SJIF Impact Factor 2022: 8.197| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 7 | Issue: 8 | August 2022 - Peer Reviewed Journal

COMPATIBILITY OF NATURAL FINE AGGREGATE WITH WASTE INDUSTRIAL STEEL SLAG IN CEMENT CONCRETE

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ABSTRACT

In this paper, waste industrial slag is used in concrete mix design to increase the compressive strength of concrete. The disposal of this type of industrial waste or by product is an environmental issue. Scientific analysis has predetermined their impact on nature; using waste slag in a creative way is a challenging task.

All laboratory scale experiments are performed to study the effect of complete replacement of fine aggregate by industrial waste slag on various parameters such as strength and durability of concrete mix. Here we replace fine aggregate with waste industrial slag.

Slag sieve analysis and mix design are performed in place of fine aggregate and compressive strength is checked after 7, 14 and 28 days respectively. A promising result was obtained after using slag in concrete. This paper reports the results of a feasibility study of waste industrial slag as fine aggregate in concrete.

KEYWORDS: *Specific Gravity, Compressive strength, Slag, Durability, Initial and final settling time, Fine aggregate, coarse aggregate*

1. Introduction

Removing sand from waterways increases the cost of sand and increases the financial visibility of the construction industry. Civil engineers have always been on the lookout for an alternative to the use of more environmentally friendly and readily available materials as a replacement for traditional components in concrete. Concrete industries have always welcomed the use of various industrial waste materials as replacements for those components.

Slag is a waste product generated in steel industries. One ton of steel means production of 130-200 kg of slag depending on the steel composition and steel production process. Slag appears as a granular material consisting of large clusters, coarse and very fine particles. Due to heavy dependence on steel industries, it is producing such large quantities which are causing environmental problems.[1]

It should be used to give proper output in concrete manufacturing for better implementation. Presently the consumption of slag in India is marked up to 20 to 25%. Fine aggregate is a key component in the application of construction industries such as plastering, concreting. Due to the boom in construction activities, the availability of natural fine aggregates has been exhausted. In this study we investigate the possibilities of using waste industrial slag as a replacement for natural sand in concrete.

2. NEED FOR THIS STUDY

Slag is a by-product of the steel and iron construction industry. These waste materials are not useful and are therefore dumped as landfills in the vicinity of the industry. Unprocessed waste can result in environmental problems and as a result waste disposal becomes a major issue. Thus, effective use of this material can bring economy and will no longer be an environmental concern.

3. OBJECTIVE

- To check the compressive strength with slag.

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- To check the physical characteristics of the concrete with and without the slag.
- To reduce the voids to enhance the strength.
- To utilize the industrial solid waste in construction industry.
- To minimized the environmental problems created due to residual of steel industries.

4. MATERIALS

4.1 Cement

The cement use for this work is OPC 53 grade.

4.1 Physical Characteristics of cement

Specific Gravity	3.15
Consistency	24%
Initial setting time	97 min
Final setting time	206 min

4.2 Typical steel slag chemical composition.

Constituent	Composition (%)
CaO	40 – 52
SiO_2	10 – 18
FeO	15 - 40 (70 - 80% FeO, 20 - 30% Fe2O3)
MnO	5 – 10
MgO	5 – 8
Al_2O_3	1 – 3
P_2O_5	0.5 – 1
S	< 0.1
Metallic Fe	0.5 – 10

Fig.1 Slag

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4.3 Experimental work

Sieve analysis test is carried out to check the feasibility of adopting the slag aggregate in concrete mix design. The result of the sieve and the IS standard limit for 20mm aggregate.

4.3 Sieve analysis result

Size of sieve (mm)	Cumulative passing Fine Aggregate	Cumulative passing Slag
Pan	91	90.6
150 micron	70.59	82.56
300 micron	58.38	68.93
600 micron	55.34	47.27
1.18 mm	21.34	22.03
2.36 mm	0	0

4.3.1 Experiment

In this experiment the cube of size 150x150x150mmof M35 grade overcast and testing is done after 7, 14, and 28 days respectively to check the compressive strength.

Fig 2:-Cube made by slag and fine aggregate

4.4 Net quantity required for 1 cubic meter

	Cement	Fine aggregate	Coarse aggregate	W/c ratio	Slag
Mix 1	436.233 kg	645.625 kg	1099.308 kg	0.45	-
Mix 2	436.233 kg		1099.308 kg	0.45	645.625 kg

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Fig 3:- Mix design by slag

Fig 4:- Mix design by Fine aggregate

4.5 Results

Design	7 days	14 days	28 days
Mix 1 (Fine Aggregate)	22 MPa	26 MPa	28.5 MPa
Mix 2 (Slag)	23 MPa	29.5 MPa	34 MPa

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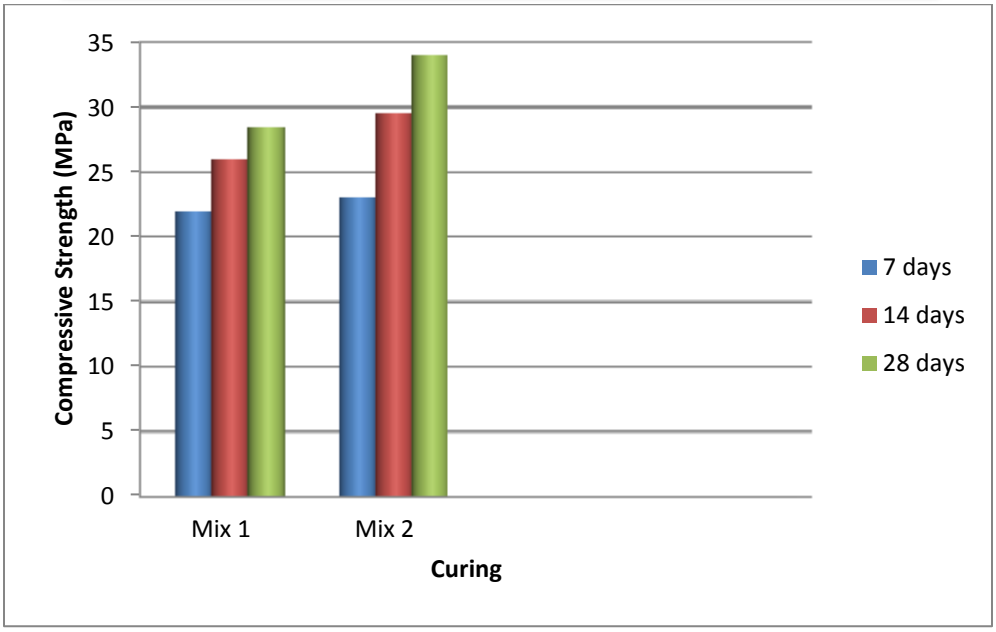

1. Bar Graph

5. CONCLUSION

- By doing this study we reduced the consumption of fine aggregate by fully replacement of Slag.
- The sieve analysis of steel slag indicates that it can be used as a replacement material of fine aggregate in the concrete mix.
- Mix design 2 (with steel slag) attains higher compressive strength on 7, 14, 28 Days respectively as compare to the concrete mix design 1 (with fine aggregate as sand).
- This study is not only useful for the use of the industrial solid waste products but also can helpful for the environmental aspect
- It should be noted that further research work is needed to ascertain the effect of waste industrial slag as a fine aggregate on the properties of concrete.

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