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EXPERIMENTAL INVESTIGATIONS ON PARTIAL REPLACEMENT OF STEEL SLAG AS PRESTRESSED CONCRETE SLEEPERS OF COARSE AGGREGATES AND ECO SAND AS FINE AGGREGATE

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Abstract: The environment problems are very common in India due to generation of industrial by-products. Due to industrialization enormous by-products are produced and the utilization of these byproducts is a big challenge faced in India. Iron slag is one of the industrial byproduct from the iron and steel making industries. Considering the specifications of physical and chemical properties of metallurgical slag we have a series of possibilities for their use in other industrial branches and in the field of civil constructions. This study shows the possibilities of using iron slag as partial replacement of fine aggregate (sand). Iron slag can be used to replace 20% to 40% of sand at increment of 10% of weight for both cube and cylinder. The strength of concrete increases rapidly with increase of the iron slag content and the optimum value of compressive strength is obtained at 30% replacement. After 30% replacement the strength decreases. Similarly in the case of split tensile strength, the strength increases with the increase in iron slag content and the optimum value of split tensile strength is obtained at 30%. The uniform load conditions for compressive strength and split tensile strength are 4KN and 2KN respectively. In this paper, the compressive strength of the iron slag concrete was studied. The results confirm that the use of iron slag overcomes the pollution problems in the environment. The results show that the iron slag added to the concrete had greater strength than the plain concrete.

Keywords coarse aggregate, compressive strength, fine aggregate, recycled steel aggregate.

1. INTRODUCTION

As slag is an industrial byproduct, its productive use grant a chance to relocate the utilization of limited natural resources on a large scale. Iron slag is a byproduct obtained in the manufacture of pig iron in the blast furnace and is produced by the blend of down to earth constituents of iron ore with limestone flux. Iron and steel slag can be differentiated by the cooling process after removed from the furnace in the industry. Mostly, the slag consists of magnesium, aluminum silicates calcium and manganese in various combinations. Even though the chemical composition of the slag is same, the physical properties of the slag vary with the different methods of cooling. The slags can be used as cement major constituents as they have greater pozzolanic properties.

1.1 OBJECTIVES

The proposed approach in this paper is planned to achieve the following objectives:

- To study the influence of partial replacement of fine aggregate with iron slag
- To compare the compressive and tensile strength of iron slag added concrete with ordinary M20 concrete
- To find the percentage of replacement in concrete that makes the strength of concrete.

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- To compare the workability of two categories of concrete

2. METHODOLOGY

To achieve our objective, it is planned to conduct

- Casting of the test specimens
- Testing normal concrete and iron slag added concrete
- Comparing the performance of these concrete
- Comprehensive analysis of test result
- Submission of finding

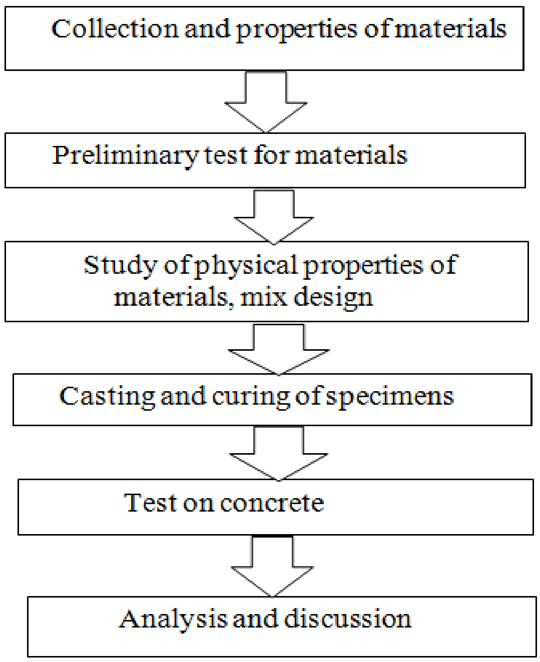

Fig. 1. Methodology for using iron slag

3. ANALYSIS OF MATERIAL PROPERTIES

Table 1 Concrete design mix (M20) proportion for casting each cube in Kg

S.No	Concrete type	Cement	Fine Aggregate	Coarse Aggregate	Iron slag	W/C Ratio
1	C20	1.4	1.68	4.2	0.42	0.45
2	C30	1.4	1.47	4.2	0.63	0.45
3	C40	1.4	1.26	4.2	0.84	0.45

3.1 DETAILS OF SPECIMENS

Size of casted cube : 150mm x 150mm x 150mm

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Size of casted cylinder : 150mm x 300mm
Size of casted prism : 100mm x 100mm x 500mm
Grade of concrete : M20

4. TEST ON HARDENED CONCRETECOMPRESSIVE STRENGTIH OF CONCRETE

Table 2. Details of specimen: Total number of casting = 36

`MOULD CASTED	CURINGIN DAYS	REPLACEMENT OF SAND		
		20%	30%	40%
CUBE	7	2	2	2
	14	2	2	2
	28	2	2	2
CYLINDER	7	1	1	1
	14	1	1	1
	28	1	1	1
PRISM	7	1	1	1
	14	1	1	1
	28	1	1	1

After the proper curing of 7&14 and 28 days the specimens are under gone compression tests. The specimens are tested under universal testing machine (UTM) by placing the entire specimen on the loading frame and tested under axial loading.

Table 3. Ultimate load for M20 grade of concrete cubes

Replacement of sand (%)	Ultimate load (KN)		
	7 days	14 days	28 days
20	753	926	1093
30	954	1117	1242
40	849	1006	1062

Table 4 Compressive strength M20 grade of concrete cubes

Replacement of sand (%)	Compressive strength (N/mm^2)		
	7days	14days	28days
20%	33.49	41.18	48.60
30%	42.41	49.66	55.21
40%	37.73	44.75	47.24

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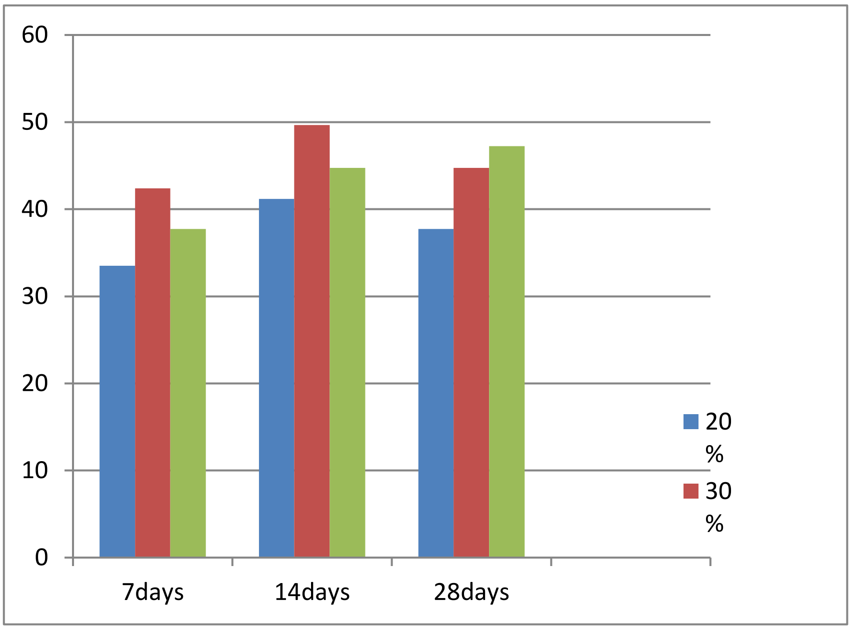

Fig.2. The comparison of strength of M20 concrete cube for 7days, 14days and 28days for respective percentage of sand replacement by iron slag

5. SPLIT TENSILE TEST

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Fig. 3. Split tensile test

Table 3. Ultimate load for concrete cylinder

Replacement of sand (%)	Ultimate load (KN)		
	7days	14days	28days
20	64	79	109
30	76	88	110
40	65	84	109

Table 4. Value of Split tensile test

Replacement of sand (%)	Split tensile test (N/mm^2)		
	7days	14days	28days
20	2.88	3.54	4.85
30	3.40	3.94	4.90
40	2.93	3.77	4.86

Table 5. Ultimate load for concrete prism

Replacement of sand (%)	Ultimate load (KN)		
	7 days	14 days	28 days
20	571	711	870
30	760	940	1062
40	645	796	924

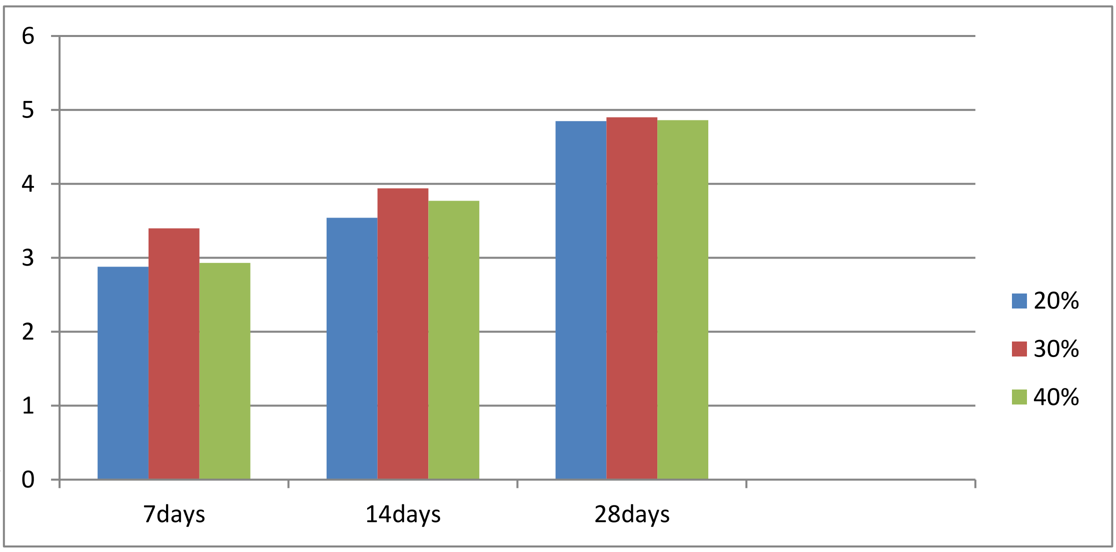

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Fig. 4. The comparisons of strength of M20 concrete cylinder for 7days, 14days and 28days for respective percentage of sand replacement by iron slag

Fig.5. Flexural strength test

Table 6. Value of flexural strength test

Replacement of sand (%)	Flexural strength (N/mm^2)		
	7days	14days	28days
20	25.4	31.6	38.7
30	33.8	41.8	47.2
40	28.7	35.4	41.1

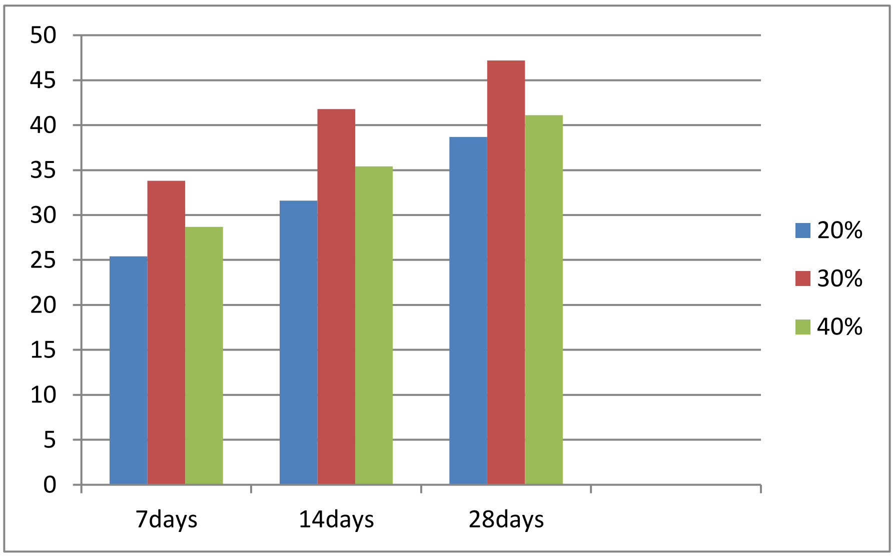

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Fig. 6. The comparisons of strength of M20 concrete prism for 7days, 14days and 28days for respective percentage of sand replacement by iron slag

6. CONCLUSION

The following conclusions are drawn from the study on iron slag added concrete and they are applicable for the range of parameters and materials used in this study. Iron slag can be formed into useful in concrete. It is observed that there is a strength increase with addition of iron slag of 30% and which there appears to be no specific enhancement in strength. This strength increase appears to be true for compression. The specific gravity of water absorption for iron slag is 2.62. The properties of iron slag are within the range of the values of concrete making fine aggregates. Thus, it concluded that the replacement of fine aggregate with iron slag up to 30% replacement reaches optimum level. However, more research studies are being made on the iron slag concrete necessary for the practical application as coarse aggregate. After the replacement of fine aggregate with 30% of iron slag the ultimate load was found to be 1242 KN. But 40% replacement of iron slag has reduced the ultimate load to 1062 KN respectively. Hence the optimum percentage replacement of iron slag should be at 30%.

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