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Behaviour on Geopolymer Mortar using Granulated Blast Furnace Slag

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Abstract*: India is one among the developing countries wherever in Construction is that the second largest trade causative to the nation's value standing next to agriculture. In today's context all the developing and a few of the developed countries face the matter of handling environmental pollution arising attributable to the development activities. Also, conservation of natural resources so as to attain property surroundings has become of the challenges nowadays. Construction activities embody the assembly of concrete, mortar, bricks, blocks etc. Major things embody cement, fine aggregates like sand, coarse aggregates, bricks, blocks, steel etc. Among this cement production quite 70% of CO2 and alternative harmful gases are generated and enters the atmosphere. This may harm the ozonosphere therefore it's necessary to scale back the assembly and consumption of cement. As an answer, it's necessary to use various building materials that doesn't produce harmful effects for the surroundings. Several researches are done on many alternatives for cement, fine aggregates and coarse aggregates. By analysis work currently a days, cement is replaced by ash, rice husk ash, slag, baggage ash, eucalyptus ash, saw dirt ash, waste sludge ash etc. by victimization this alternatives for cement, the consumption of the cement can scale back and also the production can rebelliously reduces therefore up to some extent it should solve the issues arising within the environmental pollution from construction activities.

KEYWORDS: Compressive Strength Test, Flow Table Results, Flow Table Results (River Sand), Dry Density Test, Water Absorption Test, Acid Attack Test..

I. INTRODUCTION

Mortar is that the paste created with binding and filling materials with some correct quantity of water. Mortar is employed to repair and bind the building blocks like stones, bricks, concrete blocks etc. and it's accustomed fill the joints between the blocks, seal the gaps, for application purpose and typically it's used for ornamental purpose in masonry walls. Mortar includes pitch, asphalt, and soft mud or clay, like used between mud bricks.

Geopolymer could be a new thought and it's a best different for typical hydraulic cement within the field of construction. to organize geo polymer mortar it doesn't need cement and therefore it reduces the cement production that conjointly reduces the assembly of carbonic acid gas and plenty of fuels and energy needed to provide cement.

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However, the event of geo polymer remains in its developing stage and variety of researches square measure nevertheless to return its method. Geopolymer materials represent a replacement technology that's generating appreciable interest within the industry, notably in lightweight of the continued importance on property. within the production of geo polymer mortar it doesn't need cement and conjointly it reduces the need of water. Some industrial waste materials will be used as binders during this geo polymer

II. NEED OF THE STUDY

The geo polymer mortar and concrete has many economic edges compared to OPC. the price of GGBS is simply too less compared to OPC since it associate degree industrial by-product and thought of as a waste matter. Therefore, even once leaving the worth of base-forming activators required to create the GPC, the worth of GGBS based mostly GPC was calculable to be regarding ten to thirty PC cheaper than that of hydraulic cement mortar.

In addition, less drying shrinkage, terribly low creep, additional capability for resistance to salt attack, and smart acid resistance compared to standard mortar. therefore sturdiness of Geo polymer mortar is improved that successively contributes to the economy of the project.

To prepare geo polymer mortar, it needs less energy and conjointly 80-90% of carbonic acid gas are going to be reduced compared to standard mortar. therefore it's eco-friendly & reduces the pollution. By correct combine style and formulation development, geo polymer materials derived from scoria will exhibit superior chemical and mechanical properties.

III. LITERATURE REVIEW

Anupam Bhowmick, Somnath Ghosh, in their paper "Effect of synthesizing parameters on workability and compressive strength of ash based mostly Geopolymer mortar" varied tests ar conducted as strength property like workability ad strength of compression on flyash content of geopolymer mortar and over that it's having affordable strength property i.e workability , by charging the obtainable flyash with hydroxide and water glass, strength will made. one in every of the vital property of mortar i.e flow worth varies with regard to Flyash/Sand quantitative relation and binder i.e water/fly ash quantitative relation. feasible water for improved flow worth is in between 50-80% by adjusting higher than mentioned ratios it will made a compressive strength or geopolymer i.e regarding 15-28Mpa Flyash/Fine mixture quantitative relation as 2:1. MIP examination builds up the reliance of compressive quality on the amount of pores. SEM together with EDX confirms the fortunate geopolymerization of the flyash activated by basic answer.

Ravindra N. Thakur and Somnath Ghose in their paper "Effect of combine Composition on Compressive Strength and Microstructure of ash based mostly Geopolymer Composites" conducted tests to grasp the compressive strength and microstructure of GPC paste. By mistreatment NaOH pellets and Na2SiO3 answer that they had ready basic substance answer. that they had investigated the solidifying time and solidifying temperature on development of compressive strength. that they had cured the casted specimens at 850C for forty eighthours and that they got 48.20MPa compressive strength.

Bohra Vinay Kumar religion, J. J Vijay in their paper "Investigation of the Behavior of Geopolymer Mortar with Fly-Ash beneath High Temperature" over that Geopolymers belong to a spread of inorganic chemical compound materials fashioned by activating oxide metal made minerals. Silica-metal made industrial wastes like ash etc. ar activated with basic or alkaline-silicate answer at close or higher temperature to induce Geopolymers. the target of the current analysis is to research the impact of various synthesizing parameter on the hardened properties ash based mostly geopolymer mortar exposed to totally different Elevated temperature level. associate degree experimental investigation on low atomic number 20 ash based mostly geopolymer mortar, was undertaken. share of Na2O was taken V-day and ten the troubles. SiO2 / Na2O quantitative relation was varied from one to one.6. Sand to ash quantitative relation was unbroken 2:1, 1:1, and 1:2.Curing temperature and solidifying time were 800C and seventy two hours severally. once seven days, specimens were heated in kitchen appliance at 2000C , 4000C & 5500C for four hours and so unbroken in air for cooling. Results show that the preparation of Geopolymer mortar has been accomplished by combining of allumino-silicate supply material ash with associate degree activating answer that contains hydroxide and soluble water glass. Study on workability of the ash based mostly Geopolymer mortar result shows that the share of Na2O, SiO2 / Na2O quantitative relation and Sand to ash quantitative relation affects the mortar flow. Increasing the Sand to ash quantitative relation mixture become stiffer and workability become low. Increase the alkali (% Na2O) content and salt quantitative relation (SiO2 / Na2O) increase the workability of the Geopolymer mixture.

Dakshayani K, Nutana M N in their paper "An experimental investigation on physical properties of GGBS based mostly Geopolymer Concrete" conducted tests on compressive strength and over that the compressive strength will increase with increase in concentration. any they inferred that strength will increase in GPC created with factory-made sand. so as to realize workability, the results with stream sand found to be satisfactory. The tests conducted on strength inferred that scoria is best than stream sand and M-sand. Lastly, the tests on water absorption offers out the result wherever in charge of water absorption is additional for lesser concentration than higher concentration mixes.

Lolakshi S M, Anjali H S, Chethan K M, in their paper "An experimental investigation on sturdiness of GGBS based mostly GPC" conducted sturdiness tests with variable molarities whereby they discovered reduction in strength for lower molarities. the take a look ats on acid attack and accelerated corrosion test reveals that the lower molarities ar less sturdy compared to higher ones. Depth of permeation and sorptivity is established to be additional for 8M than 12M. Lastly, cubes product of M-sand ar additional sturdy than stream sand and scoria

IV. OBJECTIVES

- The aim of the study is to develop GGBS- stream sand, M-sand, GBFS based mostly geopolymer mortar by victimization geopolymerization method.
- To replace the OPC by Geopolymers to cut back the emission of carbonic acid gas in to the atmosphere and to safeguard the surroundings.
- To study the impact of addition of plasticizers on the flow of mortar and improve the workability properties.
- To study the mechanical properties of geopolymer mortar with variable molarity and proportion remains same. The GGBS and natural sand, M sand, GBFS used as a binder and fine combination replacement severally.
- The basic properties of those geopolymer mortar, like compressive strength, modulus of snap and water absorption.

V. MATERIALS AND METHODOLOGY

The present experimental study, the geopolymer masonry bricks ar created by some man of science on GGBS, GBFS. Here GGBS is employed as a binding agent and stream sand, M sand and GBFS as a fine mixture. Mixture of NaOH pellets and Na2SiO3 is employed because the base-forming matter resolution.

VI. MATERIALS:

Ground coarse furnace scum (GGBS): The GGBS used for geopolymer combine as binder material appreciate a hydrous Portland. Alkaline activator: The Na2SiO3 is out there commercially within the style of solution; the chemical composition of Na2SiO3 is Na2O-13.52%, SiO2-28.66% and Water-57.82% by mass. NaOH is out there within the style of flakes or pellets. For my study, NaOH pellets with ninety seven to ninety eight purity were used for the preparation of base-forming matter.

Fine Aggregates: M Sand, River sand & GBFS is used as fine aggregates

GGBS

RIVER SAND

M SAND

GBFS

NaOH **Na2SiO3** **H2O**

Fig 1: Materials used for making geopolymer mortar

VII. PREPARATION OF GEOPOLYMER COMPOSITE MIXTURE

The geo polymer consists of GGBS as binding material, River sand, M sand and GBFS as fine aggregate and alkaline activator solution as the liquid used for mixing the composition.

The binder and Fine aggregate were mixed in dry condition in the ratio of 1:3 by weight in a mixing tray carefully till the uniformity of dry mix is obtained. Initially Sand and GGBS of good quality were taken in a pan, as per material required for a 70.6mm X 70.6mm X 70.6mm Mortar Cubes. Weights of GGBS & Sand are weighed as per required ratio. The fluid to Binder ratio was taken as 0.25 respectively at the time of casting the mound. The fluid is added to the mixture and mixed properly for 3 to 5 min to get a homogeneous mixture.

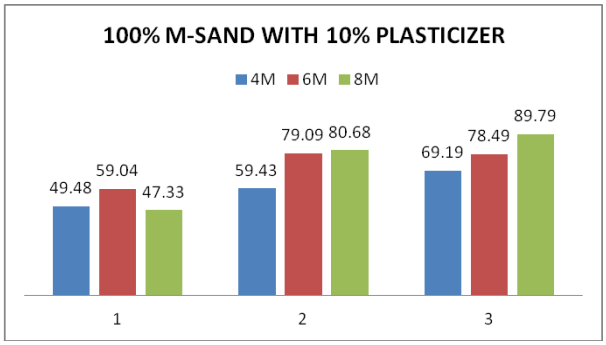
VIII. RESULTS AND DISCUSSIONS

In this section, the test result are discussed. The test results comprise the outcome of age on the compressive strength. The test specimens are made with differing molarities of 4M, 6M and 8M of 1:3 binders (GGBS) to fine aggregate ratio.

1. **COMPRESSIVE STRENGTH TEST**:

100% M-SAND WITH 10% PLASTICIZER			
Molarities	compressive strength in N/mm^2		
	3	7	3
4M	49.48	59.43	69.19
6M	59.04	79.09	78.49
8M	47.33	80.68	89.79

Table no 1.1 Compressive strength of M-Sand with 10% Plasticizer

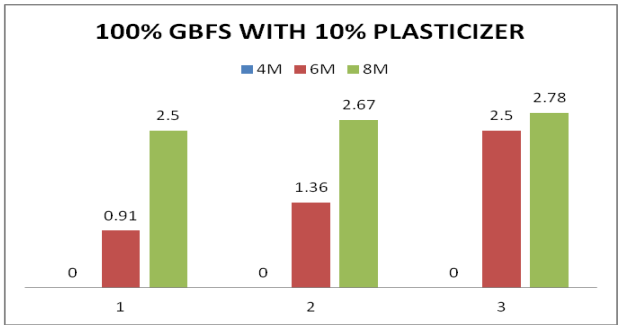


Graph no1 Compressive strength of M-Sand with 10% Plasticizer

2. Molarity comparison of Compressive Strength of GBFS Sand

100% GBFS WITH 10% PLASTICIZER			
Molarities	Compressive Strength N/mm^2 for age (Days)		
	3	7	28
4M	0	0	0
6M	0.91	1.36	2.5
8M	2.5	2.67	2.78

Table no 2.1 Compressive strength of 100% GBFS WITH 10% PLASTICIZER

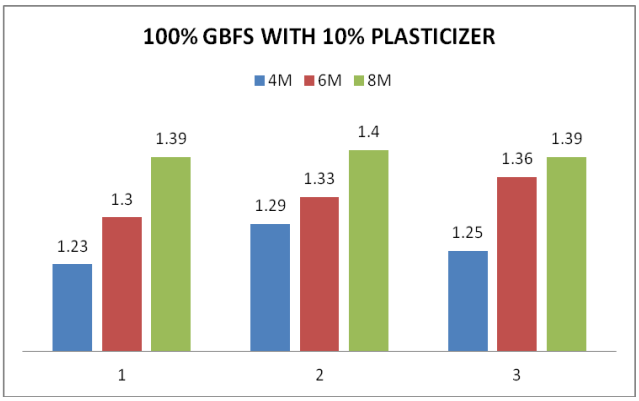


Graph 2: Compressive strength of GBFS with 10% Plasticizer

3. Dry Density Test:
Molarity comparison of Density of GBFS Sand

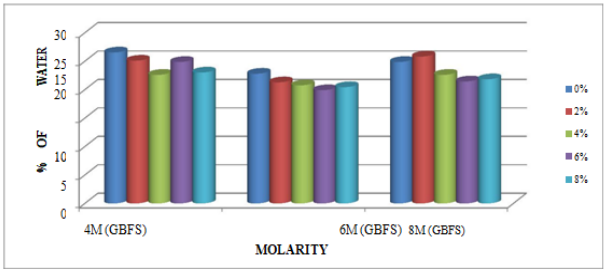
100% GBFS WITH 10% PLASTICIZER			
Molarities	Density in g/cc(Days)		
	3	7	28
4M	1.23	1.29	1.25
6M	1.3	1.33	1.36
8M	1.39	1.40	1.39

Table 3.1: Density of GBFS with 10% Plasticizer



Graph 3: Density of GBFS with 10% Plasticizer

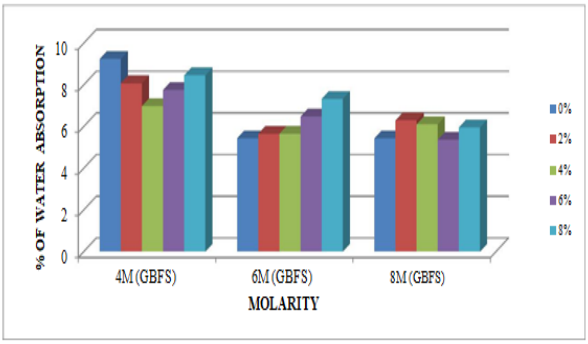
4. WATER ABSORPTION TEST
Molarity comparison of GBFS-SAND



Graph 4: Water absorption of GBFS-Sand

5. ACID ATTACK TEST:

Molarity comparison of GBFS-SAND



Graph 5: Acid Attack of GBFS-Sand

6. QUANTITY AND RATE ANALYSIS:

8 Molar compressive strength has good results compared to 6M and 4M. So only 8M cost calculation is done.

Sl.No	Materials	Rates	GPM (8M)	
		Rs.	Kg/m^3	Rs.
1	Fine aggregates	850/tonne	1459	154
2	GGBS	5/kg	490	
3	Sodium Silicate	30/kg	185	2520
4	Sodium Hydroxide	60/kg	20	
5	Water	0	55	5730
	TOTAL			**1047 3**

Table 6.1: Quantity and Rate analysis

IX. CONCLUSION

- The following conclusions is made of the restricted experimental study on the close cured geo polymer mortar
- Compressive strength of cubes will increase with increasing molar concentration that's strength of 8M is quite 6M & strength of 6M is quite 4M.
- The 3days compressive strength of 8M is a smaller amount compared to 6M and 8M, however it's high Compressive Strength at 7days.
- In sand comparison, M Sand attains a lot of strength than stream sand & GBFS, stream sand attains a lot of strength than GBFS.
- GBFS offers low strength attributable to low relative density.
- Water Absorption rate is shrunken as molar concentration exaggerated
- In molar concentration comparison likewise as sand comparison the M-SAND is best for construction work and conjointly economical.
- Non accessibility of sand at affordable value as fine aggregates in cement mortar, hunt for various material like M sand qualities itself as an acceptable alternate for sand at terribly low value.
- In the gift study, it is determined that geopolymer mortar attains high early strength will increase compared to alternative mortar.

APPENDIX

Mix Design

Sl.No	Design Parameters	Value	Units
1	Dry wet density of GPC	2200	Kg/m3
2	Ratio of Sodium Silicate to Sodium hydroxide	2.5	Constant
3	The Water content in sodium silicate	48	%
4	The Water content chosen for Mix	200	Ltrs
5	GGBS	25% of binder can	%
6	Molarity Considered for Solution	**4,6,8**	M

1 Molar = 40gm of pellets = 1000gm/ml of Water

Total Water for Alkaline

Solution for 1 cube	95.82 x (0.0706)^3	**33.71gms**
Water Content	(1000/1160)x33.71	**29.06gms**
NaOH pellets	33.71-29.06	**4.65gms**
Sodium Silicate	2.5 x 33.71	**84.275gms**

QUANTITY FOR 1 CUBE (70.6mmx70.6mmx70.6mm)		
GGBS	466.15 x (0.0706)^3	164.03gms
Sand	3 x 164.03	492.11gms
Super plasticizer		
2% of GGBS quantity		3.28gms
4% of GGBS quantity		6.56gms
6% of GGBS quantity		9.84gms
8% of GGBS quantity		13.12gms

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