



IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

e-ISSN: 2319-8753 | p-ISSN: 2320-6710



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 5, May 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118



9940 572 462



6381 907 438



ijirset@gmail.com



www.ijirset.com

Flyash Mortar using Naoh and Na₂Sio₃

Asst. Prof. Hindola Saha¹, Rhutvik Sapkal², Sumant Done³, Akash Sule⁴, Umesh Futwaik⁵

Professor, Dept. of Civil Engineering, Dr. D. Y. Patil School of Engineering and Technology, Lohegaon, Pune, India¹

Student (U.G.) Dept. of Civil Engg. Dr. D. Y. Patil School of Engineering and Technology, Lohegaon,

Pune, India²³⁴⁵

ABSTRACT: Concrete is most used material, which required large quantities of Portland Cement. Ordinary Portland Cement production is the second only to the automobile as the major generator of carbon dioxide, which polluted the atmosphere. In addition to that large amount of energy was also consumed for the cement production. Hence, it is inevitable to find an alternative material to the existing most expensive, most resource consuming Portland Cement. Geopolymer concrete is an innovative construction material which shall be produced by the chemical action of inorganic molecules. Fly Ash, a by-product of coal obtained from the thermal power plant is plenty available worldwide. Fly ash is rich in silica and alumina reacted with alkaline solution produced aluminosilicate gel that acted as the binding material for the concrete. It is an excellent alternative construction material to the existing plain cement concrete. Geopolymer concrete shall be produced without using any amount of ordinary Portland cement. This paper briefly reviews the constituents of geopolymer concrete, its strength and potential applications.

KEYWORDS: concrete ,testing chemical

I. INTRODUCTION

Concrete is the most used construction material worldwide, and ordinary Portland cement (OPC) is one of its most essential components. At present, Portland cement is an important material for manufacturing concrete. Concrete production fulfills the global demand of over 1.5 billion tons annually. The production of Portland cement releases a significant volume of carbon dioxide (CO₂) to the atmosphere, and it is also energy intensive. For each ton of synthetic Portland cement, one ton of CO₂ is estimated to be emitted into the environment. The process embraces high temperatures (1400–1500 °C) and quarry demolition to extract raw materials, and the process causes the release of greenhouse gases such as CO₂. The costs related with these energy requirements are significant. Thus, further investigation is needed. In addition to the necessity of large land area for the fly ash disposal, the use of OPC as the primary binder in every building construction is also a well-known environmental issue. Given the continuous growth of construction development, the use of cement materials in construction works is also increasing directly. This condition will increase the demand of OPC production throughout the world. This rising demand contributes roughly 7% of the total greenhouse gas emissions to the atmosphere. Indirectly, this situation causes global warming that negatively affects the planet. Therefore, alternatives must be established to reduce OPC production. Readily available commercial by-products, such as blast furnace slag and fly ash, have been adopted to meet these demands. By the 2010, roughly 780 billion tons of fly ash were produced. Recycling will improve disposal and concrete manufacturing costs. A considerable electrical power supply is needed for various uses because of modern population growth and rapid development. One of the major sources of power generation is from thermal power plant (TPP). The by-products from these power plants typically contain a fine material type called fly ash and a coarse material type called bottom ash. Disposal of fly ash is a primary problem and requires considerable land area. As the cost and land requirement are increasing, these by-products should be reused for another purpose. Davidovits proposed that aluminum (Al) and silicon (Si) react with alkaline liquid from a geological source or by-product materials, such as rice husk ash and fly ash, to produce paste. Polymerization process.

Is the chemical reaction referred to in this study, and the term geopolymer is used to describe the paste production. The production of geopolymer concrete does not use Portland cement. Geopolymer is a type of inorganic polymer that is produced by the reaction of aluminosilicate materials with alkaline liquid. Geopolymer has shown many excellent properties, such as good resistance against acid and sulphate attacks, high early strength, and good performance in high temperature. Geopolymer does not use cement, and it reduces the emission of greenhouse gas by 44–64%. Furthermore, certain wastes and by-products, such as blast furnace slag and fly ash, are appropriate sources of aluminosilicate, which are used to produce geopolymer. Given that geopolymers are made from by-product materials, they have lower environmental impact in comparison to other types of concrete binders. The rapid

growth of development has caused the imbalance of the storm water management in Malaysia. As natural areas are build up over urbanization storm, water run off flow and volumes are significantly increased. These conditions are caused by the increase of impermeable land cover and decreased frequency of flooding that occurs downstream of the urban drainage system as well as the increased potential for stream bank erosion because of high flow velocities. Thus, the water quality is degraded in general and contributes to drastic changes in streambeds. The large percentage of impervious surface is noted to contribute to another form of pollution. In this study, the main purpose is to design a concrete that allows water to pass through raining water and pavement. This type of pavement can reduce the skid resistance and provides safety to the users. Compared to normal concrete, the pervious concrete is a special concrete that contains voids and possesses high water permeability. It has been developed as an environment friendly material that is used in permeable pavement, water purification, thermal insulation, acoustic absorption, and other applications in civil engineering and architecture. Generally, the void content is between 15% and 35% with sizes of connected pore in pervious concrete that ranges from 2 mm to 8 mm in diameter, and the compressive strength is between 2.8 MPa and 28.0 MPa. The high porosity is attained by highly interconnected void content. High void content of pervious concrete allow water to drain naturally in the range of L/min/m² 81 to 730 L/min/m², and this can remove the normal surface-water drainage infrastructure, reduce the runoff from a site, and allow ground water recharge when conventional concrete does not. It can be used in the pedestrian walkways, park areas, tennis courts, greenhouses, areas with light traffic, and other civil engineering and architectural works Typically, pervious concrete consists of CA, binder, and admixture. Generally, the binding material that is used in pervious concrete is Portland cement, and further investigation on the use of other binding materials, such as geopolymer binders, in pervious concrete is still needed. Therefore, this study focuses on the use of a fly ash as a source material, sodium silicate and sodium hydroxide solution as an alkaline solution, and CA for making pervious geopolymer concrete. The water permeability and compressive strength of the pervious geopolymer concrete were tested. The obtained data will undoubtedly be beneficial for the future use of fly ash geopolymer in the construction of pervious concrete. Thus, this will lead to the reduction of cement consumption and environmental problems.

II. OBJECTIVES

Main objectives of the projects are as follows :

- To study the effect of change in molarities of NaOH on strength of cement concrete.
- Alternative to OPC concrete.
- To study the effect of curing temperature and curing period on Geopolymer concrete.
- To determine strength and workability by adding partial conventional cement along with it.
- To determine strength and workability by adding admixtures in it.
- To compare properties with conventional concrete.
- Substantial curb on production of carbon dioxide, As 01 MT (Metric Tonne) of CO₂ is released with every 1MT of OPC produced.
- Durable infrastructures with design life of 100 of years (resistance against chemical attack).
- To study literature available on Geopolymer concrete and Pervious concrete.

2.1 Scope of project :-

The investigation of using partial replacement of cement with the combination of Rice husk ash (RHA) and slag/super cane bagasse ash (SCBA) and fine aggregate with waste foundry sand (WFS). Further more, to find optimum proportion for each material in case of having a good efficiency on cost, mechanical properties of concrete (compressive strength, tensile strength, flexural strength, permeability and (workability). Using of them benefits in reducing the environment pollution and emission reduction during the disposal of excess these materials. Ordinary Portland Cement is costly material, so the partial replacements of these materials reduces the cost of concrete. Finally, complete content and organizational editing before formatting. Please take note of the following items when proof reading spelling and grammar

2.2 Problem statement:-

Research on fly ash based geopolymer is gradually increased throughout the years. There is a trend that geopolymer concrete will be replacing conventional concrete as it is more environmental friendly and more cost effective. The



dependable characteristic of geopolymer shows that it has a relatively high strength compared to the ordinary concrete. However, crack occurs most of the time in concrete after a certain period. It occurs more significantly especially after an exposure of high temperature (Kong et al., 2009). It occurs in geopolymer concrete as well. Strength characteristic of a geopolymer concrete is reduced after high temperature exposure because the propagation of cracks increased. The life span of a geopolymer structure is shortened and the weakened structure is not able to provide its designed service duration. At worst, it will lead to a structural failure with undesired casualties or deaths. Hence, in order to cater the problems, a proposal of combustion based self-healing agent, silica gel is used. Structures like tunnel or concealed structures have the tendency that will expose to high temperature as the heat is trapped. It is not very convenient and the maintainer is exposed to high risks when maintenance is needed in such area with high temperature. Geopolymer structures with self-healing attribute will heal the cracks whenever exposed to high temperature for a certain period. It will be an alternative for the construction of concealed areas where the maintenance is not able to access at ease. Geopolymer does not have autogenous healing. Hence, when it exposed to extremely high temperature, non-evaporable water will leave the geopolymer. It will trigger shrinkage where it leads to cracking. As the time goes on, it will lead to failure. If this problem occur in the structure, it will cause damages and become a disaster to the environment. This research proposed is to study the inclusion of silica gel as self-healing agent as it is expected to heal the cracks in geopolymer when exposed to extremely high temperature.

III. METHODOLOGY

Materials :

Following materials are used for making Concrete:

- a. The raw materials for pervious geopolymer concrete mixes are sodium hydroxide, sodium silicates (as alkaline solution), CA, and FA. Fly ash was collected from the Sangkat power plant in Kuching Sarawak. Three sizes of CA ranging from either 5 mm to 10 mm, 10 mm to 14 mm, or 14 mm to 20 mm were used in geopolymer pervious concrete mixes. The specific gravity of the natural aggregate was 2.63. The water absorption of the natural aggregate was 2.76% in saturated surface, and a dry condition was used for making pervious geopolymer concrete
- b. Sand – Sand size less than 4.75mm size were used as fine aggregate (sp.gravity 2.69).
- c. Coarse Aggregate – Hard granite broken stones of size 20mm were used as coarse agg. (Sp.gravity-2.75).
- d. Water – Locally available portable water conforming to IS 456 is used.

• 3.2 Methodology

The methodology for producing a self-healing concrete involves the following steps:

1. Selection and cultivation of chemical.
2. Preparation of test specimens.
3. Characterization studies

Compression Test :

Concrete is characterized by its compressive strength. It is important property of concrete, which indicates the overall quality of concrete. In practice concrete is mostly employed to resist compressive stresses. The testing is done as per IS 516-1959 Methods of test for strength of concrete. The strength is calculated by dividing the load applied with the area of the cube. Following are the compressive strength obtained for various volume of bacterial Solution. As per IS 456-2000 the compressive strength for M30 grade of concrete should not be less than 30MP



IV. RESULT

Description	Cube Notation	Weight of cube (Kg)	Compressive Strength (N/mm ²)	Average Compressive Strength (N/mm ²)
Conventional Concrete Cube	CC1	4.445	15.75	15.75
	CC2	4.395	16.30	
	CC3	4.668	15.20	
Fly ash cube with chemical of sodium hydroxide and sodium silicate	FC1	4.437	17.19	17.39
	FC2	4.512	18.10	
	FC3	4.530	16.90	

2.3 Table for 3 Days Compressive Strength of Concrete

Description	Cube Notation	Weight of cube (Kg)	Compressive Strength (N/mm ²)	Average Compressive Strength (N/mm ²)
Conventional Concrete Cube	CC4	4.542	22.30	22.10
	CC5	4.437	21.90	
	CC6	4.530	22.10	
Fly ash cube with chemical of sodium hydroxide and sodium silicate	FC4	4.585	23.32	23.17
	FC5	4.377	22.60	
	FC6	4.515	23.60	

Table for 7 Days Compressive Strength of Concrete**V. CONCLUSION**

Geopolymer mortar is the best alternative to the cement mortar which utilized the industrial waste and help in reducing environmental pollution.

- Higher concentration of sodium hydroxide solution in terms of molarity, results in higher workability and compressive strength.
- But higher concentration of NaOH solution gives viscous mix which ultimately reduces workability specifically after 13M NaOH concentration.
- Higher solution-to-fly ash ratio did not show significant variation in compressive strength of geopolymer mortar at later stage of curing.

REFERENCES

1. Salaheddin Abdulsalam Arafat¹, Ahmad Zurisman Mohd Ali^{1,*}, Siti Nazahiyah Rahmat² and Yee Loon Lee {Optimum Mix for Pervious Geopolymer Concrete (GEOCRETE) Based on Water Permeability and Compressive Strength} 01024 (2017)
2. Ahmad Zurisman Mohd Ali^{1,a} and Jay Sanjayan² { The Spalling of Geopolymer High Strength Concrete Wall Panels and Cylinders Under Hydrocarbon Fire } 02005 (2016)



3. Satish D. Kene¹ , Pravin V. Domke² , Sandesh D. Deshmukh³ , R.S.Deotale⁴ { Assessment Of Concrete Strength Using Flyash And Rice Husk Ash} Vol.1, Issue 3, pp.524-534
4. Prakash R. Vora Urmil V. Dave { Parametric Studies on Compressive Strength of Geopolymer Concrete} 2013 (2010 – 2019)
5. Farah Farhana , Mohd Mustafa Al Bakri Abdullah { Effect of geopolymer paste on compressive strength, water absorption and porosity }
6. K. Vijai R. Kumutha and B. G. Vishnuram { Effect of types of curing on strength of geopolymer concrete }
7. M. I. Abdul Aleem¹ , P. D. Arumairaj { Geopolymer concrete- a review}
8. B. Singh , Ishwarya G., M. Gupta, S.K. Bhattacharyya { Geopolymer concrete: A review of some recent developments }
9. Venkatesh. K¹ , Dr S.Arivalagan { A Review Paper on Geopolymer Concrete Using Hollow Core Slab } 2348-9480
10. Hemn Qader Ahmed, Dilshad Kakasor Jaf & Sinan Abdulkhaleq Yaseen { Flexural Capacity and Behaviour of Geopolymer Concrete Beams Reinforced with Glass Fibre-Reinforced Polymer Bars }



Impact Factor: 8.118



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details