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An Examination of the Use of Rice Husk Ash in Place of Cement in Concrete

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Abstract

The work done by numerous researchers to replace cement with Rice husk ash has been investigated in this study, and their results have been collated. The whole construction industry is looking for an acceptable and effective waste product (rice husk, fly ash, crumb rubber, etc.) that may significantly cut cement usage and, as a result, building costs. Rice husk ash might be a green supplemental material with minor to large-scale uses. It can be used to waterproof a surface. It's also due to the additive, which helps the concrete resist chemical penetration. Various compressive strength, durability, flexural strength, and workability test findings have also been described in the literature. Cement concrete is an important component of low-cost construction materials. Rice husk is one of the waste items that may be utilised to make low-cost, lightweight concrete.

Keywords*: - Concrete, Composite material, Rice husk ash, Cement*

INTRODUCTION

Concrete is widely employed as a composite material in all sorts of building projects across the world. Cement, aggregate, water, and admixtures make up this man-made commodity. It's utilised more than any other man-made substance on the planet. Concrete is manufactured in the range of 10-15 billion tonnes per year. It is rising as a result of the global expansion of infrastructure development and construction operations. Concrete manufacture consumes a considerable

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quantity of natural materials, sand, and water.

As a result, academics have focused on employing waste materials as viable alternatives in the building sector, particularly in concrete building, in order to reduce this. In reality, the use of waste materials in concrete (such as fly ash, Rice husk ash, coconut shell, crumb rubber, glass, coconut coir, slag, plastics, and so on) is one of the primary research priorities in order to achieve the objective of sustainable building. Concrete production in building operations using traditional aggregate such as granite depletes natural stone resources and has an adverse impact on the environment, resulting in an ecological imbalance. As a result, using other waste materials in concrete manufacturing helps to conserve the environment and makes concrete a long-lasting and environmentally beneficial building material. As a result, cement can be substituted with rice husk to solve such issues. It solves the problem of waste disposal, minimises pollution, and enhances the mechanical qualities of concrete.

Rice Husk Ash

One factor that influences the amount of silica supplied is the performance of rice husk ash in concrete. Rice husk ash, a pozzolanic reactive ingredient, can be utilised in high-performance concrete to increase the surface area of the transition zone between the microscopic structures of cement paste and aggregate.

HISTORY

The hard protective coverings of rice grains that are removed from the grains during the milling process are known as rice husks. Rice husk is a waste product that is widely accessible in all rice-producing nations and contains 30–50 percent organic carbon. The husks are removed from the raw grain during a conventional milling operation, revealing complete brown rice, which can then be further milled to remove the bran layer, yielding white rice. The world's current rice output is projected to reach 700 million tonnes. Rice husk makes up around 20% of the total weight of rice and is made up of the following ingredients: cellulose (50%), lignin (25–30%), silica (15–20%), and moisture (10–15%). Rice husk has a low bulk density, ranging from 90 to 150 kg/m^3.

Rice husk ash (RHA) will be found in rice-growing regions across the world, including China, India, and the Far East. RHA is a byproduct of rice husk

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incineration. During the burning of rice husk, the majority of the evaporable components are lost slowly, and the silicates are the main leftovers. The content of the rice husks, the burning temperature, and the burning period all influence the ash's properties. For every 100 kilogramme of husks burned in a boiler, for example, around 25 kilogramme of RHA is produced. Rice husk is used as a fuel for parboiling paddy in rice mills in certain locations, while it is also field-burned as a local fuel in others. However, in such instances, rice husk combustion is incomplete, and partial combustion leads to air pollution. Rice husks having a calorific value of roughly half that of coal, and assuming that the husks have roughly 8%–10% moisture content and no bran, the calorific value is calculated to be 15 MJ/kg. The volatile organic matter in the rice husk, which consists of cellulose and lignin, is removed under controlled burning circumstances. Amorphous silica with a (microporous) cellular structure dominates the remaining ash. The specific surface area of RHA, as measured by the Brunauer–Emmett–Teller (BET) nitrogen adsorption technique, can range from 20 to as high as 270 m^2/g, whereas that of silica fume, for example, is in the range of 18–23 m^2/g.

Rice Husk Ash Applications

1. Cement and building industries use it.
2. Used in the steel industry.
3. Rice husk ash as a source of silica
4. Rice husk is used to make high-quality steel because of its excellent insulating qualities, such as low heat conductivity, high melting point, low bulk density, and high porosity.
5. It's also utilised as a layer over molten metal and in the ladle, acting as an excellent insulator and preventing metal from cooling too quickly.
6. To meet the growing need for building materials, blended cement is made from rice husk ash. Rice husk ash might be a pozzolana with a high reactivity. Rice husk ash is mostly utilised as a silica fume substitute or as an additive in the production of low-cost concrete blocks.
7. Rice husk ash has a high silica concentration, making silica extraction cost effective. Silica is utilised as a reinforcing ingredient in the rubber industry, as well as in cosmetics, toothpaste, and the food industry as an

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anti-caking agent. Fine amorphous silica is in great demand for high-performance cement and concrete, which is used in bridges, marine settings, nuclear power plants, and other applications. Rice Husk Ash (RHA)-derived silica aerogels are used in super thermal insulators, catalyst supports, and dielectric materials. It has the potential to be a cost-effective raw material for the manufacturing of silicates and silica.

LITERATURE REVIEW

In addition, the use of rice husk ash as cement by substituting it with cement is examined for determining the strength qualities of concrete. In this work, the abstracts and findings of many researchers in their literature are examined and presented.

S. S. Vivek investigated the performance of Self Compacting Concrete (SCC) by substituting silica fume for cement (SF). Slump flow and T500 tests were used to evaluate the performance and qualities of new concrete, as well as the hardened qualities of concrete using the compression test. There were four SCC mixes created by replacing cement with varying amounts of silica fume ranging from 5% to 20% with a 5% increase. The compressive strength of concrete was tested at seven distinct ages: seven, fourteen, and twenty-eight days. SCC received a dose of super-plasticizer (Conplast SP430) that was optimised. It was discovered that replacing 10% of the cement with 10% silica fume and a water to powder (w/p) ratio of 0.8 improved the fresh characteristics and compressive strength of admixed concrete. Slump flow and T50test results were improved when 15% silica fume was substituted for cement with a w/p ratio of 0.8. Whereas replacing cement with 5% silica fume with a w/p ratio of 0.8 improved compressive strength at 7 and 14 days but failed to improve flow characteristics, and replacing cement with 10% silica fume with a w/p ratio of 0.8 improved fresh concrete performance and compressive strength at 28 days.

The coarse aggregate was largely replaced by coconut shell and fly-ash in Amarnath Yerramala Ramachandrudu C's experimental investigation. The percentages of coconut shell replacement were 10%, 15%, and 20%, respectively, and the percentages of coconut shell replacement by fly-ash were 5%, 25%. In his research, he found that as the amount of CS substitution increased, workability dropped. CS concretes had lower

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compressive and split tensile strengths than control concrete.

The influence of silica fumes on the characteristics of self-compacting lightweight concrete (SCLC) containing perlite and leca was investigated by Yaghuob Mohammadi. Different substances have been used to replace silica fume for this purpose. All total cementitious ingredients (cement + silica fume) in this investigation were kept at 450 kg/m3. Slum flow, L-box, U-box, V-funnel, and J-ring were all put to the test. Mixtures lacking silica fume were found to be unsatisfactory in this study. The silica fume showed satisfactory results in all of the experiments. However, substantial results were obtained for the SCLC combination with 15% silica fume. The compressive strength of samples was improved by adding silica fume.

Makarand Suresh Kulkarni investigated the impact of rice husk ash on concrete properties. The major goal of this research is to see if rice husk ash may be used as a pozzolanic material to replace cement in concrete. The addition of rice husk ash in concrete, on the other hand, is believed to increase the concrete's strength qualities. Also, an attempt has been made to construct concrete utilising rice husk ash as a source material for partial replacement of cement, which meets the different structural features of concrete, such as compressive and flexural strength. Based on the results of all of the experiments and research, it has been determined that mix M2 (M0+20 percent RHA) is the optimum combination of all the mixes for maximum tensile, flexure, and compression strength above regular concrete.

S.Ramesh investigated the behaviour of rice husk ash in cement concrete. In this investigation, RHA was used to replace 20% of the cement by weight. Workability, weight comparison, compressive strength, tensile and flexural strength of concrete are among the experimental activities and research undertaken. Experimental studies were used to report on the qualities, advantages, and applications of RHAC in this research. It is inferred from the investigations and test findings on fresh and hardened concrete that it will improve workability over standard concrete. The usage of rice husk ash will improve the corrosion resistance and durability of concrete while also reducing construction pollution.

The use of rice husk ash in concrete was investigated by P.Padma Rao. In this study, a feasibility study of using Rice

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Husk Ash as an additive to substitute Cement with fly ash (Portland Pozzolana Cement) in Concrete is conducted, as well as an attempt to analyse concrete strength characteristics. Five distinct replacement levels, namely 5%, 7.5 percent, 10%, 12.5 percent, and 15%, were chosen for the study in terms of replacement technique. This study takes into account a wide range of curing times, including 3 days, 7 days, 28 days, and 56 days. Before beginning the results, all ingredients must be warmed to room temperature, ideally 270+ 30 C. There is a progressive rise in compressive strength from 3 days to 7 days for all cement replacement levels of Rice husk ash. However, from 7 to 28 days, compressive strength increases significantly, followed by a progressive increase from 28 to 56 days.

From a rice paddy milling company, Ahmadi reported the development of mechanical characteristics of self-compacting concrete and regular concrete mixes with rice-husk ash (RHA) up to 180 days. For the self-compacting and normal concrete examples, two different RHA replacement percentages of 10% and 20% were employed, as well as two different water/cementitious material ratios (0.40 and 0.35). The findings were compared to those of RHA-free self-compacting concrete. In comparison to regular concrete, SCC mixes have stronger compressive and flexural strength as well as a lower modulus of elasticity. Replacement of up to 20% of cement in the matrix with rice husk ash resulted in a decrease in cement consumption and expenditures, as well as an improvement in concrete quality over a 60-day period. After 60 days, RHA is claimed to have a positive influence on mechanical characteristics.

According to Krishna Murthy N, Because avoids are removed, self-compacting concrete has high attributes, productivity, and working conditions. Designed for self-compacting concrete mix designs with 29 percent coarse aggregate, cement substitution with Metakaolin and class F fly ash, combinations of both, and regulated SCC mix with 0.36 water/cement ratio and 388 liters/m3 cement paste volume. Then they created Metakaolin and class F fly ash, which were both user-friendly for the SCC design combination and were seen to be the most promising building for revolutionary structural modifications.

CONCLUSIONS

There is a considerable change in the strength parameters of concrete such as

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compressive strength, flexural strength, and split tensile strength, according to a review of previous studies linked to the partial substitution of cement with rice husk ash. To determine the outcome, these tests were carried out in various grades of concrete. According on the preceding literature assessments, the ideal proportion of rice husk ash by weight of cement ranges from 10% to 30%. Concrete strength has improved up to these % replacements in terms of Compressive Strength, Flexural Strength, and Tensile Strength. Previous research has also shown that using rice husk ash as a concrete substitute improves the concrete's durability.

The use of rice husk ash has a positive impact on compressive strength and is environmentally friendly.

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