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Performance of Geopolymer Concrete with Combined Use of Sodium Hydroxide and Potassium Hydroxide

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ABSTRACT- From the beginning, binders such as red mud mortar, lime mortar, cement mortar, etc., played a major role. It has been found that the production of cement increases the quantity of uncontrollable CO2 emissions. Another adhesive that can be used in place of cement is geopolymer. Because geopolymer concrete may reduce carbon emissions, the concrete business could grow sustainably and prosper as a result. This technology has the potential to reduce CO2 emissions from the construction sector by up to 80%. To make the binder for geo polymer concrete, alkaline solutions are used to activate sources of materials rich in silica (Si) and aluminium (Al), such as fly ash, GGBS, etc. Geopolymer-made concrete includes no cement at all.

In this study, we attempted to determine the compressive strength and durability properties of geopolymer concrete using various molarities of 8M, 10M, and 12M along with Sodium Silicate solution. The alkaline activators used were Sodium hydroxide (NaOH), Potassium hydroxide (KOH), and combination of both (50%NaOH + 50%KOH). To achieve the highest pH value for better mechanical and durability characteristics, chemical analysis is done. After 7 and 28 days of age, the Compression and Permeability experiments were conducted. The GPC's strength and durability characteristics were contrasted with those of conventional concrete.

KEYWORDS- Geopolymer Concrete, flyash, Sodium Hydroxide, Potassium Hydroxide, Sodium Silicate, compressive strength, permeability test.

I. INTRODUCTION

A specific type of amorphous aluminium oxide product known as geopolymer exhibits the ideal properties of rock-forming materials, such as hardness, chemical stability, and endurance. Aggregates and geopolymer binders are used to create geopolymer concrete. This method can cut the CO2 emissions from cement by up to 80%. Concrete created without cement is known as "Geopolymer Concrete," an alternative binder technology.

Geopolymer concrete is produced using traditional methods for producing concrete. Similar to OPC concrete, the aggregates in geopolymer concrete account for around 75–80% of the mass. The silicon and aluminium in the low-calcium (ASTM Class F) fly ash react with an alkaline liquid consisting of sodium silicate and sodium hydroxide solutions to form the geopolymer paste that binds the aggregates and other unreacted components.

To create concrete, sodium hydroxide, potassium hydroxide, and their mixtures in addition to sodium silicate were used as activators. to find the ideal alkaline activator combinations to produce the appropriate strength. to determine whether geopolymer concrete is permeable. to investigate the microstructure of GPC. to evaluate the performance of GPC in comparison to traditional concrete.

II. LITERATURE SURVEY

A. Arunangsu Patra (2016)

The impact of potassium hydroxide as an activator on the compressive strength of Geo polymer concrete. In this research Sodium silicate (Na2SiO3), potassium hydroxide (KOH), fly ash Class F (Black), fly ash Class F (Gray), fly ash Class C (White), and fly ash Class F (Black) are the primary components utilised in geo polymer concrete. In this work, the compressive strength of geopolymer concrete mixtures was investigated using variable parameters such as time, silicate modulus, and KOH %. The findings indicate that relative compressive strength is stronger for materials with higher silicate modulus and higher KOH percentages than for materials with lower silicate modulus, most likely due to silica content.

B. Anurag Mishra (2008)

Has studied The effect of concentration of NaOH and curing time on fly ash based geopolymer concrete. Totally nine mixes were prepared with NaOH concentration as 8 M, 12 M, 16 M and curing time as 24 hrs, 48 hrs, and 72 hrs. Compressive strength, water absorption and tensile strength tests were conducted on each of the so cast nine mixes. Results of the investigation indicated that with increase in NaOH concentration, there was an increase in compressive strength. With increase incurring time, compressive strength also increased but it was found that the increase in compressive strength after 48 hrs of curing time was not significant. Compressive strength up to 46 MPa was obtained with curing at 60 o C. The results of water absorption test indicated that percentage of water absorption decreased with increase in NaOH concentration and curing time.

C. P. Pavithra (2016)

In order to improve compressive strength for various alkaline solution to binder proportions, studies were conducted to establish a mix design approach for GPC. The materials like Low calcium fly ash as the binder material, sodium hydroxide and sodium silicate as alkaline activator solutions and aggregate was used. Based on the mortar trial mix results, NaOH molarity and Na2SiO3 to NaOH ratio were fixed at 16M and1.5, respectively. A compression test using GPC specimens was carried out for various AAS/FA ratios, including 0.4, 0.5, 0.6, 0.7, and 0.8. NaOH solution was prepared one day in advance to account for complete dissolution of crystals and dissipation of heat liberated. From the tests, the 28 days' compressive strength obtained was 45.95MPa. was 45.95MPa.

Table 1: Results of Ph Values

S.no	Alkaline Activators	Molarity	P^H values
1.	NaOH	12M	12.30
2.	KOH	12M	16.2
3.	Na2SIO3	12M	12.25

It has been found that, GPC follow similar trend to that of normal concrete in the strength aspect where the strength decreases with the increase in the fluid content.

D. Sameer Ulbashir (2015)

The geo polymer concrete created with fly ash that has undergone compressive and split tensile strength tests.The activation of geopolymer concrete using various activators, including mixtures of sodium hydroxide (NaOH) and potassium hydroxide (KOH), has been contrasted. The results show that GPC is superior to M25 grade OPC in terms of compressive, split tensile, and flexural strengths. Moreover, the increasing trend in strengths can be seen whenever the molarity of NaoH solution (like KOH solution) is increased from 8M to 14M. The compressive strength, tensile strength, and flexural strength all rise when we add more of the NaOH chemical to the combination, which leads us to believe that NaOH is the best activator available.

III. METHODOLOGY

The methodology is shown in below figure 1.

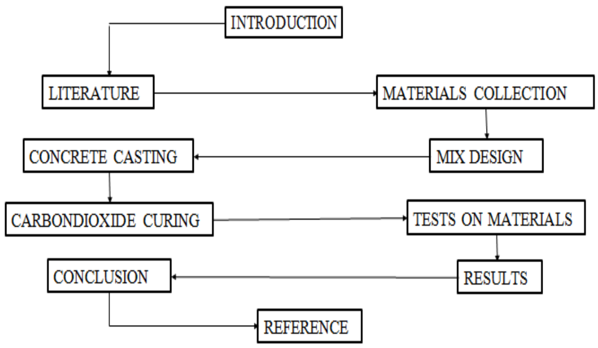

Figure 1: Step by Step Procedure

The figure 1 gives you the clear view of how the experiment is taken a head to the conclusion part.

IV. RESULTS AND DISCUSSION

The combination of NaOH and KOH at 12M concentrations had the maximum compressive strengths at both ages, it was found. Also, it was shown that any GPC concrete combination had greater early strength than OPC concrete.

Table 2: Results of Compressive Strength

s.no	Types of mix M20		Compressive strength(Mpa)	
	NaoH	KoH	7 days	28 days
Mix 1	12m(100%)	--	28.16	36
Mix 2	--	12m(100%)	30.02	43.43
Mix 3	12m(50%)	12m(50%)	35.21	49.20
Mix 4	8m(50%)	12m(50%)	31.11	39.19
Mix 5	10m(50%)	12m(50%)	34.48	41.50
Mix 6	12m(50%)	8m(50%)	35.10	44.70
Mix 7	12m(50%)	10m(50%)	37.68	46.20
Mix8	NPC	NPC	23.21	28.30

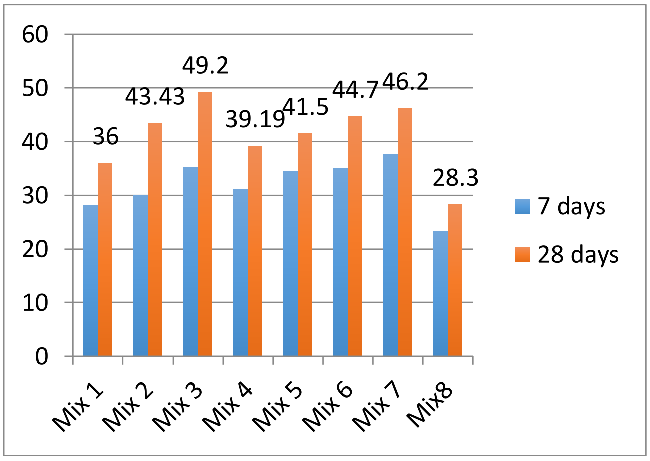

Figure 2: Graph for Compressive Strength

V. CONCLUSION

Due to lower permeability coefficients than OPC concrete, geopolymer concrete performs better than OPC concrete. Also, it was shown that as the grade of GPC concrete increased, the permeability coefficients fell similarly to OPC concrete.

For M20 grade mixes, the ideal sodium silicate to sodium hydroxide ratio is 2.5.

In comparison to ambient curing at the same age, the GPC reaches its target strength with heat curing. Similar to OPC concrete, the compressive strength of GPC concrete rises with age.

According to the findings, the combination of the aforementioned ingredients at 60 0 c enhances the strength and durability of geopolymer concrete.

Because the poly condensation process has already been finished and particle interface has been attained after 24 hours at an ambient temperature of 60°C, it has been shown that at 12 molarity of KOH, the rise in strength remains quite modest.

As we raise the proportion of the NaOH chemical in the mixture of the two chemicals, the compressive strength, permeability strength, and water flow all rise.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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