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Analysis of Complete replacement of River sand by Iron ore slag sand

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Abstract –River sand is a widely used building material as fine aggregate as a component in concrete it gives durability workability and strength which are important factors that help in construction process one of the major drawbacks is that it is causing rapid extraction of sand from river bed which in turn has a negative effect on the environment. The idea of using iron ore slag sand gives us a platform to use it as an alternative building material replacing river sand Our study says that slag sand that is obtained at the end of steel manufacture plant can be used to replace river sand 100% effectively using M30 grade. The casted molds of slag sand were cured for 7,14 and 28 days and tested and the compressive strength was found to be increasing 30% from 7 to 28 days. Split tensile strength was found to be increasing 15.6% from 7 to 28days and flexural strength was to be increasing 7.79% from 7 to 28days. The above number suggest slag sand can replace 100% river sand effectively

Key Words: iron ore slag sand, river sand, slag sand, etc.

1. INTRODUCTION

Slag sand or Blast furnace sand is a by-product that is obtained at the end of steel manufacturing plant. It is a non-metallic product, consisting of silicates and alumina silicates it does not contain any material that might affect the strength and durability of the concrete.

The slag sand pass through 4.75mm IS sieve complexly and retain in 90micron IS sieve similar to that of fine aggregate This sand according to shape is classified into sub angular to sub round having minimum voids ranging from 32% - 33% giving minimum ratio of surface area thus requiring minimum cement paste to make a good concrete and if it is sub angular voids ranging from 38% - 40% giving us workable concrete specific gravity that obtain is 2.69 which is between 2.5 – 2.7 range of natural fine aggregate which produce concrete with unit weight ranging from 23 – 26 KN/m^3 Mineralogical examination of Blast furnace of slag aggregate shows no content of any reactive form of minerals which could cause alkali aggregate reaction to occur vesicular nature of particles can promote to good interlocking between the particles.

2 MATERIALS AND METHODOLOGY

2.1 MATERIALS

The material used for the preparation of concrete are Coarse aggregate, Cement and Fine aggregate as River Sand and Iron Ore Slag Sand for their concrete respectively

2.1.1 Cement

Cement is a binding material in concrete. This concrete is used for different engineering works where strength and durability are of prime importance

2.1.2 Slag Sand

Fine aggregate plays a very important role in concrete in both its plastic and hardened state. A non-metallic product, consisting of glass containing silicates and alumina silicates of lime, is a byproduct of metal smelting processes, produced under controlled conditions.

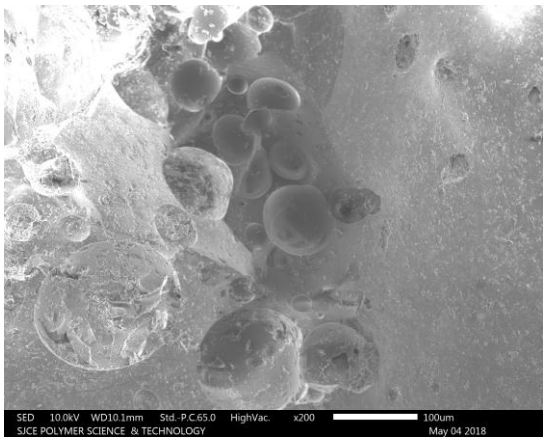


Fig 1: The SEM analysis of slag sand

The SEM analysis can magnify the sample and it is powerful than optical microscope. Slag sand is magnified up to x200 times giving the topography of the same.

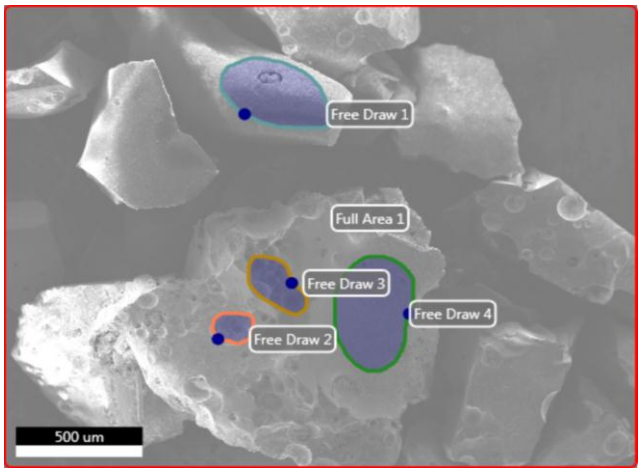
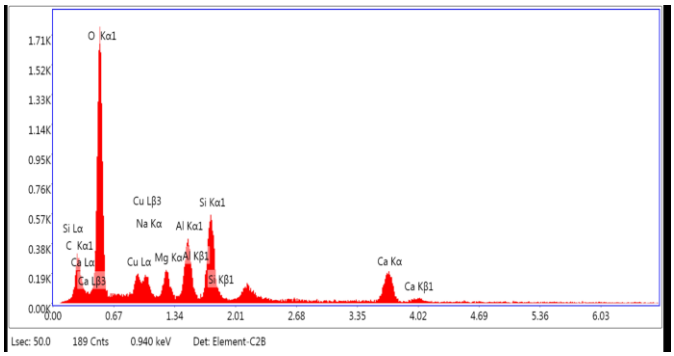


Fig 2: EDS analysis of SS



Graph 1: EDS graph of SS

Element	Weight %	Atomic %	Net Int.	Error %	Kratio
C K	5.75	9.87	18.50	15.59	0.0223
O K	46.01	59.32	214.66	8.80	0.2138
CuL	2.03	0.66	5.41	34.10	0.0122
NaK	1.60	1.43	7.67	28.29	0.0101
MgK	2.43	2.06	15.70	14.15	0.0184
AlK	8.05	6.16	51.08	7.85	0.0642
SiK	13.31	9.77	83.09	6.31	0.1119
CaK	20.83	10.72	39.69	8.05	0.1834

Table 1: Chemical Composition of SS

SEM-EDS analysis is a great method for determining different particel sizes and composition of elements presnt in the sample.The above (Table 2 , Graph 2, Fig 3) data shows the chemical composition and presence of specific elements of slag sand.

2.1.3 Jelly

Those particles that are predominantly retained on the 4.75mm sieve, are called coarse aggregate. Crushed angular stones are used.

2.1.4 Water

Water is used in concrete plays an important part in the mixing, laying compaction setting and hardening of concrete. The strength of concrete directly depends on the quantity and quality of water is used in the mix.

2.2 METHODOLOGY

The concrete was produced by 100% slag sand using M30grade as per IS 10262:2009 OPC 43 grade cement was used and the water cement ratio is taken as 0.5, the concrete batch was hand mixed on water-tight, non-absorbent platform with a shovel, trowel and necessary equipment's which gave thoroughly blended concrete that is uniform in color. The slump was measured in mm and values were recorded it was found to be 60mm true slump therefore for further tests using concrete has to be done such has compressive strength test, split-tensile test and flexural test Which were done accordingly and the following results are obtained.

3. RESULTS AND DISCUSSION

3.1 COMPRESSIVE STRENGTH TEST

Compressive strength is the capacity of the material to withstand loads tending to reduce size, as opposed to tensile, which withstands loads tending to elongate
Here we use compression testing mission to find the value of compressive strength of concrete cube by applying load until the material fails which is having a dimension of 15cm X 15cm X 15cm

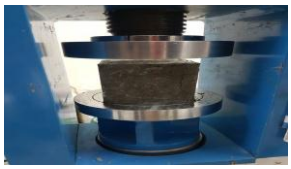
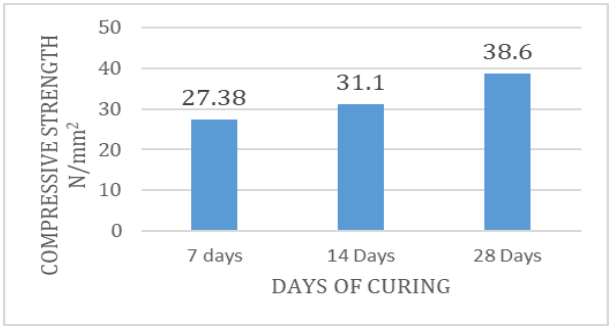



Fig 2: Compressive Testing Machine and Specimen Placed in Machine

Compressive strength = F/A
Where, F= Load applied [N]
A=Area [mm^2]

COMPRESSIVE STRENGTH (N/mm^2)			
Sl no	7 Days	14 Days	28 Days
1	26.22	30.22	37.77
2	27.5	32.44	32.88
3	28.44	30.66	43.11
Average	27.38	31.1	38.6

Table 2: Compressive Strength of Slag Sand



Graph 2 : Compressive Strength Average Values For 7,14 & 28 Days of Curing

The average compressive strength obtained for 7days was 27.38 N/mm² and for 14days was 31.1 N/mm² and for 28days was found to be 38.6 N/mm²

3.2 SPLIT-TENSILE STRENGTH TEST

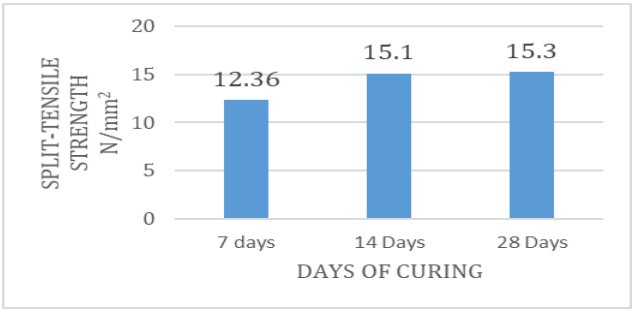
The concrete is very weak in tension due to brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary members may crack.
Here we take the cylindrical molds that has been casted and place them and apply the load in CTM and wait until the material fails or breaks and note down the breaking load.

Fig 3: Split Tensile Testing Machine and Specimen Placed in Machine

Split tensile strength =2P/pi DL
P= applied load
D= diameter of the specimen
L= length of the specimen
Therefore, P= Tsp x pi DL/2
Expected load = p x f.s
Therefore, split tensile strength is T = 2P/pi DL

Table 3: Split Tensile Strength of Slag Sand

SPLIT TENSILE STRENGTH (N/mm²)			
Sl no	7 Days	14 Days	28 Days
1	13.75	14	15.91
2	10.44	15.91	15.27
3	12.89	15.27	14.76
Average	12.36	15.1	15.3



Graph 3 : Split Tensile Strength Average Values For 7,14 & 28 Days of Curing

The average Split-Tensile strength obtained for 7days was 12.36 N/mm² and for 14days was 15.1 N/mm² and for 28days was found to be 15.3 N/mm²

3.3 FLEXURAL STRENGTH

Flexural test evaluates the tensile strength of concrete indirectly. It tests the ability of unreinforced concrete beam to withstand failure in bending the results of flexural test on concrete expressed as modulus of rupture which denotes as MPa or psi

Fig 4: Flexural Strength Testing Machine and Specimen Placed in Machine

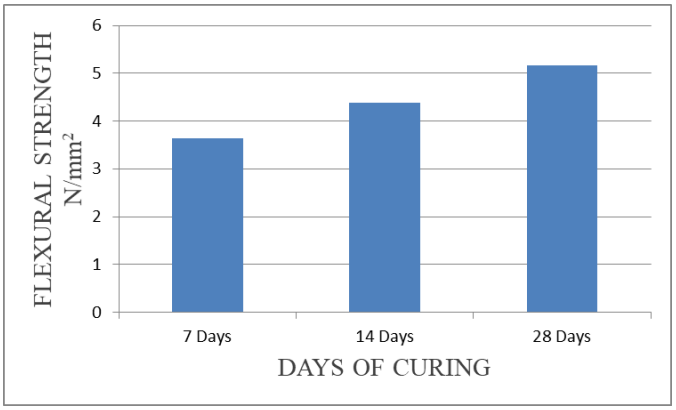
Standard size of specimen is 100mm width, 100mm depth and span of 5000mm
Test is done immediately after taken out from curing using flexural testing machine
The following expression is used for estimation of modulus of rupture
MR = 3PL/2bd²(1/3 break) and PL/bd² (Half break)

1. MR= modulus of rupture

P= ultimate applied load indicated by testing machine
L= span length
b= average width of the specimen at the fracture
d= average depth of the specimen at the fracture

FLEXURAL STRENGTH (N/mm²)			
Sl no	7 Days	14 Days	28 Days
1	3.64	4.12	4.93
2	3.53	4.54	5.37
3	3.71	4.48	5.19
Average	3.63	4.38	5.16

Table 3 : Flexural Strength Of Slag Sand



Graph 3 : Flexural Strength Average Values For 7,14 & 28 Days of Curing

The average flexural strength obtained for 7days was 3.63 N/mm^2 and for 14days was 4.38 N/mm^2 and for 28days was found to be 5.16 N/mm^2

3. CONCLUSIONS

- The compressive strength of slag sand concrete was found to be increasing 30% from 7 to 28days with an average value of 27.38N/mm^2 to 38.6N/mm^2 from 7 to 28 days respectively.
- The split tensile strength of slag sand concrete was found to be increasing 15.6% from 7 to 28days with an average value of 12.36N/mm^2 to 15.3N/mm^2 from 7 to 28 days respectively.
- The flexural strength of slag sand concrete was found to be increasing 29.65% from 7 to 28 days with an average value of 3.63/mm^2 to 4.38N/mm^2 from 7 to 28 days respectively.

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