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"STUDY AND ANALYSIS OF LOW-COST HOUSING MATERIAL FOR RURAL DEVELOPMENT"

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ABSTRACT

This study examines the strength characteristics of concrete using Wheat Husk Ash (WHA) as a partial replacement for Ordinary Portland Cement (OPC). WHA, an agricultural waste product, was used at replacement levels of 0%, 5%, 10%, 15%, and 20% by weight of cement. Concrete specimens were prepared and tested for compressive strength following Indian Standards (IS).

The results showed that lower WHA replacement levels provided similar or slightly improved strength due to filler and pozzolanic effects, while higher replacement levels reduced compressive strength. The study concludes that WHA can be used as a sustainable and cost-effective supplementary cementitious material at moderate replacement levels. Its use can reduce cement consumption, agricultural waste, and carbon emissions, supporting eco-friendly construction practices. Further studies on durability and long-term performance are recommended.

Key Words: *Wheat Husk Ash (WHA), Ordinary Portland Cement (OPC), sustainable concrete, compressive strength, ecofriendly construction, pozzolanic activity, and partial cement replacement.*

I. Introduction

The rapid growth of urbanization and infrastructure has increased cement consumption, leading to higher carbon dioxide emissions and environmental concerns. To promote sustainable construction, researchers are exploring the use of Supplementary Cementitious Materials (SCMs) as partial replacements for Ordinary Portland Cement (OPC). Among various agricultural wastes, Wheat Husk Ash (WHA) has shown potential due to its high silica content and pozzolanic properties. This study investigates the use of WHA as a partial replacement for OPC in concrete. Different replacement levels ranging from 0% to 20% were tested to evaluate their effect on compressive strength and overall performance. The research aims to promote ecofriendly construction by reducing cement usage, utilizing agricultural waste, and lowering environmental pollution.

II. Literature Review

Usman et al. [1] studied the use of amorphous silica ash (ASA) from rice husk as a partial replacement of OPC in mortar. Replacement levels of 2.5%, 5%, 7.5%, and 10% were tested. The results showed that compressive and flexural strength increased with curing time, while 5% replacement gave the best overall strength performance.

Himabindu et al. [2] investigated the replacement of cement with ceramic powder and silica fume in cement mortar. Mortar cubes were tested at 7, 14, and 28 days, and compressive strength results showed the effectiveness of alternative materials in reducing cement usage.

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Mangi et al. [3] studied Sugarcane Bagasse Ash (SCBA) as a partial cement replacement in M15 and M20 concrete. Replacement levels of 0%, 5%, and 10% were used. The study found that 5% SCBA improved compressive strength by about 12% and enhanced workability.

Arivazhagan G. et al. [4] investigated bagasse ash replacement at 10%, 15%, and 20% in concrete. The results showed improved compressive and flexural strength, with optimum performance at 15% replacement.
Negim et al. [5] examined mortar containing highvolume fly ash (FA) as cement replacement. The study sh owed that mortar properties improved up to 30% FA replacement, while higher percentages reduced strength. Addition of polymer latexes further enhanced the mechanical properties.

Wankhede and Fulari [6] studied fly ash concrete and concluded that 10% and 20% replacement improved compressive strength, whereas 30% replacement reduced it. Slump loss increased with higher fly ash content.
Soni and Saini [7] evaluated fly ash concrete at elevated temperatures. Results showed that up to 30% fly ash replacement provided satisfactory compressive and tensile strength, while higher replacements reduced performance.

Asma Abd E.H. et al. [8] investigated SCBA as a cement replacement material in concrete. The study revealed that compressive strength improved up to 20% replacement, with maximum strength achieved at 5% SCBA.

Shanmugapriya and Uma [9] studied silica fume in high-strength concrete and found that 7.5% replacement gave optimum results, increasing compressive, tensile, and flexural strength significantly.

Pradhan and Dutta [10] examined concrete containing silica fume and observed that 20% replacement produced optimum compressive strength and improved pore structure.

Roy and Sil [11] studied silica fume concrete and concluded that 10% replacement increased compressive, tensile, and flexural strength while improving durability and early strength development.

Amudhavalli and Mathew [12] carried out experiments on M35 concrete with silica fume replacement from 0% to 20%. The study showed that optimum compressive and flexural strength occurred between 10–15% replacement.

Srinivasan R. et al. [13] investigated bagasse ash replacement levels of 0%, 5%, 15%, and 25% in concrete. Results showed that increasing bagasse ash content improved compressive, tensile, and flexural strength.

Aigbodion V.S. et al. [14] studied the chemical and physical properties of bagasse ash using X-ray diffraction and scanning electron microscopy to evaluate its suitability for industrial applications.

Bargaheiser and Butalia [15] reviewed the benefits of high-volume fly ash concrete in reducing corrosion damage. They concluded that fly ash improves durability, reduces CO_2 emissions, and enhances the service life of concrete structures.

III. METHEDOLOGY

Collection of Materials: Ordinary Portland Cement (OPC), fine aggregate, coarse aggregate, and Wheat Husk Ash (WHA) were collected from reliable sources.
Testing of Materials: Basic tests were carried out to determine properties such as specific gravity, fineness, moisture content, and particle size of cement, WHA, and aggregates.
Preparation of Concrete Mix: Concrete was prepared using a mix ratio of 1:1.5:3. WHA was used as a partial replacement of cement at 0%, 5%, 10%, 15%, and 20%.
Casting of Specimens: Concrete cubes were cast in standard moulds and compacted properly to remove air voids.
Curing of Specimens: The specimens were cured in water and tested after 7, 14, and 28 days.
Strength Testing: Compressive strength tests were conducted on all concrete specimens according to IS standards.
Analysis of Results: The test results were compared to identify the optimum percentage of WHA that provides good strength and workability.

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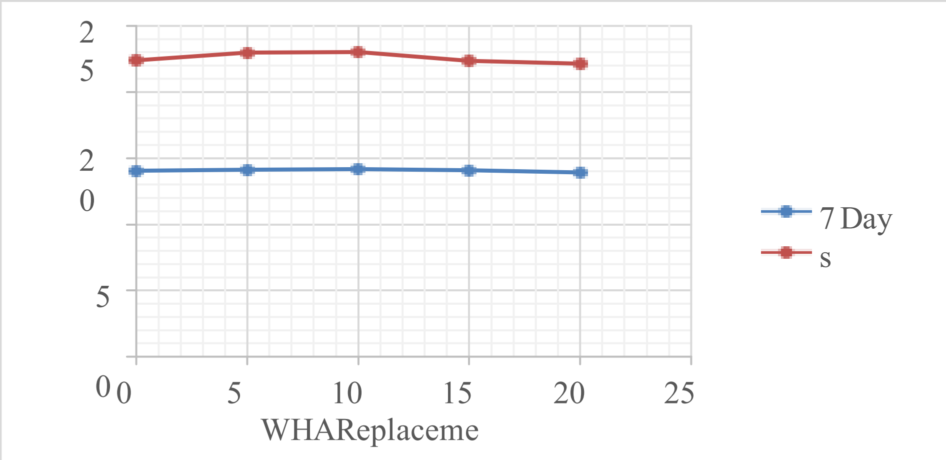
IV. RESULT ANALYSIS & DISCUSSION

ForM20-grade cement concrete:

Cement:PortlandPozzolanaCement (PPC) or OrdinaryPortlandCement (OPC)used should conformto IS1489:2015standards, ensuring adequate settingtime,strength development, and durability.

placement (%)	7 Days (N/mm^2)	28Days (N/mm^2)
0%	14.05	22.40
5%	14.12	22.98
10%	14.18	23.02
15%	14.09	22.37
20%	13.92	22.15



Fine Aggregate (F.A.): Fine aggregates must comply with IS 383:2016 Zone II grading specifications, ensuring uniform particle size distribution, proper shape, and cleanliness. This guarantees workability, compaction, and strength of the mortar.

Coarse Aggregate (C.A.): Normal River sand is locally available in the market from Damodar River and confirming to Zone II as per BIS (IS 383:1970) and Coarse Aggregatewereused inthisexperiment. CoarseAggregatesused as60% byweight of 20 mm size below& 40% of 10 mm size of total aggregate may be taken.

Wheat Husk Ash (WHA): WHA, as a pozzolanic supplementary material, should be free from organic matter and other deleterious impurities. It must meet local material standards for mortar incorporation, providing enhanced compressive strength, reduced porosity, andimproved durability whenused asa partialcement replacement.

Water: Water used in the mix must be potable and free from impurities to prevent adverse chemical reactions that could reduce hydration efficiency and mortar strength.

V. CONCLUSION

1. Wheat Husk Ash (WHA) can be effectively used as a partial replacement for Ordinary Portland Cement (OPC) in M20-grade concrete.
2. Among all replacement levels, 10% WHA showed the best compressive strength at 7 and 28 days.

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3. WHA improves the concrete microstructure by reducing cracks and increasing bonding strength.
4. The use of WHA decreases porosity and water permeability, which improves the durability of concrete.
5. Fine WHA particles fill voids in concrete, making the mix denser and stronger.
6. Replacing cement with WHA reduces cement consumption, lowers carbon emissions, and supports sustainable construction practices.
7. WHA is also economical and suitable for practical construction works such as masonry and plastering.
8. Overall, the study concludes that 10% WHA replacement provides good strength, durability, cost savings, and environmental benefits in concrete production.

REFERENCES

[1] Usman ,Aliyu; Ibrahim, Muhammad B.; Bala, Nura (2018) ―Effect of amorphous silica ash used as a partial replacement for cement on the compressive and flexural strengths cement mortar‖,IOP Conference Series: Earth and Environmental Science pp.1-8

[2] Himabindu, Ch.,Geethasri, Ch.;Hari, N.(2018),‖Comparative study on strength properties of cement mortar by partial replacement of cement with ceramic powder and silica fume‖ AIP Conference Proceedings, Volume 1966, Issue 1, id.020023.

[3] Mangi, Sajjad Ali; Jamaluddin, N.; Ibrahim, M. H. Wan; Halid Abdullah, Abd; Awal, A. S. M. Abdul; Sohu, Samiullah; Ali, Nizakat, (2017),‖Utilization of sugarcane bagasse ash in concrete as partial replacement of cement‖, IOP Conference Series: Materials Science and Engineering, Volu me 271, Issue 1, pp. 012001

[4] Arivazhagan.G,V.Ganesan(2015) Experimental studies on strength of RC concrete bypartially replacing cement with sugar cane bagasse ash, Int. J. of Innovative Research inScience, Engineering and Technology 4 pp.2228–2232

[5] Negim, El-Sayed; Kozhamzharova, Latipa; Gulzhakhan, Yeligbayeva; Khatib, Jamal; Bekbayeva, Lyazzat; Williams, Craig,(2014)‖Effect of copolymer latexes on physicomechanical properties of mortar containing high volume fly ash as a replacement material of cement‖HindawiArticle ID 670710.

[6] Wankhede P.R., Fulhari V.A. (2014), ―Effect of Fly ash on Properties of Con-crete‖, International journal ofemerging technology and advanced engineer-ing, Volume 4, Issue 7, pp. 284-289.

[7] Soni D.K., Saini J. (2014), ―Mechanical Properties of High Volume Fly Ash (HVFA) and Concrete Subjected to Evaluated 1200C Temperature‖, Interna-tional Journal of Civil Engineering Research, Vol. 5, Issue 3, pp. 241-248.

[8] Asma Abd E H, Shafiq N, Nuruddin M F and Memon FA(2014) Compressive strength and micro structure of sugar cane bagasse ash concrete, Research J. of Applied Sciences,Engineering and Technology 7 pp. 2569– 2577

[9] Shanmugapriya T.and Uma R.N. (2013),―Experimental Investigation on Silica Fume as partial Replacement of Cement in High Performance Con-crete‖, The International Journal Of Engineering And Science (IJES), Vol. 2, Is-sue 5, pp. 40-45.

[10] Pradhan D. and Dutta D. (2013), ―Effects of Silica Fume in Conventional Con-crete‖, International Journal of Engineering Research and Applications, Vol. 3, Issue 5, pp. 1307-1310.

[11] Replacement of cement by silica fume on hardened Roy D.K.S. and Sil A. (2012), ―Effect of partial concrete‖, International journal of emerging technology and advanced engineering, Vol. 2, Issue 8, pp. 472-475.

[12] Amudhavalli N.K. and Mathew J. (2012), ―Effect of silica fume on strength and durability parameters of concrete‖, International journal of engineering sciences & emerging technologies, Vol. 3, Issue 1, pp. 28-35.

ISSN : 2455-9679
SJIF Impact Factor : 6.190

[13] Srinivasan R and Sathiya K (2010) Experimental study on bagasse ash in concrete, Int. J. forServ. Learn. in Engineering 5 pp. 60–66

[14] Aigbodion V S, Hassan S B, Ause T and Nyior G B (2010) Potential utilization of solid waste(bagasse ash), J. of Minerals and Materials Characterization and Engineering 9 67–77 .

[15] Bargaheiser K.and Butalia T.S. (2007),―Prevention of Corrosion in Concrete Using Fly Ash Concrete Mixes‖, Concrete Technology Forum, Dallas, Texas, pp. 1-16.