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AN EXPERIMENTAL INVESTIGATION ON THE MECHANICAL PROPERTIES OF CONCRETE WITH GRADE M60 BY PARTIAL REPLACEMENT OF CEMENT WITH SILICA FUME AND RICE HUSK ASH

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Abstract- Higher compressive quality cement was needed nowadays due to the rapid population growth, increased need for housing and foundation, and late developments in structural design, such as tall buildings and long spans. Some common materials are used to reduce the use of concrete since the main raw material in concrete is concrete, which emits CO2 during its production. The effects of mineral admixtures on the compressive and flexural qualities of cements containing fly ash (FA), rice husk ash (RHA), and silica smolder (SF) were tentatively investigated in this investigation. The focus of the present study is on M60 grade concrete, with three distinct proportions of concrete substitution (FA + RHA + SF = 30%) using fly and rice husk debris, silica seethe, and other debris (FA + RHA + SF = 20:05:05, 18:06:06, and 16:07:07. For 50 mm to 75 mm of droop, the actual water concrete percentage used in the blend structure for M60 grade concrete is 0.29. At 7 years old and 28 days old, the solid forms and shafts are cast and tested individually for compressive and flexural quality.
Keywords— *Experimental Investigation, Mechanical Properties, Concrete, Grade M60, Partial Replacement of Cement, Silica Fume, Rice, Husk, Ash.*

INTRODUCTION

As everyone knows, concrete is a mixture of aggregates, water, and cement that is heterogeneous. Admixtures are substances that may be added to concrete to improve certain desired attributes. Concrete is essentially just a paste and aggregate combination. To produce concrete with the desired properties, admixture, fly ash, and rice husk are among the components that are added. The paste's quality determines the concrete's character. The precise measuring, mixing, and compacting of the elements is essential to producing strong, long-lasting concrete. Mudstone from industry was mostly used in construction throughout the ancient era. 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 utilise 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. 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. 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. Recycling of the disposed material is one method of treating the agricultural waste. The used of rice husk ash material in the formation of a composite material that can be used for construction. Rice husk ash is hazardous to environment if not dispose properly. This research paper deals with the study of effects on the behavior of concrete produced from partial replacement of cement with combination of FA and RHA at different proportions.

LITERATURE REVIEW

Makarand Suresh Kulkarni (2014) in this investigation optimized RHA, by controlled burn and or grinding, has been used as a pozzolanic material in cement and concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions. Up to now, little research has been done to investigate the use of RHA as supplementary material in cement and concrete production in Vietnam. The main objective of this work is to study the suitability of the rice husk ash as a pozzolanic material for cement replacement in concrete. However it is expected that the use of rice husk ash in concrete improve the strength properties of concrete. Also it is an attempt made to develop the concrete using rice husk ash as a source material for partial replacement of cement, which satisfies the various structural properties of concrete like compressive strength. His findings from the entire experimental work & studies concluded that mix M2 (M0+20%RHA) is the best combination among all mixes, which gives max, tensile, flexure & compression strength over normal concrete.

Kulkarni et al. (2014) carried out due to addition of rice husk ash, concrete becomes cohesive and more plastic and thus permits easier placing and finishing of concrete. Adding 20% RHA gives maximum, compression strength over normal concrete.

Deepa G Nair (2013) investigated on high strength and high performance concrete which are being widely used all over the world. Most of the applications of high strength concrete have been found in high rise buildings, long span bridges etc. The potential of rice husk ash as a cement replacement material is well established. Earlier researches showed an improvement in mechanical properties of high strength concrete with finely ground RHA as a partial cement replacement material. A review 22 of literature urges the need for optimizing the replacement level of cement with RHA for improved mechanical properties at optimum water binder ratio. His findings discusses the mechanical properties of RHA-High strength concrete at optimized conditions.

Harunur & Keramat (2011) investigated the durability of cement mortar in presence of Rice Husk Ash (RHA)‖. The strength and durability of mortar with different replacement level (0%, 15%, 20%, and 30%) of Ordinary Portland Cement (OPC) by RHA is investigated .It is concluded from the paper that the mortar incorporating rice husk ash is more durable than OPC mortar up to 20% replacement level.

Maurice &Godwin (2011) investigated the effects of partially replacing OPC with RHA. It is concluded that Adding RHA to concrete resulted in increased water demand, increase in workability and enhanced strength compared to the control sample. This results show that an addition of RHA from 5-10% will increase the strength.

Kartini& Mahmud (2011) reported on the Improvement on Mechanical Properties of Rice Husk Ash Concrete with Super plasticizer‖. Without super plasticizer RHA concrete attained lower compressive strength than that of the control due to the higher amount of water for similar workability. RHA concrete improves the durability of concrete. It is concluded from the paper that by adding super plasticizer to the RHA mixes, higher replacement levels are possible. Concrete containing up to 30%RHA can attain strength of 30 N/mm2 at 28 days.

Ramadhansyah Putra Jaya (2011) studied the compressive concrete strength and the gas permeability
properties over varying fineness of the rice husk ash were experimentally investigated. Their relationships among them were analyzed. In his study eight samples were made from the rice husk ashes with a different grain size were used, i:e: coarse original rice husk ash 17.96 µm (RHA0), 10.93 µm (RHA1) 9.74 µm (RHA2), 9.52 µm (RHA3), 9.34 µm (RHA4), 8.70 µm (RHA5), 6.85 µm (RHA6) and 6.65 µm (RHA7). The ordinary Portland cement was partially replaced with the rice husk ash (15 wt%). His findings showed that the RHA3 produced the concrete with good strength and low porosity. Additionally the strength of the concrete was improved due to the partial replacement of RHA3 material in comparison with normal coarse rice husk ash RHA0. On the other hand the influence 21 of OPC and RHA materials on the concrete permeability was affected by the grinding time and age (i:e:, curing time). The permeability coefficient decreased with the increasing of curing time. The relationships between compressive strength and permeability coefficient are greatly affected by curing times and are sensitive to the grinding cementations systems.

METHODOLOGY

(i) Initial Testing- To ensure the fine aggregates, coarse aggregates, and cement were suitable for producing concrete, preliminary tests were conducted on them.

(ii) Mix Design- The goal strength was 20N/mm2. The nominal mix design of 1:1.5 for fine aggregate, 3 for coarse aggregate, and 1 for cement was used.

(iii) Batching- An electronic weighing equipment was used to weigh the ingredients in batches.

(iv) Mixing- A concrete mixer was used to mix the material according to the standard for three minutes.

(v) Mold preparation- Prior to casting the specimens, each cube was cleaned, tightly screwed, and oil was applied to all surfaces to prevent concrete adhesion during casting.

(vi) Compaction- Concrete was placed in oiled molds in three layers for cubical molds and five layers for cylindrical molds, with each layer being tamped 25 times with a tamping rod.

(vii) Curing- Following a 24-hour period, all of the cast specimens were removed from the molds, labeled (to identify the casting batch), and then placed into the curing tank for seven, fourteen, and 28 days for various specimens. Throughout the curing process, it was not permitted for the specimens to dry out.

(viii) Testing- After 7, 14, and 28 days, the specimen was removed from the curing tank to conduct a variety of tests. For each sample, three specimens were evaluated, and the average value for cubes was determined. A compression testing equipment was used to evaluate the specimens.

MODELING AND ANALYSIS

(i) Materials- Ordinary Cement For the investigation, Portland cement 43 grade (OPC 43) made by Ultra Tech was utilized. The following is a list of the several cement qualities that comply with Indian Standard IS: 8112-1989. Every test was carried out in accordance with IS: 4031–1988 guidelines. Coarse Mixtures The coarse aggregates were crushed stone aggregates that were readily accessible in the area. Coarse aggregate is the material that is retained on an IS sieve with a size of 4.75 mm. aggregate with a ten-size particle In this work, mm and 20 mm were utilized. After being thoroughly cleaned and rinsed with water to remove any remaining dirt and dust, the aggregates were dried until they were surface dry. We tested the aggregates in accordance with IS: 383-1970.

High-quality Aggregate River sand that could be found nearby was utilized as fine aggregate. There was a maximum size of 4.75 mm and a minimum size of 150 microns for the fine aggregate. Fine aggregate testing complies with Indian Standard Specifications, IS: 383-1970.

(a) Water- Because it actively participates in the chemical reaction with cement, water is an essential component of concrete. The amount and quality of water needed for concrete should be carefully considered, since it aids in the formation of cement gel, which gives the material strength.

(b) Super plasticizer- Super plasticizers are often quite unique substances that enable the production of concrete, which differs significantly from concrete made with water-reducing admixtures in both its fresh and hardened states.

(c) Alccofine- High performance concrete contains an additional cementitious ingredient. The different characteristics of alccofine. Alccofine 1203's physical and chemical characteristics.

(ii) Model

(a) Preparation of Moulds- The mould shall be made up of metal, ideally steel or cast iron, and strong enough to prevent deformation. It shall be made in such a way so as to help the removal of the moulded sample without damage. Cubes of (150×150×150) mm size, beam of (100×100×500) mm and cylinders of (150D×300H) mm size were cast in standard moulds. The moulds of cubes, beams and cylinders were cleaned thoroughly of any dry concrete sticking to them of previous use. The moulds were then assembled and all the nuts and bolts were oiled and tightened. The surface of moulds was then coated with a thin layer of oil to avoid adhesion of concrete with the walls of mould so that the specimens can be detached easily later.

(b) Casting of Specimens- The moulds had a Bottom layer compacted with a temping rod with bullet nose to provide a proper formation of corners and base. Then second and third layers were placed and temped. After this the moulds were placed on the table vibrator for the compaction. Proper compaction is attained when the slurry of cement appears on the surface. The vibrator was stopped and some amount of concrete was poured to fill it. The mould was again vibrated and top surface was finished with a trowel. Casting for specimens was done for each test of normal cement concrete and for concrete having rice hush ash and alccofine.

(c) Curing- All the samples were submerged in water tank for 7 days, 14 days, 28 days, 56 days & 90 days. After the specified time period of curing, the samples were put to test. The testing programmed and methodology to be adopted as planned has been explained in this paper to achieve the listed objectives of the present investigation. The procedure adopted for testing fresh and hardened properties of concrete have also been described. Hardened and fresh properties of RHAC trial mixes have been discussed in the chapter. The test data and results of experimental investigation as obtained have been explained and analysed in detail in the ensuing chapters.

(iii) Mix Proportioning of Control Concrete- According to IS method of mix design, the proportions of control concrete were first obtained, trial mixes were carried out to determine the strength at 7, 14, 28, 56 & 90 days and the results achieved are presented in table below, where in the compressive strength obtained for M60 grade trial mixes are represented against age. The slump was measured to know the range of workability, which was desired to be between 75 to 100 mm. But the slump achieved in the trial mix was very less, hence super plasticizer was used to attain the necessary slump. Different mixes were tested for slump and ideal dosage which gave the necessary slump was noted and same was used in the final mix.

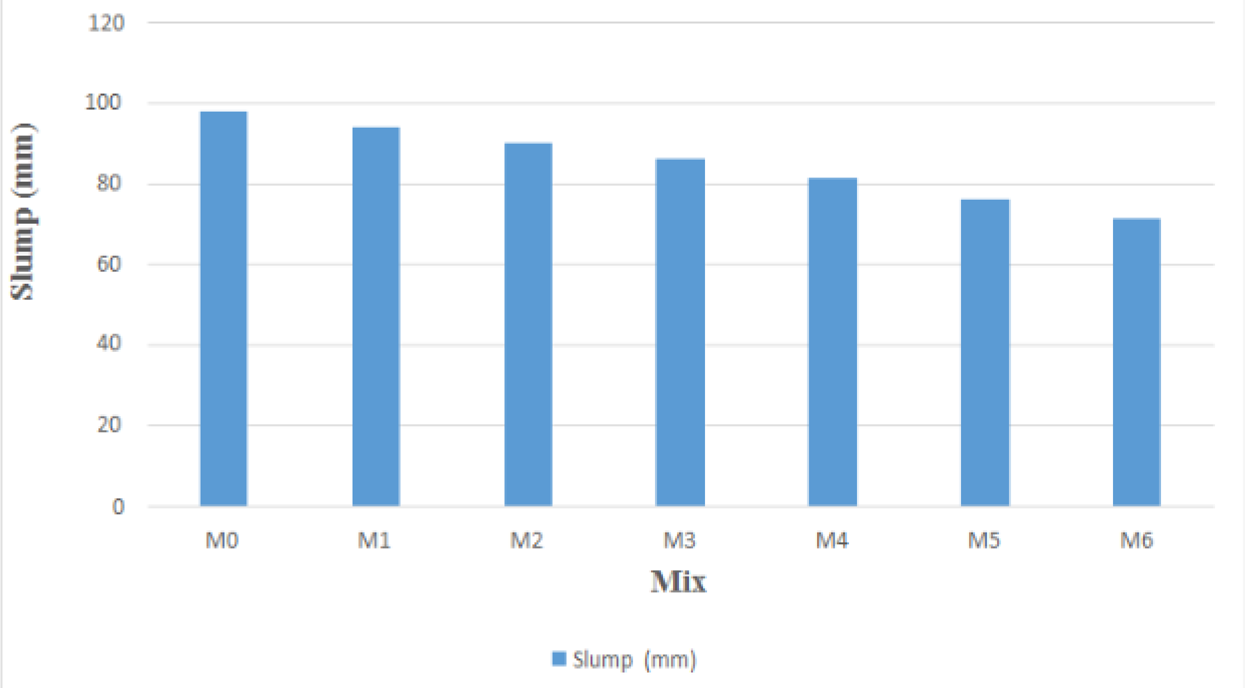
(iv) Workability- The workability of the concrete decreases by adding the RHA. The workability as measured from slump cone test for control mix was 98 mm whereas it decreases gradually by addition of SCM i.e. RHA and alccofine and reduced to 71 mm at 30% exchange of rice husk ash and 8% addition of alccofine. This decrease in workability was due to small size of rice husk ash and alccofine and also because of better packing & better intermolecular forces as the RHA acts as filler and also has self-adhesive properties leading to reduction in workability.

(a) Results obtained during Slump Cone Test-

Mix	CC	5%	10%	15%	20%	25%	30%
Slump(mm)	98	94	90	86	81	76	71

Table 1- Slump Cone Test

(b) Slump Cone Test-



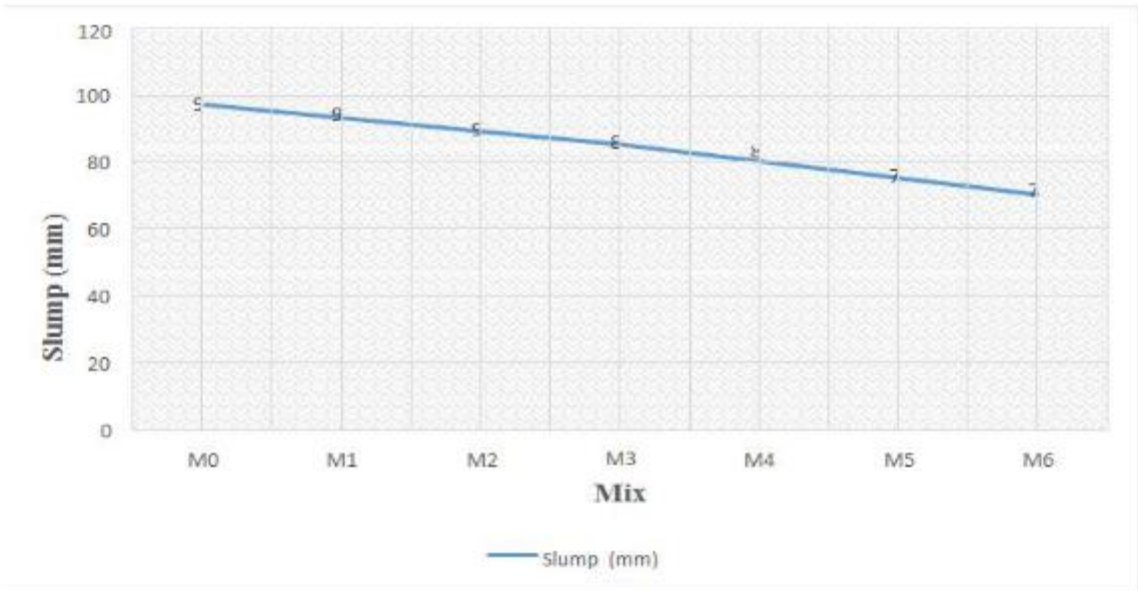


Figure 1- Slump Cone Test

CONCLUSION

It is discovered that rice husk ash is an excellent supplemental substance. The alcofine and rice husk ash employed in this study work well as pozzolanic materials because of the ash's low specific gravity, which causes a decrease in mass per unit volume and, as a result, lessens the dead weight on the structure. By using RHA, the amount of pollutants released into the environment when surplus rice husk ash is dumped is reduced. Because cement is an expensive ingredient, rice husk ash can partially replace it, lowering the cost of the concrete. based on the little study on rice husk ash's strength behavior using alccofine. The ensuing deductions are made: The compressive strength gradually increases at every cement replacement level where rice husk ash is used. On the other hand, compressive strength increases significantly between 7 and 28 days, then gradually between 28 and 56 days. Split tensile strength increases to a replacement level of 25% before showing a little downward trend. At every replacement level, flexural strength rises. The amount of greenhouse gases released may be reduced even more by using rice husk ash as a replacement in concrete. Consequently, there is a higher chance of obtaining more carbon credits.

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