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A Replacement to Sand – Slag Sand

Ganesh Khatri, L. Aparna, P.Thrivikrama Reddy
Aurora's Technological and Research Institute

ABSTRACT

Fillers play a major role in concrete. Sand is a principal component as a construction material, a product of sedimentation. Sand is available mostly in river beds. The excessive mining of sand, to meet the increase in requirement, is being carried out. The reduction and exhaustion of sand resources increased shortage of sand. This is the time to find a way out for replacement of sand with the other material which exhibit better qualities than sand.

It is observed that work-ability of concrete gets reduced due to shape of manufactured sand and usage in concrete.

Granulated Blast Furnace (BF) Slag is processed as sand is the identified alternative source of Sand (say river or rock-filled).

Blast Furnace Slag helps to reduce the cost of ground preparation for construction and other uses.

Keywords

Cement, Sand, Slag sand, Blast Furnace Slag, Coarse aggregate, Concrete, Water, Compressive strength, Compaction Factor, Specific Gravity, Water absorption.

INTRODUCTION

Sand is the principal component as a construction material. River sand is mostly being used, is formed naturally.

The natural sand being successfully obtained from river bed, for long thought to be an everlasting source of supply, is being depleted. The crisis triggered by the ban on mining of river sand, has adversely affected the construction activity and has resulted in daily wage construction workers and staff out of employment.

Fig 1: Sand

SLAG

"Slag", a non-metallic product consisting essentially of glass containing silicates and alumino-silicates of lime. This is a by-product obtained in the manufacture of pig-iron in blast furnaces at high temperatures (1400^0C-1500^0C) in the molten form. The granulated slag is formed by quenching (the molten ash from the

furnace) by water or air and steam. Slag is transported to processing plants, where it undergoes crushing, grinding, and screening operations to meet various use specifications. Processed slag is either shipped to its buyer for immediate use or, in slack seasons, stored.

Depending on the cooling method, three types of BF slag are produced: air-cooled, expanded, and granulated.

The use of slags became a common practice in Europe at the turn of the 19th century.

Table 1. Chemical Composition of Slag

Chemical	Compisition (%)
Calcium oxide	40%
Silica	35%
Alumina	13%
Magnesia	8%

Fig 2: Slag Sand

Research statement on Usage of Slag sand

Commonwealth Scientific & Industrial Research Organisation (CSIRO) carried out investigations for value-added method for slag and proved a number of technically viable and commercially interesting applications of slag. The applications include (i) base course and top course for asphalt roads, (ii) anti-skid surfacing for roads on accident prone intersections, (iii) low strength concrete for footpaths, (iv) controlled low strength fill for backfill required for trench stabilisation and (v) concrete sub-base for rigid pavements.

MATERIALS, DESIGN STRATEGIES, RESULTS

The following materials were chosen for the project.

a) Ordinary Portland Cement 53
b) River sand pertaining to zone III, size passing through 1 mm.
c) Coarse aggregate of size 12 mm
d) Slag sand passing through 1 mm sieve.

A design mix was made for M30 grade of concrete under good laboratory conditions.

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Table 2. Results of properties of materials and apparatus used

DESCRIPTION	RESULT	APPARATUS
Cement		
Grade	OPC 53	--
Fineness	1%	Dry sieving
Soundness	Sound (<10 mm)	Le-Chatelier Apparatus
Specific gravity	2.6	Specific gravity bottle
Consistency	30%	Vicat apparatus
Initial Setting	32 minutes	
Final Setting	8 hrs 10 min	
Fine Aggregate: River sand		
Specific gravity	2.64	Pycnometer
Bulking of sand	33.3%	Measuring jar
Sieve Analysis	2.62	Mechanical sieve set
Coarse Aggregate		
Specific gravity	2.64	Wire basket
Water Absorption	0.81%	
Sieve Analysis	6.95	Mechanical sieve set
Concrete		
Compaction Factor	0.69	Compaction Factor setup
Slump-cone	True	Slump-cone apparatus
Water-Cement ratio	0.43	IS Code 10262
Fine Aggregate: Slag Sand		
Specific gravity	2.90	Pycnometer
Bulking of sand	40%	Measuring jar

DISCUSSION AND CONCLUSION

A design mix pertaining to proportion of 1: 1.3: 2.46. The strength and durability characteristics of concrete mixtures have been computed in the present work by replacing 10%, 20%, 30% and fully slag sand with the sand. On the basis of present study, following conclusions are drawn.

Table 3. Results showing compressive strength of concrete with Slag sand replacement, different percentages

Slag sand Composition (% of concrete)	Average Compressive strength at 3 days (N/m^2)
0	33.23
10	39.37
20	49.90
30	55.67
100	22.69

From the corresponding results it can be understood Slag sand can be replaced partially for natural sand. The reason being Slag sand has more water absorption.

MOTTO

To save river sand: Increase ground water
To save rocks: To save hills
To save nature: To save future

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