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Strength and Durability of 8m, 10m, 12 M Geo - Polymer Concrete

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ABSTRACT: The major problem the world is facing today is the environmental pollution. In the construction industry mainly the production of Portland cement will causes the emission of pollutants results in environmental pollution. We can reduce the pollution effect on environment, by increasing the usage of industrial by-products in our construction industry. Geo-polymer concrete is such a one and in the present study, to produce the geo-polymer concrete the Portland cement is fully replaced In this research some material such as1. Industrial Weld Slag waste with NAOH Soltions 2. M Sand NAOH Soltions 3. Fly ash NAOH Soltions among the three on mixed with conventional material of Fine aggregate and Coarse aggregate and Bottom ash waste along with fly ash with were used for better utilization in Cement Concrete works. The above Three mix ratio which one become a higher strength. It decreases the overall CO2 consumption and increases the workability of concrete; as a result it improves strength and durability.
Key words: Geo-polymer, Sodium Hydroxide solutions, compressive strength

I. INTRODUCTION

Environmental pollution is the biggest menace to the human race on this planet today. It means adding impurity to environment. It has a severe effect on the ecosystem. There are many reasons which cause pollution. In our construction industry, cement is the main ingredient material for the concrete production. But the production of cement means the production of pollution because of the emission of CO2 during its production. There are two different sources of CO2 emission during cement production. Combustion of fossil fuels to operate the rotary kiln is the largest source and other one is the chemical process of calcimine limestone into lime in the cement kiln also produces CO2. In India about 2,069,738 thousands of metric tons of CO2 is emitted in the year of 2010. The cement industry contributes about 5% of total global carbon dioxide emissions. And also, the cement is manufactured by using the raw materials such as lime stone, clay and other minerals. Quarrying of these raw materials is also causes environmental degradation. To produce 1 ton of cement, about 1.6 tons of raw materials are required and the time taken to form the lime stone is much longer than the rate at which humans use it.

On the other side the demand of concrete is increasing day by day for its ease of preparing and fabricating in all sorts of convenient shapes. So to overcome this problem, the concrete to be used should be environmental friendly. To produce environmental friendly concrete, we have to replace the cement with the industrial by products such as fly-ash, GGBS (Ground granulated blast furnace slag) etc. In this respect, the new technology geo-polymer concrete is a promising technique. The term geopolymer was first coined by Davidovits in 1978 to represent a broad range of materials characterized by chains or networks of inorganic molecules. [Geo-polymer institute. Geopolymers are chains or networks of mineral molecules linked with co-valent bonds. Geopolymer is produced by a polymeric reaction of alkaline liquid with source material of geological origin or by product

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material such as GGBS. Geo-polymers have the chemical composition similar to Zeolites but they can be formed an amorphous structure. For the binding of materials the silica and alumina present in the source material are induced by alkaline activators. The most common alkaline liquid used in the geo-polymerization is the combination of Sodium hydroxide and Sodium silicate This combination increases the rate of reaction.

II. LITERATURE REVIEW

This paper presents the effect of the use of artificial sand as fine aggregate in concrete as substitutes to naturally available material like Fly ash , M Sand, Bottom ash , strength of concrete with natural sand increased by 7. 72% after fully replacing by artificial sand at 7 days 48.50 and 3. 98% at 28 days.

[1] Structural characteristics of concrete using various combinations of lateritic sand and lime stone filler as complete replacement for conventional river sand. Cubes and cylinders are made in three various grades, 0. 55 water/cement ratio produced higher strength and good workability for M20 concrete mix

[2]. Ground granulated furnace slag and saw dust is replaced in different percentages i. e. 0%, 5%, 10%, 15%, 20%, and 25% with the Fine aggregates has given good results

[3]The replacement ratios which have been studied were 0. 0%, 5. 0%, 7. 5%, 10. 0% and 15% by weight.

[4]. OBJECTIVES

1.The specific objectives of the work are To compare the compressive strength and tensile strength of geo polymer concrete with that of concrete made by replacing the waste products.

2. To study the durability characteristics of concrete made by replacing products.

3. To obtain the optimum percentage of addition of waste products like M Sand, Bottom ash fly ash, sand and aggregate for good strength and durability.

III. METHODOLOGY

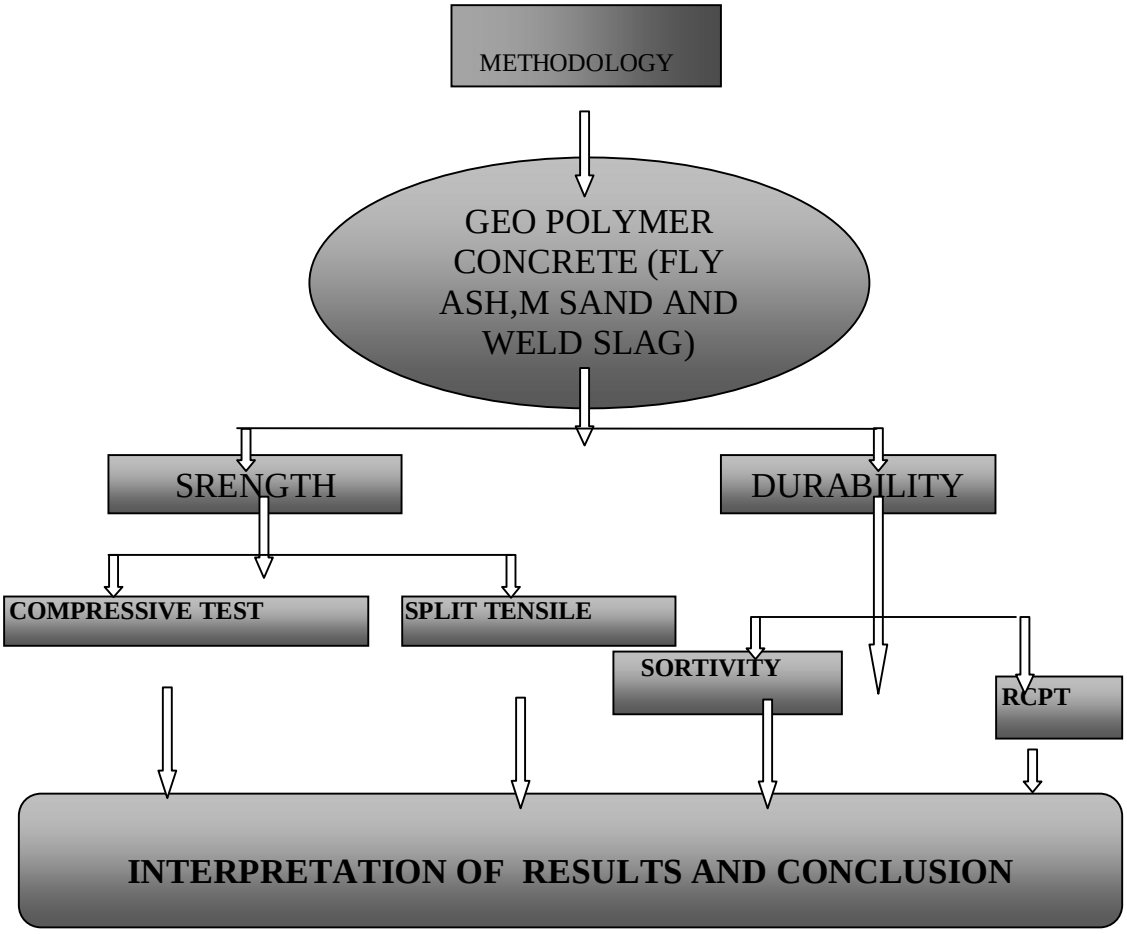

Fig.1 Flow Chart for Design Methodology

3.1 GENERAL Methodology is given in the form of flow chart in Figure 1. It explains about the type and details about the experiments. For our experiment, we are using M20 (mix shown in Table 1) concrete Sand replaced by M-Sand, Coarse aggregate replaced with lime stone. Details of mix used are tabulated in table 1. Properties of each materials used in this study are discussed in detail. The main purpose of our work is to study the optimum usage of waste products in concrete, by which the strength and durability part of the concrete is not affected. By using the waste products; the cost of concrete production is reduced by which economy is maintained. We have used 3 waste materials which are listed below

1. Fly Ash (FA)
2. M-sand (MS)
3. Bottom Ash (BA)

3.20 MIX DESIGN

Table 1 Mix Proportions for One Cubic meter

Molarity	**Mix**	Fly ash (Kg.)	M Sand (Kg.)	Sand (Kg.)	Bottom ash (Kg.)	Coarse Aggregate (Kg.)	NaoH + Na2Sio3 (Solutions) (Kg.)
8 M	M1	408.00	0.00	591.60	0.00	1256.67	144.00
	M2	408.00	0.00	591.60	0.00	1256.67	144.00
	M3	408.00	0.00	591.60	0.00	1256.67	144.00
10 M	M4	408.00	591.60	0.00	0.00	1256.67	144.00
	M5	408.00	591.60	0.00	0.00	1256.67	144.00
	M6	408.00	591.60	0.00	0.00	1256.67	144.00
12 M	M7	408.00	0.00	0.00	591.60	1256.67	144.00
	M8	408.00	0.00	0.00	591.60	1256.67	144.00
	M9	408.00	0.00	0.00	591.60	1256.67	144.00

3.3 METHODOLOGY

Preparation of Alkaline solutions

In this paper the compressive strength of geopolymer concrete is examined for the mixes of varying molarities of Sodium hydroxide (8M, 10M, and 12M). The molecular weight of sodium hydroxide is 40. To prepare 3M i.e. 3 molar sodium hydroxide solution, 120g of sodium hydroxide flakes are weighed and they can be dissolved in distilled water to form 1 liter solution. For this, volumetric flask of 1 liter capacity is taken, sodium hydroxide flakes are added slowly to distilled water to prepare 1liter solution. The weights to be added to get required molarity are given in Table.II: Weights of NaOH flakes

Table.2.

Required Molarity	**Weight in g. of Sodium hydroxide flakes**
8M	**262 g.**
10M	**314 g.**
12M	**361g.**

Mixing, Casting and Curing

The mix proportions were as given in Table.I. As there are no code provisions for the mix design of geopolymer concrete, the density of geo-polymer concrete is assumed as 2440 Kg/m3. The Other calculations are done by considering the density of concrete. The total volume occupied by the aggregates (Coarse and fine aggregates) isassumed to be 65%. The alkaline liquid to GGBS ratio is taken as 0.30. The quantities of all ingredients are kept constant as given in table-II except the molarity of NaOH is changed in the each mix. The conventional method used in the making of normal concrete is adopted to prepare geopolymer concrete. First, the fine aggregate, coarse aggregate and mixed in dry condition for 3-4 minutes and then the alkaline solution which is a combination of Sodium hydroxide solution and Sodium silicate solution with super-plasticizer is added to the dry mix. The mixing is done about 6-8 minutes for proper bonding of all the materials. After the mixing, the cubes are casted by giving proper compaction. The sizes of the cubes used are of size 150mmX150mmX150mm. For the curing geo-polymer concrete cubes, two methods are used, one by placing the cubes in hot air oven and by placing the cubes in direct sun-light. For oven curing, the cubes are placed in an oven at 600 c for an hour. Then the cubes are demoulded and kept in oven at 500 c for 3 days and 7 days. For the sun light curing, the cubes are remoulded after 1 day of casting and they are placed in the direct sun light for 3 days and 7 Days

Table 3 Average Compressive strength of the samples

	Sample Name	Average Compressive Strength in N/mm2		
		7th Day	14th Day	28th Day
1	M1	21.33	23.56	33.33
2	M2	18.67	23.11	29.78
3	M3	18.22	22.22	25.78
4	M4	19.56	23.11	28.89
5	M5	17.78	22.67	27.56
6	M6	15.11	21.33	24.89
7	M7	13.78	16.89	25.33
8	M8	13.33	16.44	22.67
9	M9	13.58	16.55	19.11

Fig. 3 Percentage Variation of Compressive Strength

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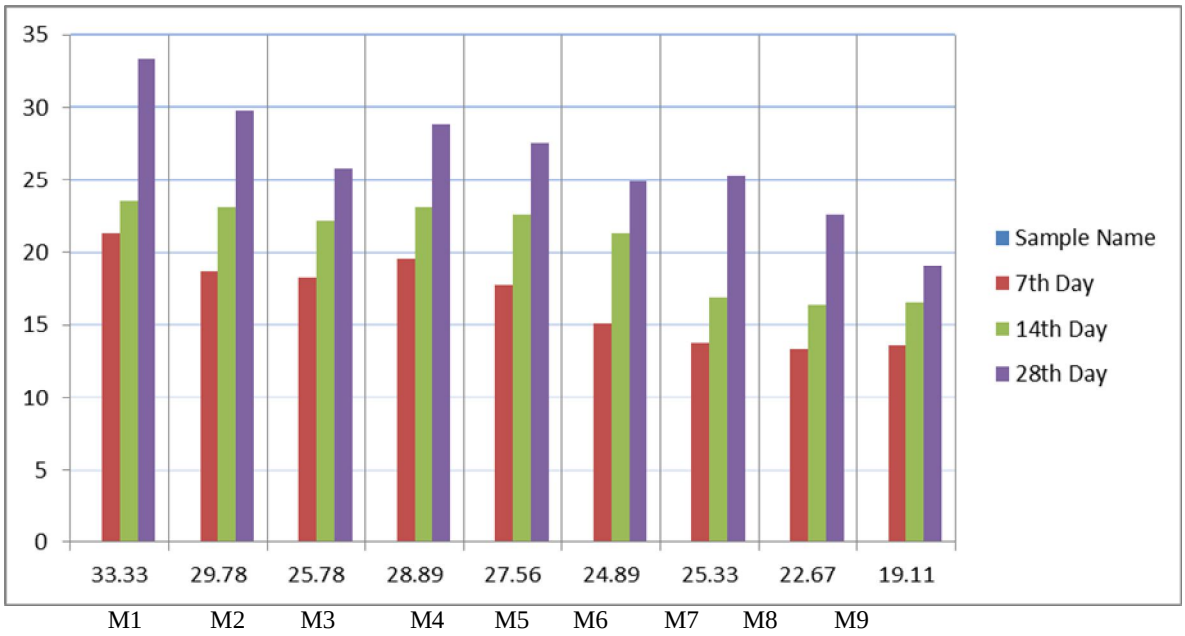

SPLIT TENSION STRENGTH TESTRESULTS

Split tension test was made and the results for 7th day, 14th day and 28th day were tabulated in table 4

Table 4 Average Split Tensile Strength of Concrete

Sl.No.	Sample Name	Average Split tensile Strength in N/mm2		
		7th Day	14th Day	28th Day
1	M1	3.54	3.25	3.54
2	M2	3.25	3.15	3.22
3	M3	3.21	3.08	3.18
4	M4	3.11	3.25	3.43
5	M5	2.69	2.67	2.90
6	M6	2.80.	2.55	3.11
7	M7	2.81	2.67	3.15
8	M8	2.78	2.41	2.58
9	M9	2.69	2.12	2.80

Fig. 4 Percentage Variation of Split Tensile Strength

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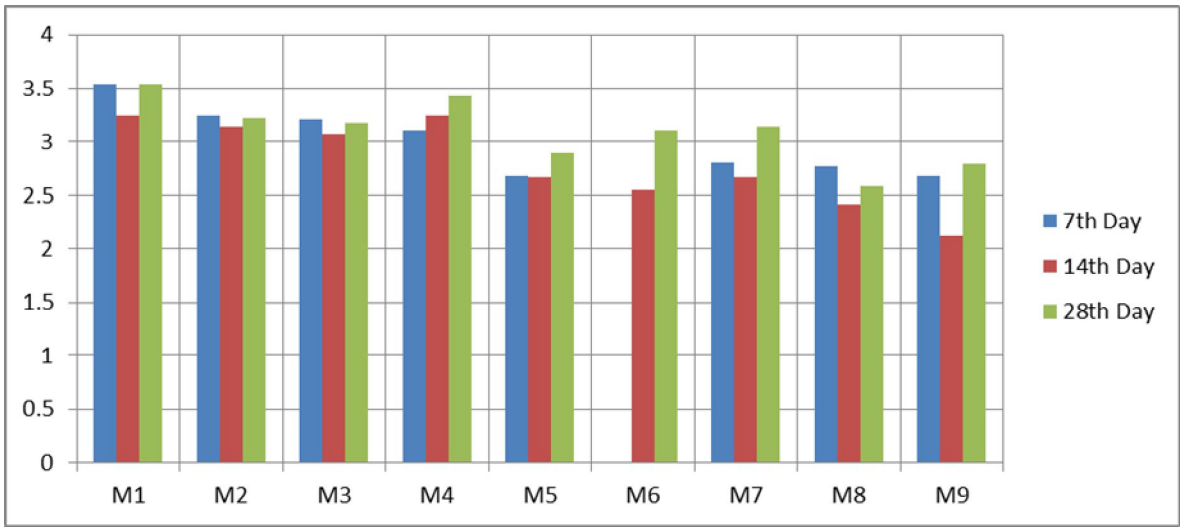

Mix M1, Compare to the other mix slightly lower the strength, The strength variations 7th, 14th, 28th Day, is all mixes proportion to increase strength. In split tensile strength, same M1 sample and M2 Sample was found better when compared to other mixes. For flexural strength, the strength of samples reduces with increase percentage of replace. In M1 sample 8. 33% increases than other mix concrete. When the percentage of Replacing raw material also decreased the strength the samples gave results with reduced flexural strength. In this Case also.

CONCLUSION

From the experiments following conclusions are made

1. In Mix (M1, M2,M3 samples) concrete fly ash and conventional concrete material when used Strength much better than other mix Nearly 33.33 N/mm^2
2. With this 100% replacement of manufactured sand, instead of river sand, coarse aggregate (M4, M5, M6 sample) give Very good results. Here the compressive strength is nearly 27.56 N/mm^2
3. Other mixes cement replacement of 100% with fly ash (M7, M8, M9, mixes) replace of river sand to adding Bottom ash, the better result of Nearly 23.33 N/mm^2

The optimum combination for good strength and durability is obtained by Replacing 100% M-sand for fine aggregate in the geo polymer concrete and bottom ash Replacing 100% for coarse aggregate.

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