VIVA-TECH INTERNATIONAL JOURNAL FOR RESEARCH AND INNOVATION
ANNUAL RESEARCH JOURNAL
ISSN(ONLINE): 2581-7280

Experimental Study on High Strength Concrete using Weld Slag

Bhavesh Tandel[1], Priyanka Dandekar[2], Vishal Karale[3], Akshay Mistry[4]
[1]*(Civil Department, Viva Institute of Technology, India)*
[2]*(Civil Department, Viva Institute of Technology, India)*
[3]*(Civil Department, Viva Institute of Technology, India)*
[4]*(Civil Department, Viva Institute of Technology, India)*

Abstract: Welding slag is a form of slag, or vitreous material produced as a by-product of some arc welding processes, most specifically shielded metal arc welding , submerged arc welding, and flux-cored arc welding. Slag is formed when flux, the solid shielding material used in the welding process, melts in or on top of the weld zone. Slag is the solidified remaining flux after the weld area cools. This Weld slag can be used as a replacement of aggregates in concrete instead of disposing it and also without compromising properties of concrete.Research will be conducted on the fresh and hardened properties of concrete using5%, 10% and 15% of Weld slag as replacement of sand. A total of 12 concrete samples will be prepared including 3 Cement Concrete cubes and 9 Weld slag mix concrete cubes, then all concrete samples will be cured at 7 days to the design of target strength of 40 N/mm2 Before that we will prepare 12 cubes to get an optimum mix, a number of trail mixes will be completed using variable cement (binder),coarse aggregates, fine aggregates and water.

Keywords – Weld slag, Partial replacement, Cement, Compressive Strength, High Performance Concrete.

I. INTRODUCTION

Concrete is a mixture of sand and coarse aggregate combined together by a hardened paste of cement and water. The increased use of concrete is going to grow the demand for its ingredients' resources (cement, sand, and gravel). The high rate of concrete constituents is increasing rapidly and hence there is a requirement for an unconventional material that is low-cost and readily presented that will also give a similar or greater strength when used for concrete. Cement is one of the constituents of concrete which is costly and its production releases large amounts of CO2 during its manufacturing.

Weld slag as replacement of sand:- One ton of steel implies the production of 130-200 kg of slag, depending on the composition the steel and steel production process. Slag often appears as granulated materials containing large cluster, coarse and very fine particles. Serious environmental problems formerly unrestrained sand and gravel takenfrom river, steel slag contains high content of Cao as well as mgo. It exhibits poor hydraulic property due to its lack of tri-calcium silicates and amorphous sio2 content. Therefore, high replacement of Portland cement with the steel slag resulted in the decrease the mechanical strength development.

II. LITERATURE RIVEW

2.2 Review of Journal Papers:

2.2.1Mehta, P.K.,

Symposium Paper Publication (5 January 1995) Explains the durability of cement mortar in the presence of rice husk Ash (RHA). The strength and durability of mortar with different replacement levels (10%, 20% and 30%) of ordinary Portland cement (OPC) by the RHA is studied here. RHA was manufactured from an uncontrolled combustion process. The test samples were prepared with 2.73 FM river sand. The samples were stored in a controlled environment to test time. The results show that the addition of RHA has shown better results for 20% replacement level OPC 90 days. In the durability test all samples passed for 20 cycles except 25% replacement level of 30%.

When the rice husk ash is converted by uncontrolled combustion of generally from 3,000 to 4,500 C, the ignition has not been completed and the considerable amount of unburned carbon found in the resulting ash. The reactivity of the amorphous silica is directly proportional to the surface area of the ash. Some research papers discovers that not only the temperature, but time is also a factor of burning rice husks to produce effective. In the case of uncontrolled burning combustion especially heap, the burning time is totally dependent on the ambient environment say temperature, humidity and wind speed. Now limited research has been conducted again with the rice husk ash collected from uncontrolled combustion process.

2.2.2 Ramakrishnan S, Velrajkumar G, Ranjith S R.S. Publication (January 2014) This paper explains the behaviour of concrete for pavement replacing different percentages of ashes hush up by weight of cement for concrete quality control mixture M40. To study the effect of the rice hull ash (RHA) on the performance of various concrete parameters to produce an economic concrete for rigid pavements.An attempt was made to use the bending strength of concrete reaches in the design of the rigid floor which is greater than the resistance to bending about the necessary IRC: 58-2002. Test conducted to study the effect of rice husk ash (RHA) on the performance of different concrete parameters to produce an economic concrete for rigid pavements. The partial replacement of cement with RHA provides the equivalent flexural strength of concrete which is more important for concrete pavements.They conclude their paper: -
1.The compressive strength decreases with the increases in percentage of rice husk ash (RHA).
For 10% replacement, the reduction is very less when compare to 20%, and 30% replacement.
2.The flexural strength of the cement-RHA concrete very less reduction in 5% & 10% of replacement
3.The porosity test shown the void ratio is reduced up to 10% replacement, and voids increases in future increment of RHA.
4.The split tensile strength, impact strength also decreases with the increases in percentage of rice husk ash (RHA)

2.2.3 Dr. A.M. Pande and S.G. Makarande International Journal of Engineering Research and Applications (Jan-Feb 2013)
Detailed, Rice Husk Ash used in this work was done in the laboratory by burning the ball using a furnace Ferro cement, incineration with temperatures not exceeding 7000 c. The ash was milled using mill Los Angeles 180, 270 and 360 minutes, XRD analysis was conducted to determine the shape of silica powder produced RHA samples. RHA samples were analysed by electron microscope to show multilayer porous surface and micro-RHA. Other materials used in the concrete mix were Portland cement, coarse aggregate 20 mm maximum size, and sand mining 5mm maximum size as fine aggregate. The fineness modulus of coarse aggregate and fine aggregate were 2.43 and 4.61 respectively.Effect of adding RHA on the properties of concrete:The fresh concrete properties of all mixtures are given. The fall was in the order of (210-230 mm), bleeding was negligible for the control mixture. For concretes incorporating RHA, no bleeding or segregation was detected. The fresh density was within (2253-2347 kg / m3), the lowest density values were for mixing this is due to the low density of RHA that led to a reduction in the mass per unit volume. Concrete incorporating finer RHA resulted in heavy concrete matrixThe SP had to be content with increased finesse and RHA percentage, due to the high surface area of RHA thus increase the demand for water to maintain fluidity, Sp content increased to 2.00% for the mixture.He gave following results in his experiments:2.1% Strength achieved for M20 grade concrete with 12.5%, 25% & 37.5% RHA:The resistance to the average is considered more for 90 days and then less for 28 days and 7 days using 75-micron RHA. The average strength obtained is 12.5% CER compared to other proportions. One of recorded samples to reach 123.81% resistance to 90 days of curing compared to CCP. When RHA 150 microns isused, again reached the average strength is more for 90 days and there is less for28days and 7 days.

III. MATERIALS AND METHODOLOGY

3.1 Materials:

3.1.1 Cement:

For casting of all specimen tested in present investigation Ordinary Portland cement of 53 grades by confirming IS 12269(1987) is used. Cement is finally grounded powder having adhesive and cohesive property which is used as binding Material for ingredients of cement concrete. In this cement 53 grade is depending upon compressive strength at 28 days. Use of higher-grade cement offer many advantages for making strong concrete.

3.1.2 Coarse Aggregates: Max 20mm sized coarse aggregates were used. Two different sized coarse aggregates were procured from stone crushers in nearby locality, 20mm and 10mm sized coarse aggregates 60% and 40% respectively were used.

Volume 1, Issue 8 (2025)
PP 01-05

3.1.3 Fine Aggregate:

Aggregates are cheaper than cement and gives greater volume stability and durability to concrete. Basically, aggregates are used to provide bulk to the concrete they also reduce shrinkage. To increase is density of concrete aggregates of two or more sizes are used. Fine aggregates help in producing workability and uniformity in concrete mix. Fine aggregate was purchased which satisfied the required properties of Fine aggregate required for experimental work and the sand conforms to Zone III as per the specifications of IS 383: 1970.

3. 1.4 Weld Slag:

Weld slag is a solid form of by product and final waste product after completion of welding process. Through the slag is a waste product primarily consists of silicates and carbonates. since the weld slag is being a solid waste, it can be used in concrete making as a replacement to some extent. The WS was obtained from local fabrication industries, and they are used to replace fine aggregate partially in the production of concrete. The physical and chemical characteristics of the welding slag were taken by reference.

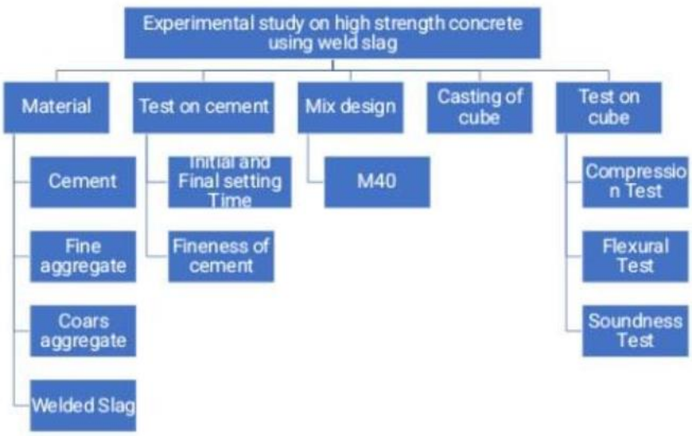
3.1.5 Water:

Fresh and clean water is used for casting and curing of specimen. Water is relatively free from organic matter, silt, oil, sugar, chloride and acidic material as per requirement of Indian Standards.

3.1.6 Admixture:

Naphthalene Based Superplasticizer is used as an admixture. This admixture is basically used to reduce water content and provide sufficient workability to concrete. Strength of concrete is also enhanced by the use of naphthalene-based superplasticizer. Specific Gravity = 1.25

3.2 Methodology:



3.3 Testing on Cubes:

3.3.1 Compressive Test:

Compressive Strength Test: Compression test was carried on concrete blocks of 70 x 70 x 70 mm size and 150 x 150 x 150 mm size. For measuring compressive strength of concrete blocks compression testing machine CTM was used.

IV. FIGURES AND TABLES (11 BOLD)

Figure captions appear below the figure, are flush left, and are in lower case letters. When referring to a figure in the body of the text, the abbreviation "Fig." is used. Figures should be numbered in the order they appear in the text.

Table captions appear centered above the table in upper and lower case letters. When referring to a table in the text, no abbreviation is used and "Table" is capitalized. (10)

V. CONCLUSION (11 BOLD)

A conclusion section must be included and should indicate clearly the advantages, limitations, and possible applications of the paper. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions. (10)

Acknowledgements (11 Bold)

The authors express their gratitude for the guidance and support of their guide, Prof. Akshay Mistry, and their friends for their support. They also thank VIVA INSTITUTE OF TECHNOLOGY for their assistance and for the opportunity to work on their project. They also express their gratitude to their principal Dr. Arun Kumar and head of civil engineering department Prof. Akshay Mistry for their support and for their invaluable guidance in completing the project.

REFERENCES (11 BOLD)

Journal Papers:

1) Mehta, P.K.,Symposium Paper Publication (5 January 1995)
2) Ramakrishnan S, Velrajkumar G, Ranjith SR.S. Publication (January 2014)
3) Aiswarya Sukumar Elson John (2014). Fibre addition and its effect on concrete strength of volume.1 in IJIRAE
4) Mustapha Abdulhadi (2014). A comparative study of basalt and polypropylene fibres reinforced concrete on compressive and tensile behaviour of volume 9 in IJETT.
5) Nirmal patel (2017). Evaluation of mechanical properties of concrete by using basalt fibre with silica fume”
6) Sai Charan, Murthy Gupta(2016). ”A comparitive study/2 on mechanical properties of basalt fibre reinforced concrete with partial replacement of cement with GGBS
7) Salahaldein Alsadey Muhsen Salem(2016). Influence of polypropylene fibre on strength of concrete of volume 5 in AJER.
8) K.Tamilarasan K.Sathes Kumar (2017) ”Strength and analysis of basalt fibre in concrete” of volume 10 in IJCTR
9) R.Gandhimati, Nidheesh P.V. (January 2013) “Use of furnace slag and welding slag as replacement for sand in concrete.”
10) A. Ananthi, J. Karthikeyan. (2015) “Properties of Industrial slag as Fine Aggregate in concrete”
11) R. Bavithra, G. Suruthi, 0, Experimental Study on Behaviour of Concrete by using Welding Slag as A Partial Replacement of Sand, International Journal Of Engineering Research & Technology (Ijert) Confcall – 2018 (Volume 06 – Issue 14).
12) Ramesh, S.T., Gandhimathi, R., Nidheesh, P.V. et al. Use of furnace slag and welding slag as replacement for sand in concrete. Int J Energy Environ Eng 4, 3 (2013).
13) Jose Ravindra Raj.B, Sankar.R, Santhiyaa Jenifer.J, "Experimental Study on Durability Enhancement of Weld Slag and Recycled Aggregate Based Geopolymer Concrete" (March 2020).
14) Muhammad Auwal Ibrahim, Esar Ahmad (Ph.D.), Shashivendra Dulawat ji, "EXPLORING THE POTENTIAL OF WELD SLAG AS AGGREGATE REPLACEMENT IN CONCRETE FOR SUSTAINABLE CONSTRUCTION: A REVIEW PAPER" (August 2024).
15) Sunidhi Rajhans, Ajay Kumar Singh, "Study on Partial Replacement of Coarse Aggregate with Steel Slag", (February 2022).
16) Manoranjan. S A, Rashika. R, Parthiban. S, "Experimental Study on Replacement of Coarse Aggregate by Weld Slag in Concrete" (2016).
17) Dr. M. Kannan, Abibalaa B, Fathima Vavu S, "Behaviour of Concrete by using Welding Slagas a Partial Replacement of Sand", (2019).
18) N. Bhuvaneswari, Dr. K. Nirmalkumar, "Experimental Study on the Mechanical Strength Properties of Steel Slag in Concrete and Weld Slag in Concrete", (February 2019).
19) Mallesh M and Nidarshana D.P: Effect of Partial Replacement of Cement By GGBS and Fine Aggregate By Steel Slag on Strength of Concrete, IJSART - Volume 3 Issue 8 AUGUST 2017 (ISSN ONLINE): 2395-1052.
20) IS 456:2000 (Reaffirmed 2005)PLAIN AND REINFORCED CONCRETE - CODE OF PRACTICE (Fourth Revision).

21) Jagdeep Singh, Varinder Singh, "Experimental Studies on Concrete Containing Welding Waste Slag", (December 2018).

22) Thi-Thuy-Hang Nguyen, Duc-Hung Phan 1, Hong-Ha Mai 2 and Duy-Liem Nguyen, "Investigation on Compressive Characteristics of Steel-Slag Concrete", (April 2020).

23) Md Tajamul Khan and Mohammed Faisaluddin: AN INVESTIGATION ON COMBINED REPLACEMENT OF CEMENT BY GGBS AND NATURAL SAND BY SLAG SAND ON STRENGTH OF CONCRETE, Khaja Banda Nawaz College Of Engineering, ISSN: 2277-9655 (I2OR), Publication Impact Factor: 3.785, Khan", 4.(6): June, 2015.

24) Chalamcharla Venu Gopal. SureshA and V. Gokul Nath Partial Replacement of Cement with GGBS in Concrete, ISSN: 2454-132X Impact factor: 4.295 (Volume3, Issues) Avail-able online at www.ijariit.com.2017.

25) Dr. A.M. Pande and S.G. Makarande International Journal of Engineering Research and Applications (Jan-Feb 2013)