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EXPERIMENTAL STUDY ON MECHANICAL PROPERTIES OF M30 GRADE CONCRETE USING S-SAND

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Abstract

Sand is a prime material used for preparation of mortar and concrete and which plays a major role in mix design. In conventional concrete, one of the ingradient sand is replaced by steel industrial waste (S-sand) and its nature is studied in this paper. In this study, extensive laboratory investigations have been undertaken to study the effect of various percentage of S-sand on the mechanical properties such as compressive strength, split tensile strength and flexural strength. Specimens of M30 grade concrete with partial replacement of fine aggregate by S-sand with the various percentage by weight of 0%, 10%, 20%, 30% & 40% were casted, cured and tested for mechanical properties. In this paper, the results of concrete of M30 grade concrete with partial replacement of S-sand are discussed.

Keywords: Concrete, Partial Replacement, S-Sand, Fine Aggregate, Strength.

1. INTRODUCTION

Concrete is an artificial material in which the aggregates both fine and coarse are bonded together by the cement when mixed with water. It plays a major role as a construction material in world. Its popularity as a basic building material in the construction is because of its economy, good durability, ease with which it can be manufactured, the ability to mould it into any shape and any size, its high compressive strength and stiffness, no thermal and electrical conductivity. Many researchers have attempted to use the waste materials to reduce the disposal problems and to improve the mechanical properties of concrete. The waste materials such as natural pumice, vermiculite, shale, slate, oil palm shell, fly ash, micro silica, bagass ash, rice husk ash, metakaolin, ground granulated blast furnace slag, silica fume, recycled concrete, recycled tyres, recycled plastics etc. can be used in concrete. In this paper, made to study the properties of concrete has been discussed by utilizing the steel industrial wastes, S-sand.

Utilization of these industrial waste materials will reduce the cost of construction and also aid to minimize the impact on the environment

2. MATERIALS AND METHODOLOGY

Cement, M-sand, water, and S-sand were used as raw materials to prepare the cement concrete. M30 grade concrete specimens were prepared in which the M-sand was replaced by S-sand at various percentages such as10, 20, 30, 50, and 75%. The compressive strength of concrete was determined at 7 and 28 days.

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2.1. Materials

Cement: OPC 53 grade cement was adopted for this study and its properties are represented in Table 1. It satisfied the requirements specified in IS 12269-2013 [9].

Table 1: Properties of cement

Properties	Values
Specific Gravity	3.09
Standard Consistency (%)	31
Initial setting time(minutes) Final Setting time(minutes)	50 400
Fineness (% Passing)	98

Fine aggregates:

Manufactured – Sand [M-sand] is used as fine aggregate to prepare mortar at various proportions. It is replaced with S-sand obtained from the place near the JSW steel plant, Toranagallu, Bellary. The properties of M-sand and S-sand are represented in Table 2. The properties of M-sand and S-sand are investigated according to IS-383: 1970 [10].

Table 2: Properties of M-sand and S-sand

Properties	M-sand	S-sand
Specific Gravity	2.69	2.63
Water Absorption (%)	3.2	11.4
Zone	II	II
Bulk Density (kg/m^3)	1440	1211

Water: Portable water abiding by IS-456:2000 was used for casting and curing mortar.

3. METHODOLOGY

Concrete specimens were prepared using 53-grade cement and fine aggregates as per IS: 2250-1995.

M-sand was replaced by weight of fine aggregates at 0, 10, 20, 30, 40, 50, 60, 70, 70, 90, 100%. The mechanical properties such as compressive strength, split tensile strength and flexural strength was determined at 7 and 28 days.

4. RESULTS AND DISCUSSION

4.1. Compressive strength

The variation of compressive strength of concrete with variation in fine aggregates replacement levels are represented in figure 1

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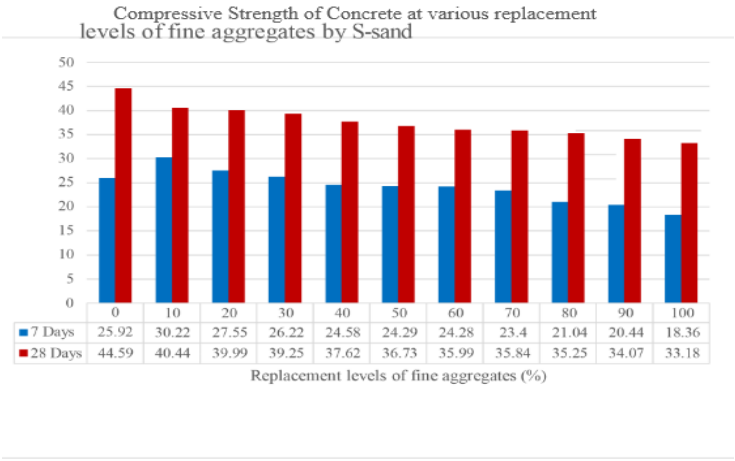

Figure 1: Compressive strength of Concrete for various replacement levels of fine aggregates by S-sand

From the figure 1, it can be noticed that, upto 40% replacement of fine aggregates with S-sand, the compressive strength achieved at 28 days satisfied the target strength criteria. It is also observed that, initial strength of concrete (at 7 days) was more for the concrete specimens containing S-sand than normal concrete till 30% replacement. Thus, it can be stated that, incorporation of S-sand in-place of fine aggregates will increase early strength of concrete.

4.2. Split tensile strength

The variation of split tensile strength of concrete with variation in fine aggregates replacement levels are represented in figure 2

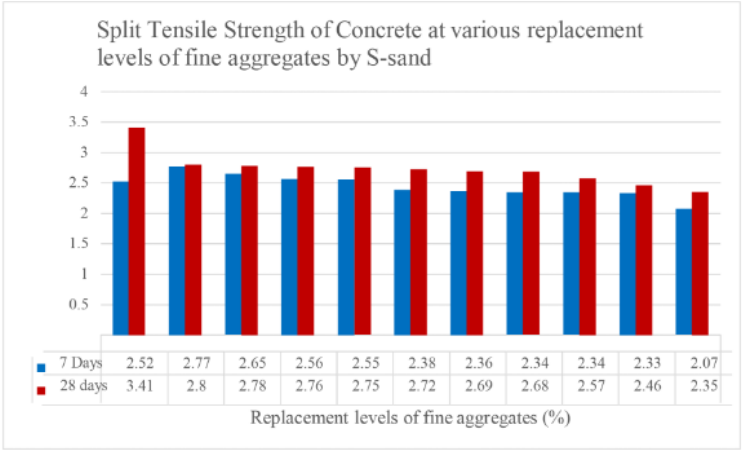

Figure 2: Split tensile strength of Concrete for various replacement levels of fine aggregates by S-sand

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From the figure 2, it can be noticed that, upto 70% replacement of fine aggregates with S-sand, the split tensile strength achieved was almost same at 28 days. It is also observed that, initial tensile strength of concrete (at 7 days) was more for the concrete specimens containing S-sand than normal concrete till 40% replacement.

4.3. Flexural strength

The variation of flexural strength of concrete with variation in fine aggregates replacement levels are represented in figure 3

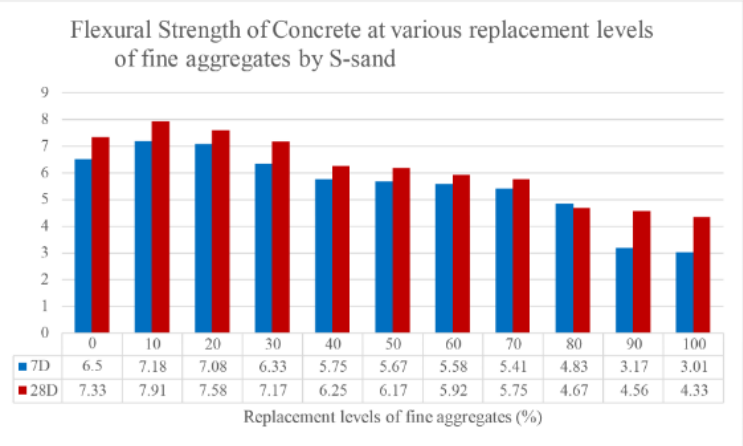

Figure 3: Flexural strength of Concrete for various replacement levels of fine aggregates by S-sand

From the figure 3, it can be noticed that, upto 20% replacement of fine aggregates with S-sand, the flexural strength achieved was more than normal concrete. It is also observed that, initial flexural strength of concrete (at 7 days) followed the same trend.

5. CONCLUSION

From the experimental studies, the following conclusions can be drawn:

1. Up to 40% replacement of fine aggregates with S-sand, the compressive strength achieved at 28 days satisfied the target strength criteria.
2. Up to 70% replacement of fine aggregates with S-sand, the split tensile strength achieved was almost same at 28 days
3. Up to 20% replacement of fine aggregates with S-sand, the flexural strength achieved was more than normal concrete.
4. Utilization of waste material near the source shrinks the production and transportation costs.
5. By using S-sand as the fine aggregate problems of landfilling, pollution nuisance and unnecessary exploitation of natural resources can be avoided.

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