Experimental Study Of Quarry Sand And Rice Husk Replacing In Concrete

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ABSTRACT

A huge amount of concrete is consumed by the construction industry. About 35% volume of concrete is comprised of sand. A good quality concrete is produced by careful mixing of cement, fine and coarse aggregates, water and admixtures as needed to obtain an optimum quality and economy. The fine aggregates or sand used is usually obtained from natural sources specially river beds or river banks. Now-a-days due to constant sand mining the natural sand is depleting at an alarming rate. Sand dragging from river beds haven led to several environmental issues. Due to various environmental issues Government has banned the dragging of sand from rivers. This has led to a scarcity and significant increase in the cost of natural sand. The present investigation aims in the study of the properties of concrete in which quarry dust and rice risk is used as a partial replacement for natural sand. The use of such materials not only results in conservation of natural resources but also helps in maintaining good environmental conditions. The basic strength properties of concrete were investigated by replacing natural sand by quarry sand and rice risk at replacement levels of 50% for three different mix proportion in M25 grade of concrete. Hence in our project concluded that the optimum percentage replacement of natural sand by quarry sand and rise risk is designated as the above grade of concrete.

Keyword: Experimental Study, Quarry Sand, Rice Husk, Replacing, Concrete

1.INTRODUCTION

1.1 General

Concrete as is well known is a heterogeneous mix of cement, water and aggregates. The admixtures may be added in concrete in order to enhance some of the properties desired specially. In its simplest form, concrete is a mixture of paste and aggregates. Various materials are added such as fly ash, rice husk, and admixture to obtain concrete of desired property. The character of the concrete is determined by quality of the paste. The key to achieving a strong, durable concrete rests in the careful proportioning, mixing and compacting of the ingredients. In the ancient period, construction work was mostly carried out with help of mudstone from industry. Fly ash is a byproduct of burned coal from power station and rice husk ash is the byproduct of burned rice husk at higher temperature from paper plant artificial fibers are commonly used nowadays in order to improve the mechanical properties of concrete. Considerable efforts are being taken worldwide to utilize natural waste and bye product as supplementary cementing materials to improve the properties of cement concrete. Rice husk ash (RHA) and Fly ash (FA) with using Steel fiber is such materials. RHA is by-product of paddy industry. Rice husk ash is a highly reactive pozzolanic material produced by controlled burning of rice husk. FA is finely divided produced by coal-fired power station. Fly ash possesses pozzolonic properties similar to naturally occurring pozzolonic material. Substantial energy and cost savings can result when industrial by-products are used as a partial replacement for the energy intensive Portland cement. Among the different existing residues and by products, the possibility of using rice husk ash in the production of structural concrete is very important for India. India is the second largest rice paddy cultivating country in the world. Both the technical advantages offered by structural concrete containing rice husk ash and the social benefits related to the decrease in number of problems of ash disposal in the environment have simulated the development of research into the potentialities of this material. A large amount of agricultural 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. Rice husk ash is hazardous to environment if not dispose properly. In our project is deals with the study of effects on the behavior of concrete produced from partial replacement of cement with combination of quarry sand and RHA at different proportions.

Sand mining on either side of the rivers, upstream or in-stream, is one of the causes for environmental degradation and also a threat to the biodiversity. Over the alarming rate of unrestricted sand mining which damage the ecosystem of natural habitats of organisms living on the riverbeds, affects fish breeding and migration, spells disaster for the conservation of many bird species, increases saline water in the rivers, etc Extraction of alluvial material from within or near a streambed has a direct impact on the stream's physical habitat characteristics. These characteristics include bed elevation, substrate composition and stability, in-stream roughness elements, depth, velocity, turbidity, sediment transport stream discharge and temperature. The demand for sand continues to increase day by day as building and construction of new infrastructures and expansion of existing ones is continuous thereby placing immense pressure on the supply of the sand resource and hence mining activities are going on legally and illegally without any restrictions. A large part of this agricultural by-product is burnt as fuel during rice processing and the resulting ash is sold as fertilizer. Other applications of RH are as silicon carbide whiskers to reinforce ceramic cutting tools, and as aggregates and fillers for concrete and board production. However, most of this agricultural by-product is simply disposed, thus representing an environmental problem. Composition of Rice Husk The reasons behind the use of RH in the construction industry are its high availability, low bulk density (90-150kg/m3), toughness, abrasive in nature, resistance to weathering and unique composition. The main components in RH are silica, cellulose and lignin. The composition of RH as a percentage of weight is shown. RH contains high concentration of silica in amorphous and crystalline (quartz) forms. The presence of amorphous silica determines the pozzolanic effect of RH. Pozzolanic effect exhibits cementitious properties that increase the rate at which the material gains strength.

2.METHODOLOGY

Figure.1 shows the Methodology adopted in this study

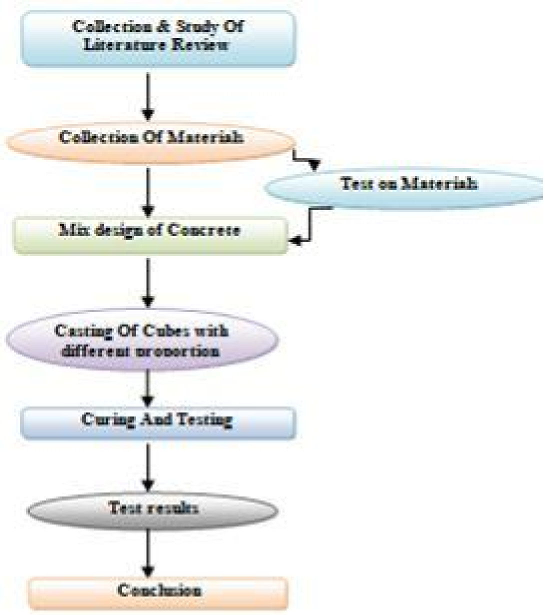

Figure.1 Methodology

3.MATERIALS COLLECTION

3.1 Cement

The cement used was ordinary Portland cement 53 (OPC 53).All properties of cement were determined by referring IS 12269 - 1987. The specific gravity of cement is 3.15. The initial and final setting times were found as 55 minutes and 258 minutes respectively. Standard consistency of cement was 30%. Cement is one of the binding materials in this project. Cement is the important building material in today's construction world. 53 grade Ordinary Portland Cement (OPC) conforming to IS: 8112-1989. Table 1 gives the properties of cement used.

3.2 Coarseaggregate

20mm size aggregates-The coarse aggregates with size of 20mm were tested and the specific gravity value of 2.78 and fineness modulus of 7 was found out. Aggregates were available from local sources. Locally available crushed blue granite stones conforming to graded aggregate of nominal size 20 mm as per IS: 383 – 1970.Crushed granite aggregate with specific gravity of 2.77 and passing through 4.75 mm sieve and will be used for casting all specimens. Several investigations concluded that maximum size of coarse aggregate should be restricted in strength of the composite. In addition to cement paste – aggregate ratio, aggregate type has a great influence on concrete dimensional stability.

3.3 Fineaggregate
The sand which was locally available and passing through 4.75mm IS sieve is used. The specific gravity of fine aggregate was 2.60. Locally available river sand conforming to Grading zone I of IS: 383 –1970.Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm Sieve will be used for casting all the specimens. Fine aggregate" is defined as material that will pass a No. 4 sieve and will, for the most part, be retained on a No. 200 sieve. For increased workability and for economy as reflected by use of less cement, the fine aggregate should have a rounded shape.

3.4 Water
The water used for experiments was potable water. Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. It should be free from organic matter and the pH value should be between 6 to7.

3.5 Quarry Dust
Quarry dust, a byproduct from the crushing process of stones (Bluemetal) which is available abundantly from rock quarries at low cost in many areas can be an economical alternative to the river sand. Quarry dust can be defined as residue, tailing material after the extraction and processing of rocks to form fine particles less than 4.75mm. Quarry dust, which is generally considered as a waste material, causes an environmental load due to disposal problem. Quarry dust being by and large, a waste product, will also reduce environmental impact, if consumed by construction industry in large quantities .Hence, the use of quarry dust as fine aggregate in concrete will reduce not only the demand for natural sand but also reduces the environmental problems .Moreover, the incorporation of quarry dust will offset the production cost of concrete and hence, the successful utilization of quarry dust as fine aggregate will turn this waste material into valuable resource Quarry dust has been used for different activities in the construction industry such as for road construction and manufacture of building materials such as lightweight aggregates, bricks, tiles and autoclave blocks. Usually, quarry dust is used in large scale in the highways as a surface finishing material. Use of quarry dust as fine aggregate in concrete draws serious attention of researchers and investigators.(Figure.2)

3.6 Rise Husk
Around 20% of the paddy weight is husk. In 2008 the world paddy production was 661 million tons and consequently 132 million tons of rice husk were also produced. Rice husk is produced in the first step in the milling process when the husk is removed form the grain in the husking stage of the rice mill. (Figure.3)

Figure. 2 Quarry dust

Figure. 3 Rice Husk

4.MATERIALS PROPERTIES
4.1 Cement
Ordinary Portland cement of 53 grades, conforming to IS 12269-1987 was used. Tests were carried out on various physical properties of cement

- Specific Gravity
- Fineness (By Sieve Analysis)
- Consistency
- Initial Setting Time

4.2 Fine Aggregate
Natural river sand was used as fine aggregate. The results obtained from sieve analysis are furnished in Table 4. The results indicate that the sand conforms to Zone II of IS: 383 – 1970. The properties of sand were determined by conducting tests as per IS: 2386 (Part- I). The results are shown in

4.3 Coarse Aggregate
Crushed granite stones obtained from local quarries were used as coarse aggregate. The maximum size of coarse aggregate used was 20 mm. The properties of coarse aggregate were determined by conducting tests as per IS: 2386 (Part – III).

- Surface Moisture
- Fineness Modulus
- Specific Gravity

4.4 Properties Of Rice Husk
Rice husk is a potential material, which is amenable for value addition. The usage of rice husk either in its raw form or in ash form is many. Most of the husk from the milling is either burnt or dumped as waste in open fields and a small amount is used as fuel for boilers, electricity generation, bulking agents for composting of animal manure, etc.The exterior of rice husk are composed of dentate rectangular elements, which themselves are composed mostly of silica coated with a thick cuticle and surface hairs. The mid region and inner epidermis contain little silica confirmed that the presence of amorphous silica is concentrated at the surfaces of the rice husk and not within the husk itself. The chemical composition of rice husk is similar to that of many common organic fibers and it contains of cellulose 40-50 percent, lignin 25-30 percent, ash 15-20 percent and moisture 8- 15 percent .After burning, most evaporable components are slowly lost and the silicates are left. The typical properties of rice husk are indicated. No other plant except paddy husk is able to retain such a huge proportion of silica in it.

4.4.1 Thermal Decomposition Of Rice Husk
There are two distinct stages in the decomposition of rice husk - carbonization anddecarbonation. Carbonization is the decomposition of volatile matter in rice husk at temperature greater than 300°C and releases combustible gas and tar. Decarbonationis the combustion of fixed carbon in the rice husk char at higher temperature in the presence of oxygen. The melting temperature of RHA is estimated as 1440°C, that is, the temperature at which silica melts.

4.4 The properties of Quarry dust:
4.4.1 Higher Strength of concrete:
The quarry dust has required gradation of fines, physical properties such as shape, smooth surface textures and consistency which make it the best sand suitable for construction. These physical properties of sand provide greater strength to the concrete by reducing segregation, bleeding, honeycombing, voids and capillary. Thus required grade of sand for the given purpose helps the concrete fill voids between coarse aggregates and makes concrete more compact and dense, thus increasing the strength of concrete.

4.4.2 Durability of concrete:
Since quarry dust (M-Sand) is processed from selected quality of granite, it has the balanced physical and chemical properties for construction of concrete structures. This property of M-Sand helps the concrete structures withstand extreme environmental conditions and prevents the corrosion of reinforcement steel by reducing permeability, moisture ingress, and freeze-thaw effect increasing the durability of concrete structures.

4.4.3 Workability of concrete:
Size, shape, texture play an important role in workability of concrete. With more surface area of sand, the demand for cement and water increases to bond the sand with coarse aggregates. The control over these physical properties of manufacturing sand make the concrete require less amount of water and provide higher workable concrete. The less use of water also helps in increasing the strength of concrete, less effort for mixing and placement of concrete, and thus increases productivity of construction activities at site.

5.TESTING PROCEDURE

5.1 General Procedure
Within the experimental research program concerning the development of mechanical properties of a partially replacement of cement by rise husk, partially replacement of sand by quarry dust, is used reference concrete of grade

M25 (REF) was considered with the following composition, accordingly. The w/c-ratio is 0.43. Coarse aggregates were chosen, having a particle size mainly varying between 2 mm and 20 mm.
An intensive experimental program is performed to study the effect of internal curing on different types of concrete properties.

5.2 Compressive Strength Test
When a specimen of material is loaded in such a way that it extends it is said to be in tension. On the other hand if the material compresses and shortens it is said to be in compression. On an atomic level, the molecules or atoms are forced apart when in tension whereas in compression they are forced together. Compressive strength is a key value for design of structures .At the time of testing, each specimen must keep in compressive testing machine. The maximum load at the breakage of concrete block will be noted. From the noted values, the compressive strength may $calculated by using below formula.

Compressive Strength = Load / Area
Size of the test specimen=150mm x 150mm x 150mm

5.3 Impact Test Set-Up
After thoroughly reviewing the literature , the present authors have used simple free-fall velocity impact tests. This method used a repeated dropping of steel mass of weight of 44.53 N (4.54 kg) through a pulley arrangement from a height of 457 mm, on to the slabs, which were placed in simple supported condition . The number of blows received on initial and final cracks (on ultimate specimen failure) was carefully counted and immediately noted down. The initial impact energy absorption (IIEA) (at first crack) results are presented and ultimate impact energy absorption.
E = n x (w x h) JoulesWhere
E = energy (absorbed by the specimen on impact) in Joules
n = number of blows (on impact specimen)
w = weight (of steel mass) in Newton
h = height (from where steel mass is dropped on the specimen) in meter

5.4 Slump Test
Fresh concrete when unsupported will flow to the sides and sinking in height will take place. This vertical settlement is known as slump. The workability (ease of mixing, transporting, placing and compaction) of concrete depends on wetness of concrete (consistency) i.e., water content aswell as proportions of fine aggregate to coarse aggregate and aggregate to cement ratio. The slump test which is a field test is only an approximate measure of consistency defining ranges of consistency for most practical works. This test is performed by filling fresh concrete in the mould and measure the settlement.

6.TEST RESULTS
6.1 Slump Test Results
Table.1. shows Slump test results

Table.1. Slump test results

MIX PROPORTION	HEIGHT OF CONE	SLUMP VALUE
M1	28	2
M2	26	4
M3	25	5

Cement :F.Agg : C.Agg : Water: Q.Dust : R.Husk

M1 - 100 % : 50 % : 100 % : 30 % : 20 %

M2 - 100 % : 50 % : 100 % : 20 % : 30 %

M3 - 100 % : 50 % : 100 % : 10 % : 40 %

6.2 Compressive Strength Test Results

Compressive strength test results given in Table2,3,4,5 and shown in Figure.4 & 5

Table.2 Compressive strength ofM1 Mix

PLATE ID	COMPRESSIVE STRENGTH N/mm²	
	7 DAYS	28 DAYS
M1	21.3	34
M2	21.24	34.14
M3	21.4	33.94
AVERAGE	21.31	34.03

Table.3 Compressive strength of M2 Mix

PLATE ID	COMPRESSIVE STRENGTH N/mm²	
	7 DAYS	28 DAYS
M1	21.1	32.4
M2	21	32.6
M3	21.3	32.5
AVERAGE	21.13	32.5

Table.4 Compressive strength of M3 Mix

PLATE ID	COMPRESSIVE STRENGTH N/mm²	
	7 DAYS	28 DAYS
M1	21.5	34
M2	21.3	33.8
M3	21.1	34.1
AVERAGE	21.3	33.96

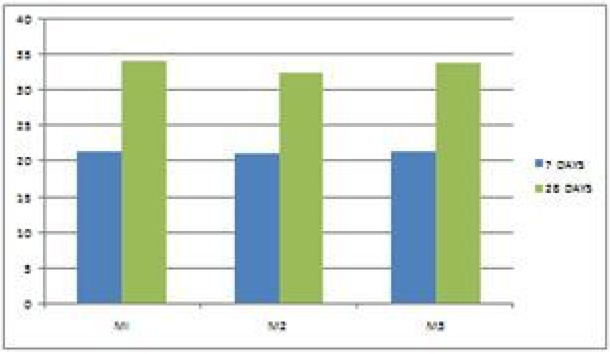

Figure.4. Compressive strength Test results in Chart

Table. 5 Comparison of the compressive strength of concrete mix with various percentage replacement of fine aggregate.

DAYS	CONTROL MIX	M1	M2	M3
7days	19.2	21.31	21.13	21.30
28days	30.8	34.03	32.50	33.96

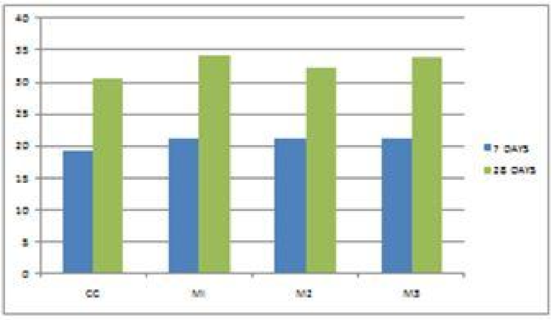

Figure.5. Comparison between control mix and M1 mix

7. CONCLUSIONS

Quarry dust and Rice husk is found to be superior to other supplementary materials like slag, and silica fume. Due to low specific gravity of RHA which leads to reduction in mass per unit volume, thus adding it reduces the dead load on the structure. Used of quarry dust and Rice husk helps in reducing the environment pollution during the disposal of excess Rice husk., so the partial replacements of rice husk & quarry dust we use three different ratios are (30% QA+ 20% RH),(20% QA+30%RH),(10% QA + 40%RH).Rice husk has been used directly or in the form of ash either as a value added material for manufacturing and synthesizing new materials or as a low cost substitute material for modifying the properties of existing products.

- Quarry dust & Rice husk can be replacing the fine aggregate in the concrete mixture up to various percentages (30% QA+ 20% RH),(20% QA+30%RH),(10% QA + 40%RH).
- The use of quarry dust and rice husk in concrete mix for a given w/c ratio, increases the tensile and Compressive strength.
- M25 grade have a maximum compressive strength is 34.14N/mm^2. Replacement of fine aggregate by sample 1 (30% QA+ 20% RH) increased the concrete strength compared to the conventional concrete mix. Sample 1 gives the maximum strength compared to sample II &sample III.
- Maximum Impact Energy At First Crack 854.85 for mix 1 get a maximum value.

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