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Befitting of Natural fine aggregate with waste slag in concrete

Tushar Dhiman[1], Dileep Mishra[1], Naveen Thakur[2]

[1] B. Tech Scholar, Department of Civil Engineering, Bharat Institute of Technology, Meerut, India
[2] Assistant Professor, Department of Civil Engineering, Bharat Institute of Technology, Meerut, India

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Abstract -*In this paper waste industrial slag has been utilized in the concrete mix design to increase the compressive strength of concrete. The disposal of this type of industrial by product is an environmental issue. Scientific analysis has predefined their impact on the nature; to use the waste slag in constructive way is the challenging task. All experiments done on laboratory scale to study the effect of full replacement of fine aggregate by industrial waste slag on the various aspect such as strength and durability of concrete mix design. Here we substitute fine aggregate with the waste industrial slag. After replacement of fine aggregate by slag sieve analysis and mix design are performed and checking of compressive strength is done after 7, 14 and 28 days respectively. A promising result has been achieved after using slag in the concrete. This paper reports the result about the feasibilities study of waste industrial slag as a fine aggregate in concrete.*

***Key Words*: Slag ,Concrete, Fine aggregate, Physical Properties.**

1. INTRODUCTION

The extraction of the sand from the waterways enhancing the cost of sand and has increases financial visibilities of the construction industry .Civil Engineers have always been looking for an alternative for the use of more eco friendly and easily available material as a replacement to conventional constituents in the concrete. Concrete industries have always welcome to use of various industrial waste material as a replacement of those constituents. Slag is the waste product originated in steel industries. One ton of steel implies the production of 130-200 kg of slag, depending on the composition of the steel and on the steel production process. Slag appears as a granulated material containing large cluster, coarse and very fine particle. Due to heavy dependency on steel industries it is generating in such a huge quantity to create the environmental problem. For the better implementation it should be used in concrete construction to give a reasonable output. Presently the consumption of slag in India is mark-able up to 20 to 25%. Fine aggregate is a main constituent in the application of construction industries such as plastering, concreting. Due to the acceleration in the construction activities availability of the natural fine aggregates are depleted. In this study we examine the possibilities of using waste industrial slag as a replacement of the natural sand in the concrete.

2. Objective

Slag is the by-product of steel and iron manufacturing industry. These waste material are not useful and so is been dumped as a landfill as a vicinity of the industry. Unprocessed waste can result in environmental issues and consequently waste disposal become a major issue. Thus, the effective utilization of this material could bring about economy and will no longer be of environmental concern. The aim of this study to check the compressive strength and physical characteristics of concrete on the basis of slag to reduce the void space and utilized in the construction industries such that to minimized environmental problem.

3. Methodology

The experimental work deals with to check the compressive strength of the concrete mix design by the full replacement of the fine aggregate with waste industrial slag.

3.1Cement

The cement use for this experimental work is OPC 53 grade.

Table -1: Physical Characteristics of cement

Specific Gravity	3.15
Consistency	24%
Initial setting time	103 min
Final setting time	211 min

Table -2: Constituent Composition

Constituent	Composition (%)
CaO	40 – 52
SiO_2	10 – 19
FeO	10 - 40 (70 - 80% FeO, 20 - 30% Fe2O3)
MnO	5 – 8
MgO	5 – 10
Al_2O_3	1 – 3
P_2O_5	0.5 – 1
S	< 0.1
Metallic Fe	0.5 – 10

Fig -1: Slag

3.2Experimental 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.

Table -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 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

Table -4: Net quantity required for 1 cubic meter

	Cement	Fine aggregate	Coarse aggregate	W/c ratio	Slag
Mix 1	438.133 kg	648.302 kg	1103.866 kg	0.45	-
Mix 2	438.133 kg		1103.866 kg	0.45	648.302 kg

Fig -4: Mix design by slag

Fig -3: Mix design by Fine aggregate

Table -5: Results

Design	7 days	14 days	28 days
Mix 1 (Fine Aggregate)	20 MPa	24.40 MPa	27 MPa
Mix 2 (Slag)	20.92 MPa	27.89 MPa	32.25 MPa

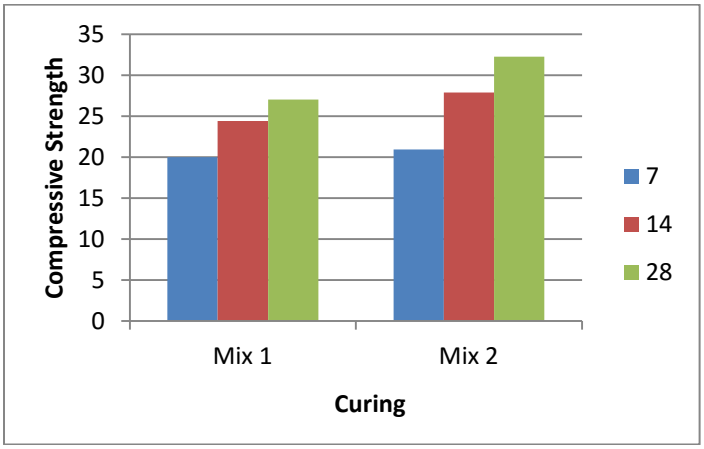

Chart -1: Result analysis

5 Conclusion

1. By doing this study we reduced the consumption of fine aggregate by full replacement of Slag.
2. Utilization of Industrial Waste and by product can contribute to sustainable development.
3. The sieve analysis of slag showed that it can be used as a replacement material of fine aggregate in the concrete.
4. Mix design 2 (slag) achieves higher compressive strength on 7,14,28 Days respectively.
5. This study is not only useful for the utilization of the industrial solid waste but also can helpful for the environmental aspect.
6. It should be noted that further research work is needed to explore the effect of waste industrial slag as a fine aggregate on the properties of concrete.

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