EXPERIMENTAL INVESTIGATION ON IRON SLAG BASED HPC

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ABSTRACT

A mixture of cement, fine aggregate, coarse aggregate is known as concrete. It plays an important role in infrastructure development like buildings, bridges and industrial structures etc. Long term performance of buildings without disintegration helps economies of nation. High performance concrete (HPC) is a concrete which shows special performance than normal concrete. This leads to usage of admixtures to improve concrete performance. On the other side cost of concrete ingredients plays the vital role, this leading to usage of alternative materials which is economic in its production. This requirement made the investigators to find new replacement for concrete ingredients which should improve long term performance and stability of structures. This work focuses on strength and durability characteristics of M30 concrete with partial replacement of sand with ROBOSand (crusher dust) and cement with IRON SLAG, usage of these replacement materials are more eco friendly. From the investigation it is concluded that strength, Acid resistance (compressive strength) were found to improve with addition of slag.

INTRODUCTION

Concrete is the most widely used construction material in the world today. Constituent materials for concrete occur naturally in all parts of the world. Concrete has been used in the construction of bridges, roads, water supply structures, hospitals, and housing to give people a social foundation, a thriving economy and serviceable facilities for many years.HPC is a concrete made with chosen materials combined according to a chosen mix design; properly mixed, transported, placed, consolidated and cured so that the resulting concrete will give very good performance in the structure in which it is kept, in the mile to which it is exposed and with the loads to which it will be subject for its design life. Mix proportions for HPC are influenced by many reasons, which include specified performance properties, locally available materials, local experience, personal preferences, and cost. With today's technology, there are many products available for use in concrete to enhance its properties.

EXPERIMENTAL INVESTIGATION

A.**Cement**

The cement used was opc confirming to IS Standards. Specific gravity of cement used is 3.13.

B.**Iron Slag**

IRON SLAGFrom iron industry in powder form was used. Specific gravity was found to be 2.95

C.**Sand**

Locally available Natural river sand of zone II as per IS 383-1970 was used. Aggregate particles passing through 4.75 mm and retained on 2.36mm was used. specific gravity was found to be 2.7

D.**ROBO Sand**

ROBO Sand (crusher dust) is Eco-friendly products whose usage helps conserve nature by preventing depletion of ground water levels. ROBO Sand specific gravity was found to 2.66

E.**Coarse aggregate**

Locally available coarse aggregate of size 20mm was used. Specific gravity was found to 2.8.

F.**Superplasticizer**

High range water reducer purchased from local market was used.

G.**Water**

Local water was used for for mixing and curing. Water used for mixing and curing were conforming to IS: 456 –2000.

Acids and Chemicals

Sulphuric acid and Hydrochloric acid with 0.1N was used for curing.

METHODOLOGY AND MIX PROPORTIONING

Methodology followed in this work Replacement of cement with IRON SLAG and ROBO Sand with sand for 20%, 30%, 40% and test such as compression test in normal and acid curing was done and results were tabulated

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required, strength, durability, and workability as economically as possible, is termed the concrete mix design. The proportioning of ingredient of concrete is governed by the required performance of concrete in two states, namely the

plastic and the hardened states. If the plastic concrete is not workable, it cannot be properly placed and compacted. The property of workability, therefore, becomes of vital importance.

A slump test has been performed and the average true slump value obtained was 60 mm.

M30 Grade with mix ratio 1:1.01:2.48 was used

RESULTS AND DISCUSSION

Cube Compressive Strength

Concrete mixtures can be designed to provide a wide range of mechanical and durability properties to meet the design requirements of a structure. The compressive strength of concrete is the most common performance measure used by the engineer in designing buildings and other structures. The compressive strength is known as the ability of the concrete to resist loads that tend to crush it. It is measured by subjecting the concrete specimens to constantly increasing load until the specimen finally fails in a compression testing machine (CTM). The compressive strength is calculated from the failure load divided by the cross-sectional area resisting the load and is reported in N/mm^2 in SI units. Cement replaced by IRON SLAG for different percentage such as 20%, 30%, 40% and sand replaced by ROBO Sand for different percentage such as 20%, 30%, 40% respectively. concrete cube specimens of 150mm x 150mm x 150mm were cast and Cubes were cured in ordinary water and Acid curing (HCL and sulphuric acid) for 7 and 28 days. Hydrochloric acid 3ml was used for 1liter of water and sulphuric acid 10ml for 1 litre water. Compressive strength for normal curing and acid curing for 7 days and 28days were shown in table 1, 2, 3

Table 1COMPRESSIVE STRENGTH TEST RESULT FOR 7 AND 28 DAYS CURING

S.No	Specimen	Avg. Compressive strength (N/mm^2)	Avg. Compressive strength (N/mm^2)
1	CONTROL CONCRETE	19.8	32.69
2	IRON SLAG 20 %	21.3	35.5
3	IRON SLAG 30 %	20.9	34.9
4	IRON SLAG 40 %	20.1	33.3
5	Robo sand 20 %	20.5	34.5

6	Robo sand 30 %	20.0	33.5
7	Robo sand 40 %	19.4	33.3
8	IRON SLAG 20% and RS 20%	20.7	33.8
9	IRON SLAG 20% and RS 30%	20.4	35.9
10	IRON SLAG 20% and RS 40%	19.9	34.1
11	IRON SLAG 30% and RS 20%	19.7	34.6
12	IRON SLAG 30% and RS 30%	19.1	33.9
13	IRON SLAG 30% and RS 40%	18.9	32.2
14	IRON SLAG 40% and RS 20%	19.0	32.0
15	IRON SLAG 40% and RS 30%	18.6	31.2
16	IRON SLAG 40% and RS 40%	16.4	30.9

Table 2 7 Days Average Compressive Strength for Acid curing

S.NO	**SPECIMEN**	**Average Compressive Strength in N/mm^2**	
		H_2SO_4 Curing	**HCL Curing**
1	CONTROL CONCRETE	19.09	19.60
2	IRON SLAG 20 %	21.10	22.30
3	IRON SLAG 30 %	21.30	22.70
4	IRON SLAG 40 %	21.09	23.30
5	Robo sand 20 %	23.50	24.70
6	Robo sand 30 %	23.10	22.60
7	Robo sand 40 %	22.03	23.60
8	IRON SLAG 20 % and RS 20 %	23.21	21.10

9	IRON SLAG 20 % and RS 30 %	23.31	23.30
10	IRON SLAG 20 % and RS 40 %	23.21	23.20
11	IRON SLAG 30 % and RS 20 %	22.44	23.10
12	IRON SLAG 30% and RS 30%	22.32	22.40
13	IRON SLAG 30% and RS 40%	22.35	22.90
14	IRON SLAG 40% and RS 20%	21.50	21.40
15	IRON SLAG 40% and RS 30%	20.550	21.30
16	IRON SLAG 40% and RS 40%	20.40	21.30

Table 3 28 Days Average Compressive Strength for Acid curing

S.NO	**SPECIMEN**	**Average Compressive Strength in N/mm^2**	
		H_2SO_4 Curing	**HCL Curing**
1	CONTROL CONCRETE	30.00	31.50
2	IRON SLAG 20 %	30.50	32.50
3	IRON SLAG 30 %	31.00	32.80
4	IRON SLAG 40 %	32.09	33.00
5	Robo sand 20 %	33.50	34.00
6	Robo sand 30 %	33.10	34.90
7	Robo sand 40 %	32.00	35.20
8	IRON SLAG 20 % and RS 20 %	33.70	34.00
9	IRON SLAG 20 % and RS 30 %	34.00	34.60
10	IRON SLAG 20 % and RS 40 %	33.20	33.00
11	IRON SLAG 30 % and RS 20 %	32.90	33.30
12	IRON SLAG 30% and RS 30%	32.00	32.80
13	IRON SLAG 30% and RS 40%	32.40	32.30

14	IRON SLAG 40% and RS 20%	32.00	31.00
15	IRON SLAG 40% and RS 30%	31.90	31.20
16	IRON SLAG 40% and RS 40%	30.70	31.70

CONCLUSIONS

Based on the results obtained from the experimental work and from the analysis,
The following conclusions were drawn

- Under Normal, H_2SO_4 and HCL curing Strength difference for replacement of IRON SLAG with cement and replacement of ROBO Sand with sand and both combination of IRON SLAG and ROBO Sand for different percentage of replacement with cement and sand was found to increase

- Specimens with IRON SLAG 20% and combination of IRON SLAG and ROBO Sand for 30% has shown better performance under normal curing.

- IRON SLAG 20% and ROBO Sand 30% replacement with cement and sand respectively showed better resistance to sulphate and acid attack than control concrete and other slag based concrete.

- IRON SLAG ,Robo sand and combination of IRON SLAG and ROBO Sand for all percentage of replacement were found to be good when compared to control concrete and M30 Grade of concrete can be made with this combination

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