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The Effect of Rice Husk on the properties of concrete By Using Steel Tube

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Abstract

Rice husk ash is a byproduct of the rice milling process and has been widely studied for its potential as a supplementary cementation material due to its polarization properties. The study aims to assess how the partially addition of RHA affects the compressive strength of concrete and axial behavior of concrete-filled steel tubular (CFST) columns.

The experimental investigation involves the effect of rice husk ash (RHA) on the properties of concrete encased in steel tubes, focusing on the compressive strength and axial deformation of M40 grade concrete mixed with ordinary Portland cement (OPC) 43. Concrete cubes and steel tube specimens were prepared with varying RHA replacement levels (0%, 5%, 10%, 15%) to determine the optimal substitution rate. Compression tests on the cubes and axial deformation tests on the steel tubes were conducted to assess the mechanical performance. From the entire experimental work & studies it is concluded that that a 10% replacement of OPC with RHA significantly enhances the compressive strength and reduces the axial deformation of the steel tube-concrete composite, suggesting that RHA can be a beneficial additive in improving the structural integrity and durability of concrete structures.

Keywords Rice husk ash (RHA) , Concrete-filled steel tube (CFST) , Compressive strength

Introduction:

Concrete, as one of the most widely used construction materials globally, plays a critical role in infrastructure development. However, traditional concrete production processes contribute to significant environmental impacts, including high carbon emissions and depletion of natural resources. In response to these challenges, there is a growing interest in developing sustainable alternatives that reduce the environmental footprint of concrete construction. Rice husk ash (RHA) has emerged as a promising supplementary material in concrete production due to its abundance polarization properties, and potential to enhance various properties of concrete. RHA is obtained from the combustion of rice husks, an agricultural waste product generated during rice milling. Through controlled burning processes, rice husks can be transformed into ash, which contains high levels of silica and other reactive compounds suitable for use in concrete mixtures.

The utilization of RHA in concrete offers several potential benefits, including improved strength, durability, and reduced environmental impact. Studies have shown that incorporating RHA into concrete mixtures can enhance the polarization reactivity, leading to increased strength development and reduced permeability.

In parallel, the use of steel tubes as reinforcement in concrete construction has gained attention for its potential to enhance structural performance and durability. Steel tubes offer advantages such as high strength, ductility, and ease of installation, making them suitable for various applications in concrete structures. By integrating steel tubes into concrete elements, such as columns, beams, and slabs, it is possible to improve load-bearing capacity, resistance to seismic forces, and overall structural integrity.

So in this paper we study the replacement of cement by RHA. We replace cement with the weight percentage that is 0%to 15%and we examine the compressive strength of the cube and deformation concrete filled steel tube. We are focus on the heavy structure so we made a design mix of M-40 and use OPC cement grade 43 then conduct the test that is initial setting time and final setting time and normal consistency test on cement and aggregate impact test and silt content test on the aggregate.

Literature Review

Several studies have highlighted the potential benefits of incorporating RHA into concrete mixtures. RHA contains high levels of amorphous silica, which reacts with calcium hydroxide during hydration to form additional calcium silicate hydrates (C-S-H), contributing to the development of strength and durability in concrete [1]. Additionally, RHA has been shown to improve the work-ability of concrete mixtures and reduce the risk of thermal cracking during curing [2]. Furthermore, RHA can mitigate the adverse effects of ASR by reducing the availability of alkali and reactive silica in concrete mixtures, thereby enhancing resistance to deleterious expansion and cracking [3].

In the realm of steel tube reinforcement, research has demonstrated its efficacy in enhancing the mechanical properties and structural performance of concrete elements. Steel tubes provide confinement to concrete, resulting in increased ductility and energy absorption capacity, particularly in columns subjected to axial and lateral loading [4]. Moreover, the use of steel tubes as form-work for concrete columns enables efficient construction processes and facilitates the integration of additional reinforcement, such as longitudinal bars and stirrups, to enhance the load-carrying capacity and seismic resilience of structural elements [5]. The abstracts and conclusions of various researchers in their literature are studied and presented in the present paper are:

Endale, S.A.; Taffese, W.Z.;Vo, D.-H.; Yehualaw, M.D. 2023, This study conducted an extensive literature review on rice husk ash (RHA), with a focus
on its particle properties and their effects on the fresh, mechanical, and durability
properties of concrete when used as a partial cement replacement

Rohit chaurasia, Sheela Malik ,Ravinder 2022, This paper summarizes the results of concrete experiments in which Plain Portland cement (PPC) was replaced with rice husk ash (RHA). Concrete specimens were made with 5%, 10%, 15%, and 20% RHA as a weight replacement for cement. Compressive strength is measured on
150 mm cubes for 7 and 28 days and the results are analysed.

Muleya, F., Muwila, N., Tembo, Ch. K., & Lungu , A. (2021), This experimental studyaimed to investigate the integrity of concrete produced in Zambia using rice husk ash(RHA) to partially replace cement. The primary goal was to carry out a cost–benefit analysis on the use of RHA in concrete. RHA was used to partially replace cement with ratios of 10 %, 20 % and 30 %. The study further concluded that the RHA based concrete was more cost-efficient in structures that were close to areas of rice production due to reduced RHA transportation costs.

Khawaja Adeel Tariq, Muhammad,Sohaib andMirza Awais Baig 2021, This research work is related to the study of effects on properties of concrete having rice
husk ash as cementitious supplementary materials. Total four mixes of concrete were
done with varying percentages of rice husk as 6%, 12% and 18%.The concrete's flexural strength with rice husk ash increases at the beginning and at the later age (i.e., 28 days) similar to control mix; however, variation in compressive and splitting tensile strength is negligible.

Ankit Gautam, Rahul Batra, Nishant Singh (2019), In this study the ordinary Portland cement is replaced in different proportion with RHA to obtain concrete with comparable and satisfactory strength and properties to that of normal concrete. The proportions of replacement chosen are at 2.5% interval starting from 5 % to 15 % and the casted concrete were tested under compression at different ages and results obtained are compared with normal concrete of same grad and it is
concluded that the results are comparable

Er. Parasram Meena, Er. Nandeshwar Lata, Dr. Bharat Nagar 2018, This paper presents a detailed experimental study on Compressive strength, split tensile strength, flexural strength at age of 7 and 28 day. Test results indicate that use of rice husk
ash in concrete has improved the performance of concrete in strength.

Paramveer Singh, Tarunbir Singh and Gurpreet Singh 2016, The research was carried out to study the mechanical properties of concrete by partial replacement of cement with rice husk ash. The M40 grade of concrete was used to examine compressive strength, split tensile strength and flexure strength after 7 days and 28 days of curing. The cement is to be replaced (by weight) with rice husk ash by 5%, 10%, 15% and 20% to get optimized results . Optimum content for compressive strength and flexurestrength is 10% replacement with cement with results .

Mr. Amitkumar . Gupta, Dr. Abhay S. Wayal 2015, This paper
presents an overview of the work carried out on the use of RHA as partial replacement of cement in concrete and its effect on workability, compressive strength and chloride permeability of concrete.

Makarand Suresh Kulkarni , Paresh GovindMirgal, Prajyot Prakash Bodhale, S.N. Tande 2014 , The main objective of this work is to study the suitability of the rice husk ash as a pozzolanic material for cement replacement in concrete. But it is concluded that mix M2 (M0+20%RHA) is the best combination among all mixes,
which gives max, tensile, flexure & compression strength over normal concrete

Dr. A.M. Pande and S.G.Makarande 2013, This report evaluates how different contents of rice husk ash (RHA) added to concrete may influence its physical and mechanical properties. Samples with dimensions of 15 X 15 cm were tested, with 12.5, 25, & 37.5% of RHA, replacing in mass the cement. Results indicate that pozzolanic reactions of ricehusk ash in the matrix composite were low in early ages, but by aging the specimens to 90 days, considerable effect have been seen in strength.

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