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Comparative Study on Performance of Rice Husk Ash and Pond Ash in Concrete

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ABSTRACT: Nowadays, concrete is the most widely utilized material in the sector. Concrete consumption is skyrocketing as the building sector expands at a rapid pace. This experimental study aims to compare rice husk ash with pond ash in concrete. RHA is a pozzolanic substance made by burning rice hulls, with a silica concentration of around 85-90%. Thermal power facilities create PA during the burning of pulverized coal. According to the assessment, RHA and PA can be utilized as an alternating cement and sand mixture. The percentages of RHA and PA in concrete vary from 0% to 25%, respectively. Compression tests are performed on cubes measuring 150mm×150mm×150mm. The cube has three curing periods: seven days, fourteen days, and 28 days. The aforementioned study investigated the workability and compressive strength of concrete with different percentages of RHA and PA.

KEYWORDS: Rice husk ash (RHA), Pond ash (PA), Fine aggregate, Compressive strength

I. INTRODUCTION

Concrete is an important and commonly used material in the building sector. Its need continues to increase, with a heavy reliance on cement, fine aggregate, and coarse aggregate. Cement and sand are in particularly high demand, with river and lake sand being the favored option. However, demand for this type of sand exceeds availability, forcing the use of alternate ingredients to achieve higher concrete strength. India is the world's second-largest producer of rice, and rice hulls are generated as trash during the milling process. When this agricultural waste is burnt and disposed openly, it endangers the ecosystem. Using rice husk ash as a replacement for sand or cement in concrete can help to reduce pollution and waste. Similarly, pond ash, a byproduct of thermal power plants, has pozzolanic qualities appropriate for concrete manufacture.

We conducted comparative research on rice husk ash and pond ash replacements in concrete at various proportions, including 0%, 5%, 10%, 15%, and 20% sand replacement. We identified the best replacement material for increasing concrete strength by conducting compressive load tests on concrete cubes. To determine the best viable option, this study takes into account both economic and environmental issues.

Advantages of RHA-
The qualities of concrete, such as impermeability, workability, strength and corrosion of steel reinforcement, can all be enhanced by substituting rice husk ash for cement while creating concrete.

Advantages of PA-
1. Generally used to provide economical concrete.
2. Effective waste management.
3. Reduce the cost of construction.
4. Improved workability of concrete.
5. Improved compressive strength of concrete.
6. Reduce the heat of hydration.

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Figure 1: Rice husk ash

Figure 2: Pond ash

II. RELATED WORK

In this paper, the influence of rice husk ash as a replacement for cement by different percentages was discussed. It was seen that the compressive strength of the concrete improved by using RHA as a partial replacement for cement. They concluded that 10% replacement of cement with RHA shows improvement in compressive strength [1]. The effect of the partial replacement of cement by rice husk ash, waste of limestone powder and wood fibre was investigated. The results show that the compressive strength of the sample increased when RHA content increased compared to others [2]. It was reported that the compressive strength of concrete made by using different proportions of RHA first increased up to 10%, after which it decreased. The optimum percentage of cement replacement with RHA was reported to be 7.5% for both compressive and split tensile strength [3].

They have researched the replacement of cement with RHA and plastic fibre. Experimental Result shows that the replacement of 5% & 10% RHA with 1% & 2% plastic fibres enhances the compressive strength and split tensile strength of concrete [4]. In this study, cement is replaced by three different percentages of RHA to investigate the compressive strength of concrete. From the result, it is found that compressive strength is increased by up to 15% RHA content [5]. In this paper, he has considered the compressive, flexure and split tensile strength of concrete. He has replaced pond ash partially for sand and got higher flexural and split tensile strength up to 20% replacement of pond ash for sand [6]. He studied that fly ash and pond ash are obtained as by-products from thermal power plants and conducted this replaced concrete will give higher compressive strength to normal concrete with OPC of 53 grade[7]. The objective of this paper is to achieve eco-friendly and economical high-strength concrete. Three parameters of hardened concrete are considered: compressive, flexural, and split tensile strength. From this study, he concluded that in areas like Goa, Kerala, and Mumbai, where pond ash is easily available, the partial replacement of sand by pond ash is highly useful and reduces environmental issues [8].

III. METHODOLOGY

I. MATERIALS

a. Cement: The cement used in the experimental work is Ordinary Portland Cement of 53 grade. Specific Gravity is 3.15.
b. Fine Aggregate: Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work. In this experimental work, washed sand is used as fine aggregate. Specific Gravity is 2.65.
c. Coarse Aggregate: The coarse aggregate used in the experimental work 20mm maximum size aggregate. Specific Gravity is 2.7.
d. Rice Husk Ash (RHA): Rice husk ash used in the present experimental study was obtained from Koppal Plant Karnataka, India.
e. Pond Ash (PA): Pond ash is obtained from NTPC, Tanda, Ambedkar Nagar, Uttar Pradesh, India.
f. Admixture: In this experimental work Complast SP430SRV water-reducing admixture is used.
g. Water: Clean potable water available in the laboratory satisfying the requirements of IS 456:2000 is used for concrete mix.

In this present study partial replacement of sand was done by using rice husk ash and pond ash with varying percentages of 0%, 5%, 10%, 15% and 20% in different concrete. The grade of concrete is M20. The required material was weighed and mixed with a concrete drum mixer. The concrete was filled into moulds in layers, each layer was compacted. After the top layer had been compacted, the surface of the concrete was finished level with the top of the

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mould, using a trowel. After 24 hours, test specimens are removed from the mould and marked for later identification. The specimens were stored in water at a temperature of 27°C for 7 days, 14 days and 28 days until the time of test. After that, the test was conducted on those specimens.

IV. RESULTS AND DISCUSSION

Test results of concrete cube specimens for M20 grade with RHA:

1. Workability of Concrete

Table 1. Results of workability of concrete with RHA

Mix	Percentage of RHA	Slump Value (mm)
Mix-1	0%	95
Mix-2	5%	85
Mix-3	10%	80
Mix-4	15%	75
Mix-5	20%	65

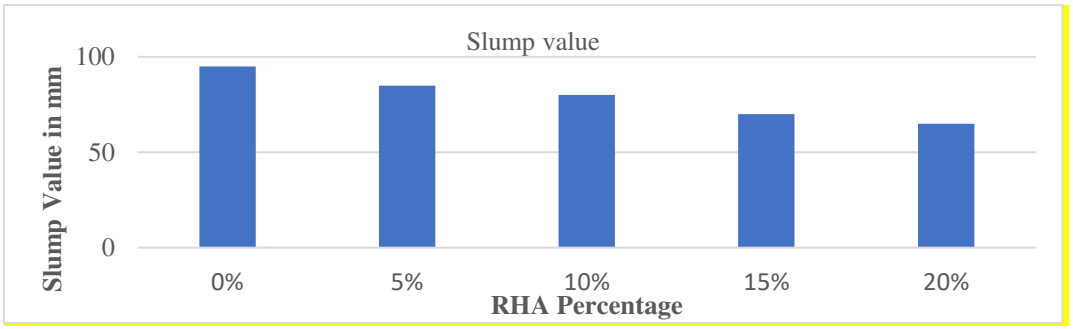

Figure 2: Workability of concrete with RHA

2. Compressive Strength Test

Table 2. Results of compressive test with RHA

Curing Days	Normal Concrete	5%	10%	15%	20%
7	13.80	14.88	14.22	12.81	12.22
14	18.66	19.33	18.88	17.40	14.49
28	21.64	24.66	20.63	18.44	16.07

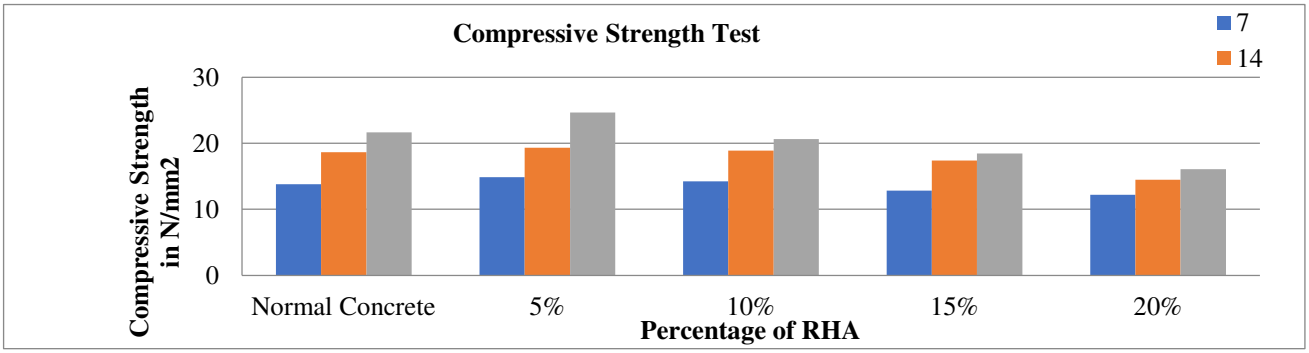

Figure 3: Compressive strength of concrete for varying percentage of RHA

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Test results of concrete cube specimens for M20 grade with PA:

3. Workability of Concrete

Table 3. Results of workability of concrete with PA

Mix	Percentage of PA	Slump Value (mm)
Mix-1	0%	65
Mix-2	5%	45
Mix-3	10%	20
Mix-4	15%	15
Mix-5	20%	15

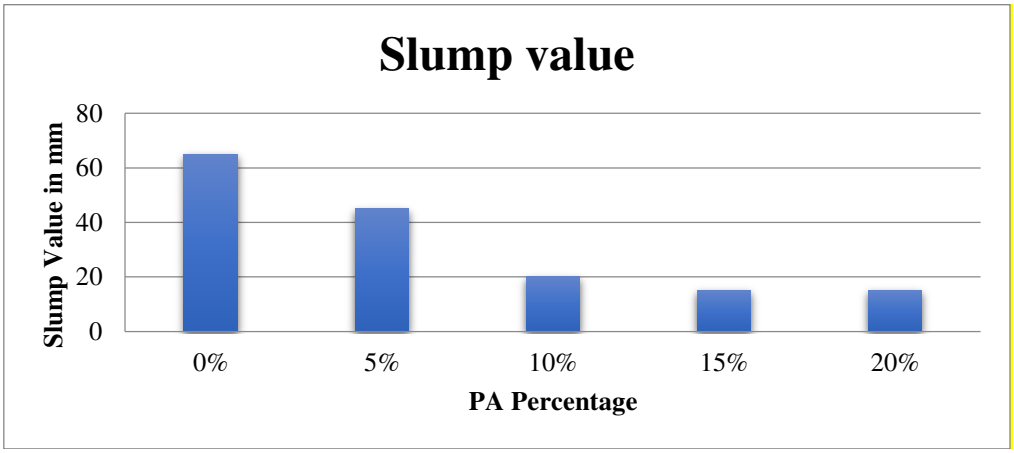

Figure 4: Workability of concrete with PA

4. Compressive Strength Test

Table 4. Results of compressive test with PA

Curing Days	Normal Concrete	5%	10%	15%	20%
7	19.1	22.5	21.3	20.6	19.7
14	20.6	19.3	29	27.9	26.8
28	31.2	36.6	39.7	42.3	43.4

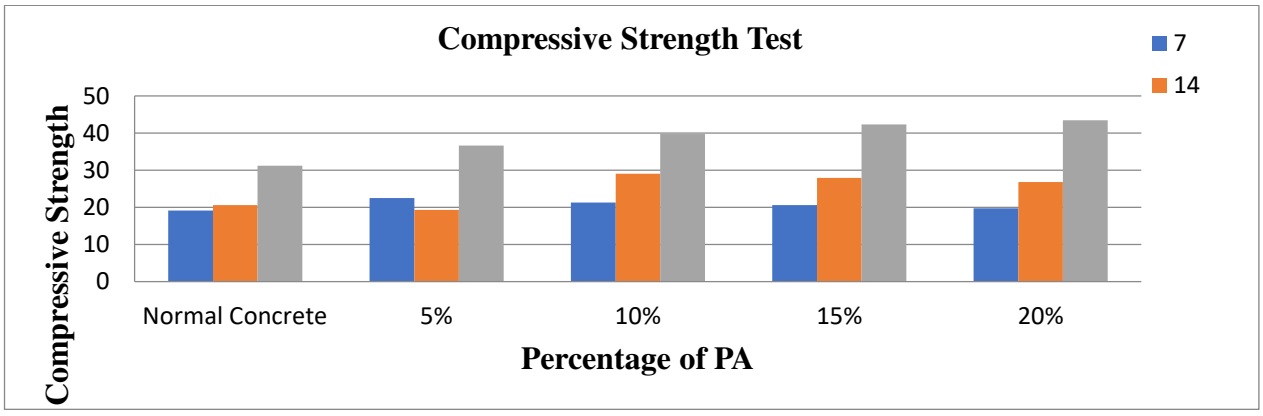

Figure 5: Compressive strength of concrete for varying percentage of PA

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V. CONCLUSION

Based on the observation of tests in concrete using rice husk ash (RHA) and pond ash (PA) as partial replacements for fine aggregate, several conclusions can be drawn. When RHA is used as a partial replacement, the workability of concrete decreases as the RHA content increases. However, the workability remains within the desired range of 75-100 mm. The maximum compressive strength achieved after 28 days is 24.66 MPa with a 5% replacement of sand by RHA. In the case of pond ash, the workability of concrete also decreases with increasing PA content, necessitating the use of a plasticizer. The maximum compressive strength obtained after 28 days is 43.5 MPa with a 20% replacement of sand by PA. These results indicate that replacing sand with pond ash results in higher strength compared to using rice husk ash. Up to 20% replacement of sand with pond ash significantly enhances strength, and the use of pond ash in concrete can also reduce environmental pollution, construction costs, and disposal problems.

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