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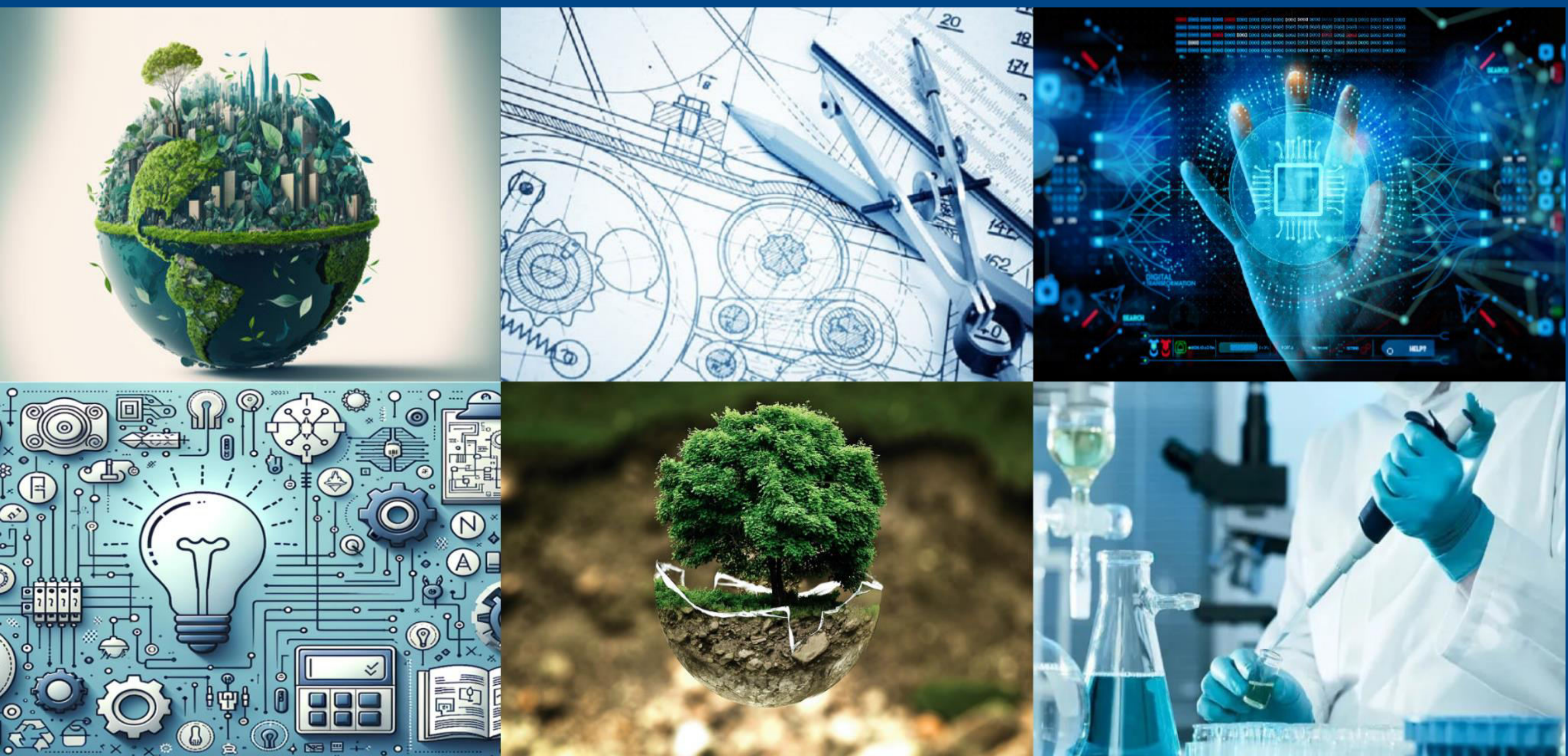

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Innovative Ferrocement Water Tank with Geopolymer Matrix and Artificial Fibres

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ABSTRACT: The project innovates water tank construction by synergizing ferrocement technology with geopolymer matrices and natural fibers. This novel approach aims to enhance durability, reduce environmental impact, and lower maintenance costs compared to conventional methods. The composite mortar includes cement, sand, fly ash, ground granulated blast-furnace slag (GGBS), jute fibers, coconut fibers, and chicken mesh, with fly ash and GGBS partially replacing cement. Sodium hydroxide and sodium silicate act as activators for geopolymerization. Testing involves varying water-to-binder ratios (0.35 and 0.40) and curing periods (7, 21, and 28 days) to assess performance against conventional mortar. Expected benefits include improved structural integrity, extended tank lifespan, and a smaller eco-footprint. The project aims to set new standards in construction practices, paving the way for more sustainable and resilient water storage solutions that align with future environmental needs.

KEYWORDS: Geopolymer mortar (Fly ash and GGBS), Cement mortar, Ferrocement techniques, Activators (Sodium Hydroxide, Sodium Silicate).

I. INTRODUCTION

India, historically an agricultural country, has seen slow industrial development due to its rural population. However, with rapid industrial growth and population increase, the consumption of natural resources has led to ecological imbalances. Renewable energy sources like solar, wind, and geothermal have gained attention as sustainable alternatives to fossil fuels, but their adoption remains limited due to economic factors. While large-scale renewable energy projects dominate, these technologies also hold promise for rural areas.

The construction industry, a significant source of pollution, contributes heavily to CO2 emissions, especially through the production of ordinary Portland cement (OPC). Geopolymer concrete offers a promising alternative, reducing CO2 emissions by utilizing fly ash and other industrial by-products instead of traditional cement. Geopolymer concrete's strength improves with finer fly ash, and it hardens at low temperatures, offering a durable, eco-friendly solution for construction.

Ferrocement, a mesh-reinforced concrete material, is another alternative that is lightweight, strong, and repairable. Combining fly ash with Ground Granulated Blast Furnace Slag (GGBS) enhances the material's strength and durability. Geopolymer concrete is especially suitable for precast applications, including bridges, floors, and panels, providing a sustainable solution to reduce the environmental impact of construction.

II. LITERATURE REVIEW

Malhotra et al. [1] highlighted that, most of the fly ash is disposed of as a waste material that covers several hectors of valuable land. The survey shows the total production of fly ash in the world is about 780 million tons per year after 2010. Fly Ash may be used either as an additive in the cement or as a part replacement of cement in concrete. The pozzolanic activity of fly ash is due to the presence of finely divided glassy silica and lime that produce calcium silicate hydrates. **Malhotra [2]** recommended replacing cement by fly ash up to 60 % known as high volume fly ash concrete. But it was observed that the pozzolanic action of fly ash with calcium hydroxide formed during the hydration of cement is very slow and the particles of size less than 45 micron are responsible for pozzolanic reaction. Therefore, for complete replacement of cement by fly ash and to achieve higher strength within a short curing period,

Davodavits [3] suggested the activation process of pozzolanic material that are rich in silica and alumina like fly ash

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with highly alkaline elements at certain elevated temperature which forms inorganic alumino-silicate polymer product yielding polymeric Si-O-Al-O bonds known as Geopolymer.

Rangan et al. [4] carried out experimental investigation on fly ash based geopolymer concrete. The global use of concrete is second only to water. As a demand of concrete as a construction material increases demand of Portland cement. It is an estimate that the production of cement will increases from about from 1.5 billion tons in 1995 2.2 billion tons in 2010. The production of one ton of cement emits approximately one ton of CO2 into the atmosphere. Several reports are in the progress to supplement the use of Portland cement in correct in order to place the global warming issue. This includes the utilization of supplementary cementing materials such as fly ash, silica fume, granulated blast furnace slag, rice husk ash and metabolic and the development of alternative binder to Portland cement.

Geopolymer are members of the family of inorganic polymers. The chemical composition of the geopolymer material is similar to natural zeolitic materials, but the microstructure is amorphous. The schematic formation of geopolymer material can be shown as described by equation (1) & (2)

n (Si_2O_5, Al_2O_2) +2nSiO_2+4nH_2O+NaOH or KOH à Na^+,K^+ + n$(OH)_3$-Si-O-Al--O-Si-$(OH)_3$

(Si-Al materials) $(OH)_2$

(Geopolymer precursor) (1)

n(OH)3-Si-O-Al--O-Si-(OH)3 + NaOH or KOH à (Na+K+) -(-Si-O-Al--O-Si-O-) + 4nH2O (OH) 2 O

O O

(Geopolymer backbone) (2)

The last term in Equation 2 reveals that water is released during the chemical reaction that occurs in the formation of geopolymers. This water, expelled from the geopolymer matrix during the curing and further drying periods, leaves behind nano-pores in the matrix, which provide benefits to the performance of geopolymers. The water in a geopolymer mixture, therefore, plays no role in the chemical reaction that takes place; it merely provides the workability to the mixture during handling. This contrasts with the chemical reaction of water in a Portland cement concrete mixture during the hydration process.

There are two main constituents of geopolymers, namely the source materials and the alkaline liquids. The source materials for geopolymers based on alumina silicate should be rich in silicon (Si) & (Al). These could be natural materials such as kaolinite, clays, etc. alternatively, by- product materials such as fly ash, silica fume, slag, rice husk ash, etc could be used as source materials. The choice of the source materials for making geopolymers depends on factors such as availability, cost of the application, & specific demand of the end users. The most common alkaline liquid use in geopolymerization is a combination of sodium hydroxide (NaOH) or Potassium hydroxide (KOH) and sodium silicate or potassium silicate.

Patankar [5] studied the effect of sodium hydroxide on flow and strength of fly ash based geopolymer mortar. Concrete/ mortar are used in most of the civil construction work in the world. However, high energy requirement and pollution involved in the production of cement hampers the image of cement-based products as sustainable materials. Efforts are continuously being made to make concrete environmentally friendly. Geopolymer is a new development in the world of concrete in which cement is totally replaced by fly ash and activated by alkaline liquids to act as a binder in the concrete/mortar mix. Experimental investigation has been carried out to study the effect of concentration of sodium hydroxide, temperature and its duration on flow and compressive strength. Activated liquid to fly ash ratio of 0.40 by mass was maintained in the

experimental work on the basis of past research. Sodium silicate solution with Na20 = 16.37%, Si02 = 34.35% and H20 = 49.28% was considered. The concentration of sodium hydroxide solution is varied as 2.91, 5.6, 8.1, 11.01, 13.11 and 15.08 Moles. Geopolymer mortar cubes of

70.7 mm side were cast. The temperature of curing was varied as 60, 90, and 120C and the duration of curing for each temperature as 6, 12, 18 and 24 hours after de-moulding. Test results show that the flow of geopolymer mortar increases with increase in the concentration of Sodium hydroxide. The compressive strength of geopolymer mortar increases with increase in duration of heating at run-runt temperature. Temperature also plays vital role in accelerating the strength, however beyond 90^0C the rate of gain of strength is mainly depends on concentration of sodium hydroxide solution.

Bhosale et al. [6] studied Geopolymer Concrete by Using Fly Ash in Construction. The most used structural material for all types of construction is concrete to enhance the strength properties and serviceability requirements by using supplementary materials in concrete. Such supplementary materials are blast furnace slag, fly ash, silica fume, steel fibers, glass fibers, rice husk, crushed stone dust etc. Every 1 ton of concrete leads to CO_2 emissions which vary between 0.05 to 0.13 tons. About 95% of all CO_2 emissions from a cubic yard of concrete are from cement manufacturing. It is important to reduce CO_2 emissions through the greater use of substitute to ordinary Portland cement (OPC) such as fly ash, clay and others geo-based material. This project should be study on the processing of geopolymer using fly ash and alkaline activator with geopolymerization process. The factors that influence the early age compressive strength such as molarities of sodium hydroxide (NaOH) need to be studied. Sodium hydroxide and sodium silicate solution were used as an alkaline activator. These studies comprise the comparison of the ratios of Na_2Si0_3 & NaOH at the values 0.39 & 2.51.

The famous report on sustainable cement industry published by Battelle Institute: titled Climate Change, is available on the Internet at the following address: This report confirms the studies carried out by Joseph Davidovits since [1990], on CO_2 emissions during Portland cement manufacture (in the LIBRARY the paper on Global Warming). Battelle's report recommends the development of geopolymer cement.

Zachar et al. [7] used fly ash & foundry sand & slag as a replacement for cement and fine coarse aggregates in concrete. Davidovits [1988] proposed that an alkaline liquid could be used to react with the silicon (Si) and the aluminium (Al) in a source material of geological origin or in by-product materials such as fly ash and rice husk ash to produce binders. Because the chemical reaction that takes place in this case is a polymerization process, he coined the term Geopolymer to represent these binders. Geopolymer concrete is concrete which does not utilize any Portland cement in its production. Geopolymer concrete is being studied extensively and shows promise as a substitute to Portland cement concrete. Research is shifting from the chemistry domain to engineering applications and commercial production of geopolymer concrete. Nowadays, the knowledge concerning the mechanisms controlling the alkali activation process is considerably advanced; however, there are still many things to investigate. In the present paper, the mechanism of activation of a fly ash (no other solid material was used) with highly alkaline solutions is described. These solutions, made with NaOH, Na_2Sio_3. This paper, report on the study of the processing of geopolymer using fly ash and alkaline activator with geopolymerization process. The factors that influence the early age compressive strength such as molarities of sodium hydroxide (NaOH) have been studied. Sodium hydroxide and sodium silicate solution were used as an alkaline activator. These studies comprise the comparison of the ratios of Na_2Si0_3 & NaOH at the values 0.39 & 2.51. The geopolymer paste samples were cured at 60°C for 1 day and keep in room temperature until the testing days. The compressive strength was done at 7 and 28 days. The result showed that the geopolymer paste with NaOH concentration, compressive strength increases with molarities increases.

Patankar et al. [8] studied on Effect of Concentration of Sodium Hydroxide and Degree of Heat Curing on Fly Ash-Based Geopolymer Mortar. It is observed that the workability as well as compressive strength of geopolymer mortar increases with increase in concentration of sodium hydroxide solution in terms of molarity. The rate of gain of strength is slow when heat cured at 40°C as compared to strength at 120°C. But there is no appreciable change in compressive strength beyond curing temperature of 90°C. Similarly, duration of heating in the range of 6 to 24 hours produces higher compressive strength. However, the increase in strength beyond 12 hours is not very significant. It is also observed that the compressive strength of geopolymer concrete increases with increase in test period up to three days.

Patankar et al. [9] studied the effect of fineness of fly ash on workability and compressive strength of geopolymer concrete. It is well known that there are environmental benefits of reducing the use of Portland cement in concrete and using a cementitious material such as fly ash or silica fume or ground granulated blast furnace slag or Metakaolin or

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rice husk ash instead.

With silicon and aluminium as the main constituents, fly ash is an effective cement replacement material. Recognizing the fact that concrete made with fly ash is eco-friendly, attempts have been made to replace more than 50% cement to produce high volume fly ash concrete. The literature on the subject indicates that fly ash activation can be achieved as follows.

1. Activation of silicon and calcium in class C fly ash by low to mild concentration of alkaline solution resulting in calcium silicate hydrate (C-S-H) and
2. Activation of silicon and alumina rich class F fly ash by highly alkaline solutions to form inorganic Alumino-silicate called geopolymer.

Patankar and Biradar [10] studied on the effect of Fineness on Activation of Fly Ash based Geopolymer Concrete. Fly ash has great potential as a cement replacing material in concrete as it contains high amount of silicon and aluminium. The concrete made with such industrial waste is eco-friendly and so it is called as "Green concrete". Fly ash, the finely divided residue that results from the Combustion of ground or powdered coal in thermal power station is available abundantly all over the world. In India more than 100 million tons of fly ash is produced annually. Out of this, 17 - 20 % fly ash is utilized either in concrete or in stabilization of soil, V. **Patankar, Ghugal et al. [11]** studied on Selection of suitable quantity of water, degree and duration of heat curing for geopolymer concrete production.

Concrete is the world's most important construction material. 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. World production of hydraulic cements is close to one thousand million tons per year. The climatic change due to global warming is one of the major issues concerning with the environmental pollution. The global warming is caused by the emission of greenhouse gases like CO2 to the atmosphere by various industries. Cement industry is one of the major contributors for the emission of greenhouse gasses which is about 1.35 billion tons annually.

Dawood, Shawkat et al. [12] The delves into the flexural performance of ferrocement, emphasizing its integration with sustainable high-performance mortar. Researchers have explored alternatives like fly ash, silica fume, and metakaolin in mortar to enhance both mechanical properties and environmental sustainability. Natural fibers, such as jute and coir, have been incorporated to bolster flexural strength, crack resistance, and overall performance, presenting eco-friendly alternatives to traditional steel mesh reinforcement. Sustainable high-performance mortar not only impacts flexural strength but also plays a pivotal role in fortifying the durability of ferrocement structures against environmental factors like corrosion. Curing methods, including ambient and accelerated curing, significantly influence the flexural properties. The highlighted the potential of sustainable mortar to optimize flexural performance, contributing to environmentally conscious and resilient ferrocement construction.

Ramireza, Castillob et al. [13] In this paper, they focused on the thermal conductivity of coconut fiber-filled ferrocement sandwich panels, a critical aspect in construction materials for energy-efficient building envelopes. Researchers have explored the incorporation of coconut fibers as fillers in ferrocement to enhance thermal insulation properties. The unique composition of coconut fibers contributes to lower thermal conductivity, making these panels effective insulators. Studied investigate the influence of fiber content, panel density, and fabrication methods on thermal performance. The paper underscores the potential of coconut fiber-filled ferrocement sandwich panels as sustainable alternatives for achieving improved thermal insulation in construction, addressing the need for energy-efficient building materials in the context of modern sustainable design.

Castro and Naamam [14] They explored the reinforcement of cement mortar with natural fibers, presenting an eco-friendly alternative for construction materials. Researchers have investigated the incorporation of fibers such as jute, coir, and bamboo to enhance the mechanical properties of cement mortar. The addition of natural fibers improves tensile strength, ductility, and crack resistance, contributing to the overall durability of mortar-based constructions. Studies highlight the potential of these reinforced mortars in various applications, including masonry, plastering, and concrete elements. The emphasized the sustainable aspect of using natural fibers, promoting the development of environmentally conscious and resilient construction materials.

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Naaman [15] This paper focused on the evolution of thin cement-based composites which are defined here as products having less than about 50 mm in thickness. They are considered made of two main components: a cement-based matrix and reinforcement. The reinforcement may be made of different materials, and can be continuous, discontinuous or a hybrid combination of both. Related products include cement boards, corrugated cement sheets, pipes, cladding, shells, roofs, domes, water tanks, water channels, boats, housing elements and the like.

Matalkaha, Bharadwajb et al. [16] This paper highlighted the research focus on developing sandwich composites for building construction using locally available materials. Studied emphasize the feasibility and sustainability of incorporating indigenous resources, showcasing the potential for cost-effective and environmentally friendly solutions in the construction industry.

Aldama et al. [17] Rheological behavior of cement paste augmented with natural fibers, a crucial aspect in understanding the material's flow and deformation characteristics. Researchers have explored the incorporation of natural fibers, such as jute, sisal, and coir, to enhance the rheological properties of cement paste. The addition of fibers influences viscosity, yield stress, and workability, impacting the overall handling and casting of concrete. Studied emphasize the potential benefits of improved fiber dispersion and orientation in mitigating segregation and enhancing the homogeneity of the mix. The paper underscores the importance of comprehending the rheological aspects for optimizing the performance of fiber-reinforced cement paste in diverse construction applications.

Dominguez et al. [18] They focused on the thermal lag and decrement factor of coconut- ferrocement roofing systems, essential considerations for energy-efficient building design. Researchers have investigated the integration of coconut fibers within ferrocement to enhance thermal performance. The unique composition of coconut-ferrocement exhibits a delayed response to temperature fluctuations, providing thermal lag. Additionally, the decrement factor, representing the rate of temperature change, is influenced by the thermal mass of the roofing system. highlighted the potential of coconut-ferrocement in minimizing temperature variations and energy consumption within buildings.

Aziz, Lee et al. [19] They explored the application of natural fiber-reinforced concretes (NFRC) in low-cost housing construction, addressing the need for sustainable and cost-effective building materials. Researchers have extensively investigated fibers like jute, sisal, coir, and bamboo, evaluating their effectiveness in enhancing the mechanical properties of concrete. NFRC presents a promising alternative, offering benefits such as reduced material costs, increased tensile strength, and improved crack resistance. Studies emphasize the potential of NFRC in addressing socio-economic challenges by providing affordable and environmentally friendly solutions for low-cost housing. The review highlights the importance of optimizing fiber content, mix design

and construction practices to ensure the structural integrity and durability of NFRC-based structures.

Pavithraa R, Porkodi N et al. [20] The silica content in both fly-ash and GGBFS are high that enhance the strength in concrete and hence used here with mix proportions. This GPC tile completely avoids the use of cement (OPC) and hence it is called as no cement mortar tile and is highly economical and eco-friendly by nature. Thus, Geopolymer tile is observed to have excellent physical and mechanical property. With these property the precast GPC tiles is prepared and checked for adequate strength, thermal resistance and durability. Results for the conventional mortar cubes were also tested for 3 different mix ratios of fly ash and GGBS such as 50:50, 60:40, 70:30 for 7th, 14th, 21st and 28th days. Accordingly, the ratio 60:40 shows greater strength for the mortar cube and so the whole project is carried with fly ash: GGBS ratio as 60:40. Thus, the tiles and cubes are casted with this mix ratio.

III. METHODOLOGY OF PROPOSED SURVEY

In the present experimental work, low calcium fly ash procured from National Thermal Power plant at Eklahare, Nasik was used as source material. The residue of fly ash retained on 45µm IS sieve was reported as 7.67%. Table 1 and 2 show the physical properties and chemical composition of fly ash. The laboratory grade sodium hydroxide in flake form (97.8% purity) is used for the preparation of different molar solution and sodium silicate (50.72% solid) solutions were used as alkaline activators. Table 3 and 4 show the contents in sodium hydroxide flakes and sodium silicate solution, respectively. Godavari river sand was used as filler material. The sand is sieved using sieves of sizes 2mm, 1mm, 500 micron and 90 microns. These sizes fractions are combined in equal proportion to maintain grading

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complying with standard sand as per IS 650:1991. The alkaline solution-to-fly ash ratio was considered as 0.35 by maintaining 13 molar NaOH concentrated solution. Oven curing was done at 60°C for 6 hours duration.

1Fly ash:

Low calcium processed fly ash procured from Dirk India Private Limited; Nashik under the tread name Pozzocrete-63 is used in the present investigation.

2.2 GGBS:

The GGBS which was obtained from quenching molten iron slag from a blast furnace in water or stream, to produce a glassy, granular product that is then dried and ground into a fine powder.

Table 2.1 Physical properties of fly ash and GGBS

Sr. No.	Physical properties	Processed Fly ash (Pozzocrete-63)	Specification as per IS 3812-1981, by Mass
1	Colour	Light grey	----
2	Residue retained on 45 µm	07.67 %	34 % maximum
3	Specific Surface Area (Blaine)	458 m^2/kg	320 m^2/kg
4	Specific gravity	2.25	----
5	Moisture content	0.45 %	2 % maximum
6	Autoclave expansion	0.024%	0.8 %

Table 2.2 Chemical composition of fly ash and GGBS

Sr. No.	Chemical Composition	Pozzocrete- 63, (%)	Specification as per IS 3812-1981, by Mass, (%)
1	$SiO_2 + Al_2O_3 + Fe_2O_3$	96.02	70 (minimum)
2	SiO_2	77.10	35 (minimum)
3	Al_2O_3	17.71	----
4	Fe2O3	01.21	----
5	MgO	0.90	5 (maximum)
6	SO3	2.20	3 (maximum)
7	Na2O	0.80	1.5 (maximum)
8	CaO	0.62	----
9	Total chlorides	0.03	0.05 (maximum)
10	Loss of ignition.	0.87	5 (maximum)

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2.3 Fine Aggregate

Locally available Crushed sand is used as fine aggregate. The physical properties and grading of fine aggregate are shown in Table 2.3

Table.2.3 Physical properties of Aggregate

Physical Properties	Type	Maximum Size	Specific Gravity	Water Absorption	Moisture Content
Fine Aggregate (Sand)	Crushed Sand	4.74 mm	2.83	3.12 %	Nil

2.4 Alkaline activator

The activation of fly ash was achieved using a combination of sodium hydroxide and sodium silicate solutions, with the latter being an alkaline activator.

Table 2.5 Chemical composition of sodium silicate solution

Sr. No.	Chemical Composition	Content
1	Na_2O (%)	16.37
2	SiO_2 (%)	34.35
3	Ratio of Na_2O: SiO_2	1:209
4	Total solid (%)	50.72
5	Water content (%)	49.28

Table 2.6 Chemical composition of sodium hydroxide

Sr. No.	Chemical Composition	Percentage
1	Sodium hydroxide (Minimum assay)	97
2	Carbonate	2
3	Chloride	0.01
4	Sulphate	0.05
5	Potassium	0.1
6	Silicate	0.05
7	Zinc	0.02

2.5 Preparation of sodium hydroxide solution

The study focuses on the preparation of sodium hydroxide solution for geopolymer mortar/concrete. The solution is prepared by adding 40 gm NaOH flakes in distilled water, which can cause severe burns. To avoid direct contact with skin and eyes, the molarity of the solution is determined by measuring the solid content in a liter of NaOH solution. The solution is prepared two days before casting mortar cubes to cool it to room temperature.

2.6 Preparation of geopolymer mortar mixes

Geopolymer mortar was prepared by fully replacing cement with fly ash and activating it with alkaline solutions (NaOH and Na2SiO3). A mix with a 1:3 ratio of fly ash, GGBS, and sand was used, with the water-to-cementitious materials ratio adjusted for workability. Before casting, oil and grease were applied to the molds for easy demoulding. The alkaline solution was prepared in a one-liter measuring cylinder, mixed, and allowed to sit for 2 hours. The dry mix of fly ash and sand was combined with the alkaline solution on a steel plate, mixed thoroughly, and found to be viscous and dark. The workability of the fresh mortar was tested using a flow table. The mortar was cast into 70.7 mm cubes, compacted, and leveled. After 24 hours, the cubes were cured at 60°C for 6 hours, cooled in the oven, weighed, and tested for compressive strength at 7 days.

2.7 Ferrocement Technology

2.7.1Chicken Mesh:

Chicken wire mesh has specific properties for plastering use chicken wire mesh is formed by twisting two adjacent wires at least 4 times, forming a strong honey comb mesh structure. So, it is high strength and durability and improve corrosion resistance.

Types of Chicken Mesh:

Hexagonal Chicken Mesh:

Hexagonal chicken mesh, constructed from galvanized steel wire, is a lightweight and flexible material extensively utilized in building construction. Its hexagonal pattern imparts strength and adaptability, making it suitable for tasks like plaster reinforcement and soil erosion control. Available in diverse wire gauges and mesh sizes, it allows for customization based on specific needs. The galvanized coating enhances durability by preventing corrosion. Cost-effective, easy to cut, and versatile, chicken mesh is valued for its affordability, ease of handling, and various construction applications.

Square Chicken Mesh:

Square chicken mesh, often made from galvanized steel wire, exhibits strength and stability with its square pattern. Commonly used in building construction, it serves for tasks like plaster reinforcement and concrete support. The mesh is available in different wire gauges and mesh sizes, allowing for customization based on specific project needs. The galvanized coating enhances durability, preventing corrosion. Affordability, ease of handling, and adaptability make square chicken mesh a valuable choice for various construction applications.

3. Casting

3.1 Casting of Ferro-Geopolymer mortar cubes:

1. Collect the Materials like Cement, Fly ash, GGBS, Sand, Sodium silicate and Sodium Hydroxide, etc.
2. Preparation of Alkaline activators. Take Sodium silicate and Sodium hydroxide in even quantity and add 100 ml water and mixed it well. Kept this mixer for 30 minutes for proper mixing.
3. Then fly ash, GGBS and the sand were mixed together in the pan for 3 minutes.
4. The liquid component of the mixture was then added to the dry materials and mixed it thoroughly for approximately 4-5 minutes to manufacture fresh geopolymer mortar.
5. The fresh concrete was cast into the moulds immediately after mixing.
6. After casting cubes were kept in mould for 24 hours for setting. Then after 24 hours of setting specimen were removed from mould and kept for curing for 7 days.
7. After curing specimen were tested under Compressive testing machine.

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Geopolymer Mortar cubes samples

Compressive test on Geopolymer mortar

Casting of Ferrocement Water tank

Step 1: Binding Hexagonal chicken mesh to weld square mesh.

Step 3: Geopolymer and cement Mortar mix for bottom base fill up.

Step 4: Prepare mortar for both sides of the water tank

FERROCEMENT Water Tank is READY

IV. CONCLUSION AND FUTURE WORK

Cement Mortar: Shows varying strengths ranging from 25 to 29 N/mm². The higher water/binder ratio and water curing likely influenced these results.**Geopolymer Mortar:** Demonstrates consistent strengths of 29 to 31 N/mm², despite a lower water/binder ratio and natural curing. This suggests geopolymer has potential for high early strength development and durability. The compressive strengths of geopolymer mortar specimens ranged from 29 to 31 N/mm²,

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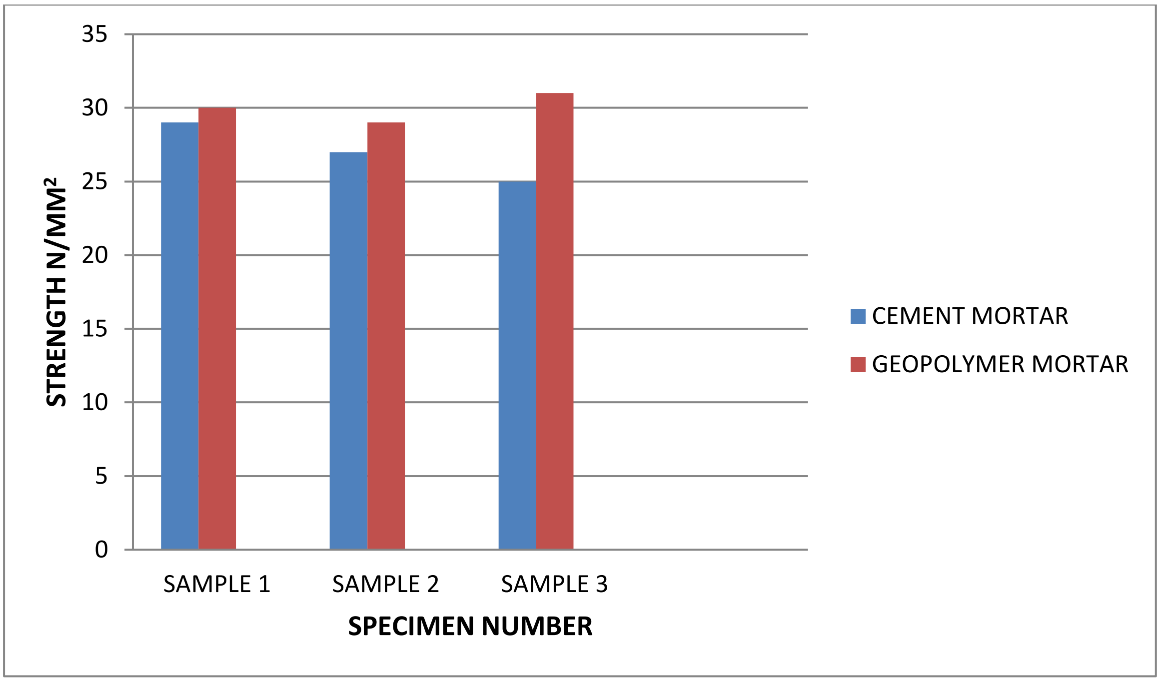
whereas cement mortar strengths varied between 25 and 29 N/mm². Geopolymer achieved higher strengths likely due to its lower water/binder ratio of 0.35 compared to cement mortar's 0.45, and the use of an alkaline solution in its mix, which contributed to enhanced early strength development and durability. These factors indicate geopolymer mortar's potential for superior performance in structural applications compared to traditional cement mortar. Geopolymer mortar exhibits promising compressive strengths compared to traditional cement mortar under similar conditions. Further studies could explore optimizing mix proportions and curing methods to enhance performance and application suitability.



Graph no. 1 Comparison of compressive strength of cement mortar and geopolymer mortar.

V. CONCLUSION

1. The use of a geopolymer matrix increases the durability of the water tank, providing better resistance to chemical attacks and environmental degradation compared to traditional cement.
2. Comparison between cement mortar and geopolymer mortar, it is observed that the compressive Strength of geopolymer mortar is greater than cement mortar.
3. It is observed the about Geopolymer mortar ratio 1:3 it gives good strength compared to 1:2 and 1:4.
4. It gives green technology to nation.
5. The innovative materials allow for quicker construction times compared to traditional RCC tanks, leading to faster project completion.
6. The improved materials result in lower maintenance requirements, as the tank is more resistant to typical wear and tear factors.

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