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EFFECT OF CRUMB RUBBER ON COMPRESSIVE STRENGTH OF GEOPOLYMER CONCRETE

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Abstract: - Geopolymers are new materials for fire and heat-resistant coatings and adhesives, medicinal applications, high-temperature ceramics, new binders for fire-resistant fiber composites, toxic and radioactive waste encapsulation and new cements for concrete.[1] In this study crumb rubber(Waste material) was used for the replacement of conventional fine aggregates to find out the possible best replacement of conventional fine aggregate. From the study it indicates that replacement by crumb rubber is reducing the compressive strength of Geopolymer concrete.

Keywords: Fly Ash, Crumb Rubber, Geopolymer Concrete, alkaline solution

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INTRODUCTION

Geopolymers are novel materials intended for fire and heat-resistant coatings and adhesives, medicinal applications, high-temperature ceramics, novel binders for fire-resistant fiber composites, toxic and radioactive waste encapsulation and novel cements for concrete [2].

The properties and utilize of geopolymers are being explored in numerous scientific and industrial disciplines: recent inorganic chemistry, physical chemistry, colloid chemistry, mineralogy, geology, and in further types of engineering practice technologies.

Geopolymers are division of polymer science, chemistry and technology that forms one of the most important areas of materials science. Polymers are either organic material, i.e. carbon-based, or inorganic polymer, for example silicon-based.

The organic polymers comprise the classes of natural polymers (rubber, cellulose), synthetic organic polymers (textile fibers, plastics, films, elastomers, etc.) and natural biopolymers (biology, medicine, pharmacy) [3]. Raw materials used in the synthesis of silicon-based polymers are mainly rock-forming minerals of geological origin [4].

Materials:

a. Fly ash

Fly ash used in this study was unprocessed fly ash from torrent power plant (locally available). The whole quantity of fly ash was obtained from one batch. Later, Fly ash was used in small proportions in mass concreting for dams and other hydraulic.

Table -1: Chemical Properties of Fly Ash

Chemical composition weight %	Fly Ash
SiO_2	53.79
Al_2O_3	32.97
Fe_2O_3	5.51
CaO	1.84
MgO	0.92

Na_2O	0.37
K_2O	1.76
TiO_2	2.10
SO_3	0.46
P_2O_5	0.15

b. Course Aggregates & Fine aggregate

Locally available crushed stones of 10 mm and 20 mm aggregates were used as coarse aggregates. Local river sand and crumb rubber was used as fine aggregate in the concrete mixtures.

Table -2: Sieve analysis of Fine Aggregate

COARSE AGGREGATE 10 MM				
Sieve	Retain	Retain	Cumulative	Passing
	Gm	%	%	%
12.5	16	0.8	0.8	99.2
10	212	10.6	11.4	88.6
4.75	1445	72.25	83.65	16.35
2.36	308	15.4	99.05	0.95

Table -3: Sieve analysis of Coarse Aggregate

Sieve	**Retain**	**Retain**	**Cumulative**	**Passing**
	Gm	%	%	%
10 mm	0	0	-	10
4.75 mm	6	3	3	97
2.36 mm	38	19	21	79
1.18 mm	54	27	48	52
600	31	15.5	63.5	36.5
300	43	21.5	85	15
150	10	5	90	10
Pan	20	10	100	0

c. Alkaline Solution as binder materials

The alkaline liquid used was a combination of sodium silicate solution and sodium hydroxide solution. The sodium silicate solution (NaOH = 15.38%, Na_2SiO3 = 46,15%, and water = 38.46% by mass) was purchased from a local supplier in bulk. The sodium hydroxide (NaOH) in flakes or pellets from with 97%-98% purity was also purchased from a local supplier in bulk. The NaOH solids were dissolved in water to make the solution. To make alkaline solution first of all to prepare 10 M solution 400 grams of NaOH are dissolved in 1000 gm of water than 1200 grams of Na_2SiO_3 are added in dissolved solution. Then this solution kept as it for 24 hours at normal room temperature.

Mix Proportion:

Table 4-Mix Design

Mix Design	Fly Ash(kg)	Fine Aggregate(kg)	Coarse Aggregate(kg)	Alkaline Solution	Crumb Rubber (kg)	% of Replacement
M0	469.33	554.07	1212.44	462.22	0	0
M1	469.33	498.663	1212.44	462.22	55.407	10%
M2	469.33	443.256	1212.44	462.22	110.814	20%
M3	469.33	387.849	1212.44	462.22	166.221	30%
M4	469.33	332.442	1212.44	462.22	221.628	40%
M5	469.33	277.035	1212.44	462.22	277.035	50%

EXPERIMENTAL PROGRAM

Geopolymer Concrete Cubes having grade M30 were made by fly Ash as a 100% replacement of cement, Alkaline Solution, fine aggregate, crumb rubber and coarse aggregates. Dimensions of moulds were 150 mm X 150mm X 150 mm. After casting, all moulds were cured by different methods natural, Self, Oven cured. Mix proportion of geopolymer concrete as per table – 4.

RESULTS

Table- 5 compression test result

Mix Design	7th Day Strength (N/mm²)		14th Day Strength (N/mm²)		28th Day Strength (N/mm²)	
	Self Cured	Oven Cured	Self Cured	Oven Cured	Self Cured	Oven Cured
M0	16.72	25.07	22.50	29.25	30.95	33.43
M1	16.39	24.59	22.06	28.68	30.35	32.78
M2	15.15	22.72	20.71	26.93	28.82	31.13
M3	14.77	22.16	20.36	26.47	28.50	30.78
M4	13.99	20.99	19.60	25.48	27.76	29.98
M5	13.65	20.48	19.13	24.86	27.08	29.25

CONCLUSION

The maximum compressive strength achieved in normal Geopolymer concrete. Increasing the crumb rubber content in Geopolymer Concrete will decrease the compressive strength of Geopolymer Concrete. The maximum compressive Strength gain from the Oven Curing of 24 hours.

REFERENCES

1. Ankush Chakravorty, Raj Khatri, Tejkuvarba, Abhijitsinh Parmar, “EFFECT OF AGGREGATE SIZE AND SILICA FUME ON THE WORKABILITY OF GEOPLOYMER CONCRETE”, International Journal of Research in Engineering and Technology, Volume: 03 Issue: 04, Apr-2014
2. Michael J. Gibbs, Peter Soyka and David Conneely - CO2 Emissions from cement production, (ICF Incorporated). It was reviewed by Dina Kruger (USEPA).
3. Stevenson, M., and Panian, L. - “Sustainability through Strength,” Concrete International, V. 31, No. 3, Mar. 2009, pp. 34-39.
4. Raijiwala D.B. Patil H. S. - Geopolymer concrete: A concrete of next dicade.

5. Joseph Davidovits - Geopolymer chemistry & application 2nd edition (June 2008), Institute Geopolymer, France
6. Prof. M. A. Bhosale, Prof. N. N. Shinde - Geopolymer Concrete by Using Fly Ash in Construction (Energy, shivaji University, India), (Department of Energy Technology, Shivaji University, Kolhapur)
7. N. Lloyd and V. Rangan - Geopolymer Concrete Sustainable Cement less Concrete
8. Satpute Manesh B., Wakchaure Madhukar R., Patankar Subhash V. - Effect of Duration and Temperature of Curing on Compressive Strength of Geopolymer Concrete
9. Djwantoro Hardjito, Steenie E. Wallah, Dody M.J. Sumajouw, and B.V. Rangan - Factors influencing the compressive strength of fly ash-based Geopolymer concrete
10. S.vaidya ,E.i.diaz,E.n.allouche - Experimental evaluation of self cure geopolymer concrete for mass pour applications
11. ashida A Jhumarwala, P. S. Rao , T. N. Patel - Experimental Investigation on Self-Compacting Geopolymer Concrete (SCGC)
12. Djwantoro Hardjito, Steenie E. Wallah, Dody M.J. Sumajouw, and B.V. Rangan - Factors influencing the compressive strength of fly ash based geopolymer concrete
13. M. Olivia*, Curtin University of Technology, Australia, P. Sarker, Curtin University of Technology, Australia, H. Nikraz, Curtin University of Technology, Australia - Water Penetrability of Low Calcium Fly Ash
14. Abhijitsinh Parmar, IJPRET, 2014; Volume 3 (4): 100-106