement or part replacement of cement in concrete.

1.2 Geopolymer Concrete :-

In 1978, Davidovets proposed that an alkaline liquid can be used to react with sub-product material to create binders such as cylindone (C) and Aluminum (AL) as well as flyash and GGBS. Geopolimer concrete is a new material in which cement is completely replaced by pozzolanic materials which are rich in silicon (C) and aluminum (Al) fly ash.It is activated by highly alkaline fluids so that the binder can be constructed which binds the set in concrete when subject to high temperatures. Geoplymers were developed as a result of research in heat-resistant material after a series of horrific fires. In this research non-combustible and non-combustible jeepolymer resins and binsers were produced. Bhupolimar is being studied extensively and Portland cement shows promise as a green alternative for concrete. Research is moving from the domain of chemistry to the commercial applications of engineering applications and Bhupolimar. It has been found that Geopolymer concrete has good engineering properties. The chemical process involved in this case is polymerization. Polymerization process related to a chemical reaction between polymerous aluminum-silicon rich minerals like fly ash under highly alkaline conditions at high elevation temperature, polymerization of C-O-AL-O bond yield. Alkaline fluids are usually sodium or potassium-based. In our project, we have used potassium hydroxide (KOH) and potassium silicate (K_2Sio_3).

2.Material Used

2.1. Flyash

Flyash is one of the naturally-occurring products from the coal combustion process and is a material that is nearly the same as volcanic ash. Volcanic ash concrete was used thousands of years ago to produce Roman concrete structures that exist and function today; e.g., the Pantheon, Coliseum, and ancient aqueducts. When coal is burned in today's modern electric generating plants, combustion temperatures reach approximately 2800°F. The non-combustible minerals that naturally occur from burning coal form bottom ash and fly ash. Bottom ash is a light-weight aggregate material that falls to the boiler bottom for collection. Fly ash is the material that is carried off with the flue gases, where it is collected and can be stored in silos for testing and beneficial use classification

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2.2. Aggregate :

Coarse Aggregates are crushed, angular of two size 20mm and 12.5 mm is going to be used. Two sizes crashed, angular coarse aggregates is

C.A-I = 20 mm (70%)
C.A-II = 12.5 mm (30%)

2.3. Water :

In this project, casting and curing of specimens were done using potable water which shall be free from deleterious materials. Water plays role only to prepare Potassium Hydroxide.

2.4. Potassium Silicate :

Potassium silicate is the name for a family of inorganic compounds. The most common potassium silicate has the formula K2SiO3, samples of which contain varying amounts of water. These are white solids or colorless solution.

2.5. Potassium Hydroxide :

Potassium hydroxide, also known as potassium hydrate and caustic potash, is a strong alkaline chemical available in pellets and flakes. With the chemical formula KOH, potassium hydroxide is one of the compounds people call lye. Potassium hydroxide is included in cleaning products, and has uses in industry and in medical diagnostics.

3. REASEARCH REVIEW

3.1. Research Performed By Various Investigators:

A.T.Sayyad, and S. V. Patankar (2013), *"Effect of steel fibre s and low calcium fly ash on mechanical and elastic properties of geopolymer concrete composites".*

In this paper, the impact of steel fiber and low calcium fly ashes on the mechanical and elastic properties of ground-resin concrete mixed was studied. Test tested fresh tablets such as flow table test, wet density and dry density and they analyzed the effect of stratric fiber and low calcium fly ash, such as concrete on the strength of the compact strength, flexile split tensile strength and geopolimer concrete mixed bond strength. The results of the test show that the function of the Bhavalimar concrete including steel fiber decreases with increase in fiber content and the addition of steel fiber increases the density of the jeepolymer concrete. Apart from this, the author stated that the optimum fiber content for the maximum value of geopololer concrete with different strengths is 0.2%.

Fareed Ahmed Memon, Muhd Fadhil Nuruddin, Sadaqatullah Khan, Nasir Shafiq, Tehmina Ayub (2013), *"Effect of sodiumum hydroxide concentration on fresh properties and compressive strength of self-compacting geopolymer concrete".*

This paper studied the impact of sodium hydroxide concentration on the fresh properties and the compressed power of self-compacting geopolymer concrete (SCGC). The concentration of sodium hydroxide was used separately from 8 m to 14 m. Test methods like slam flow, V-funnel, L-box and Jering were used to assess the performance characteristics of the SCGC. The test samples were fixed at 70 degree Celsius for a 48 hour period and then kept in room temperature until the test day. Infectious strength test was done at the age of 1, 3, 7 and 28 days The test results show that the concentration variation of sodium hydroxide has minimal impact on the fresh properties of the SCGC. With the increase in sodium hydroxide concentration, the functioning of fresh concrete was slightly reduced; However, this increased compressed power had increased. Concrete samples of 12 m sodium hydroxide concentration have the maximum transmissible power.

Ganpati Naidu.P, A.S.S.N.Prasad, S.Adiseshu, P.V.V.Satayanarayana (2012), *"A study on strength properties of geopolymer concrete with addition of G.G.B.S".*

In this paper, the strength properties of the geopololor concrete mixture have been studied with Gobbs, which had become percent to fly in ash. The authors suggested that instead of monomer, sodium silicate solution obtained in the market is in the form of slow or trimmer, and in combination with sodium hydroxide helps in the polymerization process. It was seen that Bhavilamma increased the percentage of lava (GGBS) for jumping with cumulative capacity of concrete. 90% of the Geopolymer Concrete was acquired within 14 days. Growth of Lava (GGBS) increases with the increasing tensile strength of concrete gypsolimer increases tissue in the age of geopolymer concrete, as an increase in mill growth (GGBS), there is a significant increase in flex strength in ash. It was also found that with the increase in lava material the time for the establishment of concrete was reduced.

K.Vijai, R.Kumutha, and B.G.Vishnuram (2012), *"Experimental investigation on mechanical properties of geopolymer concrete composites".*

In this letter, the authors told that there are limitations in Bhupolimmar concrete, such as the delay in setting the time and the need for heat to gain strength. In order to eliminate these limitations in the Bhupolimar concrete mixture, 10% fly ash was replaced by general portland cement. The results of the test showed that in the context of Geopolimer concrete mix in the replacement of 10% fly ash by normal portland cement in the jeepolimer concrete mixture, an increase of 73%, 128% and 17% respectively. Apart from this, the authors pointed out that geo-polymer enhanced its mechanical properties such as compactive strength, division tensile strength and flexural strength, by adding fiber to 0.25% to 0.75% by concrete volume in concrete composites.

M.A.Bhosale, and N.N.Shinde (2012), *"Geopolymer concrete by using fly ash in construction".*

In this paper, the factors that have been introduced are that the early ages of the solid particles of geography affect infectious power such as sodium hydroxide in this letter, there is also an arrangement for activation of fly ash with alkaline solution. Alkaline catalyst was used as sodium hydroxide and sodium silicate solution. In the proportion of 0.3 9 and 2.5 values compared to Naosio and NOAH, the test was conducted to check the mechanical properties of geopolimer concrete, such as compact strength, division tensile strength, flexural strength, rebound hammer test, Acid-resistant test temperature for ambient temperature and oven. It was seen from the results of the test that compared to the ambient temperature, there was more pressurized power for oven dry temperatures. With this, it was seen that the strength of the compressor increases as the increase in sulfur hydroxide jerusalems.

V. Sathish Kumar, B. S. Thomas, and A. Christopher (2012), *"An environmental study on the properties of glass fibre reinforced geopolymer concrete".*

In this letter, the authors stated that fly ash, alkaline and glass fiber which contain mechanical properties of Bhupolimar Solid Composite (GPCC). They found that the density of Jeepolimer concrete mixed was almost equal to conventional concrete. In the Bhupolimar Concrete Mix, in respect of geopolimer concrete, increase in compressed power, fructal strength and split tensile strength by fiber percentage to fiber percent by the amount of concrete.

R. Anuradha, V. Sreevidya, R. Venkatasubramani, and B. V.Rangan (2012), *"Modified guidelines for geopolymer concrete mix design using Indian standards".*

In this paper, the authors presented revised guidelines for the design of Geopololer Concrete mixture, which were relevant to IS 10262-2009. Apart from this, the authors examined the applicability of existing mix design with Bhololimer concrete. In this study, 100% cement was replaced with Class F fly ash and 100% sand was replaced by M-Rad. With the help of testing and error methods, the authors get successful results in the preparation of low calcium fly ash based geo-chemical concrete. Apart from this, the authors said that Bhupolimar concrete is an excellent option for ordinary portland cement and it is advisable to treat heat for Bhayololimar concrete. Apart from this, Bhupelimiar concrete has excellent compression power with one day and is suitable for structural application. It has also been observed in this study that the result of the compactive power obtained for M-RED is less than the river's sand.

S. V. Patankar, S. S. Jamkar, and Y. M. Ghugal (2012), "*Effect of sodium hydroxide on flow and strength of fly ash based geopolymer mortar".*

This paper studied the effect of the Jeepolimer Binder ratio with water on the production of fly ash based Bhupolimmer concrete. The authors of this study make changes in the amount of water in the mixture without disturbing the mixture mixture and test the mechanical properties of fresh concrete and hard concrete. It is found that maintaining the other parameters increases the flow of geopolymer concrete growth with increasing water-to-jeepolymer binder ratio. Mean high ratio gives different mix whereas low ratio gives sticky and dry mix. It has also been found that the compressed power of the Bhupolimar concrete decreases as a proportion of the increase in water-to-jeepolimer binding. And it has been said that the appropriate range of water-to-jeepolymer binder ratio was between 0.24 and 0.35.

S. V. Patankar, S. S. Jamkar, and Y. M. Ghugal (2012), *"The effect of partial replacement and full replacement of cement by low calcium fly ash".*

This paper studied the effect of partial replacement and full replacement of cement by two calcium fly ash in two steps. It was found that with the increase in the replacement of cement by fly ash, the compactive strength decreases. Replacement of up to 40% of cement, initial power is less, but in 60 days of treatment the strength is similar to conventional concrete during at least 28 days of treatment. Beyond 40% replacement of cement, efficiency and strength has decreased and time has been decided to increase. Beyond 60% replacement of cement, demand for water increases the difficulty in the mix, it takes more time to get rid of cubes and to gain strength.

Shankar H. Sanni, and Khadiranaikar. R.B. (2012), *"Performance of geopolymer concrete under severe environmental conditions".*

This paper presented the demonstration of geopolimer concrete under severe environmental conditions. Geographic Simulation (GPC) is in the form of a binding machine in the form of inorganic polymer of alumino-silicate, while in conventional concretes the Portland Cement (P-C) C-S-H gel (next to the free lime) is generated . It is well known that the mechanisms of attack by Sulfuric Acid and Magnesium Sulfat are different. Typically conventional concretes are not resistant to long-term contact for high concentration of these solutions, as the deciphetion of C-SH will occur. As a result of this, the OPC solid surface becomes soft and can be removed, thus, the internal concrete layers can be exposed for degradation. Due to the magnesium sulphate attack at the same time, the reason for the D-certification of C-SH is due to magnesium silicate hydrate (M-S-H). It also destroys the binding capacity of CHH and leads to loss of adhesion and strength in concrete. Due to the durability of the samples, separation of GPC samples in 10% sulfuric acid and 10% magnesium sulphate solutions, periods of surface degradation and depth of docligation, changes in weight and strength during the period of 15, 30 and 45 days. Were monitoring The results of the test show that compared to conventional concrete, there is excellent resistance to fly ash-based Bhupolimer concrete acid and sulphate attack from the heat. In this way we can say that the production of geopolymer is a relative high strength, excellent quantity stability and better stability.

Venkateswararao J., Srinivasa Rao K., Rambabu K., and Brahma Reddy T. (2011), *"Comparative study on mechanical properties of geopolymer and their composites".*

This paper saw the effect of steel fiber on the functioning and mechanical properties of geographic pump concrete composites (GPCC). Includes 80% fly ash and 20% granulated blast furnace slag in GPCC. Steel fiber was added to mix in 0.25%, 0.5%, and 0.75% volume of concrete. It was found that the boundaries of the GPC are delayed especially in determining the time and the heat treating system can be removed from the place of 20% fly ash with GGBS. It was found that due to the increased fibers, the function value decreases. By replacing 20% fly ash by GGBS, improved mechanical properties such as compact strength, splitting tensile strength, and flexural strength. Increasing the strength of the flow of steel fiber compactive strength, division tensile strength, GPCC, increased heat compared to GPC under heat treatment.

N.A.Lloyd, and B.V.Rangan (2010), *"Geopolymer concrete: A review of development and opportunities".*

This paper studied Geopolymer Mix Design Development so that the capacity and strength of the Geopololer concrete could be increased. Impact of factors such as temperature and governance treatment, overall size, strength, moisture content, preparation and grading on work and strength. In this study the mix ratio was characteristic of alkaline fluid for throwing ash from mass of 0.35 and was partially flown for a total mass ratio of about 75% with nominal power. Samples were cured under the treatment of steam. They have placed thermoplasts in three different sized samples to measure the actual temperature that arises inside the solid samples. They examined the effect of treating steam by delaying the increase of the strength of the jeepolimer concrete, they found that adding 24 hours before the treatment or the day of rest enhances the compact power of the mixture. Apart from this, he found that the reduction in fines resulted in an increase in recession. There was no fraction of the mix with a lower penalty percentage; Although the compressed power decreased

Nguyen Van Chanh, Bui Trung, Dang Van Tuan (2008), *"Recent research geopolymer concrete".*

In this paper, the result of the study material, the composite composite, the microstructure of the geographic pump and the parameter affecting the properties of the paroparimer concrete were presented. They found that a three-dimensional polymer chain and ring structure made of CO-O-Al-O bond were constructed. Geopolicimer used polycondensation of silica and alumina preders and high alarse materials to achieve structural strength. The author also studied that the temperature of the growing temperature of the jeepolimer concrete increases from 60 degrees Celsius to 90 degree Celsius; the compressed power of fly ash based Bhupolimmer concrete also increases. And the fly ash based compact power of heat depends on the age of the Bhupolimmar concrete. There is excellent suitability and durability between the ash-based mucilage solid concrete fly acid and salt environment.

D.Hardjito, and B.V.Rangan (2006), *"Development of fly ash-based geopolymer concrete: progress and research needs*".

In this letter, the development of low calcium fly ash based Bhupolimmer concrete was studied. The author of this study examined the mechanical properties of fresh and harsh Bhupolimer concrete. They noticed that the mixture of fresh fly ash based Bhaukolimmar concrete growth has increased with the addition of additional water, but as the proportion of water from the mass reduces the fly ash based geo-chemical concrete for the mass of the species, It has been found that the fresh concrete can be easily controlled for 120 minutes, without any signs and no sharpening in the strength. It has also been found that combining the concentration of sodium hydroxide increases the growth of fly ash-based Bhupolimmar concrete, and the proportion of sodium hydroxide increases with sodium silicate on a large scale, the compressive strength of concrete increases also.

Susan, Bernal; Ruby, De Gutierrez; Silvio Delvasto; Rodriguez (2006), *"Performance of geopolymeric concrete reinforced with steel fibers".*

In this paper, the development of fracture cruelty in the early years of reinforced Bhololymer concrete with steel fiber was studied. The results of the test indicate that the incorporation of steel fibers in the geo-polymer concrete reduces the compressed power in the younger age and the tensile strength, flexural strength and toughness of the split are greatly increased, besides the authors saw that similar portland cement The strength and cruelty of Bhanolimar was comparable to that of the solid steel fiber with the same ratio of binder and steel fiber.

4. ACKNOWLEDGEMENT

It is an opportunity of immense pleasure for us to present the paper **"FLY ASH BASED GEOPOLYMER CONCRETE"**.The credit goes to our project guide **Prof. S. L. Hake** and H.O.D. of Civil Engineering **Prof. M. N. Shirsath** whose positive attitude, moral support and encouragement lead to the success of the project.We are also graceful to our project coordinator **Prof. S. L. Hake** for his guidance and valuable suggestions, important to us from time to time. We are also thankful to our principal **Prof. M. S. Uttarwar** for being very generous with his advice and encouragement.

Mr. Ankalkote Avinash R

Mr. Bhise Sachin B.

Mr. Gaikwad Akash P .

Mr. Latpate Shrikrushna J .

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