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A REVIEW ON PERFORMANCE OF HIGH STRENGTH IN HUSK ASH CONCRETE WITH QUARRY DUST AS A PARTIAL REPLACEMENT FOR SAND

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Abstract

Cement concrete is a universal material used for civil engineering construction. Modern civil engineering, constructions have their own structural and durability requirement related with concrete to better suit the intended function of the structure.

Various civil engineering construction with reinforced concrete or plain concrete are multi-storied buildings, bridges, chimneys, water tanks, hydraulic structures like dam etc .Each structure has its own intended purpose and hence the corresponding requirement related with concrete say for example, multi-storied buildings require concrete of high compressive strength.

Cement one of the ingredient in concrete is the most energy intensive materials to produce, and during the production of cement the carbon dioxide is released in the atmosphere which is the great cause for environmental pollution. Therefore it is the best opportunity to reduce cement content in the concrete mix, by replacing it with admixtures and pozzolans, such as fly ash, silica fume, rice husk, metakaolinetc .These pozzolans are available in abundance, there for pozzolans in concrete not only solves the problem of its disposal also improve the properties like workability, durability, impermeability, strength etc.

Keywords: Ash, Quarry dust, sand,Silt, Fly ash.

1.INTRODUCTION

The natural river sand is the cheapest resource of sand. However the excessive mining of river bed to meet the increasing demand for sand in construction industry has led to the ecological imbalance in the state. Now the sand available in the riverbed is very coarse and contains very high percentage of silt and clay. The silt and the clay present in the sand reduces the strength of the concrete and holds dampness. The natural river sand is the product of sedimentation. Mica, coal, fossils and other organic impurities present in the river sand above certain percentage makes the sand useless for concrete work.

Acute shortage and high price for river sand has led to the adulteration of sand with salty sea sand which has raised serious concern in the construction industry.

Necessity

Change in living standard of people, environmental concerns and economy has made to search for substitutes for basic constituents of concrete. Along with durability and serviceability of the structures, person also wants aesthetic view and fast erection of the structure. To cater to these requirements- new technologies, new construction practices and new concrete making materials are being used. In today's world, various kinds of civil engineering structures are coming into picture, placing greater demand on material performance, the need for more fundamental information on the behavior of concrete under different types of loads is of prime importance.

Aim and Scope

1. To investigate the behavior of modified rice husk ash concrete (MRHAC)composite with various volume fractions of RHA.
2. To investigate the strength properties of MRHAC composite with various volume fractions of RHA.
3. To investigate other properties such as workability, density and elastic constants.
4. To compare the properties of these special concretes with that of normal concrete.
5. To determine the properties of hardened concrete, such as compressive strength, split tensile strength, flexural strength and pull out strength.

2.METHODOLOGY

2.1 Introduction

Concrete is one of the most common material used in the construction industry. In the past few years, many research and modification has been done to produce concrete which has the desired characteristics. There is always a search for green or eco-friendly concrete. Due to the ecological hazards posed by the mining of river bed to meet the need for natural sand, and limestone for the production of cement,several replacements are being used in concrete. A cementitious material such as sugarcane bagasse ash, flyash etc. are used as cement replacements, and manufactured sand is used as a replacement for natural sand. In the present study, blended cement concrete with the incorporation of rice husk ash and M-sand, replacing certain percentage of cement and natural sand has been introduced to suit the current requirements.

2.1.1 Green concrete

Green concrete can be defined as the concrete with material as a partial or complete replacement for cement or fine or coarse aggregates. The substitution material can be of waste or residual product in the manufacturing process. The substituted materials could be a waste material that remain unused, that may be harmful (material that contains radioactive elements). Green concrete should follow reduce, reuse and recycle technique or any two process in the concrete technology. The three major objective behind green concept in concrete is to reduce greenhouse gas emission (carbon dioxide emission from cement industry, as one ton of cement manufacturing process emits one ton of carbon dioxide), secondly to reduce the use of natural resources such as limestone, shale, clay, natural river sand, natural rocks that are being consumed for the development of human mankind, thirdly use of waste materials in concrete that also prevents the large area of land that is used for the storage of waste materials that results in the air, land and water pollution.

2.1.2 Rice husk ash (RHA)

Rice husk ash (RHA) is a by-product from the burning of rice husk. Rice husk is extremely prevalent in East and South-East Asia because of the rice production in this area. The rich land and tropical climate make for perfect conditions to cultivate rice and is taken advantage by these Asian countries. The husk of the rice is removed in the farming process before it is sold and consumed. It has been found beneficial to burn this rice husk in kilns to make various things. The rice husk ash is then used as a substitute or admixture in cement. Therefore the entire rice product is used in an efficient and environmentally friendly approach.

Fig 2.1 Rice Husk ash

2.1.3 Quarry Dust

Sand is used as fine aggregate in mortars and concrete. Natural river sand is the most preferred choice as a fine aggregate. River sand is a product of natural weathering of rocks over a period of millions of years. It is mined from the river beds and sand mining has disastrous environmental consequences. River sand is becoming a scarce commodity and hence exploring alternatives to it has become imminent. Rock crushed to the required grain size distribution, is termed as Quarry Dust. In order to arrive at the required grain size distribution the coarser stone aggregates are crushed in a special rock crusher and some of the crushed material is washed to remove fines.

Fig 2.2 Quarry Dust

2.1.3 Superplasticising admixture

Following are the uses of Superplasticising admixture

- To produce pumpable concrete
- To produce high strength, high grade concrete by substantial reduction in water resulting in low permeability and high early strength.
- To produce high workability concrete requiring little or no vibration during placing.

Advantages are enlisted as follows

- Improved workability - easier, quicker placing andcompaction.
- Increased strength - provides high early strength forprecast concrete with the advantage of higher water reduction ability.
- Improved quality - denser, close textured concrete withreduced porosity and hence more durable.
- Higher cohesion - risk of segregation and bleedingminimized; thus aids pumping of concrete.
- Chloride free- safe in prestressed concrete and withsulphate resisting cements andmarine aggregates.
- Workability- can be used to produce flowing concrete thatrequires no compaction.
- Durability reduction in W/C ratio enables increase in densityand impermeability thus enhancing durability of concrete.

2.2 LiteratureReview

Now a days all over the world, concrete is one of the most extensively used material in the construction industry. As concrete is such a popular and important construction material a lot of research is done and some still going on to improve the mechanical properties of concrete. A lot of research work has been done and is going on the use of steel slag and also bagasse ash as cement replacement in enhancing different properties of concrete. Research work done by different researchers is discussed here in brief.

YashwanthM.K. *et.al.* [1]investigated experimentally the fresh and hardened properties of lightweight concreteusing sugarcane bagasse ash as replacement for cement by weight at 0%, 5%, 10%, 15% and 20% and expanded polystyrene beads as 100% replacement for coarse aggregate respectively. They found that thereis marginal increase in workability with bagasse ash content up to 10%.The compressive strength of lightweight concrete increases with bagasse ash content up to 15% and beyond in strength. This 15% bagasse ash replacement strength is slightly less than ordinary portland cement based lightweight concrete at 28 days.

R.Srinivasan*et.al.*[2] In this paper, Bagasse ash has been chemically and physically characterized, and partially replaced in the ratio of 0%, 5%, 15% and 25% by weight of cement in concrete. The result shows that the strength of concrete increased as percentage of bagasse ash replacement increased.

V. Subathra Devi *et.al.*[9] studiedthe effect of partial replacement of coarse and fine aggregates by steel slag (SS), on the various strength and durability properties of concrete, by using the mix design of M20 grade. The optimum percentage of replacement of fine and coarse aggregate by steel slag is found. Workability of concrete gradually decreases, as the percentage of replacement increases, which is found using slump test. Compressive strength, tensile strength, flexural strength and durability tests such as acid resistance and rapid chloride penetration, were experimentally investigated. The results indicated that for conventional concrete, the partial replacement of fine and coarse aggregates by steel slag improves the compressive, tensile and flexural strength. The mass loss in cubes after immersion in acids is found to be very low. Deflection in the RCC beams gradually increased, as the load on the beam increased, for both the replacements.

3. SYSTEM MODELLING

The present research work is experimental and requires preliminary investigations in a methodological manner.

3.1Material and Grade of Control Mix

- Selection of type and grade of control mix, mix design by an appropriate method, trial mixes, final mix proportions.
- Estimating total quantity of concrete required for the whole experimental work.
- Estimating quantity of cement, fine aggregate, coarse aggregate, Quarry Dust, rice husk ash, super plasticizers required for the work.
- Testing of properties of cement, fine aggregate, coarse aggregate.
- Obtaining the properties of Quarry Dust and rice husk ash.

3.2 Production of Concrete Mixes

- Production of control mix(concrete of grade M-50) in laboratory is carried out by ACI method.
- Modified Concrete is produced by adding Quarry Dust to the plain concrete as fine aggregate replacement. Rice husk ash was added to the modified concrete as a cement replacement varied from 5% to 20% at constant interval of 5% by weight of cement.

3.3 Test Conducted on Material used in Experimental work

The ingredient ofconcrete *i.e.* cement, fine aggregate are tested before producing the concrete. The relevant Indian standard codes were followed for conducting various tests on concrete.

3.3.1Tests on cement

The cement used in this experimental work is "53 grade ordinary portland cement". All properties of cement are tested by referring IS 12269 – 1987[18] specification for 53 grade ordinary portland cement. Test results are presented in Table 3.1.

Table 3.1 Physical Properties of Cement. (Confirming to IS 12269 – 1987) [18]

Sr. No.	Description of test	Results
1	Fineness of cement (residue IS sieve No .9)	3%
2	Specific gravity	3.15
3	Standard consistency of cement	29%
4	Setting time of cement	
	a) Initial setting time	135 minute
	b) Final setting time	288 minute
5	Sound test of cement (with le- Chatelier'smould)	1.5 mm
6	Compressive strength of cement	
	a) 7 days	57.8 N/mm^2
	b) 28 days	79.5 N/mm^2

3.3.2 Water

Potable water available in laboratory is used for mixing and curing of specimen.

4 CONCLUSIONS

The following conclusions are drawn from the test result and discussion of this investigation.

1. The maximum compressive strength, flexural strength, split tensile and bond strengths achieved are 60.35, 14.49, 3.00and 10.85 MPa at 10% of RHA volume fractions respectively.
2. Elastic constants of QDC and MRHAC are obtained by various methods. Empirical expressions for modulus of elasticity i.e. static and dynamic have been developed in terms of QD and RHA volume fraction and cube compressive strength of QD and MRHAC. Predicted values of modulus of elasticity are excellent agreement with those of expression derived from the graph plotted

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