Properties of Concrete Comprising of Fly Ash and Rice Husk Ash for Partial Substitution of Fine Aggregates

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Abstract - *Increased population and technological advances have to lead to a rise in the amount of industrial and agricultural waste. Many scientists throughout the world are thus actively developing ways to eliminate these wastes or utilize them as a better alternative to added value resources. Among the few waste materials are rice husk ash (RHA) and fly ash (FA). The results of preliminary trials to examine the impact on compressive strength, split tensile strength, and flexural strength of a concrete incorporated with FA and RHA waste are discussed in this paper. The results showed that FA and RHA created mortar with better strength in low substitution levels as partial substitutes for cement at a percentage of 0, 10, 20, and 30 percent. Low substitution levels up to 22.5% FA and 7.5% RHA were determined to be an ideal blend for the best usage of RHA and fly ash in 56 days of curing. Thus the employment of the OPC, RHA, and FA mixture enhances the strength qualities of concrete created in this way quite well.*

Key Words: Industrial by-products, cement, rice husk ash (RHA), fly ash (FA).

1. INTRODUCTION

Concrete is an engineering material fabricated from sand and gravel or crushed stone that combines cement, water, and sand. Hydration is considered the chemical reaction between cement and water and through the mechanism the aggregates are strengthened and bounded. Around the world, significant endeavors are being made to use natural waste and byproducts as supplemental cementing constituents to enhance the characteristics of concrete, like few of these products include a composite blend of RHA, FA, or steel fiber. Soon, the public engineering sector will be facing the challenge of building designs that are in line with the concept of sustainable development, through the use of highly effective, environmentally friendly materials and products. Different ingredients are applied to achieve the desired property concrete, such as FA and RHA since the Fly Ash (FA) and Rice Husk Ash (RHA) are some of the waste matters that reduce the cost of construction is utilized in concrete. Also with the recourse to these additives, the weight of concrete decreases, hence causing the concrete to lighter enabling it for utilization in applications where lightweight construction material is more suitable. FA is a coal derivative produced in burned-off coal in coal-based thermal power plants, while RHA is a concomitant of paper mills generated at a higher temperature by burning rice husk.

Fig -1: Agriculture wastes.

2. Literature Review

In recent times, plenty of researches have been carried in connection to the practice and utilization of concrete development from industrial, agricultural, or thermoelectric plant scraps. Many pozzolanic materials, such as FA, condensed silica fume, blast furnace slag, and RHA, have enabled the production of high-performance concrete. As industrial by-products were employed as a partial replacement for Portland cement in the advanced twentieth century, the energy demands were subdued and costs were saved. So, among various existing residues and materials, the ability to use RHA to produce structural concrete is critical for India. India is the world's second-largest rice paddy manufacturer. The technological advantages of rice husk for structural concrete, as well as the social advantages of reducing environmental disposal problems, have simulated research success based on this material's ability. Many tropical countries, especially in Asia, such as India, Thailand, the Philippines, and Malaysia, dispose of a variety of agricultural wastes. Inability to properly dispose of waste would cause social and environmental issues. Recycling recycled materials are one method of dealing with hazardous waste. RHA and FA are waste materials that can be used to make a composite material that can be built from a combination of FA and RHA in varying proportions and partial cement replacements.

3. Experimental program

Huge deals of works have been accounted for on concrete enclosing FA or RHA concerning the strength attributes of cement. Still, the examinations on the utilization of these materials are as yet meager, consequently coupled impact augmentation of FA and RHA on the compressive strength, flexural strength, and split tensile strength of cement has been inspected in this current work by replacement of concrete by FA of 0 %, 10%, 20%, and 30% substitution and RHA by 0%, 10%, 20%, 30% replacement of cement at curing ages of 7, 28 and 56 days to suggest an ideal extent of FA and RHA as a concrete substitute as a ternary blend. Solid concrete samples were tested for destructive experiments including compressive strength test on cube sizing 150x150x 50 mm in accordance with IS: 516 1959, flexure strength test on beam 150x150x700 mm as per IS: 516 1959, and split tensile strength in cylinder 50 øx300 in accordance with IS: 5816 1999.

Table -1: Experimental design matrix.

Mix	% of cement	% Replacement of FA	% replacement of RHA
M0	100	0	-
M1	90	10	-
M2	80	20	-
M3	70	30	-
M4	90	-	10
M5	80	-	20
M6	70	-	30
M7	70	27.5	2.5
M8	70	25	5
M9	70	22.5	7.5
M10	70	20	10
M11	70	17.5	12.5
M12	70	15	15

4. Results and discussion

Table 1 presents the findings of experimental investigations for various tests which were conducted to evaluate the effect of waste FA and RHA on compressive strength, splitting tensile strength, flexure strength of concrete. Waste FA and RHA were used as a partial replacement of cement at the percentage of 0, 10, 20 and 30%.

Table -2: Comparison of different strengths with different curing days

Mix	7 Days Curing			28 Days Curing			56 Days Curing		
	Compressive Strength (1)	Split tensile strength (2)	Flexural Strength (3)	Comp. Strength (4)	Split tensile strength (5)	Flexural Strength (6)	Comp. Strength (7)	Split tensile strength (8)	Flexural Strength (9)
M0	28.2	3	3.63	39.11	3.29	6.28	42.23	3.54	6.73
M1	28.35	3.17	4.41	39.36	3.49	6.98	42.48	3.66	7.25
M2	28.5	3.31	5.01	39.81	3.56	7.7	43.83	3.79	7.96
M3	27.65	2.91	4.73	38.09	3.23	7.12	41.23	3.51	7.11
M4	24.15	2.81	3.34	31.42	3.09	4.07	33.78	3.25	4.19
M5	24.27	2.68	2.72	29.51	2.79	3.72	30.66	2.96	4.28
M6	25.01	2.59	2.31	26.04	2.73	3.37	29.16	2.88	3.47
M7	26.51	2.87	4.69	35.34	3.09	6.76	40.39	3.29	6.86
M8	26.94	2.75	5.39	39.04	2.91	7.56	44.59	3.06	7.66
M9	22.41	3.04	5.73	40.32	3.27	8	47.56	3.49	8.16
M10	21.89	2.86	5.23	34.95	3	7.19	41.29	3.15	7.3
M11	20.61	2.51	5.11	34.89	2.69	6.56	39.24	2.82	6.67
M12	20.06	2.4	4.93	31.01	2.39	6.33	37.28	2.68	6.43

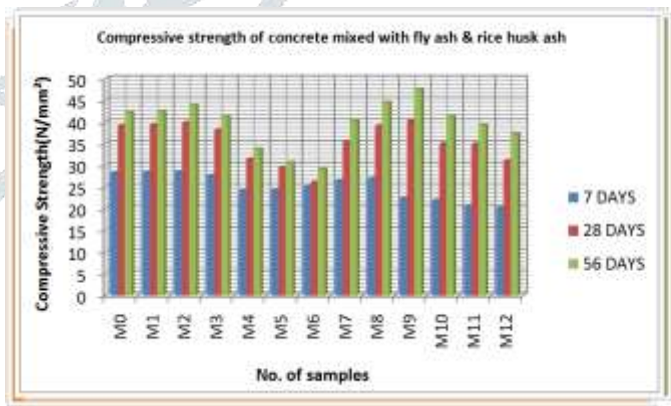

Fig -2: Graph showing compressive strength of concrete mixed with FA and rice husk ash.

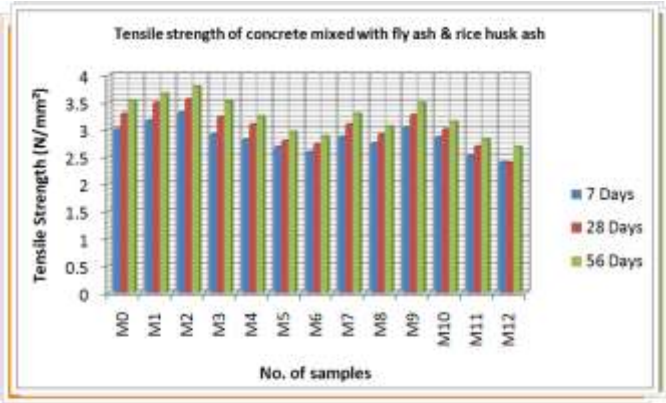

Fig -3: Graph showing tensile strength of concrete mixed with FA and rice husk ash.

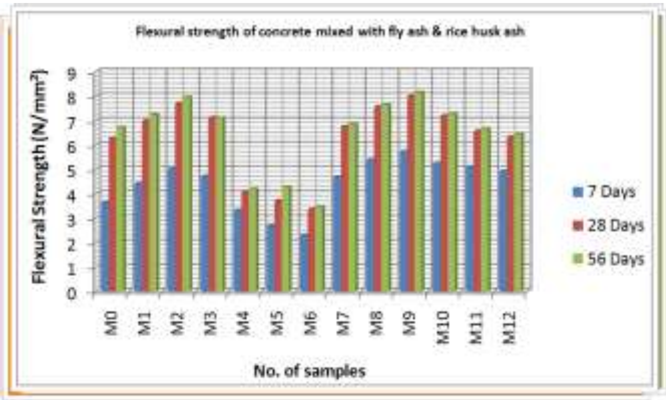

Fig -4: Graph showing tensile strength of concrete mixed with FA and rice husk ash.

Figure 2 reveals the results of compressive strength when of concrete mixed with FA and RHA on 7, 28 and 56 days curing. The effects on compressive strength are plotted here. It is seen that a composite with 22.5 % FA with 7.5 % RHA(M9) gives maximum compressive strength and this combination is best for the utilization purpose of these waste materials as compared to others.

Figure 3 reveals the results of tensile strength when of concrete mixed with FA and RHA on 7, 28 and 56 days curing. The effects on tensile strength are plotted here. It is seen that a combination of 20 % fly ash with 0 % rice husk (M2) gives higher tensile strength but It is also clearly seen that a combination of 22.5 % fly ash with 7.5 % rice husk (M9) for utilization purpose of these waste materials give better flexural strength results in comparison to other proportions

Figure 4 reveals the results of flexural strength when of concrete mixed with FA and RHA on 7, 28 and 56 days curing. The effects on flexural strength are plotted here. It is clearly seen that a combination of 22.5 % fly ash with 7.5 % rice husk (M9) for utilization purpose of these waste materials give better flexural strength results in comparison to other proportions.

5. Conclusions

The current investigation reveals following conclusions:

- Compressive strength is highest with the rise in the portion of FA and RHA up to substitution (22.5%FA and 7.5% RHA) of Cement in Concrete for separate mix proportions at 56 days curing.
- There was not a considerable enhancement in STS and it was just 1% higher than M0 with combination of 22.5% FA and 7.5% RHA and that also at 56 days curing.
- The highest 56 days Flexural strength was acquired with amalgamation of 22.5% FA and 7.5% RHA mix in contrast to M0.
- It is inferred from the results obtained that combination of 22.5% FA and 7.5% RHA mix comes out to be the optimal mix for the best use of RHA and Fly ash.
- FA and RHA are waste matters; they reduce the cost of construction.
- This indicates the possibilities for partial substitutions in concrete production for fly ash and rice husk ash.

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