To Study the Strength Properties of Concrete Prepared Using Partial Replacement of Iron Slag

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***Abstract*— The environmental related problems of dumping the waste produce from industries are very common in India due to generation of industrial byproducts. Due to initiative of the government like Made in India which promote industrialization and which leads to generation of enormous byproducts and to utilize these byproducts is the main challenge faced in India as we are not aware about the dumping problem and horizontal land area is also decreasing. Iron slag is one of the industrial by-products from the iron and steel making industries.**

In this paper, the compressive strength of the concrete prepared using iron slag after the variation of its percentage w.r.t. fine aggregate has been done. The concrete prepared is of grade M30.

***Index Terms*— concrete grade M30, iron slag, compression test value, industrial by-product.**

I. INTRODUCTION

During iron melting, the scrap material is exposed to high temperature and oxygen. Consequently, oxides are formed on the surface as a more or less viscous layer that can be removed. Slag is mainly a collection of compounds such as SiO2, Al2O3, Cao, FeO, MgO, MnO but can entrap cast iron droplets. Slag also forms during melt treatment and contains sulphides._In iron metallurgy, control of slag formation is essential to reach the alloy target chemistry by assisting in the removal of impurities and protecting the furnace refractory lining from excessive wear. Another aspect is also to minimize iron loss. The aim is a slag mainly consistent of oxides of calcium, silicon, magnesium, and aluminium. The chemical properties of iron slag if separated are the same material that is being used for production of the cement and every element has different effect on the enchance of the properties of the mix prepared.

The objective of the present work is to study the changes in compressive strength by performing partial replacement of fine aggregate(sand) with Iron slag. It is proposed to partially replace fine aggregates with iron slag and find its effect on the strength characteristics of concrete. Three percentage levels of replacement i.e. 25, 30 and 35 percent are considered for partially replacing sand with iron slag. M_{30} concrete grade is initially designed without replacement and subsequently sand is partially replaced with iron slag.

II. MATERIAL AND METHODS

The various type of material used in casting process of concrete are: fine aggregate, course aggregate, cement, water and iron slag obtained from nearby steel plant.

MIX DESIGN (M_{30})

Test data for materials

SR NO.	MATERIAL	PROPORTION
1	Specific gravity of cement	3.15
2	Specific gravity of coarse aggregates	2.78
3	Specific gravity of fine aggregates	2.32
4	Zone of fine aggregates	II
5	Water absorption of coarse aggregates	0.43%
6	Water absorption of fine aggregates	0.88%

Table 1: Proportion of Material Used

III. RESULT AND DISCUSSION

1. COMPRESSIVE STRENGTH TEST:

12 number of test specimens of size 150x 150x 150 mm were prepared for testing the compressive strength concrete. The concrete mixes with varying percentages (0%, 25%, 30%, 35%) of iron slag as partial replacement of fine aggregate (sand) were cast into cubes. In this study, to make concrete, cement and fine aggregate were first mixed dry to uniform color and then coarse aggregate was added and mixed with the mixture of cement and fine aggregates. Water was then added and the whole mass mixed. The interior surface of the moulds and the base plate were oiled before concrete was placed. After 24 hours the specimens were removed from the moulds and placed in clean fresh water. The specimens so cast were tested after 7, 14 and 28 days of curing measured from the time water is added to the dry mix. The load was applied axially without shock till the specimen was crushed. Results of the compressive strength test on concrete with varying proportions of iron slag replacement at the age of 7 and 28 days are given in the Table 2

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Mix(%)	Compressive Strength(N/mm^2)		Average Compressive Strength after 7 days	Average Compressive Strength after 14 days	Average Compressive Strength after 28 days
	Specimen 1	Specimen 2			
0	20.02	20.18	20.10	25.55	32.30
25	33.45	33.53	33.49	41.18	48.60
30	42.39	42.43	42.410	49.66	55.24
35	37.67	37.79	37.73	44.75	47.24

Table 2: Compressive Test Result

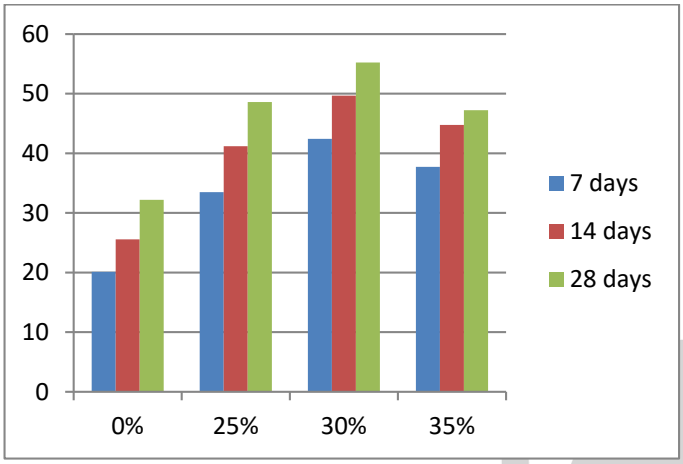

Figure 1: Comparison of compression test according to days

2. SPLIT TENSILE STRENGTH TEST

12 number of Test specimens of size 150x 300 mm i.e. cylinder were prepared for testing the split tensile strength of concrete. As done in case of cubes, the concrete mixes with varying percentages (0%, 25%, 30%, 35%) of iron slag as partial replacement of fine aggregate (sand) were cast into cylinders for subsequent testing. The splitting tensile strength test actual consists of applying a diametric compressive load along the entire length until failure occurs. This loading induces tensile stresses on the plane containing the applied load and compressive stresses in the area around the applied load. Results of the compressive strength test on concrete with varying proportions of iron slag replacement at the age of 7 and 28 days are given in the Table 3

Mix(%)	**Average Split Tensile Strength after 7 days**	**Average Split Tensile Strength after 14 days**	**Average Split Tensile Strength after 28 days**
0	2.48	3.21	4.67
25	2.88	3.54	4.85
30	3.40	3.94	4.90
35	2.93	3.77	4.86

Table 3: Compressive Test Result

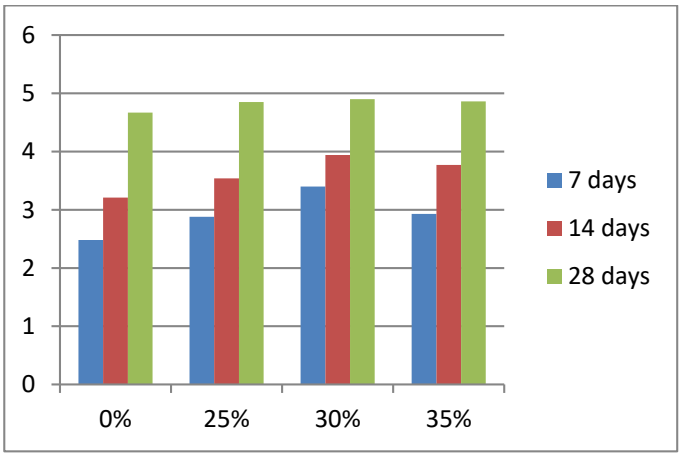

Figure 2: Comparison of STS

IV. CONCLUSION

1. The compressive strength increases as compared to control mix as the percentage of iron slag is increased. After adding 25% iron slag in the mix, there is an increase in compressive strength after 7 days, 14 days and 28 days respectively as compare to control mix. After 30% there is decrease in compressive strength. At 30% there is enormous increase in compressive strength of cube.
2. The optimum value of compressive strength comes at 30%.
3. There is no much change observed in the STS even up to 30 % but decrease in the strength is observed on adding 35%.
4. There as been observed a drop in the compressive beyond the replacement of 30% as can be seen from the value obtained from 35% replacement.

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