" GEO-POLYMER CONCRETE USING RICE HUSK ASH BY CURING AT AMBIENT TEMPERATURE"

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Abstract:- In present scenario as the construction activities increases, the demand of concrete also increased day by day. Concrete is one of the fundamental important materials used in field of civil engineering. An attempt has been made to replace the cement with industrial waste materials such as fly ash, rice husk ash (RHA) and Ground granulated blast furnace slag (GGBS) which acts as alternative binder and curing at ambient temperture. Fly ash is rich in silicate as well as alumina. GGBS is a slag which is usually used for partial replacement of cement. In the present study molarities of Sodium Hydroxide (NaOH) are taken as 12M. The effect of durability test by acid attack and sulphate attack is performed.

Keywords:-.GGBS, Fly ash, Ambient curing, RHA, Alkaline activated solution

2.Introduction

Concrete is widely used as construction material and OPC is the main component used for making concrete. The cement industry is responsible for CO2 emission and green house effect, because the production of one ton Portland cement produces approximately one ton CO2 to the air which is not eco-friendly. Sir Davidovits give the term Geo-polymer to represent these binders material. Fly ash, silica fume, ground granulated blast furnace slag, and rice husk ash can be used as an alternative binder instead of cement in concrete. Concrete is used in buildings, bridges and in other structures, is taken for granted as massive and weighty construction material. There was much experimental work conducted to improve the properties of the concrete by replacing or adding waste materials in the concrete mix degin. The waste material can be replacing the aggregates or cement in concrete. Many researches has been conducted to reduce the aggregate and cement material in concrete. In terms of reducing the global warming, the Geo-polymer technology could reduce the CO2 emission in to atmosphere, caused by cement and aggregate industries about 80%. The source material that is rich in silicon (Si) and Aluminium (Al) is reacted with a highly alkaline solution through the process of geo-polymerisation to produce the binding material.Geo-polymer concrete has excellent properties and is well-suited to manufacture precast concrete products that are needed in rehabilitation and retrofitting of structures after a disaster.

3.MATERIAL USED

Sample of GGBS, FLY ASH& RHA tested for its chemical composition at Mukesh A. Patel technical consultancy & civil engineering laboratory, Ahmadabad. The results of the composition are as shown in Table below.

Table 1.Chemical Analysis of GGBS, FLY ASH& RHA

CHEMICAL COMPONENT (% By Mass)	GGBS	FLY ASH	RHA
SiO_2	81.55	48.10	2.36
Fe_2O_3	0.37	11.56	19.72
Al_2O_3	1.86	12.81	39.05
CaO	14.12	5.32	34.27
K_2O	0.04	0.12	0.06
MgO	0.97	1.28	1.02
Chloride	0.026	0.038	0.023
Loss Of Ignition	4.50	2.84	0.88

4. MIX PROPORTIONS

Table 2. Mix Deign

MIX	GGBS + FLY ASH (50%EACH)	RHA
M1	100%	0%
M2	95%	5%
M3	90%	10%
M4	85%	15%
M5	80%	20%

Table 3. Detail Mix Deign

Sr.no.	Mix	M1	M2	M3	M4	M5
1	Coarse aggregate(kg/m^3)	1293.6	1293.6	1293.6	1293.6	1293.6
2	Fine aggregate(kg/m^3)	554.4	554.4	554.4	554.4	554.4
3	NaOH (kg/m^3)	45.06 (10M)	45.06 (10M)	45.06 (10M)	45.06 (10M)	45.06 (10M)
4	Na_2SiO_3 (kg/m^3)	112.65	112.65	112.65	112.65	112.65
5	Fly ash (kg/m^3)	197.15	187.28	177.43	167.57	157.716
6	GGBS (kg/m^3)	197.15	187.28	177.43	167.57	157.716
7	RHA (kg/m^3)	0	19.72	39.43	59.14	78.858
8	Extra Water (10% of binder)	39.43	39.43	39.43	39.43	39.43

5. Tests conducted & Results.

5.1. Compressive strength test

Compression test of concrete cubes is carried out as per IS 516:1959 using Universal Testing Machine in concrete laboratory of L.D. College of Engineering, Ahmedabad .The cubes were tested after 3 days and 7 days of curing. The results of compression test are tabulated as below.

Table 4.Average compressive strength at the end of 3,7&28 days.

Mix	Average compressive strength at the end of 3day (MPa)	Average compressive strength at the end of 7day (MPa)	Average compressive strength at the end of 28day (MPa)
Mix-1	27.69	30.34	34.87
Mix-2	29.46	32.69	38.15
Mix-3	24.43	27.54	31.34
Mix-4	15.17	19.92	23.38
Mix-5	10.54	12.91	14.76

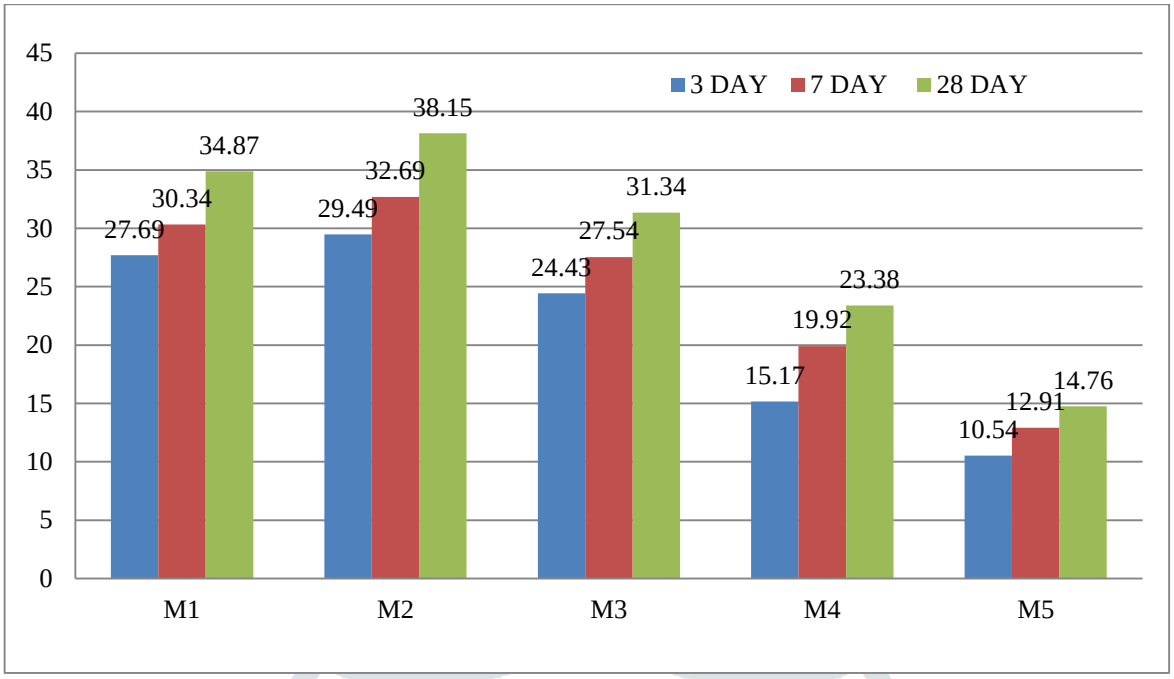

Figure 1.Average compressive strength at the end of 3,7&28 days.

5.2. Split tensile strength test

Split tensile strength of cylinder is carried out as per IS 5816:1999 using Universal Testing Machine in concrete laboratory of L.D. College of Engineering, Ahmadabad a. The cylinders were tested after 3,7& 28 days of curing. The results of splitting tensile test are tabulated as below.

Table 5.Average split tensile strength at the end of 3,7&28 days.

Mix	Average Split tensile strength at the end of 3day (MPa)	Average Split tensile strength at the end of 7day (MPa)	Average Split tensile strength at the end of 28day (MPa)
Mix-1	1.326	2.173	2.31
Mix-2	1.346	2.283	3.11
Mix-3	1.288	2.106	2.21
Mix-4	1.271	1.342	2.15
Mix-5	1.247	1.314	2.026

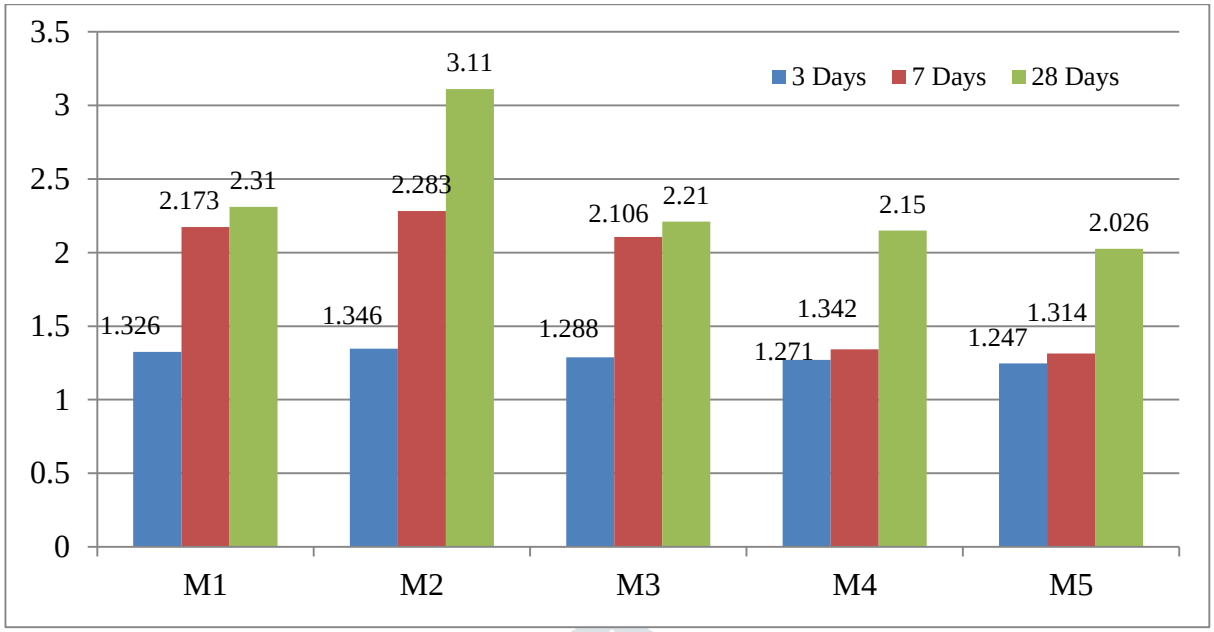

Figure 2.Average split tensile strength at the end of 3,7&28 days.

5.3. Acid attack test.

Acid attack test was conducted as per IS 4456:1967. After curing of 28 days, the cubes of size 150 X 150 X 150 mm of Mix M1, M2, M3 M4 & M5 are submerged in 5% sulphuric acid solution for 28 days. Before submerging the cubes in solution its weight are noted than after 28 days of exposure again its weight were noted after wiping out soft material. The weight loss and reduction in compressive strength is determined after 28 day exposure. Specific gravity sulphuric acid solution at 25ºC is about 1.84.

Table 6. Change in compressive strength after acid attack test.

Mix	Comp. Strength without Exposure (MPa)	Compressive strength after 28 day Exposure (MPa)	% Reduction of Compressive strength
M1	34.87	30.97	11.18
M2	38.15	34.02	10.83
M3	31.34	27.82	11.22
M4	23.38	20.48	12.39
M5	14.76	12.48	15.39

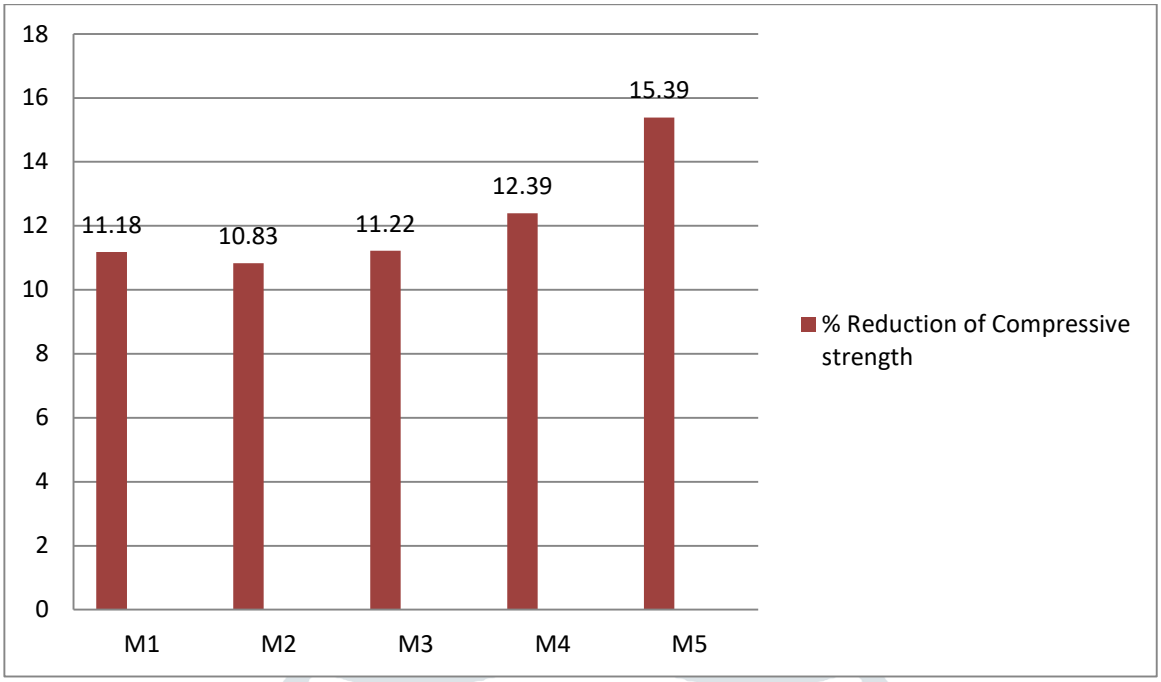

Figure 3. Change in compressive strength after acid attack test.

5.4. Sulphate attack test

Sulphate attack test was conducted as per IS 4456:1967. After curing of 28 days, the cubes of size 150 X 150 X 150 mm of Mix M1, M2, M3 M4&M5 are submerged in 5% Magnesium sulphate solution for 28 days. The weights of cubes are noted before submerging it in solution. After exposure of 28 days the cubes were cleaned and its weights were noted. The weight gain and reduction in compressive strength is measured after 28 day exposure. PH of 5% aqueous solution of Magnesium sulphate is 5.0-8.2.

Figure 7. Change in compressive strength after sulphate attack test.

Mix	Comp. Strength without Exposure(MPa)	Compressive strength after 28 day Exposure(MPa)	% Reduction of Compressive strength
M1	34.87	32.88	5.70
M2	38.15	36.03	5.55
M3	31.34	29.40	6.19
M4	23.38	21.92	6.25
M5	14.76	13.78	6.64

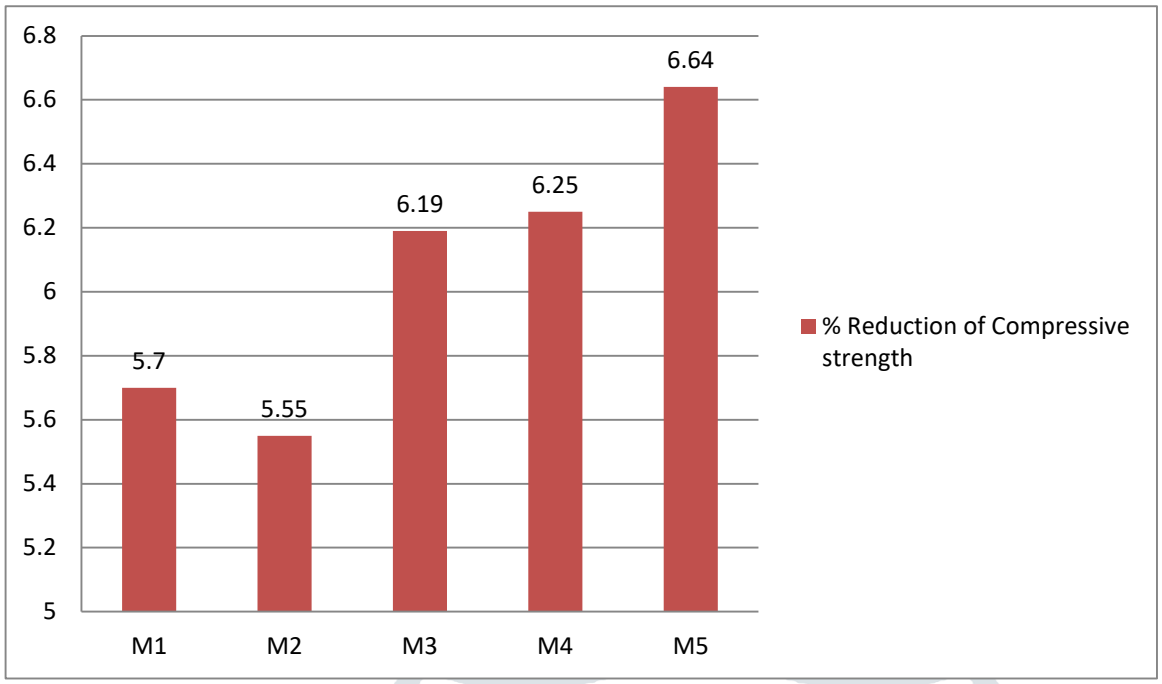

Figure 4. Change in compressive strength after sulphate attack test.

6. CONCLUSIONS

1) The additions of RHA beyond 5% have a retarding effect on the compressive strength.
2) The workability of the fresh geo-polymer concrete decreases when the fly ash & GGBS is replaced by rice husk ash.
3) Mix M2 which contain 5% replacement of RHA with fly ash & GGBS (50% each) developed maximum compressive strength of 38.15 MPa at the end of 28 days.
4) Mix M2 also show good resistance to acid attack and sulphate attack.

7. ACKNOWLEDGEMENT

- I am grateful to all researchers whose papers have been reviewed in the above study. The study of these review papers provided a lot of knowledge about Geo-Polymer Concrete At Ambient which will be helpful in my future research work. I am also thankful of my guides Prof. K.A.Parmar, Assistant Professor at L.D. College of Engineering for their continuous guidance and support.

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