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Comparative Study on Strength Characteristics of Fly Ash Based Geopolymer Concrete with 8, 10 & 12 Molar Naoh Activator

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Abstract: *Ordinary Portland cement is a major construction material worldwide. Cement manufacturing industry is one of the carbon dioxides emitting sources besides deforestation and burning of fossil fuels. The global warming is caused by the emission of greenhouse gases, such as CO2, to the atmosphere. Among the greenhouse gases, CO2 contributes about 65% of global warming. The cement sector accounts for around 7% of worldwide greenhouse gas emissions of the earth's atmosphere. In order to address environmental effects associated with Portland cement, Alternative binders for concrete production are needed. Low-calcium (Class F) fly ash-based geopolymer from Vijayawada was used in this study. Geopolymer concrete was made with the help of a thermal power plant. The combination of sodium silicate solution and sodium hydroxide solution was used as alkaline solution for fly ash activation. Alkaline solution to fly ash ratio was varied as 0.45. The concentration of sodium hydroxide solution was maintained as 8M, 10M & 12M (Molars). The curing condition of geopolymer concrete was varied as ambient curing. The compressive strength, Split Tensile Strength of the geopolymer concrete was tested at various ages such as 7 and 28days. From the test results it was found that as the alkaline solution to fly ash ratio increases, the strength of geopolymer concrete also increases.*

Keywords: Geo-polymer concrete, fly ash, metakaolin & alkaline solution

I. INTRODUCTION

Standard Portland cement (OPC) is a vital material within the producing of concrete and it act as its binder to combine all the combination along. However, the utilization of cement leads harmful to atmosphere and decreasing of material (limestone). The creating of Cement causes the burning of enormous quantities of fuel and decomposition of stone, leading to vital emissions of carbonic acid gas (Kong And Sanjaya, 2008),As such, Geopolymer concrete had been introduced to scale back the on top of downside. Geopolymer concrete conjointly provides smart results like high Compressive strength, Low creep , glorious acid resistance and low shrinkage (Lodeiro et al., 2007). The utilization of binder in Geopolymer concrete is replaced by ash that conjointly provides pozzolanic properties as Cement and high with corundum and salt. Ash is residue from the burning of coal and it's wide accessible in anywhere and ends up in waste management proposal. The reaction of geopolymerization is exceptionally very sensitive to different raw materials like particle size and distribution, crystallization degree, etc., different alkali - activators like Sodium/potassium hydroxide, Sodium/potassium silicate, and the ratio of these two, etc., different Si/Al ratios, different water/ash ratios, different curing conditions (temperature, moisture degree, opening or healing condition, curing time, etc.).

II. OBJECTIVES

- The objectives of this study are as follows
- To study the effect of alkaline solution to binder ratio, concentration of sodium hydroxide solution and curing conditions on fly ash based geopolymer concrete.
- To determine the compressive strength &split tensile strength of fly ash based geopolymer concrete at various

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ages such as 7 days and 28days.

III. MATERIALS

The materials used for making flyash-based geopolymer concrete specimens were low-calcium fly ash, aggregates, alkaline liquids, extra water and metakolin.

The properties of fly ash are presented in Table 1.

Table 1: Physical properties of Fly ash

S.NO	DESCRIPTION	VALUES
1	Specific Gravity	3.12
2	Fineness of fly ash	**7.13**

Table 2: Chemical composition of fly ash

S. No.	Name of the Chemical	% by weight	S. No.
1	Sulfate (SO_4)	1.24%	1
2	Magnesium Oxide (MgO)	0.91%	2
3	Titanium Dioxide (TiO_2)	0.42%	3
4	Ferric Oxide ($Fe_2O_3 + Fe_3O_4$)	4.17%	4

IV. EXPERIMENTAL INVESTIGATIONS

4.1 Compressive strength results

The cube specimens of 150mm x 150mm x150mmwere cast and tested in compression testing machine for 7 ,28 days of curing period for different proportions of concrete mix and presented in table.

Table 3: Compressive Strength of geopolymer concrete

S. No	Molarity	28 days	56 days	90 days
1	NC	28.05	30.36	32.63
2	8M	28.62	31.03	33.53
3	10M	29.52	32.11	34.53
4	12M	30.66	33.38	35.88

4.2 Split Tensile Strength Test

At the age of 28,56 and 90days, the cylindrical specimens (150mm diameter x 300mm height) were tested for evaluating the split tensile strength. The experiment is performed by putting a cylindrical sample horizontally between a compression-testing machines loading surface and the load is applied until the cylinder fails along the vertical diameter.

Table 4: Split tensile strength of concrete with recycled aggregates as partial replacement of cement in concrete

S. No	Molarity	28 days	56 days	90 days
1	NC	2.76	3.01	3.20
2	8M	2.79	3.03	3.25
3	10M	2.91	3.17	3.40
4	12M	2.97	3.23	3.46

V. CONCLUSION

In this study, the concrete ingredient like cement is partially replaced by fly ash and metakaolin. Fly ash various different molarities of 8M, 10M and 12M.

The Compressive strength of normal concrete at the age of 28, 56 days and 90 days are N/mm² are 41.78 &62.84 N/mm² .

1. At 8M partial replacement of fly ash with cement the compression strength of concrete at 7 and 28 days are 20.08 and 28.62N/mm^2.

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2. At 8M partial replacement of fly ash with cement the split tensile strength of concrete at 7 and 28 days are 1.94 and 2.79N/mm^2.
3. At 10M partial replacement of fly ash with cement the compression strength of concrete at 7 and 28 days are 20.63 and 29.52N/mm^2.
4. At 10M partial replacement of fly ash with cement the split tensile strength of concrete at 7 and 28 days are 2.03 and 2.91N/mm^2.
5. At12Mpartialreplacementofflyashandmetakaolinwithcementthecompression strength of concrete at 7 and 28 days are 36.48 and 55.21N/mm^2.
6. At 12M partial replacement of fly ash and metakaolin with cement the split tensile strength of concrete at 7 and 28 days are 3.47 and 5.30N/mm^2.

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