International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Comparison of River Sand and Iron Ore Slag Sand

Arun A[1], Madhan M B[2], Sagar Gotur[3], Sethupathy G[4], Divya Nair[5]

[1,2,3,4] *Students, @ RGIT, Bangalore, Karnataka,*
[5] *Assistant Professor, Dept. of Civil Engineering, RGIT, Bangalore, Karnataka, India*

Abstract – *River sand (RS) 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 (SS) gives us a platform to use it as an alternative building material replacing river sand. This study aims at the comparison of slag sand and River Sand using M30 grade. The casted molds of slag sand and River Sand were cured for 7, 14 and 28 days and tested for Compressive Strength, Split-Tensile Strength and Flexural Strength.*

Key Words: *River sand, Iron ore slag sand, SEM, EDS.*

1. INTRODUCTION

Rapid extraction of sand from river bed causing so many problems like losing water retaining soil strata, deepening of the river beds and causing bank slides, loss of vegetation on the bank of rivers, disturbs the aquatic life as well as the agriculture due to lowering of water table in the well, etc. The heavy exploitation of river sand for construction purposes leads to various harmful problems. Therefore, construction industries of developing countries are in stress to identify alternative materials to replace the demand for river sand [4]. Hence, it can be replaced by Compatible Iron Ore Slag Sand which meets the technical requisites of fine aggregate that is used as building material. The comparative analysis will help to show the similarities and differences of Slag Sand and River Sand.

2. MATERIALS AND METHODOLOGY

2.1 GENERAL

The present study deals with the comparative study of results obtained for tests conducted on river sand and slag sand. Chemical analysis (quantum lab solutions, Bangalore Karnataka India), SEM analysis, EDS analysis, Compressive Strength, Split-Tensile Strength and Flexural Strength were done.

2.2 MATERIALS

Materials 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.

2.3 METHODOLOGY

The concrete was produced by using 100% slag sand and river sand with the design mix M30 grade 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 were checked. The properties of materials that are used in production concrete were tested according to codal requirements of IS10262:2009, IS383:1983, IS456:2000.

3. COMPARISON OF RIVER SAND AND SLAG SAND

3.1 GENERAL

River sand is a mineral that is extracted from the river bed and it is a building material that is used widely used it has silicon dioxide as a major component which has a property of giving strength to concrete.

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.

3.2 COMPARITIVE STUDY

The slag sand and river sand pass through 4.75mm IS sieve complexly and retain in 90micron IS sieve similar to that of fine aggregate. Both sands 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

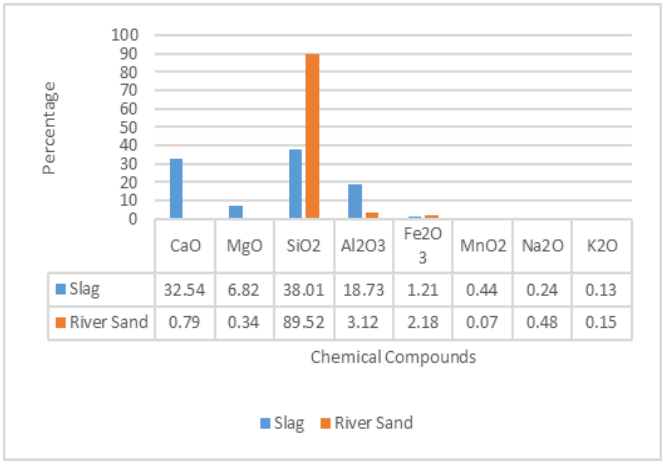
Chemical examination of Blast furnace of Slag Sand and River sand shows no content of any reactive form of minerals which could cause alkali aggregate reaction to occur vesicular nature of particles can promote to good interlocking between the particles.

3.3 CHEMICAL ANALYSIS OF RIVER SAND AND IRON ORE SLAG SAND

Chemical Compounds	River Sand	Slag Sand
CaO	0.79	32.54
MgO	0.34	6.82

SiO_2	89.52	38.01
Al_2O_3	3.12	18.73
Fe_2O_3	2.18	1.21
MnO_2	0.07	0.44
Na_2O	0.48	0.24
K_2O	0.15	0.13

Table 1: Compounds of RS and SS



Graph 1: Chemical compound comparison of RS and SS

The above chemical analysis shows distribution of chemical compounds present in different percentages of Slag Sand and River Sand and the comparison between them. SiO_2 is the major component in the river sand where as in slag sand CaO and SiO_2 are the major components in the slag sand.

3.4 SEM ANALYSIS

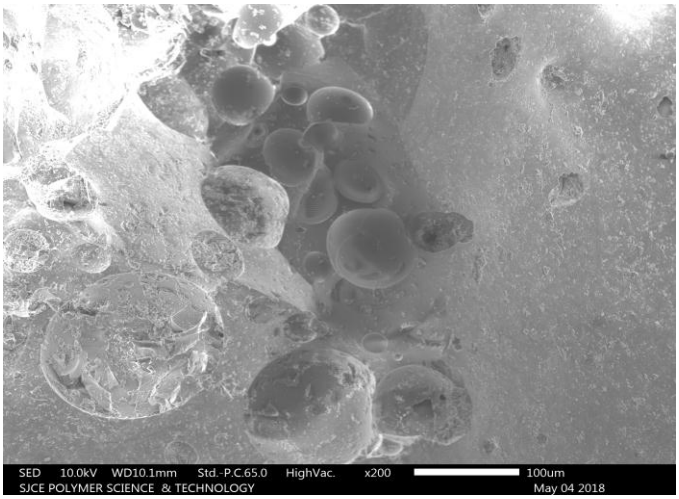


Fig 1: SEM Analysis of SS

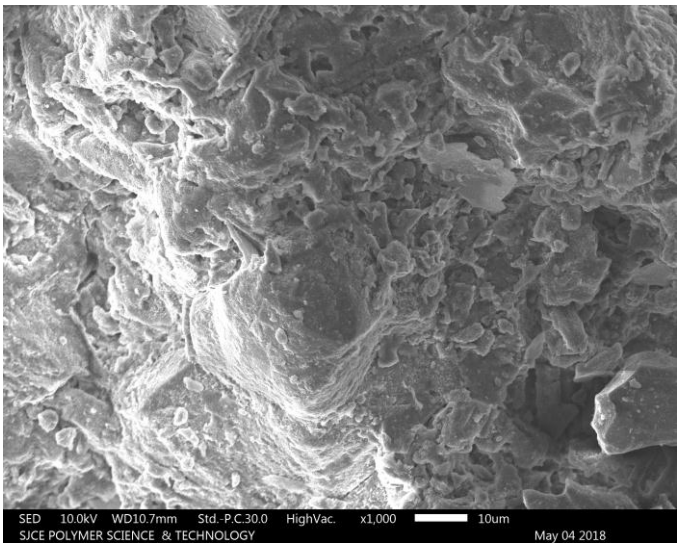


Fig 2: SEM Analysis of RS

The SEM analysis can magnify the sample and it is powerful than optical microscope. Slag Sand is magnified up to x200 times similarly the river sand is magnified up to x1000, giving the topography of both the surfaces respectively.

3.5 EDS ANALYSIS

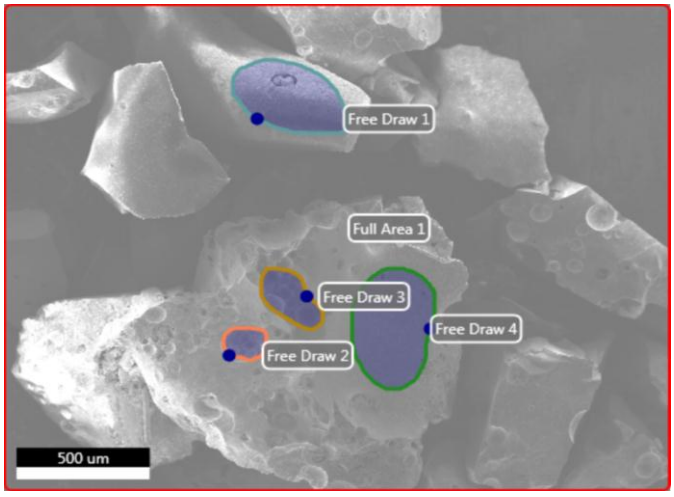
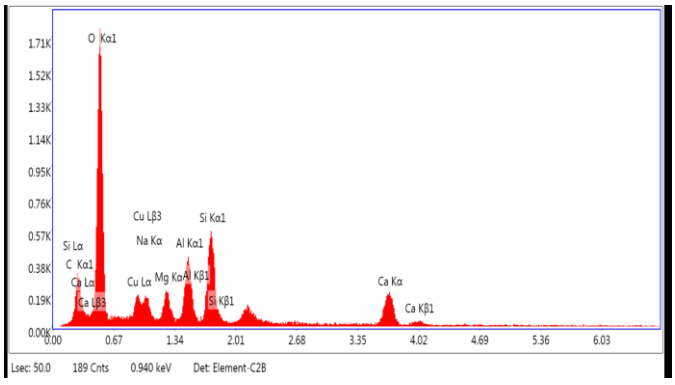


Fig 3: EDS analysis of SS



Graph 2: EDS graph of SS

eZAF Smart Quant Results

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 2: 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.

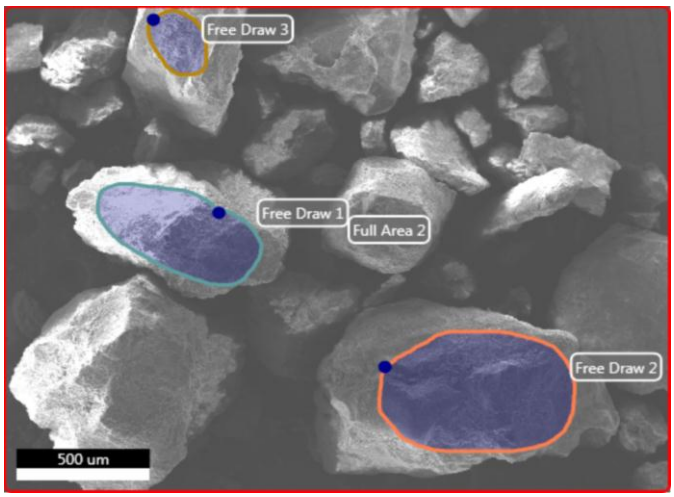
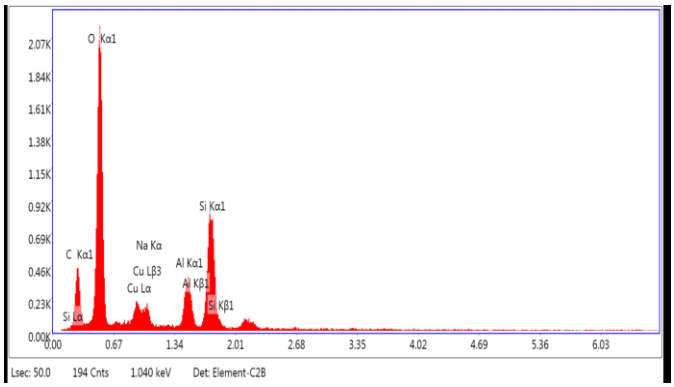


Fig 4: EDS analysis of RS



Graph 3: EDS graph of RS

eZAF Smart Quant Results

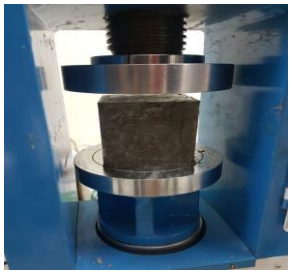
Element	Weight %	Atomic %	Net Int.	Error %	Kratio
C K	17.01	25.83	49.48	11.79	0.0533
O K	43.88	50.03	292.70	7.25	0.2609
CuL	5.42	1.56	17.32	13.69	0.0350
NaK	3.31	2.63	18.12	14.55	0.0214
AlK	8.50	5.75	60.23	6.41	0.0678
SiK	21.88	14.21	150.51	5.03	0.1814

Table 3: Chemical composition of RS

The above (Table 3 , Graph 3, Fig 4) data shows the chemical composition and presence of specific elements of River sand. The above test results were obatained in SJCE polymer science & technology, mysore.

4. RESULTS AND DISCUSSION

4.1 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

Compressive strength = F/A

Where, F= Load applied [N]

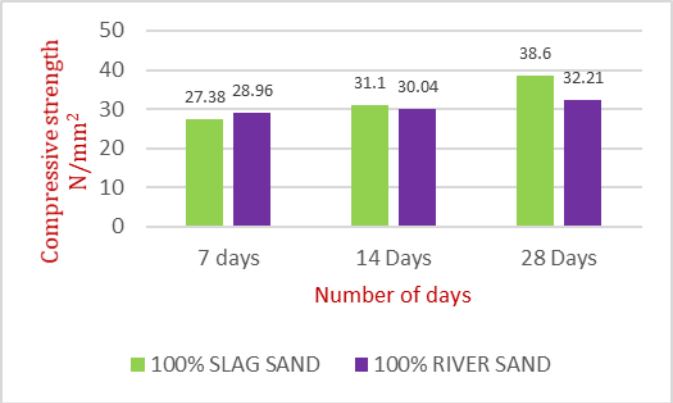
A=Area [mm²]

COMPRESSIVE STRENGTH of 100% Slag Sand (N/mm²)			
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 4: Compressive strength of slag sand

COMPRESSIVE STRENGTH of 100% River Sand (N/mm²)			
Sl no	7 Days	14 Days	28 Days
1	32.66	30.22	30.22
2	26.22	29.25	32.55
3	28	30.66	33.87
Average	28.96	30.04	32.21

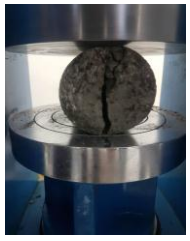
Table 5: Compressive strength of River sand



Graph 4: Comparision of SS and RS

- The compressive strength of 100% slag sand concrete was found to be increasing 30% from 7 days to 28 days.
- The compressive strength of River sand concrete was found to be increasing 10.09% from 7 days to 28 days.

4.2 SPLIT-TENSILE STRENGTH



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 have 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.

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

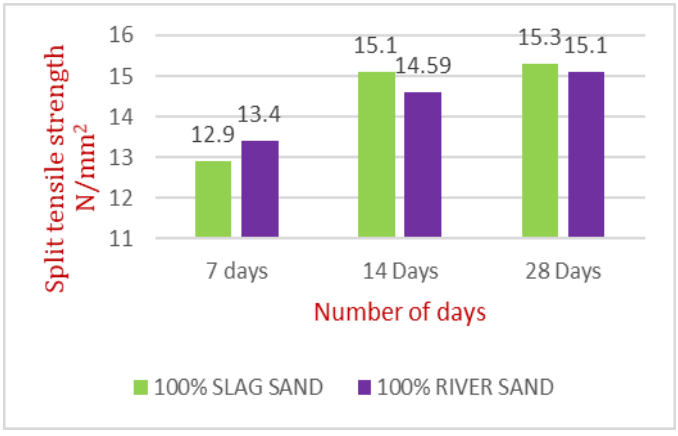
Therefore, split tensile strength is T = 2P/pi DL

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

Table 6: Split Tensile Strength of 100% Slag Sand

SPLIT TENSILE STRENGTH of 100% River Sand (N/mm²)			
Sl no	7 Days	14 Days	28 Days
1	10.8	14	16.55
2	12.73	15.27	12.73
3	16.55	14.51	15.91
Average	13.36	14.59	15.1

Table 7: Split tensile strength of river sand



Graph 5: Split tensile strength of SS and RS

- The Split Tensile strength of River sand concrete was found to be increasing 11.25% from 7 days to 28 days.

- The Split Tensile strength of 100% slag sand concrete was found to be increasing 15.6% from 7 days to 28 days

4.3 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

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 = $3PL/2bd^2$(1/3 break) and PL/bd^2 (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

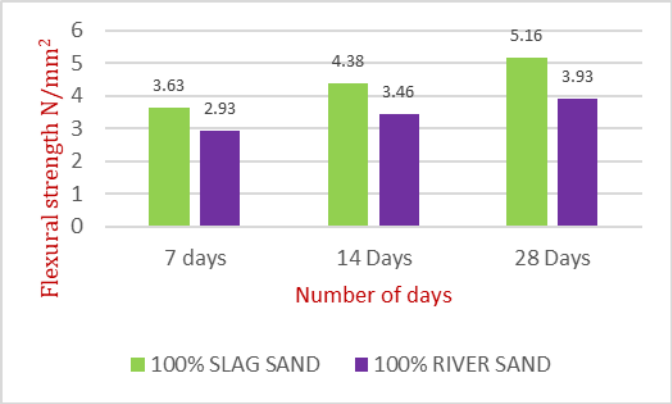
d= average depth of the specimen at the fracture

FLEXURAL STRENGTH (N/mm²)			
Sl no	7 Days	14 Days	28 Days
1	2.9	3.24	4
2	2.87	3.5	3.88
3	3.04	3.65	3.91
Average	2.93	3.46	3.93

Table 8: flexural strength of Slage Sand

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 9: flexural strength of River Sand



Graph 6: Flexural strength of SS and RS

- The Flexural strength of 100% slag sand concrete was found to be increasing 30% from 7 days to 28 days.
- The Flexural strength of River sand concrete was found to be increasing 25.44% from 7 days to 28 days.

5. CONCLUSIONS

1 Comparative study of river sand and iron ore slag sand from the above results suggests that slag sand can be replaced effectively with river sand.

2 Iron ore slag sand is an eco-friendly alternative building material that can be used for construction instead of river sand.

3 The results obtained also show slag sand have more compressive and flexural strength compared with river sand.

REFERENCES

[1]. Nandini reddy and P. Gopal, 'REPLACEMENT OF RIVER SAND BY IRON SLAG' International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163 Issue 04, Volume 4 (April 2017).

[2]. Chetan Khajuria, 'USE OF IRON SLAG AS PARTIAL REPLACEMENT OF IRON SLAG 'International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 6, June 2014.

[3]. Jyoti R. Mali, Piyush Bagul, Yogesh Biyani, Pradip Pandhare, Hemant Bafna and Mandar Joshi, 'PARTIAL REPLACEMENT OF FINE AGGREGTES WITH GGBS' International Journal of Advance Research, Ideas and Innovations in Technology.

[4]. Sindhu.A. E and Karthikeyan.N, 'EFFECT OF RELACING SAND WITH CAST IRON SLAG ON COMPRESSIVE STRENGTH OF CONCRETE' International Journal of Science and Engineering Research (IJ0SER).

[5].M. SOUNDAR RAJAN, 'STUDY ON STRENGTH PROPERTIES OF CONCRETE BY PARTIAL REPLACEMENT OF SAND BY STEEL SLAG' International Journal On Engineering Technology and Sciences – IJETS™, ISSN (P): 2349-3968, ISSN (O): 2349-3976.

BIOGRAPHIES

Arun A, Student @ Rajiv Gandhi institute of technology, B.E. civil engineering, Bangalore, Karnataka, India

Madhan M B, Student @ Rajiv Gandhi institute of technology, B.E. civil engineering, Bangalore, Karnataka, India

Sagar Gotur, Student @ Rajiv Gandhi institute of technology, B.E. civil engineering, Bangalore, Karnataka, India

Sethupathy G, Student @ Rajiv Gandhi institute of technology, B.E. civil engineering, Bangalore, Karnataka, India

Divya Nair, Assistant Professor, Dept. of Civil Engineering, RGIT, Bangalore, Karnataka, India