National Conference on
"Role of Engineers in Nation Building" organized by VIVA Institute of Technology, Mumbai
(6th and 7th March 2020)
International Journal of Engineering Research & Science (IJOER)
ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March-2020]

Experimental investigation on use of cupola slag in concrete.

Vishal Urade

Department of Civil Engineering, Viva institute of technology.
Email: Vishalurade10@gmail.com

***Abstract*—**Nowadays waste materials are utilized in the preparation of conventional concrete. In the present work the waste material considered is cupola slag which is by-product of cast iron manufacturing. The design mix for M20 and M25 grade concretes were arrived and the target strength was found to be 25.860 N/mm2 and 31.510 N/mm2 respectively. Cupola slag was used in concrete as partial replacements for fine and coarse aggregates (5%,10%,15%, 20%, 25%, 50% and 100%) to ascertain applicability in concrete. Since the disposal of cupola slag in open area causes environment pollution, it can be recycled for use in construction industry without producing any harm to human and environment. The maximum compressive strength attained was 34..878 N/mm2 and 38.432 N/mm2 at 15% for both M20 and M25 grades of concrete respectively at 28 days. Similarly the maximum split tensile strength attained was 3.286 N/mm2 and 3.789 N/mm2 for M20 and M25 grades at 15% and 10% respectively. The concrete with cupola slag as partial replacement for coarse aggregates gives less strength when compared to fine aggregates.

***Keywords*—Slag-cupola,Fine aggrgegate,Coarse aggregate, Sand,Compressive strength,Split tensile strength**

I. INTRODUCTION

Nowdays, development in India is mainly by implementation of infrastructure projects. Due to that construction projects are executed at very rapid rate. In the developing country like India, availability of natural resources is also an influencing factor apart from funding due to this rapid infrastructural growth it requires large amount of construction material like cement, aggregates, wood etc. R.C.C. structures are preferred over steel structures in India which requires larger quantity of concrete. Since availability of natural resources of concrete is limited as we get it from natural deposits at present, there is a need to develop a new material that can effectively replace with conventional without compromising with strength and durability properties of concrete.

In recent research, waste products like rick husk, saw dust, paper waste etc. has been used in concrete as partial replacements for fine and coarse aggregates. Olutoge et al. (1995) concluded that Palm kernel shell is light and therefore ideal for substitution as aggregate in the production of light weight concrete. Olanipekun et al. (2006) investigated the properties of coconut shells (CCS) and palm kernel shells (PKS) as coarse aggregates in concrete. Baricova et al. (2010) concluded that blast furnace and cupola furnace slag can be utilized in the concrete production. Ivanka Netinger et al. (2010) studied the basic characteristics of slag and analyzed the possibilities of the application of slag in road as sub surface materials. Ahmed Ebrahim et al. (2012) revealed that that the mechanical characteristics, and the resistance factors were improved by adding steel slag. Lewis (2012) discussed briefly the composition, properties, and uses of iron blast furnace slag and of steel slag and concluded that it can be used for structural fills, where very high stabilities are obtained. Based on the above literature review, in the present work cupola slag is used as partial replacements for fine and coarse aggregates in concrete in steps of 5 % up to 25%. Also study was extended for 50% and 100% replacements.

II. OBJECTIVE

i. To check the properties and strength of concrete without and with addition of cupola slag.

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III. MATERIAL AND METHOD

3.1 CEMENT

OPC 53 Grade i cement was used in this work with specific gravity of 3.03, standard consistency 26%, 42 and 240 minutes of initial and final setting time respectively, soundness of 2.25mm and compressive strength of 56.25 MPa at 28 days.

SAND

Sand obtained from Banas River, confirming to Zone-II, with fineness modulus of 2.31, specific gravity of 2.56, and water absorption of 3.05% was used in this work.

3.2 COARSE AGGREGATES

Coarse aggregates obtained from basalt rock were used with combination of grits in 60:40 ratios with following properties

SR.NO	PROPERTIES	AGGREGATE VALUE
1	Specific gravity	2.56
2	Water absorption	1.21%
3	Impact value	16%
4	Crushing value	21%

3.5 CUPOLA SLAG

Cupola slag procured from local distributor is used in this work after crushing and sieving operation.

IV.EXPERIMENTAL INVESTIGATION

Test performed:

1.Compressive Strength: This test is carried out on conventional concrete and Cupola slag concrete on 7 &28 days for M20 and M 25 grade of concrete.

2.Splite tensile test:- This test is carried out on conventional concrete and Cupola slag concrete on 7&28 days for M20 and M 25 grade of concrete.

V. CONCLUSION

The following conclusions were drawn from the experimental studies for M20 and M25 grades of concrete.

i. The maximum value of compressive strength obtained is 34.878 N/mm2 and 38.432 N/mm2 for M20 and M25 grades of concrete respectively when the fine aggregate is replaced by 15% cupola slag.

ii. The required strength of M20 concrete is achieved for 100% replacement in the case of M20 grade concrete and for 25% in the case of M25 grade concrete.

iii. The maximum value of compressive strength is 31.510 N/mm2 for M20 grade when coarse aggregates is replaced by 5% of cupola slag, but the required strength is achieved up to 20% replacement.

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iv.The maximum value of compressive strength is 25.860 N/mm2 for 5% replacement in the case of M25 grade concrete.

v. The maximum split tensile strength was achieved for 15% and 5% replacement of fine aggregates in the cases of M20 and M25 grades respectively. The split tensile strength gradually decreases when coarse aggregate is replaced by cupola slag in both the grades of concrete.

ACKNOWLEDGEMENTS

From the present study it is found that cupola slag when used as fine aggregate perform better than its use as coarse aggregate. The reason may be due to its mineralogical composition and size of crystals.

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