EXPERIMENTAL STUDY OF GEOPOLYMER CONCRETE BLOCKS

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Abstract - *Construction is one of the fast growing fields worldwide. As per the present world statistics, every year around 260,00,00,000 tons of cement is required. This quantity will be increased by 25% within a span of another 10years. Since the limestone is the main source material for the ordinary Portland cement .An acute shortage of Portland cement may come after 25to 50 years. Moreover while producing 1 ton of cement, approximately 1 ton of carbon-di-oxide will be emitted to the atmosphere, which is a major threat for the environment. By producing all the geopolymer concrete all the above mentioned issues shall be solved. Since, Geopolymer concrete doesn't use any cement, the production of cement, shall be reduced and hence the pollution of atmosphere, by the emission of carbon-di-oxide shall also be minimized. In this study replacement materials used in geoploymer concrete blocks with different grades of concrete. Utilization of pozzalanic materials also investigated. Mechanical properties such as like compressive strength tensile strength, modules of elasticity also investigate and compare the conventional concrete.*

Key Words: Geopolymer, Concrete Hollow Blocks, carbon-di-oxide, Water Absorption, Compressive Strength.

1. INTRODUCTION

1.1 GENERAL

Production of Portland cement is increasing due to the increasing demand of construction industries. Therefore the rate of production of carbon dioxide released to the atmosphere during the production of Portland cement is also increasing. Generally for each ton of Portland cement production, releases a ton of carbon dioxide to the atmosphere. The greenhouse gas emission from the production of Portland cement is about 1.35 billion tons annually, which is about 7% of the total greenhouse gas emissions. Therefore to reduce the pollution, it is necessary to reduce or replace the cement from concrete by other cementitious materials like fly ash, blast furnace slag, rice husk, etc. In this work, fly ash and Ground Granulated Blast furnace Slag is used instead of cement.

1.2 GEOPOLYMER

Geopolymer materials represent an innovative technology that is generating huge amount of interest in the construction industry considering sustainable material. The name "Geopolymer" was coined by Prof.J.Davidovits in 1978 and he found that the polymerization process involves a substantially fast chemical reaction under alkaline condition on Si-Al minerals, those results in 3D polymeric chain and ring structure consisting of Si-O-Al-O bonds.

The main concept behind this geopolymer is the polymerization of the Si-O-Al-O bond which develops when Al-Si source materials like Fly ash or rice husk is mixed with alkaline activating solution (NaOH or KOH solution with Na_2SiO_3 or K_2SiO_3). It is similar in appearance and physical composition to ordinary Portland cement concrete. Like OPC concrete, geopolymer concrete is typically 75-80% by mass aggregates and derives its strength from the paste that binds these aggregates together. The nature of this binder is the fundamental difference between an OPC and geopolymer concrete.

1.3 CONSTITUENTS OF GEOPOLYMER CONCRETE

1.3.1 Fly Ash

Fly ash which is rich in silica and aluminium are used for this GPC. The fineness of fly ash gives a major impact on the strength of the GPC where it is seen that a processed fly ash with fineness of 542 m^2/kg shows a result of 80 MPa with 24 hours continuous curing at 90^0C with a lower fineness the strength decreases.

1.3.2 Ground Granulated Blast Furnace Slag

GGBS is a partial replacement of fly ash for the Geopolymer concrete. It increases the engineering proprieties of the material. GGBS is a byproduct from iron. The blast furnaces used to make iron. The iron ore is reduced to iron and remaining materials from slag. The use of GGBS for concrete material contributes to the saving the natural resources and energy in cement manufacturing process and to reducing CO2 emissions and environment impact.

1.3.3 Fine Aggregate

In this study, locally available river sand which is free from impurities is used. The size of it is less than 2.36 mm. The fine aggregate is conforming to Zone III as per IS 383-1970.

1.3.4 Coarse Aggregate

The coarse aggregate can be used in case of geopolymer concrete also. A size of 12 mm crushed stone chips which free from dust are used here.

1.3.5 Sodium Hydroxide

Generally NaOH is available in market in pellets or flakes form with 96%to 98% purity where the cost of the product depends on the purity of the material. The solution of NaOH was formed by dissolving it in water with different molarity. It is recommended that the NaOH solution should be made 24 hours before casting and should be used with 36 hours of mixing the pellets with water as after that it is converted to semi-solid state.

Table -1: Chemical Composition of Sodium Hydroxide

Chemical Composition	Percentage
Na_2O	7.5-8.5%
SiO_2	25-28%
PH	Neutral

Fig -1: Sodium Hydroxide Pellets

1.3.6 Sodium Silicate

It is also known as waterglass which is available in the market in gel form. The ratios of SiO_2 and Na_2O in sodium silicate gel highly effect the strength of GPC. Mainly it is seen that a ratio ranging from 2 to 2.5 gives a satisfactory results. The sodium silicate is available in liquid form and is available in plastic container as shown in Figure 2.

Table -2: Chemical Composition of Sodium Silicate

Chemical Composition	Percentage
Assay	97%
Carbonate(Na_2CO_3)	2%
Chloride(Cl)	0.01%
Sulphate(SO_2)	0.05%
Lead(Pb)	0.001%
Iron(Fe)	0.001%
Potassium	0.1%
Zinc(Zn)	0.02%

1.4 NECESSITY OF GEOPOLYMER CONCRETE

Construction is one of the fast growing fields worldwide. As per the present world statistics, every year around 260,00,00,000 tons of cement is required. This quantity will be increased by 25% within a span of another 10years. Since the limestone is the main source material for the ordinary Portland cement .An acute shortage of Portland cement may come after 25to 50 years. Moreover while producing 1 ton of cement, approximately 1 ton of carbon-di-oxide will be emitted to the atmosphere, which is a major threat for the environment. The cement production generated carbon-di-oxide, which produces the atmosphere, the thermal industry produces a waste called fly ash which is dumped on the earth, occupies large area. By producing all the geopolymer concrete all the above mentioned issues shall be solved. Since, Geopolymer concrete doesn't use any cement, the production of cement, shall be reduced and hence the pollution of atmosphere, by the emission of carbon-di-oxide shall also be minimized.

1.5 PROPERTIES OF GEOPOLYMER CONCRETE

- GPC are set at room temperature
- They are non-toxic , bleed free
- Long working life before stiffening
- It is impermeable
- Higher resistance to heat and resist all inorganic solvents.
- Higher compressive strength.

Compressive strength of GPC is very high compared to the OPC concrete. The GPC also showed very high early strength. The compressive strength of GPC is about 1.5 times more than that of the compressive strength of ordinary OPC concrete.

1.6 ADVANTAGES OF GEOPOLYMER

One of the primary reasons to use geopolymer is for the environmental reasons. The industrial production of the cement produces about 0.9kg of Co_2 per Kg of OPC produced. This make it one of the polluting process on the earth, and approximately 5% of the worldwide co_2 production. Every Kg of Portland cement that is replaced with a geopolymer is potentially one less Kg of $Co_{2,}$ since most geopolymer used are by products of other industries and therefore require little to no extra energy to produce.

1.7 HOLLOW CONCRETE BLOCKS

Hollow blocks are very popular and are extensively used in building construction throughout the country because of the many advantages such as durability, strength and structural stability, fire resistance, insulation and sound absorption it possess. The cement concrete blocks have an attractive appearance and are readily adaptable to any style of architecture. The blocks are used for both load bearing and non load bearing walls. The raw materials cement, sand and stone chips are used for the concrete mixture. The size of the stone chips should be 12 mm and below but well graded. In this work 400mm x 100mm x 200mm size of the blocks are used. The locally available hollow block made of cement, fine and coarse aggregate with water is shown in Figure 3. The construction works of hollow blocks are shown in Figure 4.

Fig -2: Hollow Concrete Blocks

Fig -3: Hollow Concrete Blocks Construction

1.8 HOLLOW CONCRETE BLOCKS USED IN CONSTRUCTION

- The dead load of hollow concrete block is much lesser than a solid block; due to this, one can work with the structural engineer and reduce steel consumption in construction.
- Hollow concrete blocks require minimal mortar.
- If these blocks are engineered properly then dimensional accuracy and finishing quality is obtained.
- Usage of linte blocks brings tremendous operational efficiencies resulting in lower cost.
- Hollow concrete blocks have additives to improve their water resistance and seepage minimization.

Hollow concrete blocks can be engineered to achive very high compressive strengths.

1.9 ADVANTAGES OF GEOPOLYMER BLOCKS

- Initially the block is purely made up of ecofriendly such as fly ash, GGBS & ecofriendly chemical alone.
- Reduce the global warning & simultaneous decrease the unwanted excavation of pollutant. And usage for the manufacturing of bricks using. Waste dumping fly ash instead of clay materials.
- Neat finishing and act as a good thermal insulation for structures.
- The mechanical properties of goepolymer composite are as good as organic composite. In addition geopolymer resist all organic solvent
- Geopolymer are very easy to make, as they handle easily and do not require high heat.
- Hollow block need low maintenance

1.10 LIMITATIONS OF GEOPOLYMER CONCRETE

- Brining the base material fly ash to the required location.
- High cost for the alkaline solution.
- Safety risk associated with the high alkalinity of the activating solution.

2. SCOPE AND OBJECTIVES

2.1 SCOPE

- Casting of conventional cement concrete hollow blocks.
- Casting of hollow geopolymer concrete blocks.
- Testing of hollow cement concrete and geopolymer concrete blocks.
- Compare the results with available cement concrete blocks

2.2 OBJECTIVES

- To study the properties of fly ash, GGBS and their utilization.
- Development of geopolymer concrete mix.
- To study the different grades of geopolymer concrete to suit hollow block
- Study the characteristics of geopolymer concrete blocks.

To study the strength and durability of geopolymer concrete blocks.

3. EXPERIMENTAL STUDY

3.1 GENERAL

This chapter describes the hollow concrete blocks, details of geopolymer concrete mix and the preparation of alkaline solutions are explained in detail.

3.2 PRELIMINARY TESTS

3.2.1 Specific Gravity Test

The specific gravity of fine and coarse aggregates, cement and flyash are found using specific gravity bottle

Table -3: Specific Gravity Test

Sl.No	Materials	Specific Gravity
1	Fine Aggregate	2.68
2	Coarse Aggregate	2.76
3	Cement	3.00
4	Fly ash	2.32

3.2.2 WATER ABSORPTION TEST

The water absorption of fine and coarse aggregate are found and is given below.

Fine Aggregate : 1.0%

Coarse Aggregate : 0.4%

3.3 DETAILS OF CONCRETE MIX

The laboratory program conducted in this investigation is focused on four basic GPC mixes and these are designated with the molarities of NaOH (5M, 6M, 7M, 8M). The ratio of sodium silicate to sodium hydroxide solution is fixed as 2.5. The ratio of fly ash, sand and coarse aggregate was 1:3:4 with activator solution to fly ash ratio as 0.45. The details of concrete mixes are shown in Table

Table -4: Details of concrete mix

Sl. No	Molarity	Percentage (%)	
		Fly Ash	GGBS
1	5M	100	0
2	6M	100	0
		50	50
		0	100
3	7M	100	0
4	8M	100	0
		50	50
		40	60
		60	40
		0	100

3.4 MOLARITY CALCULATION

Molarity of NaOH solution plays a vital role in the strength of geopolymer concrete. With a high concentration of NaOH solution a higher compressive strength can be achieved. The molarities of NaOH solution is calculated by 5M, 6M, 7M, 8M.

Molarity Calculation = 5 x 40 = 200gms of NaOH,40 is the Molecular weight of NaOH

Molarity Calculation = 6 x 40 = 240gms of NaOH,40 is the Molecular weight of NaOH

Molarity Calculation = 7 x 40 = 280gms of NaOH,40 is the Molecular weight of NaOH

Molarity Calculation = 8 x 40 = 320gms of NaOH,40 is the Molecular weight of NaOH

3.5 PREPARATION OF ALKALINE SOLUTION

The alkaline liquid should be made prior to one day before mixing because at the time of mixing of Na_2Sio_3 with NaOH solution. It generates a huge amount of heat and the polymerization takes place by reacting with one another, which will act as a binder in the goepolymer concrete .The ratio of sodium silicate solution to sodium hydroxide solution is fixed as 2.5.

3.6 CONCRETE PREPARATION

The laboratory program conducted in this investigation focused on four basic mixes and these are designated with the molarities of NaOH. The concentration of NaOH used in the experiment is based on the research of previous researches. All the concrete are designed similar to the normal concrete, such that the density is approximately equal to 2400 kg/m^3. Accordingly the performances of geopolymer concrete block specimens made with 5M, 6M, 7M, 8M of NaOH are evaluated. The ratio of sodium silicate solution to sodium hydroxide solution is fixed as 2.5. The ratio of fly ash: sand: coarse aggregate is 1:3:4 with ratio of activator solution to fly ash as 0.45.

3.7 CASTING OF GEOPOLYMER CONCRETE CUBES

The alkaline activator is prepared in the laboratory by mixing with the sodium hydroxide solution with the sodium silicate solution about 24 hours before actual concrete mixings to enhance reactivity of the solution. Concrete ingredients are mixed in the laboratory panmixture. Aggregates, prepared in saturated surface dry condition, and the binders (fly ash) were dry mixed thoroughly in the mixture. Premixed alkaline activated solution is then added gradually in the mixture. Mixing is continued for further 4 to 6 minutes depending on the consistency of the mixture. Concrete moulds are filled with geopolymer concrete mixture in three layers and compacted (Figure 4.4). The moulds are then cured in a controlled temperature of 60^o C samples are demoulded after curing and then left in room temperature for air curing until testing. The size of the cube is 100X100 mm.

3.8 CURING

Curing temperature is an important factor till now for the strength point of view of geopolymer concrete. The main polymerization process or the chemical reaction of Geopolymer concrete takes place with the temperature imposed to it during the curing. It may attain almost its 70% strength within the first 3 to 4 hours of hot curing. The rate of increase of strength is rapid in the initial 24 hours of curing beyond that the gain of strength was moderate So the specimens should be cured for 24 hours only which will sufficient enough. Generally the curing which is done for geopolymer is hot steam curing or normal hot curing in oven with in a temperature of 60^o C – 90^o C for 24 hours. Though a curing temperature of 60^o C is more effective than other temperature. The electric oven is used to cure geopolymer concrete and the Figure 4.5 shows the specimen kept in electric oven.

3.9 COMPRESSIVE STRENGTH TEST

In the case of cubes, the specimen is placed in the machine in such a manner that the load is applied to the opposite sides of the cubes at cast. The axis of the specimen is carefully aligned with the centre of the thrust of the spherically seated plate. No packing is used between the faces of the specimens and the steel plate of testing machine. A spherically seated block is brought to bear on the specimens; the movable portion is rotated gently by hand so that uniform seating may be obtained. The load is applied without shock and increased continuously until the specimen to the increasing loads breaks down and no greater load can be sustained. The maximum load to the specimen is then recorded. The Average compressive strength of Geopolymer concrete cubes should be calculated.

Compressive Strength

(MPa) = Failure load/ cross sectional area

The testing og geopolymer concrete cubes are shown in Figure 4.6. The test results of compressive strength of different combination of Geopolymer concrete cubes are given in Table 4.3.

Table -5: Compressive Strength of Geopolymer Concrete Cubes

Molarity	Geopolymer cubes		Area(mm^2)	Average Compressive Strength (MPa)
	Fly ash (%)	GGBS (%)		
8M	100	0	10000	4.07
	50	50		10.17
	40	60		13.43
	60	40		7.27
	0	100		24.87
7M	100	0	10000	3.63
6M	100	0	10000	1.53
	50	50		28.10
	0	100		46.33
5M	100	0	10000	1.95

3.10 CONVENTIONAL HOLLOW BLOCKS PREPARATION

The quantities of the constituents of the concrete were obtained from the Indian Standard Mix Design method (IS: 10262-2009). The suitable mix proportion for hollow concrete blocks was chosen from the several trials as 1:3:4 (1 part of Cement : (1 part of Sand and 2 part of quarry powder): 4 part of chips) with W/C ratio of 0.45. The Hollow block was prepared in the laboratory using hand mixing. The cement, fine aggregate and coarse aggregate were first mixed in dry state to obtain uniform colour and calculated amount of water obtained from workability test was added and the whole concrete was mixed for five minutes in wet state (Figure 4.7). Meanwhile the moulds are screwed tightly to avoid leakage; Oil was applied on inner surface of the moulds. Using the mix, the conventional hollow concrete blocks were cast and the hollow blocks were immersed in a clean water tank. After curing the specimens for a period of 28 days, the specimens were removed from the water tank and allowed to dry under shade. The size of block is 400 x 200 x 100mm. The casting of conventional concrete hollow block is shown in Figure 4.8. The hollow blocks after casting are shown in Figure 4.9.

3.11 CURING OF HOLLOW BLOCKS

The hollow blocks were immersed in a clean water for curing. After curing of the specimens for a period of 28 days, the specimens were removed from the water tank and allowed to dry under shade. The curing of conventional concrete hollow block is shown in Figure 4.10.

3.12 COMPARISON OF HOLLOW BLOCKS

The hollow blocks which are made in our laboratory are compared with locally available hollow blocks (Figure 4.11) and their compressive strength were tested. Then the results of both the hollow blocks were compared and given in Table 4.4. The compressive strength test on concrete hollow block is shown in Figure 4.12.

Table -6: Compressive Strength of Hollow Concrete Blocks

Specimens	Area of blocks (mm^2)	Average Compressive Strength (MPa)	
		7 days	28 days
Cast in lab	25600	5.02	10.28
Purchased	25600	3.34	4.12

3.13 HOLLOW GEOPOLYMER CONCRETE BLOCKS

From the results of different molarities of geopolymer concrete cubes, 8M was choosen for the casting of hollow geopolymer concrete blocks. In this molarity different percentages of Fly ash and GGBS (Ground Granulated Blast Furnace Slag) ratio were investigated by the mix 100%FA, 50%FA:50%GGBS, 40%FA:60%GGBS, 60%FA,:40%GGBS, 100%GGBS. The size of the block is 400X100X200 mm. Using the mix, the Geopolymer hollow concrete blocks were cast and the hollow blocks were allowed to set for 24 hours. The constituents of Geopolymer concrete and mix are shown in Figure 4.13. The Geopolymer hollow blocks after casting is shown in Figure 4.14

3.14 CURING OF HOLLOW GEOPOLYMER CONCRETE BLOCKS

Curing temperature is an important factor till now for the strength point of view of geopolymer concrete. The main polymerization process or the chemical reaction of Geopolymer concrete takes place with the temperature imposed to it during the curing. It may attain almost its 70% strength within the first 3 to 4 hours of hot curing. The rate of increase of strength is rapid in the initial 24 hours of curing beyond that the gain of strength was moderate So the specimens should be cured under atmosphere temperature only which will sufficient enough. The curing carried for geopolymer is in ambient condition for three days and is shown in Figure 4.15.

3.15 COMPRESSIVE STRENGTH OF GEOPOLYMER BLOCKS

In the case of blocks, the specimen having five different percentage of Fly ash and GGBS (60%FA:40%GGBS, 50%FA:50%GGBS, 40%FA:60%GGBS, 100%FA, 100%GGBS) with 8M were tested and it is placed in the machine in such a manner that the load is applied to the same sides of the blocks at cast. The axis of the specimen is carefully aligned with the centre of the thrust of the spherically seated plate. A thin plywood is used between the faces of the specimens and the steel plate of testing machine. The compressive strength of hollow concrete blocks are within the limits specified by IS: 2185 (Part I)-1979, Hollow and Solid Concrete Blocks. The different mixes of Geopolymer hollow blocks are shown in Figure 4.16. The compressive strength test on hollow blocks are shown in Figure 4.17. The 3rd day compressive strength test on Geopolymer hollow blocks are given in Table 4.5. The 7th day compressive strength test on Geopolymer hollow blocks are given in Table 4.6.

Table -7: Compressive Strength of Hollow Geopolymer Concrete blocks (8M) 3rd day strength

Molarity	Geopolymer cubes		Area(mm^2)	Average Compressive Strength (MPa)
	Fly ash (%)	GGBS (%)		
8M	100	0	25600	4.23
	50	50		10.31
	40	60		13.42
	60	40		7.09
	0	100		20.24

Table -8: Compressive Strength of Hollow Geopolymer Concrete blocks (8M) 7th day strength

Molarity	Geopolymer cubes		Area(mm^2)	Average Compressive Strength (MPa)
	Fly ash (%)	GGBS (%)		
8M	100	0	25600	4.38
	50	50		10.61
	40	60		13.73
	60	40		8.5
	0	100		20.55

3.16 DURABILITY TEST ON HOLLOW CONCRETE BLOCKS

3.16.1 Sulphuric acid resistance test

Acid resistance was tested on both conventional specimens at the age of 28 days of curing and geopolymer specimens at the ambient curing. The specimens were weighed and immersed in water diluted with one percent by weight of sulphuric acid for 28 days. Then, the specimens were taken out from the acid water and the surfaces of the blocks were cleaned. Then the weight and the compressive strength of the specimens were found out and the average percentage of loss of weight and compressive strength were calculated. The Sulphuric acid is shown in Figure 4.18.The Acid resistance test on Conventional and GPC hollow blocks are shown in Figure

The specimens were weighed and immersed in water diluted with Third percent by weight of sulphuric acid for 28 days. Then, the specimens were taken out from the acid water and the surfaces of the blocks were cleaned. Then the weight and the compressive strength of the specimens were found out and the average percentage of loss of weight and compressive strength were calculated. The HCL Acid resistance test on both Conventional and GPC hollow blocks are shown in Figure 4.21 & 4.22.

Table -9: Acid resistance test result

Sl.No	Types of Blocks	% of Weight Loss		% of Compressive Strength Loss	
		HCL(3%)	H_2SO_4(1%)	HCL(3%)	H_2SO_4(1%)
1	Conventional blocks	1.88	0.97	16.34	21.20
2	Geopolymer blocks	0.47	0.35	5.01	5.28

3.17 WATER ABSORPTION TEST

The casted specimen is subjected to water absorption test, to study the character of geopolymer blocks. After the curing period is completed, the specimen are immersed in the water tank and left for 24 hours. It is weighed accurately after 24 hours. The cleaned specimen is weighed accurately. From these two values, the water absorbed by the entire specimen to be calculates. The water absorption test on both conventional and GPC are shown in Figure 4.23 & 4.24. The water absorption test results are given in Table 4.8.

Table -10: Water absorption test result

S.NO	TYPES OF BLOCKS	PERCENTAGE INCREASE IN WATER
1	Conventional blocks	5.059
2	Geopolymer blocks	2.085

4. RESULTS AND DISCUSSION

4.1 GENERAL

This chapter describes the experimental work and the results of conventional Hollow concrete blocks, geopolymer concrete cubes.

4.2 COMPRESSION STRENGTH HOLLOW CONCRETE BLOCKS

In the case of blocks, the specimen is placed in the machine in (Figure 5.1) such a manner that the load is applied to the same sides of the blocks at cast. The axis of the specimen is carefully aligned with the centre of the thrust of the spherically seated plate. The compressive strength of hollow concrete blocks of size 400mm x 200mm x 100mm were tested by compression testing machine. The comparison of 7 days and 28 days compressive strength are shown in Figure 5.1 & 5.2.

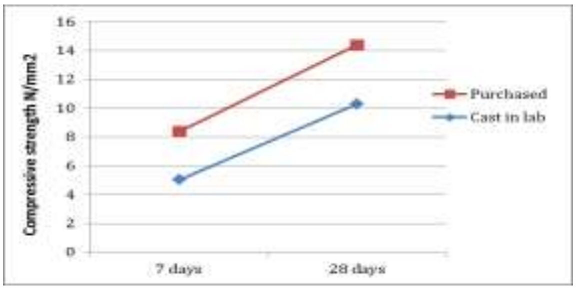

Chart -1: Compressive strength of Hollow concrete block

4.3 COMPRESSIVE STRENGTH OF GEOPOLYMER CONCRETE CUBES

The comparison of geopolymer concrete cubes with different molarities [5M, 6M, 7M, 8M]

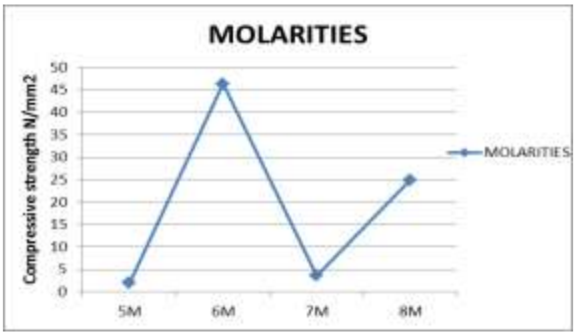

Chart -2: Comparison of Geopolymer concrete with different molarities

4.4 COMPRESSIVE STRENGTH OF GEOPOLYMER HOLLOW BLOCKS

From the results of Geopolymer concrete cube trials, 8M of NaOH strength gives the required compressive strength as per the IS 2185 (Part I)-1979 code. The compressive strength of different mixes (60%FA:40%GGBS, 50%FA:50%GGBS, 40%FA:60%GGBS, 100%FA, 100%GGBS) should be calculated and the comparative results of 3rd and 7th day are shown in Figure 5.5 and Figure 5.6.

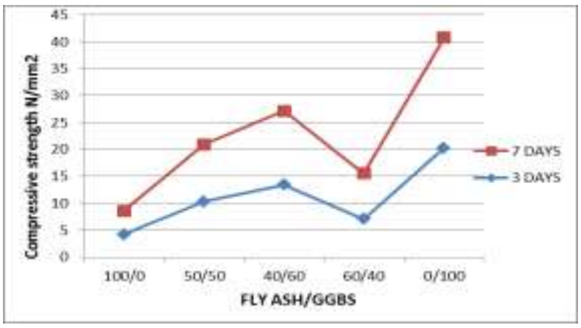

Chart -3: Compressive strength of Geopolymer concrete

4.5 WATER ABSORPTION TEST

The percentage of water absorbed by the conventional hollow blocks and Geopolymer hollow blocks are compared each other and the result is shown in Figure 5.7.

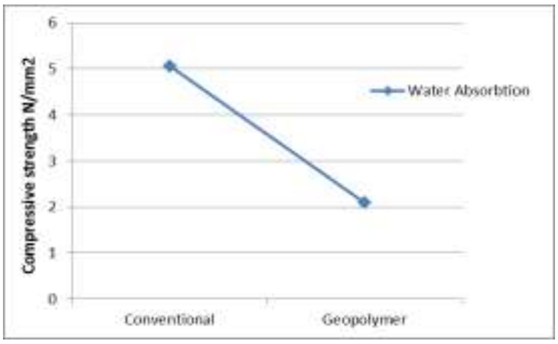

Chart -4: Water absorption of Geopolymer concrete

Water absorption (%) = (W1-W2)/ (W1) X 100

W1 - Wet Weight of the blocks

W2 – Dry Weight of the blocks

5. CONCLUSION

5.1 GENERAL

Based on the experimental investigations carried out on conventional and Geopolymer hollow blocks the following conclusions are drawn.

5.2 CONCLUSIONS

1. The Conventional hollow blocks available in the market are tested in the laboratory and the same cast in laboratory with the same mix proportion and compared.
2. The locally available hollow blocks obtained the average compressive strength of **3.34 N/mm²** and **4.12 N/mm²** at 7 and 28 days.
3. The conventional hollow blocks cast in laboratory obtained the average compressive strength of **5.02 N/mm²** and **10.28 N/mm²** at 7 and 28 days.
4. The increase in compressive strength of conventional hollow blocks cast in lab compared to locally available hollow blocks is due to adequate curing.
5. The Geopolymer concrete of having equal strength of conventional concrete was developed with several trial mixes.
6. The strength of GPC is mainly based on the concentration of Sodium hydroxide. The GPC was made with 5M, 6M, 7M and 8M concentration of Sodium hydroxide with varying percentage of cementitious material (Fly ash & GGBS). Finally GPC made with 8M concentration of Sodium hydroxide was selected to cast hollow blocks.
7. The GPC hollow blocks were made with 8M concentration of Sodium hydroxide with 100%FA, 50%FA+50%GGBS, 40%FA+60%GGBS, 60%FA+40%GGBS and 100%GGBS combinations.
8. From the different combination of Fly ash and GGBS, it is found that 60%FA+40%GGBS gives the compressive strength of GPC hollow blocks as **7.09 N/mm² and 8.5 N/mm²** at 3rd and 7th day cured under ambient conditions. As per the IS code 2185 (Part I)-1979 the minimum compressive strength of hollow block is **7 N/mm²**
9. The percentage of water absorption at 24 hours was observed in conventional and GPC hollow blocks as **4.059% and 2.085%** respectively.

10. The percentage of weight loss observed after 28 days immersed in 1% concentration of Sulphuric acid (H_2SO_4) in conventional and GPC hollow blocks as **0.97% and 0.35 %** respectively.

11. The reduction in strength observed in acid resistance test on conventional and GPC hollow blocks as **21.20 % and 5.28 %** respectively.

12. The percentage of weight loss observed after 28 days immersed in 3% concentration of Hydrochloric acid (HCL) in conventional and GPC hollow blocks as **1.88 % and 0.47 %** respectively.

13. The reduction in strength observed in acid resistance test on conventional and GPC hollow blocks as **16.34 % and 5.09 %** respectively.

14. Hence, it is recommended that ambient cured GPC hollow blocks for construction purposes since it is satisfying all the requirements.

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