

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.

2. METHODOLOGY & EXPERIMENTAL PROGRAM:

2.1. Objective:

The objective of the present investigation is, to study the performance characteristics of the source materials

1. Study & evaluation of chemical composition & effects of NaOH& sodium silicate on fly ash.
2. Study of polymerization process in Fly ash, NaOH& sodium silicate of the composition that is geopolymer.
3. Testing of geopolymer by using universal testing machine.
4. Analysis of geopolymer testing & comparison.

2.2. Material Used

1. Fine aggregate (fineness modulus 2.6 — 2.8).
2. Sodium silicate solutions (8M, 10M, 12M and 14M)
3. Low calcium class F type fly ash
4. Sodium hydroxide (98% purity in pure form)
5. Distilled Water.

2.3. Chemical Composition of Fly Ash:

Description	Fly Ash (% wt)
Silica	55-65
iron oxide	5-7
aluminum oxide	22-25
calcium oxide	5-7
magnesium oxide	<1
titanium oxide	<1
Phosphorous	<1
alkali oxide	<1

2.4. Physical Properties of Fly Ash:

Physical properties	Properties of fly ash used	Properties of fly ash according to IS 1320-1981
Specific gravity	2.51	-
Initial setting time	120 minutes	-
Final setting time	280 minutes	-

Fineness specific surface in m ² / kg min	320	340
Lime reactivity Avg compressive strength	4.00	6.200

In the research work, low calcium, class F dry fly ash obtained from **Raichuris** used as base material to make the geopolymers. Sodium silicate (Na₂SiO₃) mixed with sodium hydroxide (NaOH) as an alkaline activator has been used in this study, NaOH in pellet form with 97% purity & Na₂SiO₃ consist of Na₂O=9.4%, SiO₂=30.1% & H₂O=60.5%, with weight ratio SiO₂/Na₂O=3.20-3.30), By varying the ratio of Na₂SiO₃&NaOH i.e. 0.39. & 2.51. Oven dry curing temperature i.e., 600 for time in 24 hours is kept constant.

3. Compressive Strength Test (IS: 516 -1959)

The compressive strength of concrete is one of the most important and useful properties of concrete. In most structural application concrete is implied primarily to resist compressive stress. In this experimental investigation, only geopolymer concrete cubes are used for testing compressive strength. The load at which the control specimen ultimately fail is noted, compressive strength is calculated by dividing load by area of specimen .The figure 5.12 shows the apparatus for compressive strength testing.

$$f_c = P/A$$

Where f_c = cube compressive strength in

p = cube compressive load causing failure in n

A = cross sectional area of cube in mm²

The compressive strength for mix designations 8 m to 14 m are shown in tables at 7 days and at 28 days. it is observed that as the molarity and Na₂SiO₃ / NaOH ratio is increased the compressive strength increases. Result for compressive strength will be for 7 days & 28 days for oven drying & ambient temperature.

Compressive Strength Test Results at 7 Days For Cube 150mm X 150mm X 150mm

Size	specimen	compressive strength N/mm ²	avg.compressive strength N/mm ²
8m	sample 1	30.3	30.33
	sample 2	33.0	
	sample 3	28.0	
10m	sample 1	34.0	36.8
	sample 2	37.0	
	sample 3	39.44	
12m	sample 1	39.0	41.06
	sample 2	43.2	
	sample 3	44.0	
14m	sample 1	44.0	42.83

	sample 2	46.0	
	sample 3	38.5	

$\text{Na}_2\text{SiO}_3 = 2.51 \text{ (od)}$

NaOH

Where od =Oven Drying

Compressive strength test results at 28 days For cube 150mm x 150mm x 150mm

Table 3.2 : compressive strength test results at 28 days			
Size	specimen	compressive strength N/mm ²	avg.compressive strength N/mm ²
8m	sample 1	32	32.79
	sample 2	36.5	
	sample 3	30	
10m	sample 1	37	37.72
	sample 2	37.5	
	sample 3	38.0	
12m	sample 1	45	43.5
	sample 2	41.5	
	sample 3	44	
14m	sample 1	47	47.43
	sample 2	50.5	
	sample 3	44.8	

$\text{Na}_2\text{SiO}_3 = 2.51 \text{ (od)}$

NaOH

Od = Oven drying



fig.casting of specimen



fig. setup for compressive strength

Compressive Strength Test Results at 7 Days For Cube 150mm X 150mm X 150mm Using Fly Ash

Table 3.3 : compressive strength test results at 7 days			
Size	specimen	compressive strength N/mm²	avg.compressivestrength N/mm²
8m	sample 1	13.0	15.83
	sample 2	18.0	
	sample 3	16.5	
10m	sample 1	14.9	16.78
	sample 2	17.0	
	sample 3	17.1	
12m	sample 1	19.11	17.23
	sample 2	15.19	
	sample 3	17.2	
14m	sample 1	19.3	17.32
	sample 2	15.31	
	sample 3	17.29	

$\text{Na}_2\text{SiO}_3 = 0.39$ (at)

NaOH

Compressive Strength Test Results at 28 Days For Cube 150mm X 150mm X 150mm Using Fly Ash

Table 3.4 : compressive strength test results at 28 days			
Size	specimen	compressive strength N/mm²	avg.compressive strength N/mm²
8m	sample 1	14	16.16
	sample 2	17.2	
	sample 3	17.3	

10m	sample 1	18	18.92
	sample 2	19.2	
	sample 3	20.2	
12m	sample 1	23.3	20.47
	sample 2	17.39	
	sample 3	21	
14m	sample 1	24.3	21.57
	sample 2	18.5	
	sample 3	21.6	

$\text{Na}_2\text{SiO}_3 = 0.39$ (at)

NaOH

Where at = ambient temperature

4. CONCLUSION

The construction industry is in demand of ecofriendly & greener materials which are durable. As compared to the existing concrete materials, fly ash is advantageous but its uses as tested against strength & durability needs to be confirmed. The present project work emphasis on the research & development activity in construction materials using fly ash with geopolymers.

The project work reveals with preparation of test samples of fly ash with geopolymers of different composition in the ratio of 0.39 & 2.51. The samples are prepared with the different molarities such as 8,10,12,14. Tests for compressive strength, split tensile strength, flexural strength, rebound hammer test, acid resistant test are carried out on samples as above for ambient temperature (A.T) & oven drying (O.D) for 7 & 28 days, as per prevailing standards for respective properties. The details of the results are summarized as under.

Compressive Strength Test:

1. For ratio $\text{Na}_2\text{SiO}_3 / \text{NaOH} = 2.51$, As higher concentration in terms of molar of solutions, results in higher compressive strength of fly ash based geopolymer concrete.
2. For ratio $\text{Na}_2\text{SiO}_3 / \text{NaOH} = 0.39$, It is observed that, when quantity of sodium silicate & sodium hydroxide is reversed by mass, it is observed that compressive strength increases as increase in molarity. For both cases that is 1 & 2 compressive strength is more for oven drying as compare to specimen left in ambient temperature.

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