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# The Study of Mechanical Properties of High Strength Polypropylene Fibre Reinforced Concrete using RICE HUSK ASH

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***Abstract*— Rice husk is an agro-waste material and by burring it, rice husk ash is obtained which is highly pozzolanic in nature. RHA and fibres are used in this study to enhance properties of concrete. This study was conducted to investigate the strength and properties of rice husk ash concrete reinforced with polypropylene fibre. The properties included are the materials characteristics and compressive strength. For this, an experimental program was planned in which ten concrete mixes were prepared. OPC was partially replaced by RHA at 5%, 15% and 25% with addition of fibres at 0% and 0.5% by weight of binder. The water/binder (w/b) ratio was kept constant at 0.38. To determine compressive strength, for each concrete mix, 6 cubes of size 150 x 150 x 150 mm were cast for testing at 7, 28 and 56 days. The results have been presented in the form of figures and tables. For compressive strength, the addition of RHA in concrete mix was found to increase the compressive strength at 5% and 15% replacement as compared to control mix whereas further addition of RHA at 25% decreases the compressive strength and addition of fibres increases compressive strength at 0.5% fibre content.**

***Keywords*: Rice husk ash, polypropylene fiber, compressive strength, Workability**

## I. INTRODUCTION

Rice husk is an agricultural residue which accounts for 20% of the 649.7 million tons of rice produced annually worldwide. The produced partially burnt husk from the milling 000000 32……..00.by utilizing this material as a supplementary cementing material. The chemical composition of rice husk is found to vary from one sample to another due to the differences in the type of paddy, crop year, climate and geographical conditions. Burning the husk under controlled temperature below 800 °C can produce ash with silica mainly in amorphous form.

## II. SCOPE OF WORK

The work presented in this paper reports an investigation on the behavior of concrete with rice husk ash and polypropylene fibre .The physical and chemical properties of RHA were first investigated and compared to the ordinary Portland cement (OPC). Mixture proportioning was performed to produce high workability concrete with target strength of 30 MPa for the control mixture.

## III. EXPERIMENTAL WORK

The Experimental program consisted of batching six mixes containing 0%, 0.5% and 1.0% volume fractions of fibres and a plain control mix.

## IV. MATERIALS

***Cement***

Ordinary Portland Cement (OPC) from a single lot was used throughout the course of the investigation. The physical properties of the cement as determined from various tests conforming to Indian Standard ARE: 1489-1991 are listed in Table 3.1. All the tests were carried out as per recommendations of IS: 4031-1988. Cement was carefully stored to prevent deterioration in its properties due to contact with the moisture.

Table 1: Physical and Mechanical Properties of Ordinary Portland cement

| Sr. No. | Properties | Observations |
|---|---|---|
| 1 | Fineness (90 micron IS Sieve) | 4 percent |
| 2 | Initial setting time | 65 minutes |
| 3 | Final setting time | 400 minutes |
| 4 | Standard consistency | 35 percent |
| 5 | 28-days compressive strength | 46 MPa |

**Coarse aggregates and fine aggregates**

As for the aggregates, crushed stone aggregates with maximum size 12.5 mm and locally available river sand was used. As can be seen from the gradation of the aggregates presented in Table 2, the maximum aggregate size was 12.5 mm. Both the coarse and fine aggregate had a specific gravity of 2.72 and 2.65, and water absorptions of 0.87% and 0.60%, respectively.

Table 2: Grading of Coarse and Fine Aggregates

| Oxide composition(% by mass) | OPC | RHA |
|---|---|---|
| $SiO_2$ | 20.99 | 88.32 |
| $Al_2O_3$ | 6.19 | .46 |
| $Fe_2O_3$ | 3.86 | .67 |
| CaO | 65.96 | .67 |

 

| | | |
|---|---|---|
| MgO | .22 | .44 |
| $Na_2O_3$ | .17 | .12 |
| $K_2O$ | .60 | 2.91 |

Table 5 shows the compressive strength behavior of concrete mix after 7, 28 and 56 days

| | | |
|---|---|---|
| LOI | 1.73 | 5.81 |
| Specific gravity | 2.94 | 2.11 |

**Rice Husk Ash**

Rice husk ash used was taken from laboratory which was procured from Andhra Pradesh. Rice husk ash was of grey colour and light in weight. Specific gravity of RHA was 1.96.

Table3- chemical and Physical properties of OPC and RHA

Rice husk ash,(b) burnt RHA, (c)RHA after grinding

| S.NO. | Sieve size | Fine (% passing) | Coarse (% passing) |
|---|---|---|---|
| 1 | 20mm | 100 | 100 |
| 2 | 12.5mm | 100 | 97.833 |
| 3 | 10mm | 100 | 44.163 |
| 4 | 4.75mm | 99.6 | 2.893 |
| 5 | 2.36mm | 96.8 | - |
| 6 | 1.18mm | 73.1 | - |
| 7 | 600µ | 50.1 | - |
| 8 | 300µ | 18.3 | - |
| 9 | 150µ | 4.2 | - |
| 10 | Pan | Zone II | - |

**Chemical admixture**

In order to maintain the high workability of the concrete mixtures Glenium SKY777. Glenium SKY777 is based on second generation polycarboxylic ether polymers and supplied as a light brown liquidinstantly dispersible in water. Glenium SKY777 complies with IS: 9103:1999 and EN934-2 T11.1/11.2. Glenium SKY777 conforms to ASTM-C-494 Type 'F' and Type 'G'depending on the dosages used. The dosage of SP was different for different concretemixes to obtain constant slump value of 100 + 10 mm. Super-plasticizer was added intoconcrete mix after 50 to 70% of the mixing water has been added. Dosage of SP wasvaried from 0.3 - 0.7 % by weight of binder

**Fibres**

Polypropylene fibres have been used in the concrete, but these may reduce flow ability and passing ability. Trials are therefore needed to establish the optimum type, length and quantity to give all the required properties to both the fresh and hardened concrete. Fibres can be used to improve the stability of concrete as these help prevent settlement and cracking due to plastic shrinkage of the concrete. Polypropylene fibres are used to minimize the minor cracks. Their length and quantity is selected depending on the maximum size of aggregate and on structural requirements. If they are used as a substitute for normal reinforcement, the risk of blockage is no longer applicable but it should be emphasized that using concrete in structures With normal reinforcement significantly increases the risk of blockage. Polypropylene fibres of 12mm in length in the range of 0.5%

**Test Procedure:**

An experimental program was planned to investigate strength p of concrete containing rice husk ash as partial replacement of cement and polypropylene Fibres. The basic properties of concrete constituent materials, concrete mix details along with method of casting and curing, workability of concrete, details of tests performed on hardened concrete are presented. The mixes were designated as M1, M2, M3, M4, M5, M6, M7, M8, M9 and M10. To achieve the objective of investigation the lab experiments were carried out. This experiment is divided into following stages-

- Physical characteristics of material used
- Mix Design
- Casting and curing of tests specimens
- Testing the hardened properties of concrete mixes

Mixture proportioning was carried out according to the current Indian mix design method. The water to binder ratio was kept constant as 0.38, the superplasticizer content had to be adjusted to maintain a slump of for all mixtures. The total mixing time was 5 minutes then the samples were casted and left for 24 hours. After that, samples were demoulded and placed in the curing tank until the testing time at the age of 7, 28, and 56 days.

**Table 4: Different proportions of cement and RHA for concrete mix design**

| S. No | Mix designation | | Compressive Strength (MPa) | | |
|---|---|---|---|---|---|
| | | | 7 days | 28 days | 56 days |
| 1 | M1 | 100% OPC | 26.88 | 38.22 | 41.78 |
| 2 | M2 | 95% OPC+5%RHA | 27.94 | 40.78 | 43.2 |
| 3 | M3 | 85%OPC+15%RHA | 28.41 | 41.08 | 44.4 |
| 4 | M4 | 75%OPC+25%RHA | 26.94 | 38.43 | 42.1 |
| 5 | M5 | 95% OPC+5%RHA+0.5% Fibre | 29.52 | 44.45 | 47.89 |
| 6 | M6 | 85%OPC+15%RHA+0.5% Fibre | 30.62 | 46.88 | 49.7 |
| 7 | M7 | 75%OPC+25%RHA+0.5% Fibre | 28.69 | 42.20 | 46.7 |

 

| w/c ratio= .38 | | mix ratio 1:1.93:2.18 | |
|---|---|---|---|
| S.no | %age of cement | RHA % | %age of polypropylene |
| Mix 1 | 100% | 0% | - |
| Mix 2 | 95% | 5% | - |
| Mix 3 | 85% | 15% | - |
| Mix 4 | 75% | 25% | - |
| Mix 5 | 95% | 5% | .5% |
| Mix 6 | 95% | 15% | .5% |
| Mix 7 | 85% | 25% | .5% |

Table 5: Compressive strength of concrete

Compressive strength of concrete mixes at different replacement by RHA with 0% fibres at 7, 28 and 56 days and compare it with mix having 100% OPC

## V. CONCLUSIONS

As the replacement of cement by RHA in concrete mix increases, the workability of concrete mix was found to decrease as compared to control mix and the addition of polypropylene fibres into concrete mix also decreases the workability.The addition of RHA in concrete mix was found to increase the compressive strength at 5% and 15% replacement as compared to control mix whereas further addition of RHA at 25% decreases the compressive strength and inclusion of polypropylene fibres into concrete mixes increases the compressive strength at 0.5% fibres content as compared to the control mix.

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