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THE EXPERIMENTAL ANALYSIS OF COMPRESSIVE STRENGTH AND BOND STRENGTH OF EMBEDDED REINFORCEMENT IN GREEN CONCRETE BY USING RICE HUSK ASH AND SILICA FUME ASH AS CEMENT REPLACEMENT.

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Abstract:

The main components of concrete are aggregates and paste. During the manufacturing of concrete when water is added to the binding material and aggregates (coarse and fine) the chemical reaction occur which makes the bond between the aggregates and made it like artificial stone. The binding material cement concrete creates environmental pollution correlated with cement production in context of emission of Carbon Dioxide (CO2) and raw materials natural lime extraction. The rapid utilization of concrete needs the ample amount of cement which decreases the natural resources and emits the CO2 in atmosphere. Because of that certain works is needed to minimize these big issues. In recent decade great number of scholars working on partial replacement of cement with the pozzolanic materials. To reduce the CO_2 emission and saves the natural resources. Therefore, in research the rice husk ash and silica fume ash utilized as partially cementing material. The experimental analysis concluded that rice husk ash and silica fume enhance the bond strength of concrete. The optimum percentage of RCA as cement replacement was 10% which enhance the compressive strength up to 60% compared to the conventional concrete. Whereas 10% of silica fume ash was optimum cement replacement which improves the compressive strength up to 10% as compared to conventional concrete.

Keywords: Concrete, Rice husk ash, silica fume ash, compressive strength, slump flow

Introduction:

Concrete is the counted as most widely utilized building product in the construction industry and is endlessly being utilized to develop different structures. Its capability to resist freezing and thaw action, resistance to chemical, flowability [1-3], highly durable and flexible are the main purposes makes concrete so demanding. Concrete has been employed in uncountable architectural monstrosities. But in spite of having numerous benefits, concrete's conservational identifications have derived under inspection. Cement which is the most vigorous constituent of concrete, that performances as a binder and adhesives all other components. It is so abundant broadly utilized that the world cement manufacture subsidizes to 8% to 10% of anthropogenic global Carbon Dioxide (CO_2) gas emissions [4-6]. The greenhouse gas is one of the chief reasons of global warming and climate variation. Therefore, with the increase in temperatures, the essential for sustainable green concrete has enlarged.

Green concrete partakes nothing to ensure with its color [7] Green concrete is kind of concrete which exploits waste materials as at least one of its constituents, or its manufacture method does not prime to environmental obliteration [8-9]. Green concrete however should not concession on the strength and behavior while employing the waste resources. Manufacturing approaches and procedure, life cycle sustainability influences and quantity of cement swapped are the key features which are utilized to recognize weather a concrete is green or not [10-11].

While green concrete tails reduce, reuse and recycle practices, the main purpose behind the expansion of green concrete is to decrease the CO_2 gas emissions, to perimeter the utilization of natural possessions and the usage of waste materials in concrete, which otherwise are disposed-off, appraisal money for the discarding and producing environmental pollution. Many waste ingredients occur which can possibly be utilized in concrete, but some are formed on large amount instigating environmental problems concerning their disposal. Rice Husk Ash (RHA) and silica fume ash are two of the most formed waste materials in the ecosphere. This paper analysis the potential utilization of RHA and SFA in concrete to establish a green sustainable concrete which could solve the environmental problems tackled during the discarding of such waste ingredients as well as decrease of CO_2 gas emissions.

Methodology

Materials

The Ordinary Portland cement CEM I 42.5 N that obeys with ASTM C0150-04AE01, registered name as Falcon cement was designated for this study. In this study, the RHA and SFA were utilized as cement replacement. The fine aggregate (hill sand) was utilized. Physical characteristics like specific gravity, water absorption, fine modulus and color of hill sand and coarse aggregates are publicized in Tables I.

Table: The physical properties of fine and coarse aggregate

Tests names	Fine aggregate	Coarse aggregate
Specific gravity	2.65	2.67
Fineness modulus	3.12	¾”
Water absorption	9%	0.3%
Field moisture content	4.7%	4.7%

Test Parameters and Mixture Proportions

Specimen Preparation

Mix Proportion

By selecting target mean strength, water/binder ratio, RHA, SFA and cement percent, the total mix require water and fine sand was designed. In this research, the density of concrete was fixed as 2400 kg/m3. The proportion of cement, sand and water content of the conventional concrete mix which was utilized through this study is 1: 2: 3.2 while the water/binder ratio was 0.55. The mix amount of RHA and SFA to be substitute as cement in concrete contented for each consignment is revealed in Table 2 and Table 3.

Table 2 Mix proportion of Rice Husk Ash blended concrete

S. No	%age	Mix ID	Cement (Kg)	Rice Husk Ash	Fine aggrega te (Kg)	Coarse aggrega te (Kg)	Water (Litres)	S. No
1	Control	3.04	0	0	5.02	7.5	1.41	0.55
2	RHA5	2.89	5	0.15	5.02	7.5	1.41	0.55
3	RHA10	2.74	10	0.3	5.02	7.5	1.41	0.55
4	RHA15	2.58	15	0.46	5.02	7.5	1.41	0.55
5	RHA20	2.43	20	0.61	5.02	7.5	1.41	0.55
6	RHA30	2.13	30	0.91	5.02	7.5	1.41	0.55

Table 3 Mix proportion of Silica Fume blended concrete

S. No	%age	Mix ID	Cement (Kg)	Silica Fume Ash	Fine aggrega te (Kg)	Coarse aggrega te (Kg)	Water (Litres)	S. No
1	Control	3.04	0	0	5.02	7.5	1.41	0.55
2	SFA5	2.89	5	0.15	5.02	7.5	1.41	0.55
3	SFA 10	2.74	10	0.3	5.02	7.5	1.41	0.55
4	SFA 15	2.58	15	0.46	5.02	7.5	1.41	0.55
5	SFA 20	2.43	20	0.61	5.02	7.5	1.41	0.55
6	SFA 30	2.13	30	0.91	5.02	7.5	1.41	0.55

The ASTM C 143 was fallowed to analyze the For fresh state property such as slump flow of concrete by incorporating the RHA and SFA as cement replacement. For hardened property name as compressive strength was examined three cylinders mix at 28 days. ASTM C 31 was fallowed to test for compressive strength of concrete.

Results and discussions

Slump Flow Test

For all specimen slump test was investigated by incorporating various percentages of RHA and SFA. Table 4 shows the slump flow of the concrete mixes. From Table 4 it can be seen that the incorporation of RHA and SFA the slump flow decreased. At 30% replacement of RHA and SFA the 60% workability decreased because the surface area of RHA and SFA is higher which absorbs the water.

Table 4 The slump flow of RHA and SFA mixes.

Specimen	Slump flow (inches)					
	CS	MK5	MK10	MK15	MK20	MK30
RHA	3.1	2.8	2	1.6	1.2	1
SFA	2.9	2.6	2	1.7	1.4	1.1

Compressive Strength Test

The table 5 present the compressive strength of the concrete by incorporating the various percentages of the RHA and SFA as cement replacement. The results describe that the incorporation of RHA the compressive strength increased rapidly, 60% compressive strength increased at 10% replacement of RHA. Whereas with the incorporation SFA the compressive strength significantly increased up to 10 % with 10% replacement of SFA with cement. The compressive strength increased because with incorporation of RHA and SFA the pozzolanic gel introduced in concrete mix which triggered the strength of concrete.

Table 5 The Compressive strength of RHA and SFA mixes

Specimens	**Compressive Strength (psi)**	
	RHA	**SFA**
CS	2728	2728
5%	3882	2112
10%	4311	3009
15%	3804	2892
20%	3149	2237
30%	2919	2102

Bond strength test

The table 6 and 7 present the band strength of the concrete by incorporating the various percentage of the RHA and SFA as cement replacement. Bond strength test were done on specimen of different mix ratio using RHA and SFA as a cement replacement for 28 days. The cement was replaced by 5 %, 10%, 15 %, 20 % and 30%. The result of bond strength for various specimen are shown below in table 6 and 7.

Table 6 Bond Strength of concrete cylinder

Mix Type	Water to binder ratio	Pull out Strength (KG)
CS	0.55	6020
SF5	0.55	6080
SF10	0.55	6230
SF15	0.55	6970
SF20	0.55	6490
SF30	0.55	6920

Table 7 Bond Strength of concrete cylinder

Mix Type	Water to binder ratio	Pull out Strength (KG)
CS	0.55	6020
RHA 5	0.55	6800
RHA 10	0.55	6900
RHA 15	0.55	6670
RHA 20	0.55	6420
RHA 30	0.55	5935

Conclusions

From the research, it is concluded that:

The slump flow was decreased with the incorporation of RHA and SFA compared to conventional concrete because the surface area of RHA SFA is large which causes the high-water absorption.

The Compressive strength of concrete was enhanced when RHA and SFA was utilized compared to conventional concrete. The 60% compressive strength were increased with the incorporation of 10% RHA whereas 10% compressive strength increased with the 10% incorporation of SFA compared to conventional concrete.

It is observed from the experimental work that curing of silica fume and rice husk ash blended concrete at 28 days increase bond strength using 15% silica fume and 10% rice husk ash in concrete.

Thus 15% of silica fume and 10% rice husk ash in concrete as a partial replacement of cement is recommended as optimum content for bond strength.

Hence, the outcomes describe that the RHA and SFA could be utilized as cement replacement to reduce the CO_2 emission, reduce the disposal of waste and saves the natural resources of lime. Whereas for the slump flow certain admixtures are required to improves the slump flow of concrete when RHA and SFA utilized as cement replacement.

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