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Use of Fly Ash, Rice Husk Ash and Quarry Dust for Making Green Concrete

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***Abstract:*— During the 20th century there has been an increase in the consumption of mineral admixtures by the cement, sand and concrete industries. This rate is expected to increase and the increasing demand for cement, sand and concrete is met by partial cement replacement. Substantial energy and cost saving can result when industrial by-products are used as a partial replacement for the energy intensive Portland cement and manufactured sand for natural sand. The presence of mineral admixtures in concrete is known to impart significant improvements in workability and durability. The use of by-products is an environmental friendly method of disposal of large quantities of materials that would otherwise pollute land, water and air. This paper presents the experimental study to investigate the influence of partial replacement of cement by Fly Ash (FA) & Rise Husk Ash (RHA) and Natural sand with Quarry Sand (QS) on the concrete compressive strength, split tensile strength and flexural strength by better understanding of chemistry of constituents of the concrete mix. The use of by-products is an environmental friendly method of disposal of large quantities of materials that would otherwise pollute land, water and air. This study focuses on utilization of waste Pozzolona products such as Fly Ash (FA) and Rice Husk Ash (RHA) as partial replacement to OPC and natural sand by Quarry Sand (QS) to produce blended concrete with an objective to increase the optimum percentage of replacement of pozzolona to OPC without affecting the concrete properties.**

***Index Terms* - Rise Husk Ash (RHA), Fly Ash (FA), Quarry Sand (QS), Compressive Strength, Split Tensile Strength and Flexural Strength.**

I. INTRODUCTION

The construction industry relies heavily on cement for its operations in the development of shelter and other infrastructural facilities. It then becomes extremely difficult for majority of the people to own their own houses or many collapse structures in attempt to reduce cost. In recent years, remarkable efforts have been taken in the domain of concrete engineering and technology to research and study the utilization of by-products and waste materials in the production of concrete. The successful utilization of these materials will result in the reduction of global warming and environmental loading, waste management cost and concrete production cost, besides enhancing the properties of concrete in both fresh and hardened state. . Efforts in this direction have been focused in identifying and optimizing the benefits of different types of cement replacement materials as well as identifying alternative materials as aggregates in concrete and by better perceptive of constituent's chemistry of the concrete mix. The purpose of this research is to study the effects of Fly Ash, RHA & Quarry Sand on the workability, compressive strength, flexural tensile strength, splitting tensile strengths, modulus of elasticity of rice husk ash concrete. Over the past years, there has been an increasing number of papers on the use and utilization of industrial, agricultural and thermoelectric plants residue in the production of concrete. Different materials with pozzolanic properties such as fly ash, condensed silica fume, blast-furnace slag and rice husk ash have played an important part in the production of high performance concrete. During the late 20th century, there has been an increase in the consumption of mineral admixture by the cement and concrete is met by partial cement replacement. Substantial energy and cost savings can result when industrial by-products are used as a partial replacement for the energy intensive Portland cement.

FLY ASH- Fly ash is an industrial by product resulting from the combustion of pulverized coal. In the recent years fly ash is being widely used as a cementitious and pozzolanic ingredient in concrete. Fly ash improves both fresh concrete and hardened concrete properties of hydraulic cement concrete. It can be introduced as a separate batched material or as a component of blended cement (ACI232.2R-03). In recent years, large volumes of fly ash (over 50% volume replacement of cement with fly ash) are being incorporated into structural concrete. Super plasticizers are being used to overcome the deficiencies caused by replacing cement with large volumes of fly ash in hydraulic cement concrete. High performance High volume fly ash (HVFA) concrete represents a new technology for building durable and

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sustainable buildings and infrastructure during the 21st century.

RICE HUSK ASH- India is a major rice producing country, and the husk generated during milling is mostly used as a fuel in the boilers for processing paddy, producing energy through direct combustion and / or by gasification. About 20 million tons of RHA is produced annually. This RHA is a great environment threat causing damage to the land and the surrounding area in which it is dumped. Lots of ways are being thought of for disposing them by making commercial use of this RHA.The particle size of the cement is about 35 microns. There may be formation of void in the concrete mixes, if curing is not done in properly. This reduces the strength and quality of the concrete, which is made out of this RHA, is finer than cement having very small particle size of 25 microns, so much so that it fills the interstices in between the cement in the aggregate. That is where the strength and density comes from. And that is why it can reduce the amount of cement in the concrete mix.

QUARRY DUST- The cheapest and the easiest way of getting substitute for natural sand is by crushing natural stone to get artificial sand of desired size and grade which would be free from all impurities is known as Quarry Sand. Crushed sand is widely used around the world and structural Engineers of major projects around the world insist on the compulsory use of the crushed sand because of its consistent gradation and zero impurity. The use of crushed sand results in dense and cohesive concrete thus increasing the strength and life of the concrete. They generally represent less than 1% of aggregate production. The addition of QS to normal concrete mixes is limited because of its high fineness. The addition of QS to fresh concrete increases the water demand and consequently the cement content for given workability and strength requirements. However, a potential benefit to using QS is the cost savings, because the material cost varies depending on the source. Need of Research-

A large amount of agricultural & industrial waste was disposed in most of tropical countries especially in Asia for countries like India, Thailand, Philippine and Malaysia. If the waste cannot be disposed properly it will lead to social and environmental problem. Recycling of the disposed material is one method of treating the agricultural & industrial waste. The use of Fly Ash & Rice Husk Ash material in the formation of a composite material that can be used for construction. Fly Ash & Rice Husk Ash is hazardous to environment if not dispose properly.

The main source of natural sand is river beds. However, natural sand is slowly and consistently becoming scarce. It does not have sufficient fines and is not properly graded. Moreover, the presence of other impurities such as coal, silt, bones, shells, silica, mica etc results in reduced strength of cement concrete. The decay of these materials, due to weathering effect, shortens the life of cement concrete. Moreover, since it is an environmental hazard to extract natural sand from river bed, even the Government has banned it from to time. Thus, a technically superior substitute to natural sand is Quarry or Crushed Sand.

II. SCOPE AND OBJECTIVES -

- To enhance the property of concrete.
- To minimize the use of conventional material by using mineral admixtures and chemical admixtures.

III. EXPERIMENTAL INVESTIGATION-

A. Material Used- Cement-

Ordinary Portland cement (53 Grade) is used. Cement is a fine, grey powder. It is mixed with water and materials such as sand & aggregate to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. The ordinary Portland cement contains two basic ingredients namely argillaceous and calcareous. In argillaceous material clay predominates and in calcareous materials calcium carbonate predominates.

The physical properties of the cement tested according to Indian standards procedure confirms to the requirements of IS 10262- 2009 and the physical properties are given in table –

Table 1: Physical properties of cement

SR. NO	PROPERTIES	RESULT OBTAINED	STANDARD VALUES
1	Standard Consistency	33%	-
2	Initial Setting Time (minutes)	32	Not be less than 30 minutes
3	Final Setting Time(minutes)	330	Not be greater than 600 minutes
4	Soundness(mm)	5	<10
5	fineness	9.0%	<10%
6	Specific gravity	3.15	-

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Fine Aggregates

The sand used for the experimental program of sieve analysis. The sand was first sieved through 4.75mm to remove any particles greater than 4.75 mm and then was washed to remove the dust. The sand confirming to zone II as per IS 383:1970 was used for making references concrete. Properties used in the experimental work are tabulated in table-

Table 2: Physical properties of fine aggregates

SR. NO.	PROPERTIES	RESULT OBTAINED
1	Type	Natural
2	Specific Gravity	2.67
3	Bulkage	8.5%
4	Fineness Modulus	2.48
5	Surface Texture	Smooth
6	Particle Shape	Rounded

Coarse Aggregate

All types of aggregate are suitable. The normal maximum size is generally 10-20mm. consistency of grading of vital importance. Coarse aggregate confirming to IS 383:1970.

Regarding the characteristics of different types of aggregates, crushed aggregates tend to improve the strength because of the interlocking of the angular particles, whilst rounded aggregates improve the flow because of lower internal friction

Table 3: Physical Properties of Coarse Aggregates (20 mm)

SR NO	PROPERTIES	RESULT OBTAINED
1	Type	Natural
2	Specific Gravity	2.67
3	Surface Texture	Rough
4	Particle Shape	Angular

Table 4: Physical Properties of Fly Ash

Test Conducted	Test Results	Requirements as per IS3812 (part 1)-2003
Consistency (%)	27.5	---------
Specific gravity (gm/cc)	2.2	---------
Setting Time Initial (min) Final (min)	250 330	---------
Soundness Test (mm) By Autoclave expansion method (%)	- 0.0516	Max. 0.8
Fineness % by weight by sieving (% Retention on 45 micron sieve-wet sieving	45.55	Not more than 34

Table 5: Physical Properties of Rice Husk Ash

Test Conducted	Test Results	Requirements as per IS3812 (part 1)-2003
Consistency (%)	40	---------
Specific gravity (gm/cc)	2.139	---------
Setting Time Initial (min) Final (min)	195 260	---------
Soundness Test (mm) By Autoclave expansion method (%)	- 0.0468	Max. 0.8
Fineness % by weight by sieving (% Retention on 45 micron sieve-wet sieving	29.3	Not more than 34

B. Mix Proportion and Mix Details

TYPE OF CONCRETE MIX	CONCRETE MIX				
	CEMENT	RHA	FLY ASH	Quarry Sand	SAND
A	100	0	0	0	100
A_1	70	7.5	22.5	45	55
A_2	70	5	25	45	55
A_3	70	5	25	15	85

C. Test Specimens and Test Procedure

150 mm concrete cubes and cylinders of 150 mm diameter and 300 mm length were used as test specimens to determine the compressive strength of concrete and split tensile strength of concrete for both cases (i.e., normal concrete and GGBS concrete). The ingredients of concrete were thoroughly mixed till uniform consistency was achieved. The cubes and cylinders were properly compacted. All the concrete cubes and cylinders were de- moulded within 24 hours after casting. The de-moulded test specimens were properly cured in water available in the laboratory at an age of 7, 14 and 28 days. Compression test was conducted on a compression testing machine available in the laboratory as per IS 516-1959. The load was applied uniformly until the failure of the specimen. The split tensile strength was conducted as per IS 5816-

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1976. The specimen was placed horizontally between the loading surfaces of the compression testing machine and the load was applied without shock until the failure of the specimen. The concrete beams of size (150mm x 150mm x 700mm) were tested as per IS 516-1959 for flexural strength. The load was applied through two similar rollers mounted at one third points of the supporting span. The load was applied without shock until the failure occurs.

D. Observations

Type of Proportion	Slump Value
A	68mm
A_1	62mm
A_2	66mm
A_3	67mm

Slump Test:

Slump values of various proportions in M30 grade concrete- Compressive Test on Cube as per IS 516-1959: (Size: 150x150x150) mm

The compressive strength of concrete was determined at the age of 7 days and 28 days as presented. The specimens were cast and tested as per IS: 516-1959:

TYPE OF MIX PROPORTION	7 Days N/mm^2	14 Days N/mm^2	28 Days N/mm^2
A	23.86	29.2	36.51
A_1	21.30	28.88	35.11
A_2	16.45	20.2	27
A_3	20	23.21	30.66

Split Tensile Strength On Cylinder: As per IS 5816-1999:

TYPE OF MIX PROPORTION	7 Days N/mm^2	14 Days N/mm^2	28 Days N/mm^2
A	4.12	4.63	4.95
A_1	4	4.35	4.76
A_2	3.61	3.98	4.10
A_3	3.42	3.40	3.43

Flexure Strength Test On Beam: As Per IS : 516-1959:

TYPE OF MIX PROPORTION	7 Days N/mm^2	14 Days N/mm^2	28 Days N/mm^2
A	4.97	5.07	5.23
A_1	4.50	4.96	5
A_2	3.7	3.79	3.90
A_3	3.51	3.27	3.30

IV. CONCLUDING REMARKS -

Based on the experimental investigation, the following conclusions can be drawn:

1.Compressive Strength increases with increase in percentage of RHA(7.5%), Quarry sand(45%).
2. The Maximum 28 days split tensile strength was obtained with 7.5% RHA, 22.5% fly ash & 45% Quarry Sand.
3.The Maximum 28 days Flexural strength was obtained with 7.5% RHA, 22.5% fly ash & 45% Quarry Sand.

REFERENCES

1. Aysegul Petek Gursel, , Helena Maryman, Claudia Ostertag, “A life-cycle approach to environmental, mechanical, and durability properties of “green” concrete mixes with rice husk ash” Journal of Cleaner Production Volume 112, Part 1, 20 January 2016, Pages 823–836

2. H.A.F. Dehwah “Mechanical properties of self-

compacting concrete incorporating quarry dust powder, silica fume or fly ash" ,Construction and Building Materials,Volume 26, Issue 1, January 2012, Pages 547–551

3. S.N. Raman , T. Ngo, P. Mendis, H.B. Mahmud " High-strength rice husk ash concrete incorporating quarry dust as a partial substitute for sand" Construction and Building Materials,Volume 25, Issue 7, July 2011, Pages 3123–3130

4. Gemma Rodríguez de Sensale, "Effect of rice- husk ash on durability of cementitious materials" , Cement and Concrete Composites,Volume 32, Issue 9, October 2010, Pages 718–725

5. Specification for Coarse and Fine Aggregates from Natural Sources for Concrete. IS 383-1970 Bureau of Indian Standards, New Delhi.

6. Code of Practice for Plain and Reinforced Concrete. IS 456-2000, Bureau of Indian Standards, New Delhi.

7. Methods of Sampling and Analysis of Concrete. IS 1199-1959, Bureau of Indian Standards, New Delhi.

8. IS 10262: 2009, "Guidelines for Concrete Mix Design Proportioning", Bureau of Indian Standards, New Delhi.

9. IS 2386: 1963, "Methods of test for Aggregates for Concrete", Part I & III, Bureau of Indian Standards, New Delhi.

10. IS 516:1959, "Methods of Tests for Strength of Concrete", Bureau of Indian Standards, New Delhi

11. Concrete Technology by M. S. Shetty