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Effect of Partial Replacement of Rice Husk and Fly Ash in the Concrete

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ABSTRACT

Rice husk burning and coal-fired power plant emissions cause a slew of environmental issues. The recycling of rice husk ash (RHA) and fly ash (FA) from power plants as reactive materials for the production of sustainable (green) concrete is discussed in this study. The goal of this study is to see how effective RHA and FA replacement ratios are on the fresh and hardened properties of concrete mixtures. For each recyclable material, the replacement ratio from the cement content was 30%. (10% RHA and 20% FA). The drop of freshly poured concrete was determined. The compressive strength and bond strength of hardened concrete were also studied as mechanical properties. The compressive strength was measured at 7 and 28 days. The water permeability of cured concrete was tested as a physical property. When compared to the control combination, test showed that the RHA and FA improved mechanical and physical qualities. The cementitious concentration of 450 kg m3 produced better results than the other materials used. The replacement ratio of 30 percent cement by 10% RHA and 20% fly ash, in particular, resulted in enhanced mechanical characteristics. The water permeability of all combinations reduced as the cementitious concentration increased due to the decrease in air content. As the cementitious content reduced, the water permeability loss ratios improved.

Keywords: RHA,FA, Compressive Strength

1.INTRODUCTION

Concrete is a heterogeneous mixture of cement, water, and particles, as is widely known. Admixtures are substances that can be mixed into concrete to improve specific qualities. Concrete is a mixture of paste and particles in its most basic form. To obtain concrete with the necessary properties, various ingredients such as fly ash, rice husk, and additive are added. The quality of the paste determines the character of the concrete. The proportioning, mixing, and compacting of the elements are crucial to generating a strong, long-lasting concrete. Construction work was largely done with mudstone from the industries throughout the ancient times. Artificial fibres are often employed nowadays to improve the mechanical qualities of concrete. Fly ash is a by-product of burned coal from power plants, while rice husk ash is a by-product of burned rice husk at a higher temperature from paper plants. Efforts are being made all over the world to use natural waste and by-products as supplementary cementing materials in cement concrete to improve its qualities. Such materials include rice husk ash (RHA) and fly ash (FA) made with steel fibre. RHA is a byproduct of the paddy farming industry. husk of rice Ash is a highly reactive pozzolanic substance made by burning rice husk under regulated conditions. Finely split FA is produced by coal-fired power plants. Pozzolanic properties of fly ash are similar to those of naturally occurring pozzolanic material. There have been a growing number of studies published in recent years on the usage and exploitation of industrial, agricultural, and thermoelectric plant leftovers in concrete manufacturing. Fly ash, condensed silica fume, blast-furnace slag, and rice husk ash, among other pozzolanic ingredients, have played a significant role in the creation of high-performance concrete. The consumption of mineral additive by cement has increased in the late twentieth century, and partial cement replacement is used in concrete When industrial by-products are employed as a partial replacement for energy-intensive Portland cement, significant energy and cost savings can be realised. The prospect of employing rice husk ash in the manufacturing of structural concrete is one of the most important leftovers and by products for India. India is the world's second-largest rice paddy-growing country. The technical advantages of structural concrete including rice husk ash, as well as the social benefits associated with a reduction in the amount of ash disposal problems in the environment, have sped up study into the material's potential. Agricultural waste was disposed of in huge quantities in most tropical countries, particularly in Asia, in countries such as India, Thailand, the Philippines, and Malaysia. If waste is not properly disposed of, it will cause social and environmental problems. One approach of dealing with agricultural waste is to recycle the materials that have been discarded. Using rice husk ash with fly ash to make a composite material that can be utilized in building. If not properly disposed of, rice husk ash is dangerous to the environment. This research report looks at the impact of replacing 30% of cement with 20% FA and 10% RHA on the behaviour of concrete.

2.LITERATURE REVIEW

The literature on the potential uses of rice husk as a suitable aggregate for concrete has been studied and the results are being shown below.

(Persson 2001)reported on the mechanical properties of self-compacting concrete, such as strength, creep, elastic modulus, and shrinkage, as well as the corresponding parameters of standard compacting concrete (NCC). There were eight different proportions of sealed or air-cured specimens in the study. The water binder ratio (w/b) employed in this experiment ranges from 0.24 to 0.80. SCC made up half of the mixes, while NCC made up the rest. In the creep studies, the time interval at which the concrete mix was loaded varied between 2 and 90 days. The results showed that the elastic modulus, creep, and shrinkage of SCC were not significantly different from those of NCC.

(Zareei et al. 2017)studied that from a rice paddy milling sector, reported the development of mechanical properties 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 results were compared to those of RHA-free self-compacting concrete. In comparison to regular concrete, SCC mixes have higher 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 reduction in cement consumption and expenditures, as well as an improvement in concrete quality over a 60-day period.

(Prabu, Rambharath, and Vivek 2020)study looked at how well self-compacting concrete (SCC) performed when cement was replaced with varied amounts of silica fume (SF). Slump flow test, T500 test, and compression test were used to assess the performance and qualities of fresh concrete. There were four SCC mixes created by replacing cement with varying percentages of silica fume ranging from 5% to 20% with a 5% increment. The compressive strength of concrete was tested at seven distinct ages: seven, fourteen, and twenty-eight days. Superplasticizer (Conplast SP430) was added in an optimal dosage for SCC. 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. While 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, replacing cement with 10% silica fume with a w/p ratio of 0.8 improved fresh concrete performance and compressive strength at 28 days.

(MohaMMadi et al. 2015)studied that the influence of silica fumes on the characteristics of self-compacting lightweight concrete (SCLC) with perlite and leca was investigated. 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 tests were performed. Mixtures lacking silica fume were found to be unsatisfactory in this study. All of the experiments that included silica fume yielded acceptable results. However, significant results were obtained for the SCLC combination with 15% silica fume. The compressive strength of the samples was improved by adding silica fume.

3.METHODOLOGY

The study comprises the mix-design of M25 grade concrete with 30 % replacement of cement with 10% rice husk ash and 20% fly ash. Initially, Rice husk is burned which is afterward converted into Rice Husk Ash. After the mix-design as per (Bureau of Indian Standards 2019)for the concrete of grade M-25. The proportion of first trial is 1:1.319 :2.67 representing the ratio of cement, sand and coarse aggregates.

Table 1 Mix-Proportions of the materials for 3 Cubes

MATERIALS	QUANTITY
Cement	3.67 kg
Fine agg.	4.84 kg
Coarse agg.	9.83 kg
W/C Ratio	0.48

Fig. 1 Before and After Casting of Concrete

4. MATERIAL USED

Rice Husk Ash used was obtained from Rice Mill located in Bhatagaon, Raipur, Chhattisgarh, India. The Specific gravity of rice husk ash is 2.14 and bulk density is 0.781 g/cc RHA, produced after burning of Rice husk (RH) has high reactivity and pozzolanic property. (Bureau of Indian Standards (BIS) 2000), recommends use of RHA in concrete but does not specify quantities. Chemical compositions of RHA are affected due to burning process and temperature. Silica content in the ash increases with higher the burning temperature.

Fig.2 Rice Husk

Fly Ash used was obtained from Sejbahar Brick Kiln, Raipur, Chhattisgarh, India. Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of power generation facilities. Depending upon the source and makeup of the coal being burned, the components of the fly ash produced vary considerably, but all fly ash includes substantial amounts of silica (silicon dioxide, SiO_2) (both amorphous and crystalline) and lime (calcium oxide, (CaO). Fly ash is commonly used to supplement Portland cement in concrete production, where it can bring both technological and economic benefits, and is increasingly finding use in synthesis of geopolymers and zeolites.

Fig.3 Fly Ash

5.EXPERIMENTAL RESULT

Here are the results of various test performed on the cube -

5.1 Report for workability test

Fresh concrete was tested using slump cone test to find the workability of control concrete and concrete of combination of RHA and FA with partial replacement of cement.

AT W/C = 0.48

Table 2 Slump Value

Concrete	Slump Value	Degree of Workability	Remark
M-25	90 mm	Medium	Plastic
30% replaced cement concrete	110 mm	High	Plastic

Percentage workability increased = 6.66 %

Fig.4 Slump Cone Test

5.2 Report for Compressive Strength Test

For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M25 grade of concrete. The mould was filled with different proportions of cement, Rice Husk Ash and Fly Ash. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demolded and were transferred to curing tank wherein they were allowed to cure for 7 and 28 days. After 7and 28days curing, these cubes were tested on digital compression testing machine as per I.S. 516-1959. The failure load was noted.

Fig.5 Compressive Test

Table 3 Compressive Strength

Concrete Block	Compressive Strength in N/mm² in 7 days	Compressive Strength in N/mm² in 28 Days
M-25 Concrete	16.25	25
30%Replaced Cement	27.11	30.66

6.CONCLUSION

Based on experiments and test results on fresh & hardened concrete the following conclusions are drawn: ***Improvement in Fresh Concrete Properties:*** Due to addition of rice Husk ash, concrete becomes cohesive and more plastic and thus permits easier placing and finishing of concrete. It also increases workability of concrete. The bulk density of RHA concrete is reducing with increase in RHA content. ***Compressive Strength:*** Due to addition of RHA it is observed that early strength gain is slightly more with addition of 10%, RHA in normal concrete at 7 days. In 28 days, tests result it is found that with addition of 10% RHA in normal concrete strength is slightly more than of normal concrete. RHA is also use for manufacturing load bearing blocks bricks tiles in low cost. As the Rice Husk Ash is waste material, it reduces the cost of construction. It helps in reducing the pollution in environment.

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