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RESEARCH ARTICLE

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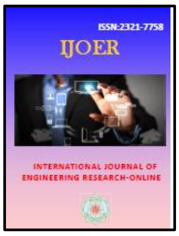
MECHANICAL PROPERTIES OF CONCRETE MADE OF PARTIAL REPLACEMENT WITH PLASTIC WASTE AND RICE HUSK ASH

MOHD.TALAHA[1], AKASH AGRAWAL[2], YOGENDRA KUSHWAHA[3]
[1]M. Tech Student, [2,3]Assistant Professor
Department of Civil Engineering, Shepherd Institute of Engineering & Technology
Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, India
talahasiddiqui0000@gmail.com,



ABSTRACT

India is a major rice producing country and the husk generated during millings is mostly used as fuel in the boilers for processing paddy, producing energy through direct combustion and/or by gasification. Rice Husk Ash (RHA) is produced annually approx. 20 million tonnes and is a great environmental threat, causing damage to the land and the surrounding area in which it is dumped. The process of combustion, by converting rice husks to ashremoves the organic matter and leaves silica rich residue. This paper reports the study of compressive strength, split tensile strength, flexural strength and workability of concrete involving rice husk ash (RHA) and plastic waste in different proportions. Volume mix grade of concrete was taken for experimental study. RHA content was used from 5% to 20% at the interval of 5% by replacing Pozzolona Portland Cement (P.P.C.) and plastic crush were used 5% by replacing the coarse aggregate. Plastic wastes were obtained by crushing the plastic into small pieces. The compressive strength, split tensile strength, flexural strength and workability of concrete was checked at 7 days and 28 days of curing period. The results show that concrete samples having RHA and plastic waste showed lower strength as compared to controlled concrete samples.

Keywords:Compressive strength, flexural strength, Plastic waste, Rice husk ash (RHA), Split tensile strength, workability

1. Introduction

Coarse aggregates and cement are the most essential used in the production of the concrete in field of construction. In excess utilization of these natural resources is having an adverse impact on the environment and climatic conditions. To preserve natural resources such aggregates, is a need to the society and its well-being and can be preserved by using suitable substitute that are rejected and are considered as waste.Concrete is a man-made material which is used for various construction works such as house construction, bridge construction, roads and pavements. Simply, concrete is a mixture of cement paste and aggregates. Concrete is an important part of society's infrastructure. Concrete has unlimited opportunities for advanced applications, design and construction techniques. It is the material of choice where strength, impermeability, durability, performance, fire resistance and abrasion resistance are needed. Its high compressive strength and mould ability has made its widespread use. It has major disadvantages that it is brittle and weak in tension. Still concrete is better option than any other available materials for construction works. Advanced technologies of Concretesuch as reinforce cement concrete (R.C.C.) and fiber reinforced concrete (F.R.C.) provides extra strength and durability against sliding, cracking, buckling and overturning. Use of industrial and domestic wastes such as fly ash, timber ash, steel fiber, rice husk ash, blast furnace slag, glass fiber and plastic wastes, the properties of concrete can be upgraded. These wastes can be found as natural materials, byproducts or industrial wastes. Dumping of these wastes on earth surface is causing the environment pollution. Rice husk ash (RHA) is a waste material, is a by-product obtained from the burning of rice husk. It has high reactivity and pozzolonic property. To conserve resources, utilization of industrial and biogenic wastes as supplementary cementing materials has become an important part of concrete construction. Industrialization has resulted in large deposition of plastic waste. It is non-biodegradable material which is harmful to the environment. Plastic waste can be used as fibres in concrete to improve the properties of concrete.

2. Material and methodology

To study the effect of plastic wastes as partial replacement of coarse aggregate in concrete & rice husk as partial replacement of cement in concrete on the workability, compressive strength ,flexural strength and split tensile. For the above 30 cubes of 150mm were cast in the laboratory. Cubes were cast using a volume mix of 1:1.5:3 with different percentage of rice husk (5%,10%,15%& 20%) and plastic waste at 5% in each and every percentage of rice husk replacement. To find the respective strength of conventional concrete at the end of 7 & 28 days of moist curing.

Materials used for the study

Cement: In this experimental study, Pozzolana Portland Cement (P.P.C) of Prism brand obtained from single batches throughout the investigation was used.

Cement is an adhesive and cohesive material. Cement is capable to bound solid materials into compact durable mass

Coarse aggregate: The coarse aggregate was locally available quarry, passing through 12.5mm sieve and retaining on 4.75mm sieve. Aggregate retained on 4.75 mm sieve are identified as coarse aggregate. Locally available coarse aggregate with fraction of 20mm was used in the present experimental work. Aggregate was washed to remove dust and dirt.

Fine Aggregate: The fine aggregate was locally available river sand which is passed through 4.75 mm sieve.

Locally available zone II river sand conforming to IS 383-1970 was used in this experimental work. To remove the impurities and particle greater than 4.75 mm, It was passed by IS Sieve 4.75mm

Water: Water that is fit for drinking (potable) is used for mixing and curing. The water cement ratio (w/c) of 0.55 for volumetric ratio 1:1.5:3

Plastic waste: Plastic waste is obtained by local vendors of Allahabad. Plastic body are been crushed into smaller pieces. Aggregates are replaced by plastic waste upto 5% percentage by its weight.

Rice husk : Rice husk ash is obtained from local farmers of Allahabad. Cement are replaced by rice husk ash at various percentage by its weight. (such as 5%,10%,15% & 20%).

3. Methodology

Methods that were followed for the Specimen Preparation

Volume Mix: Concrete was prepared volumetrically in the ratio 1:1.5;3, the water cement ratio was kept as 0.55

Setting time: Concrete products were de-moulded 12 - 18 hours after the casting.

Mixing Process: The mixing is the most important process of concreting and is done as per the recommendations. Even a small deviation can have a large influence on the workability of the wet concrete and so the properties and appearance of final composite 63control specimens were cast to determine the compressive strength at 7 and 28 days respectively. The specimens were mix using a volume mix 1:1.5:3

Vibration of Moulds: In this process the moulds was vibrated in which the concrete mix was poured. The vibration process basically has two functions. It enables the mix to fill the mould completely and also helps in releasing the air trapped in the mix and allows compaction to take place. After the mould is completely filled, the excess concrete (if any) is removed which may interfere with de moulding when the concrete has set. The final trowelling should be carried out when the concrete is green as it is easier to do this. The concrete has set to placed in the vibration table which is used for purpose of vibration of concrete & to achieve a good trowel face than grinding . For proper compaction of wet concrete, mould were vibrated on vibrator. There are two main function of vibrator, it enabled the mix to fill the mould completely and also release air trapped in the mix. It also allows compaction to take place. When concrete has set carry out final towelling. Vibration gives smooth surface.

De-Moulding: It took more time to de-mould, clean and re-apply release agent that it does to fill the mould. Hammering the mould is lower and less effective than a steady force. It also causes less damage if a product is overstressed on de-moulding it may crack at a later date. Therefore, de-moulding should be carried out with lots of care. Casted blocks or cube of concrete should be allowed to dry out after being put into curing process. The mould was cleaned as early as possible after de-moulding it.

Curing: Concrete products with low water cement ratio can dry out rapidly before the complete hydration. The cement never achieves its full strength and thus the concrete properties are sceptically affected. To assure compete hydration, it was fundamental need that the products were kept damp immediately after de-moulding and during the period of curing. Several methods that are currently in use are storing it in a humid chamber or fog room, sealing in polythene bags, or by immersing it totally in the water. Concrete products will achieve a significant proportion of their ultimate strength when the main cure is carried out for 7, 14 and 28, in humidity of greater than 95% RH and with a minimum temperature of 200C. A suitable post-curing management will allow the remainder of the strength to be attained.

3. Results and discussion

Compressive strength: Three set of cubes were casted for V1, V2, V3, V4, V5 with the replacement of cement by rice husk percentage 0, 5, 10, 15 & 20 and replacement of aggregate by plastic waste at 5% age. For the time periods of 7and 28 days with a water cement ratio of 0.55 and the results of the same are as follows:

Table 1: Compressive strength of plastic waste and rice husk concrete (W/C=0.55)

S. No.	Cube Designation	Water Cement Ratio	Different % age of rice husk and 5% plastic waste	Average Weight	Average Compressive Strength At 7 days	Average compressive strength At 28 days	% Change in Strength
1	V1	0.55	0%	8.7	14.14	23.70	referral
2	V2	0.55	5%	7.9	12	19.78	-16.54
3	V3	0.55	10%	7.7	11.6	15.85	-33.12
4	V4	0.55	15%	7.7	9.8	15.04	-36.54
5	V5	0.55	20%	7.6	8	11.7	-50.63

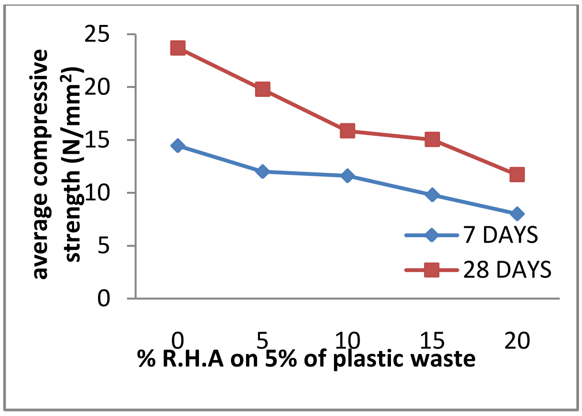


Figure 1: Average compressive strength VS % of R.H.A on plastic waste

Split tensile strength: Three set of cylinder were casted for V1, V2, V3, V4, V5 with the replacement of aggregates by plastic waste and rice husk with the cement percentage 0, 5, 10, 15 & 20 for the time periods of 7 & 28 days with a water cement ratio of 0.55 and the results of the same are as follows:

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Table 2: Split tensile strength of plastic waste and rice husk concrete (W/C=0.55)

S. No.	cylinder Designation	Water Cement Ratio	Different % age of rice husk and 5% plastic waste	Average Weight	Average Compressive Strength At 7 days	Average compressive strength At 28 days	% Change in Strength
1	V1	0.55	0%	1.5	3.96	3.59	Referral
2	V2	0.55	5%	1.4	3.59	3.96	10.30
3	V3	0.55	10%	1.4	3.02	3.40	-5.29
4	V4	0.55	15%	1.4	2.46	2.83	-21.16
5	V5	0.55	20%	1.4	1.70	2.27	-36.76

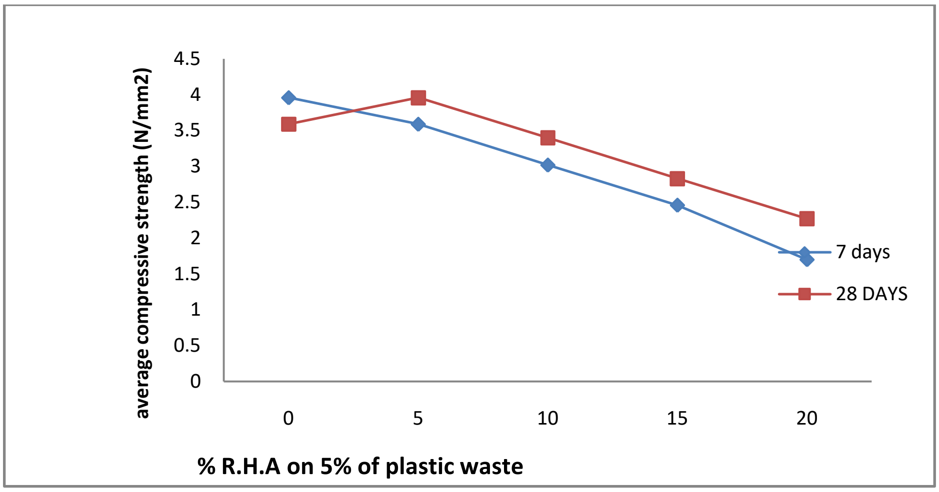

Fig. 2: Average split tensile strength VS % of R.H.A on plastic waste

Flexural strength: Three set of beam were casted for V1, V2, V3, V4, V5 with the replacement of aggregate percentage 0, 5, 10, 15 & 20 for the time periods of 7 and 28 days with a water cement ratio of 0.55 and the results of the same are as follows:

Table 3: flexural strength of plastic waste and rice husk concrete (W/C=0.55)

S. No.	Cube Designation	Water Cement Ratio	Different % age of rice husk and 5% plastic waste	Average Compressive Strength At 7 days	Average compressive strength At 28 days	% Change in Strength
1	V1	0.55	0%	9	12.75	Referral
2	V2	0.55	5%	3.50	5.99	-53.01
3	V3	0.55	10%	4.62	5.99	-53.01
4	V4	0.55	15%	3.12	5.62	-55.9
5	V5	0.55	20%	1.62	4.12	-67.68

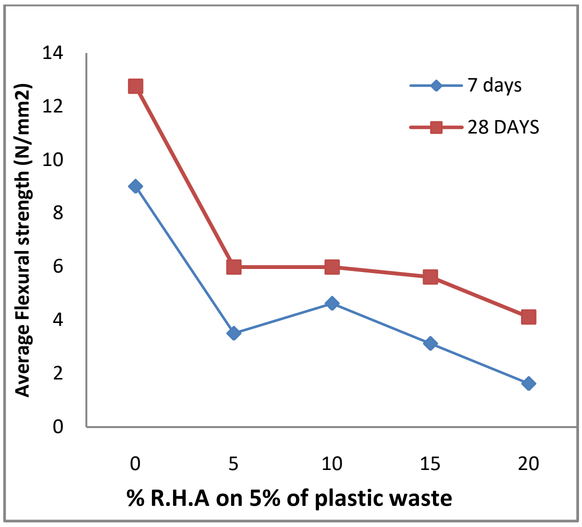

Fig. 3: Average Flexural strength VS % of R.H.A on plastic waste

Workability: The workability of the replaced concrete is same as that of the referral concrete. Replacement of coarse aggregate by the plastic waste and cement by rice husk does not affect the workability.

The values observed are as follows:

Table 4: workability of the plastic waste and rice husk concrete

Percentage of ceramic	Workability
0%	25mm
5%	25mm
10%	20mm
15%	18mm
20%	15mm

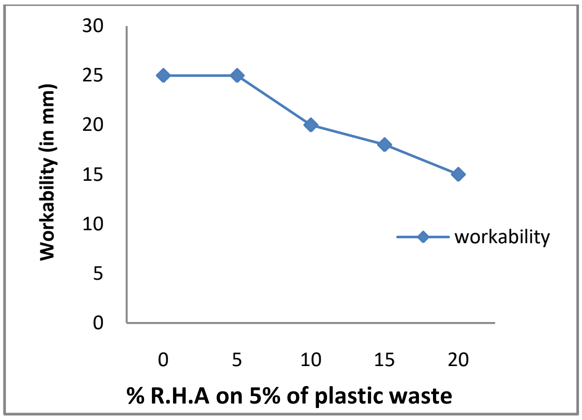

Fig. 4: WorkabilityVS % of R.H.A on plastic waste

4. Conclusions

From the above study following conclusions are drawn

1) With the increase in the percentage of rice husk ash the strength of concrete decreases.
2) Usage of Plastic waste and Rice husk ash in concrete is not feasible as the main characteristics (i.e. compressive strength gets reduced).
3) At 5% plastic waste& 5% rice husk ash replacement, the strength gets reduced by-16.54%, At 5% plastic waste &10% rice husk ash replacement, the strength gets reduced by-33.12 %, At 5% plastic waste& 15% rice husk ash replacement, the strength gets reduced by -36.54 %, At 5% plastic waste & 20% rice husk ash replacement, the strength gets reduced by -50.63 %.
4) Split Tensile strength of concrete also gets reduced with the usage of plastic waste and rice husk ash.
5) Flexural strength of concrete also gets reduced with the usage of plastic waste and rice husk ash.

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