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HIGH PERFORMANCE CONCRETE WITH ULTRAFINE SLAG

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Abstract: India has an enormous growth in the steel and copper industries. The following are major by products from these industries: ground granulated blast furnace slag (GGBS) - a by-product in the manufacture of iron in steel industry. If they are not disposed off properly, they may cause environmental hazards to the surrounding area. Considering the long term performance and stability of structures, this study suggests replacing some percentage of cement with cement with GGBS to develop high performance concrete. This paper presents an experimental investigation to assess the durability parameters of high performance concrete with the industrial wastes.

Keywords- High Performance Concrete, Ground granulated blast furnace slag, Fly ash

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INTRODUCTION

In India, most of the construction activities are made with concrete, as it is easily available and the molding can be done even by unskilled labour. Thus, concrete is becoming a very important material for every human. Concrete is being used for all major constructions, like dams, towers, water tanks, houses, roadways, and railway sleepers etc. Long-term performance of structures has become vital to the economies of all nations. Concrete has been the major instrument for providing stable and reliable Infrastructure. Deterioration, long term poor performance, and inadequate resistance to hostile environment, coupled with greater demands for more sophisticated architectural form, led to the accelerated research into the microstructure of cements and concretes and more elaborate codes and standards. As a result, new materials and composites have been developed and improved cements evolved. One major remarkable quality in the making of high performance concrete (HPC) is the virtual elimination of voids in the concrete matrix, which are mainly the cause of most of the ills that generate deterioration.

Recently, composites are fastly replacing the conventional concrete. With many major developments in concrete industry, the waste material utilization in the manufacturing of concrete, being used as a replacement material for the ingredients, is also growing. India has an enormous growth in the steel industries and copper industries. The Following are major by products in these industries: ground granulated blast furnace slag (GGBS) - a by-product in the manufacture of iron in steel industry.

II HIGH PERFORMANCE CONCRETE

ACI defines HPC as "Concrete meeting special combinations of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing and curing practices".

High-performance concrete characteristics are developed for particular applications and environments; some of the properties that may be required include:

- High strength
- High early strength
- High modulus of elasticity
- High abrasion resistance
- High durability and long life in severe environments

- Low permeability and diffusion
- Resistance to chemical attack
- High resistance to frost and deicer scaling damage
- Toughness and impact resistance
- Volume stability
- Ease of placement
- Compaction without segregation
- Inhibition of bacterial and mold growth

III LABORATORY WORK

2.2. PREPERATION OF HPC

High-performance concretes are made with carefully selected high-quality ingredients and optimized mixture designs; these are batched, mixed, placed, compacted and cured to the highest industry standards. Typically, such concretes will have a low water-cementing materials ratio of 0.20 to 0.45. Plasticizers are usually used to make these concretes fluid and workable. Table 1 lists materials often used in high-performance concrete and why they are selected.

Table.1 Materials used in High Performance Concrete

Material	Primary contribution/Desired property
Portland cement	Cementing material/durability
Slag	Cementing material/durability/high strength
Super plasticizers	Flowability
Optimally graded aggregate	Improve workability and reduce paste demand

IV CONCRETE MIX DESIGN

DESIGN STIPULATIONS

Gradation designation:	**M 60**
Type of Cement	O.P.C. 53 Grade
Maximum Size of Aggregate	20 mm
Degree of Supervision	Good

Test Data for Material	
Sp. Gravity of Cement	3.20
Sp. Gravity of Water	1.00
Chemical Admixtures	Superplastisizer
Sp. Gravity of GGBS (Ground granulated blast furnace slag)	Alccofine
Sp. Gravity of 10mm aggregate	2.90
Sp. Gravity of 20mm aggregate	2.93
Sp. Gravity of Natural Sand	2.74
Sp. Gravity of Crushed Sand	2.72
Sieve Analysis of Fine Aggregate	Separate Analysis is done
Sieve Analysis of Coarse Aggregate	Separate Analysis is done

Compressive Strength for w/b ration =0.25

Sr. No		Binder Material			FA in Kg		CA in Kg		SP	Strength in MPa		Slump
		OPC	FA	GGBS Alcoffine	N S	C S	20 mm	10 mm	Kg/m³	7 days	28 days	in mm
1	OPC	550	0	0	453	368	591	479	6.60	58.33	81.60	160
2	GB7.5	508.75	0	41.25	449	364	587	475	6.74	55.75	67.44	165
3	GB10	495	0	55	447	363	585	474	6.89	67.28	85.51	155
4	GB11	489.50	0	60.50	447	363	584	473	6.93	70.54	88.60	155
5	GB12.5	481.25	0	68.25	446	362	583	472	7.63	74.33	90.33	150
6	FA10/ GB9	445.50	55	49.50	444	361	581	470	6.69	60.26	81.58	170
7	FA 20	440	110	0	445	362	582	471	5.72	52.15	79.23	170
8	FA20/ GB10	385	110	55	440	357	575	466	6.16	60.23	80.41	170
9	FA25/ GB8.50	365.75	137.50	46.75	439	357	574	465	5.66	54.50	78.30	175
10	FA30/ GB7	346.50	165	38.50	438	356	572	464	5.49	50.20	72.31	180

Strength development of Comparison in between mix proportion of binder material GGBS & GGBS with fly ash

Sr. No	% used (GGBS)	Strength in MPa	
		7 days	28 days
1	OPC	58.33	81.60
2	GB 7.50	55.75	67.44
3	GB 10	67.28	85.51
4	GB 11	70.54	88.60
5	GB 12.5	74.33	90.33
	Fly & GGBS		
1	FA 10/GB 9	60.26	81.58
2	FA 20	52.15	79.23
3	FA20/GB10	60.23	80.41
4	FA25/GB8.50	54.50	78.30
5	FA30/GB7	50.20	72.31

V CONCLUSION

1. For A given slump and w/b ratio, mixes having higher fly ash replacement level requires lesser dosages of Superplastisizer but requires high dosages for higher GGBs
2. The processed fly ash and GGBS (Alcoffine) used for replacement to cement, slump value is decreases with increase of slag and strength is increased
3. Use of ternary blending helps on offsetting the effect of ground granulated blast furnace slag (GGBS), has in increasing the dosage of super plasticizer in HPC mixes to achieve a given workability.
4. HPC mixes incorporating fly ash take longer time to set as compared to those without them, thereby confirming the fact that addition of fly ash retards the setting time of concrete

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