REUSE OF CAST IRON SWARS POWDER AS A PARTIAL REPLACEMENT OF FINE AGGREGATE IN CONCRETE

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ABSTRACT

This study is focused about the feasibility of reusing cast iron swars powder in concrete by partially replacing fine aggregate. The test performed to evaluate cast iron swars powder concrete quality included slump, fresh density, and dry density, Compressive Strength, Flexural Strength and Split Tensile Strength. Two types of Conventional reference concrete mixes M_{20} and M_{25} were prepared. Concrete mixes were made with C.I swars powder replacing 15%, 20% and 25% of the sand and with the same amount of cement, coarse aggregate and water-to-cement ratio as in the reference mixes. A series of 288 experiments and 96 tests were carried out. Cube, Beam and cylinder specimens made with all the types of concrete mixes were cured for 3, 7 and 28 days. The experimental results shows that the concrete mixes made with C.I swars powder had higher compressive strength, flexural strength and split tensile strength than the reference concrete mixes.

Keywords: *cast iron swars powder, concrete, fine aggregates, compressive strength*

INTRODUCTION

In construction industries, the innovation technologies are expanded in all activities. The need of innovation in concrete is not only for the making special type of concrete or high strength concrete, it is reduced the requirement of raw materials like cement, sand, gravel. The reuse of Cast Iron Swars powder as a partial replacement of fine aggregate in concrete is indirectly reduces Global Warming impact. One of the main goals of sustainable waste management is to maximize recycling and reuse. Recycling is a logical option for materials not suitable for composting. Metals, plastics and glass are the most common of these materials (Hawken, 1994). Recycling provides opportunities for long-term diversion of major volumes of market-limited waste from landfills and for the development of lower-cost and energy-efficient products (Soroushian et al., 1995). Reuse of industrial solid waste as a partial replacement of aggregate in construction activities not only saves landfill space but also reduces the demand for extraction of natural raw materials. Preserving natural aggregates is a matter

of sustainable development to ensure sufficient resources for future generations. Since approximately three-quarters of the volume of concrete is occupied by aggregate; it is not surprising that aggregate quality is of considerable importance. Not only can the aggregate limit the strength of concrete, but the aggregate properties also greatly affect the durability and structural performance of the concrete.

EXPERIMENTAL STUDY

In this experimental study, the sand is partially replaced by cast iron swars powder about 15%, 20% and 25%. This partially replacement of cast iron swars powder is made in two mix proportions M_{20} and M_{25}.The mix proportion calculations are made by the reference of IS 10262-1982.The behavior of partially replaced cast iron swars powder concretes are compared with the conventional concretes (M_{20} and M_{25}). This comparison is based on the study of slump cone value, compressive strength, flexural strength and split tensile strength. All these tests are made as per Indian standards. The properties of cast iron swar powder are displayed in the Table1.

Table 1: Properties of cast iron swars powder

S.No	***Property***	***Value***
1	Fineness Modulus	2.72
2	Specific Gravity	4.50
3	Colour	Black–gray

PREPARATION OF TEST SPECIMENS

The test specimens were prepared as per IS 516-1959. The specimens were cast in cast-iron steel moulds. The inside of the mould was applied with oil to facilitate the easy removal of specimens. Fresh concrete was placed in the mould in three layers and each layer was compacted. After 24 hours, the test specimens were demoulded and placed in a curing tank till the age of curing periods [3, 7 and 28days]. The mix proportions of reference concrete are given below in Table-2.

Table: 2 Mix details of conventional Concrete

S.No	***Type of concrete***	***Mix Proportions [Cement : Sand : Gravel : W/C Ratio]***
1	M_{20}	1 : 1.4 : 3.02 : 0.5
2	M_{25}	1 : 1.02 : 2.4 : 0.4

RESULTS AND DISCUSSION

This study is based on the partially replacement of sand by using cast iron swars powder in M_{20} and M_{25} grade concrete. Here the comparison is made between conventional concrete and cast iron replaced concretes. This comparison is based on the factors of slump value, fresh and dry densities of the concretes, compressive strength, split tensile strength, and flexural strength.

A. Slump Cone Test

The slump test has done as per IS 456-2000. The test has carried out for all the three Cast Iron Swars Powder concrete compared with the reference concrete [M_{20} and M_{25}]. The average of three specimen slump value has taken as slump of the specified type of concrete. The values are noted in following Tables 3 and 4

Table: 3 Slump cone test values of M_{20} Grade Concrete

S.No	*% of C.I Swars Powder*	*Slump [cm]*	*Decrease in Slump [%]*
1	0	8.45	0
2	15	8.10	4.50
3	20	7.80	8.50
4	25	7.45	13.50

Table: 4 Slump cone test values of M25 Grade Concrete

S.No	*% of C.I Swars Powder*	*Slump [cm]*	*Decrease in Slump [%]*
1	0	5.20	0
2	15	4.75	9.50
3	20	3.50	48.50
4	25	2.75	89.0

From the tables 3 and 4 in infers that the slump value was decreased with the increasing percentage of cast iron swars powder. The results demonstrate that the tendency of the slump value is decrease below the reference mix. This tendency might be due to an addition of cast iron swars powder, because if the percentage of cast iron swars powder increases means then the stiffness of the concrete will get increases. This will lead to a lesser value of slump.

B. Density of Fresh Concrete

Due to partial replacement of cast iron swars powder in concrete, the density of both fresh and dry concrete densities will get vary. The tabulated values of fresh concrete density were calculated immediately after the casting.

Table: 5 Fresh density of M_{20} Grade Concrete

S.No	*% of C.I Swars Powder*	*Density of Concrete (Kg/m^3)*	*Increase in Density of concrete [%]*
1	0	2581.36	0
2	15	2599.18	1.0
3	20	2617.54	1.5
4	25	2634.07	2.0

Table: 6 Fresh density of M_{25} Grade Concrete

S.No	*% of C.I Swars Powder*	*Density of Concrete (Kg/m^3)*	*Increase in Density of concrete [%]*
1	0	2590.78	0
2	15	2630.62	2.0
3	20	2643.70	2.5
4	25	2670.12	3.0

From the table 5&6, we can infer that the density of fresh concrete is getting increases in both the grades of concrete (M_{20} & M_{25}). This increment is proportional to the increment of cast iron swars powder in percentage. It is because of the unit weight of cast iron swars powder. Here we partially replaced cast iron swars powder in the place of sand in concrete. When compared to the unit weight of sand, the unit weight of cast iron swars powder is high. So an increasing percentage of cast iron swars powder in the concrete will increases the weight of the concrete.

C. Density of Dry Concrete

The Dry Density of partially replaced C.I Swars Powder concrete has compared with the two references concretes [M_{20} and M_{25}]. The tabulated values of dry concrete density were calculated in the corresponding curing periods.

Table: 7 Dry density of M_{20} Grade Concrete

S.No	*% of C.I Swars Powder*	*3 days*	*7 days*	*28 days*
1	0	2530.37	2571.36	2608.40
2	15	2565.93	2616.80	2617.28
3	20	2600.49	2636.05	2641.50
4	25	2580.24	2605.43	2619.77

Table: 8 Dry density of M_{25} Grade Concrete

S.No	*% of C.I Swars Powder*	*3 days*	*7 days*	*28 days*
1	0	2503.71	2537.31	2564.46
2	15	2532.45	2549.25	2575.15
3	20	2568.10	2579.75	2589.20
4	25	2550.2	2560.25	2575.10

From the table 7&8, we can infer that the dry densities of concrete are getting increases with increasing percentage of C.I swars powder concrete. It is because of increasing percentage of cast iron swars powder in concrete will increases its specific gravities.

D. Compressive Strength of Concrete

In this study cast iron swars power was partially replaced for sand in concrete and replacement of C.I swars powder was made about 15%, 20% and 25% in the M_{20} and M_{25} grade concrete and its compressive strength was compared with a reference concretes. The comparison graphs and explanations are given below.

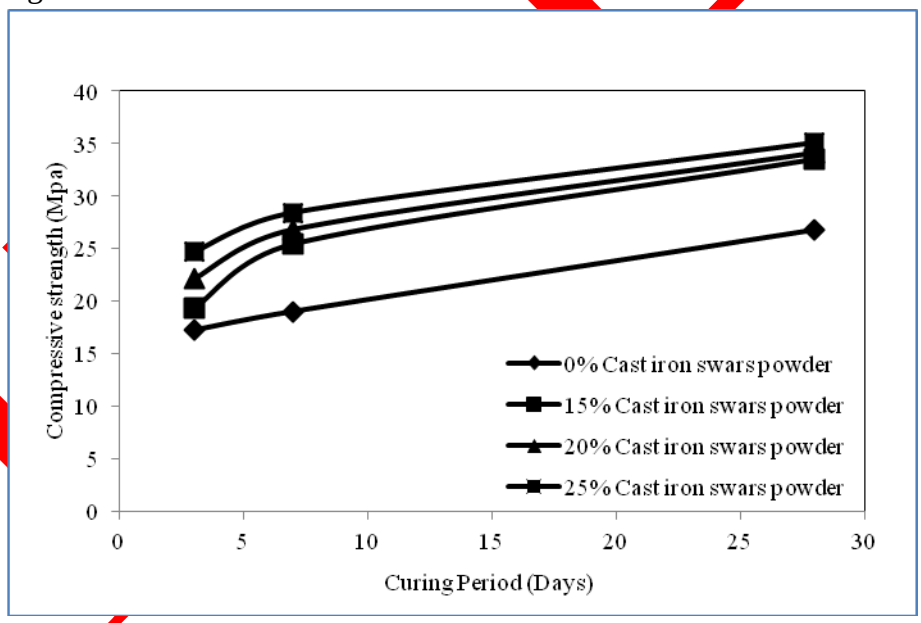

Fig 1 Compressive strength for M_{20} concrete

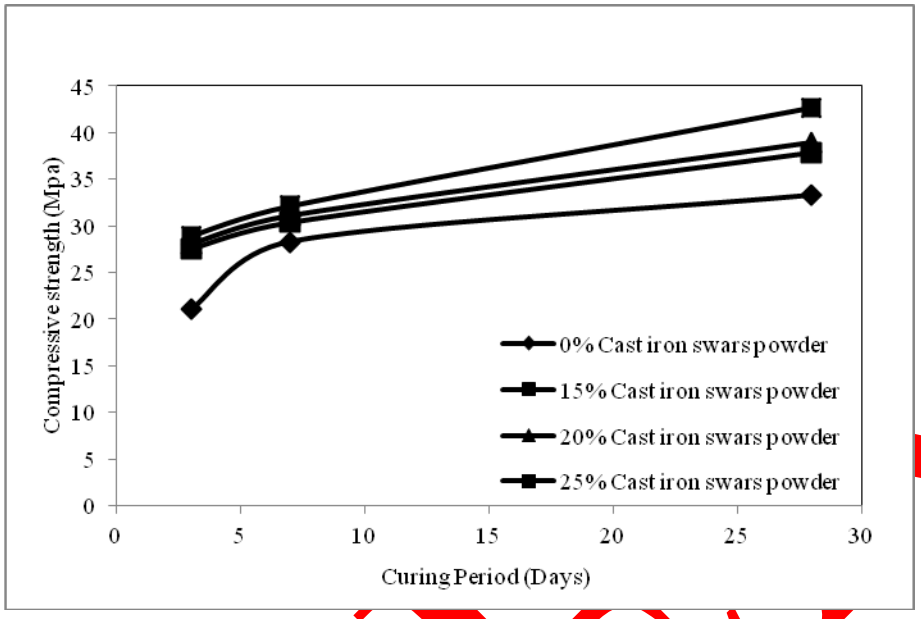

Fig 2 Compressive strength for M_{25} concrete

From Fig 1&2, it is infer that compressive strength of concrete is getting increases with increasing percentage of cast iron swars powder in concrete. The compressive strength of concrete made with partially replacement of sand with C.I powder of 15%, 20% and 25% are increased by 25.36%, 27.57% and 31.15% as compared to M_{20} concrete and 13.60%, 16.93% and 28.23% as compared to M_{25} concrete respectively. This tendency can be attributed that the density of cast iron swars powder is higher than the density of sand.

E. Split Tensile Strength of Concrete

Here we partially replaced cast iron swars powder in the place of sand as 15%, 20% and 25% in concrete and the split tensile strength of concrete compared with reference concrete specimens [M_{20} and M_{25}] at curing periods of 3, 7, and 28 days. The comparison graphs are given below.

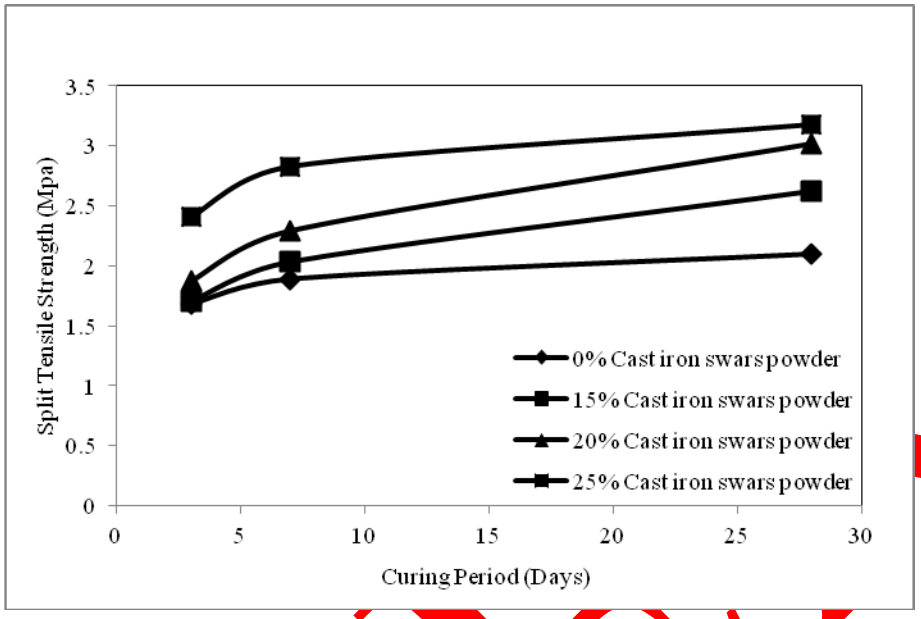

Fig 3 Split Tensile strength for M_{20} Concrete

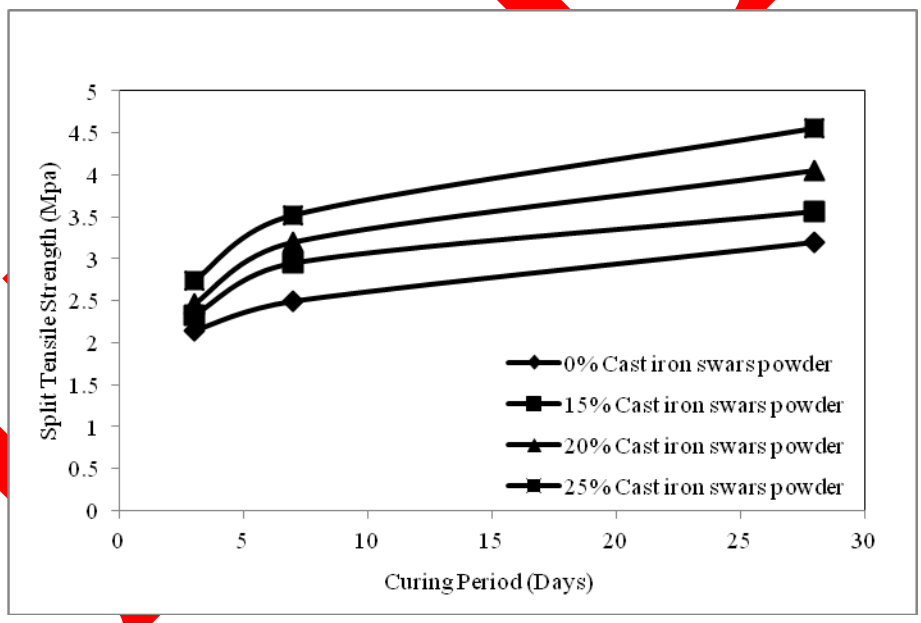

Fig 4 Split Tensile strength for M_{25} Concrete

From the Fig. 3, it infers that the split tensile strength of concrete made with partially replacement of sand with C.I powder of 15%, 20% and 25% are increased by 24.76%, 43.81 % and 51.43% as compared to M_{20} concrete. Similarly from the Fig.4, it infers that the split tensile strength of concrete made with partially replacement of sand with C.I powder of 15%, 20% and 25% are increased by 11.25%, 26.88% and 42.19% as compared to M_{25} concrete. The result shows that when there is an

increase in the quantity of C.I Swars powder, there is an increase in the split tensile strength of the concrete.

F. Flexural Strength of Concrete

The flexural strength of concrete specimen made with partial replacement of sand with C.I swars powder of 15%, 20% and 25% and the result is compared with the reference concrete specimens of M20 and M_{25} at the curing periods of 3, 7, and 28 days. The comparison graphs and explanations are given below.

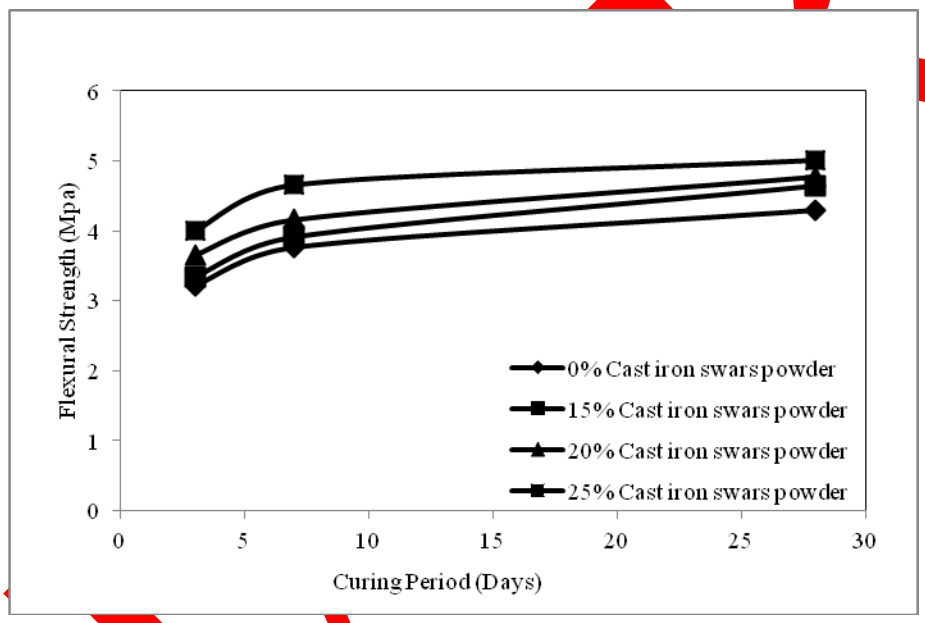

Fig 5 Flexural strength for M_{20} Concrete

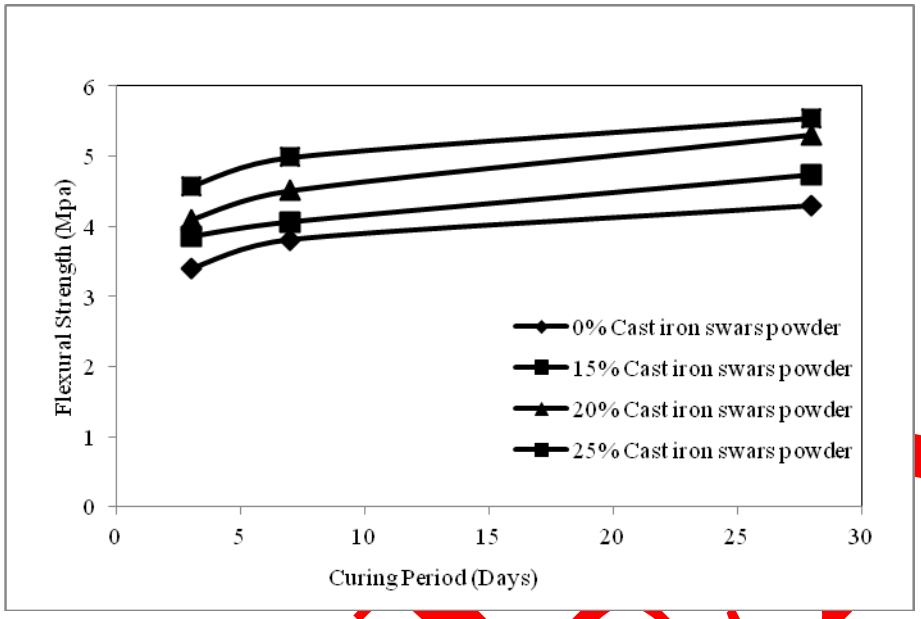

Fig 6 Flexural strength for M_{25} Concrete

From Fig. 5 and 6, it clearly indicates that the flexural strength of concrete specimen increases with the increasing percentages of C.I swars powder in concrete as compared to reference mix concrete [M_{20} and M_{25}]. The flexural strength of concrete made with partial replacement of sand with C.I powder of 15%, 20% and 25% are increased by 8.14 %, 11.16 % and 16.51% as compared to M_{20} concrete and 10.49%, 23.54% and 29.37% as compared to M_{25} concrete respectively. This is due to the high density of cast iron swars powder.

CONCLUSION

The tests of concrete mixes made with cast iron swars powder as partial replacement of sand revealed that the method performed efficiently to improve most properties of the Cast Iron Swars powder concrete mixes. The following conclusions can be made based on the results of this study:

- The slump values of the C.I Swars powder concrete mixes decreases with an increasing percentage of the iron aggregate. This tendency might be due to the increment of concrete stiffness as an increasing of cast iron powder in concrete.
- The fresh density and dry density values of C.I swars powder concrete mixes at each curing ages are getting increases with increasing percentage of C.I swars powder in concrete. It is because of increasing percentage of C.I swars powder in concrete will increases its specific gravities.

- The compressive strength of the concrete mix made of 25% of C.I swars powder is increases 31.15% and 28.23% above the reference concrete M_{20} and M_{25} respectively at curing period of 28 days.
- The split tensile strength of the concrete mix made of 25% of C.I swars powder is increases 51.43% and 42.19% above the reference concrete M_{20} and M_{25} respectively at curing period of 28 days.
- The flexural strength of the concrete mix made of 25% of C.I swars powder is increases 16.51% and 29.37% above the reference concrete M_{20} and M_{25} respectively at curing period of 28 days.

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