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EXPERIMENTAL STUY ON COCOCNUT FIBRE REINFORCED, TRIPLE BLENDED CONCRETE OF M60 GRADE CONCRETE

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Abstract:

Cement is a precious resource because it can be used to build sturdy structures, as well as roads and railways. In many developing countries, on the other hand, cement is prohibitively expensive due to a lack of local resources to produce enough of the material to meet national demand. Rice husk ash and coir, a material physically richer in silica, can be utilised as an extra cementitious material and can substitute a portion of Portland cement in concrete without scarifying its compressive strength in rice, coconut-producing countries. For decades, experts have been working to increase the quality, strength, and toughness of concrete, one of the most widely utilised man-made structures in civil engineering. In thermal power plants, coal combustion generates fly ash as a by-product. Fly ash was identified as pozzolona and this has led to the use of fly ash in production of concrete which improves many qualities of concrete. Rice husk ash is the product of rice. RHA, coir are also improves the workability, reduces segregation, bleeding, and lower heat of hydration In this project, the detailed experimental investigation was done to study the effect of Partial replacement of cement by up to 15% RHA, 10% fly ash, 0.5% coir in combines proportions starting from 7.5 % RHA, 10%fly ash, 0% coir mix with the gradual increase of RHA and coir simultaneously 10%, 15% and 0.2%,0.5%. In this project fly ash is maintain 10% only. The tests on hardened concrete were destructive in nature which includes compressive test for size (150×150×150 mm) at 7,28 days of curing as per IS:516-1959and split tensile strength on cylinder (150×300 mm) at 7, 28 days of curing as per IS 5816-1999.The work presented in this paper reports the effects on the behaviour of concrete produced from cement with combination of RHA, FA, Coir at different proportions on the mechanical properties of concrete such as compressive strength, and split tensile strength Investigation reported that the combination of 10% RHA, 10% FA, 0.2% Coir gives better results. Partial replacements of RHA, FA, Coir reduces the environmental effects, produces economical and eco-friendly concrete. Therefore, the combination stated above is recommended whenever the combine of RHA, FA, and Coir is proposed to be used.

1.0 Introduction:

The rising nations concern of possessions depletion and worldwide toxic waste has challenged many researchers to pursue and advance new materials based on renewable capitals. These contain the use of by-products and surplus ingredients are designed for building construction. Aggregates characterized under this section are those directly used without the requirement for processing The high cost of orthodox building material is a major factor acting construction in India. In emerging countries where rich agricultural and industrial wastes are cleared, these wastes can be recycled for various purposes in construction industry. This will have twin the advantages, reduction in the price of construction material and also as a means of dumping wastes. Thus the approach is logical, worthy and attributable. Therefore an effort has been completed in this study to utilize the designed study of coconut fiber reinforced, triple blended concrete of M60 grade concrete. Coir fibers and Rice husk ash are new materials used in the field of construction.

Rice Husk Ash:

Rice is the seed of the monocot plants Oryza sativa (Asian rice) or Oryza glabaerreima (African rice). Rice is developed in all universes with the exception of Antarctica. Rice development is the standard movement to give sustenance of the million people of the world and furthermore the wellspring of the wage for some families. A insufficient countries of Asia and Africa are exceptionally dependent on the rice as a sustenance. Rice is the second most devoured nourishment after maize in everywhere throughout the world. Asia is the commanding mainland for generation of rice. Around 90 % of rice supply of the world is created by Asia.

Table: the chemical composition of Rice husk as organic fibers.

Rice husk	Range (%)
Cellulose	40-50
Lignin	25-35
Ash	15-20
Moisture	8-15

In this century, the use of rice husk cinder (RHA) as bond substitution is another pattern in solid innovation. Additionally, to the extent the maintainability is concerned, it will likewise take care of issues generally experienced in discarding the squanders [Chandra, 1997]. Transfer of the husks is a major issue and open store consuming isn't adequate on natural grounds, thus the lion's share of husk is at present going into landfill.

Applications of Rice Husk

Reasonableness of Rice husk (RH) to be utilized for various applications relies on the physical and synthetic properties of the husk, for example, fiery debris content, silica content and so on. The immediate utilization of rice husk as fuel has been found in control plants. Aside from this, RH utilizes as a wellspring of crude material for the blend and advancement of new stages and mixes. A point by point portrayal identified with utilization of rice husk in mechanical divisions and additionally different fields is given beneath.

2.0 Review of literature

The main problem with agricultural waste materials is with their disposal or storage. Burning these wastes cause many harmful environmental problems. Many research groups have been working on the utilization of the waste materials for potential applications. Literature on the production and applications of the RHA, Fly Ash and Coir materials are reviewed. Some of the reports on the concerned topic are given below.

[1] Jay. J. Lad, Prof. A.R. Draji, Dr. K.B. Parikh (February 2017) did test examination at Dahood Govermental building school. They examined on "Quality and toughness investigation of cement by utilizing Rice Husk Fiery remains and Coconut Fiber". The advancement of cement by utilizing diverse negligible of Rice Husk Fiery remains and Coconut Fiber Their exploratory is done for the assessing the impact of Rice Husk Cinder and Coconut Fiber in M30, M40 and M50 review o concrete.

[2] M.M. Prasad (2015) explored the impact of 17%, 22%, 27% and 32% of bond substitution by fly cinder and silica rage on traditional M20 review of cement. M20 review of cement has been considered as reference blend. Examples are thrown and restored regularly for 28 days and after that tried for flexural quality and split rigidity to disappointment according to IS determinations and the outcomes have been looked at. The test outcomes demonstrate that the flexural and split elasticity of fly fiery remains silica smolder concrete containing upto 27% fly cinder in addition to silica seethe are practically identical to that of customary cement.

[3] Fayaz Shaik, Malavika Chakravarthy (2015) examined the impact of the execution by the utilizing supplementary cementitious materials to accomplish high quality multi mixed cement blends. An endeavour is made to look at the execution of multi mixed cement blends with customary Portland bond (OPC) concrete. The opc concrete blends bond was mostly and supplanted by Fly ash(FA), Silica Fume(SF), Metakaolin(MK) in various extents of 5%, 10%, 15% and furthermore in various mixes of these materials tried.

3.0 Materials used in concrete and discussion

In this chapter, different types of materials used in their descriptions like R.H.A, F.A, Fiber Coconut or Coir replacement, chemical admixture/c ratio and age of curing. Those materials carried out of preliminary properties of ingredients. Those materials are used in different percentages R.H.A 7.5%+ F.A 10%+ Coir 0%, R.H.A 10%+ F.A 10%+ Coir 0.2%, R.H.A 15%+ F.A 10%+ Coir 0.5%

Cement

Cement used in the investigation in Portland Pozzolona Cement (PPC), conforming to Indian standard IS 1489 (part 2)1991. In this investigation I used Panama cement.

Uses of Rice Husk Ash

This item can be utilized in an assortment of uses like

- Green Concrete
- High Performance Concrete
- Refractory
- Ceramic Glaze

Physical properties of coir fiber

The physical properties of coir fiber are adopted and as shown in table 3.3.1. In this investigation coir was taken from Dhulapally market.

Table: Physical Properties of Coir Fiber

Ultimate length		0.6 mm
Diameter/width		16 micron
Single fiber	Length	6 to 8 inches
	Density	1.4 g/cc
	Tenacity	10 g/tex
Breaking Elongation		30%
Moisture regain at 65% RH		10.5%
Swelling in water		5% in diameter

Table: Chemical Properties of Coir Fiber

Water soluble	5.25%
Pectin & related compounds	3.30%
Hemi-Cellulose	0.25%
Cellulose	43.44%
Lignin	45.84%
Ash	2.22%

Coconut fiber in construction:

Plain concrete is a fragile material with low rigidity. There has been a relentless increment in the utilization of short and arbitrarily appropriated normal fibres to strengthen the network (glue, mortar and cement). Filaments adjust the conduct of solid when a split happens by crossing over the breaks and along these lines can give some post splitting sturdiness. Strands crossing the split assurance a specific level of pressure exchange between the two countenances of break, giving a lingering quality to the composite, whose extent relies upon the fibre, framework and fiber– grid interface Quality and strength are frequently viewed as the most imperative criteria in solid structure plans. These criteria particularly apply for marine structures, which are presented to risky conditions and utilized in rock solid undertakings, for example, opposing scraped area and disintegration from sea waves, high stacking for shipments, and high seismic stacking from the crash of water transports to the structure, among others and as appeared in figure

Figure: Coconut Fiber Bridging Crack

Table: Chemical Composition of Fly Ash

Component	Bituminous	Sub bituminous	Lignite
Sio_2 (%)	20-60	40-60	15-45
Al_2O_3 (%)	5-35	20-30	20-25
Fe_2o_3(%)	10-40	4-10	4-15
Cao (%)	1-12	5-30	15-40
Loi (%)	0-15	0-3	0-5

Discarding and Marketing Agency

In the point of reference, fly fiery debris made from coal ignition was simply entrained in pipe gases and diffuse into nature. This made ecological and wellbeing worries that supported laws that have lessened fly fiery remains emanation to < 1% of cinder delivered. All around over 65% of fly slag delivered from coal control stations is willing of in landfills and fiery remains lakes, in spite of the fact that organizations, for example, Duke Energy are beginning activities to uncover coal cinder bowls because of the negative biological effect concerned.

Fly Ash Impact on Ecological

Fly fiery remains having high substance of poisonous/overwhelming metals might be utilized saved under master exhortation. The condition service's master board opined that the interface between the water and fly fiery remains at the base of fly powder filled void outcomes in filtering of substantial metals into groundwater framework as clear by elevated

amounts of follow components especially overwhelming metals in ground water tests gathered from destinations found near the slag filled voids.

General Problems with Admixture

General issues that emerge because of contrariness among concrete and water reducers are Rapid loss of functionality, exorbitant enlivening/impediment of setting, and low rates of quality gain. Very frequently, there even exists contrariness between a specific substance and a specific group of the same generally perfect concrete, demonstrating that the idea of the issue is intricate, and needs additionally understanding.

4.0 Experimental investigation on cement materials

In this chapter, different tests carried out on different types of materials used in investigation, the preliminary properties of R.H.A, F.A, F.C replacement of cement, mix design process of determination of quantities of ingredients, test for workability, compressive strength and split tensile strength are discussed in this chapter.

Setting times of cement

The reason for this test is to determine an opportunity to be permitted between blending of cement and setting in position in structures. At the point when water is added to bond, the glue begins hardening and picking up quality, all the while losing its versatility. This is called setting of bond. The time required for this procedure is called setting time. Two kinds of setting times are recognized. Final setting time is the time when the bond glue turns out to be hard to the point that the annular connection to the needle, under standard weight neglects to leave stamp on the solidified concrete glue, however the needle can establish a connection.

Compressive strength of cement

The compressive quality of solidified bond is the most critical of the considerable number of properties. Along these lines, it isn't astonishing that the bond is constantly tried for its quality at the research centre before the concrete is in essential works. Quality tests are not made on perfect bond glue in view of troubles of unreasonable shrinkage and resulting splitting of slick concrete. Quality of concrete is in a roundabout way found on bond sand mortar extents. The standard sand is utilized for finding the quality of concrete. It will affirm to IS 650– 1991.

Description of Mould:-

The test shape ought to be as cubes square having zone confront equivalent to 50 cm2. The form ought to be metallic not agreeable to assault by concrete mortar and the shape material will be adequate thick to stay away from bends. The shape will be machined with the goal that when amassed the measurements and the inward faces will be exact to 7.06 cm and the point between the contiguous inside countenances will be 900 + 0.50. The base plate will be of such measurement as to help the form amid the filling without spillage.

Description of high frequency vibrator:-

It comprises of a form lodging associated with a vibrator table through movable spring nuts. The vibrator is laying on spring bolsters which are mounted on a fixed casing. The vibrator is controlled by a fast engine at 2800 r.p.m. to incite a recurrence of 12000 cycles of vibration to the mortar blocks. A clock change is associated with set to two minutes keep running of the vibrator.

Procedure:-

a. Preparation of cement mortar cubes:-

1. Take 200g of cement and 600g of standard sand (Ennore sand) in a non porous enamel tray and mix them with trowel for a minute.
   Weight of sand for one mould data was adopted and as shown in table 4.2.3a.

Table: Weight of Sand for One Mould

Standard Sand	Weight of Sand (g)
Coarse Sand	200
Medium Sand	200
Fine Sand	200

Include water of amount [P/4 + 3] % of consolidated of weight of concrete and sand (where 'P' is the rate water required to deliver a glue of standard consistency) and blend three fixings altogether until the point when the blend is of uniform shading. The season of blending ought to be not as much as the three minutes and not more than the four minutes.

Mixture Proportion

The target strength of mixture was 40 Mpa. Trial mixtures were made to verify the resulting actual strengths. After adjustments in the trial mixtures, the final mixture was arrived at as 1:1.447:3.24 with water cement ratio of 0.3 by weight.The control mixture was cast with fly ash, rice husk ash and coconut fibre. Cement replacement levels by rice husk ash in mixture were 7.5%, 10% and 15% with 10% of fly ash. For these mixtures, further replacements of cement were made by coconut fibre at replacement levels of 0%, 0.2%, and 0.5%. For all the mixtures, 0.8% of super plasticizer added.

Slump test:

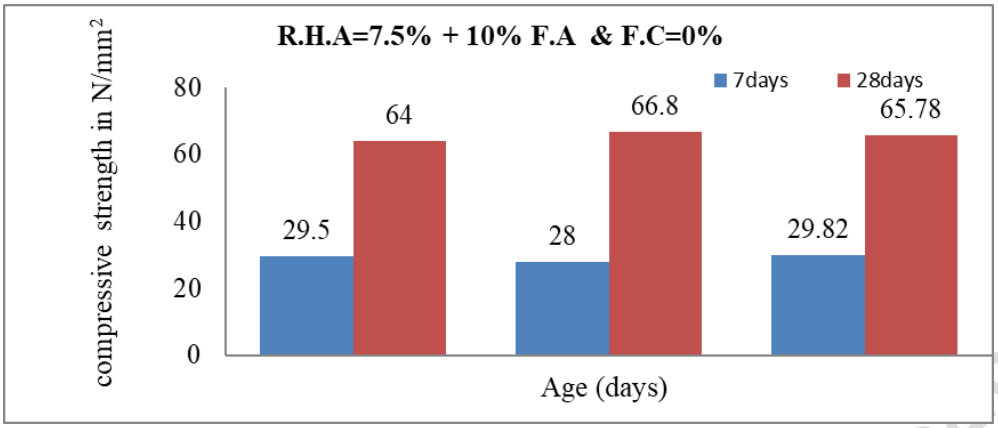
The reason for droop test is to decide the consistency or surface of crisp cement and to check its consistency. Consistency or consistency of cement is imperative to a fruitful solid undertaking. The whole cone is 300mm high. This is done while the cone is held immovably against a level firm surface. The term rodding alludes to a cutting movement performed with a long metal bar, 600mm long and 15.6mm in width. The utilization of a lump of rebar bar isn't viewed as appropriate. The cone is brimming with compacted or rodded cement and now starts the copy some portion of the "droop test". The individual playing out the droop test must lift the cone off the crisp cement in a way not to irritate the solid.

Results and discussions

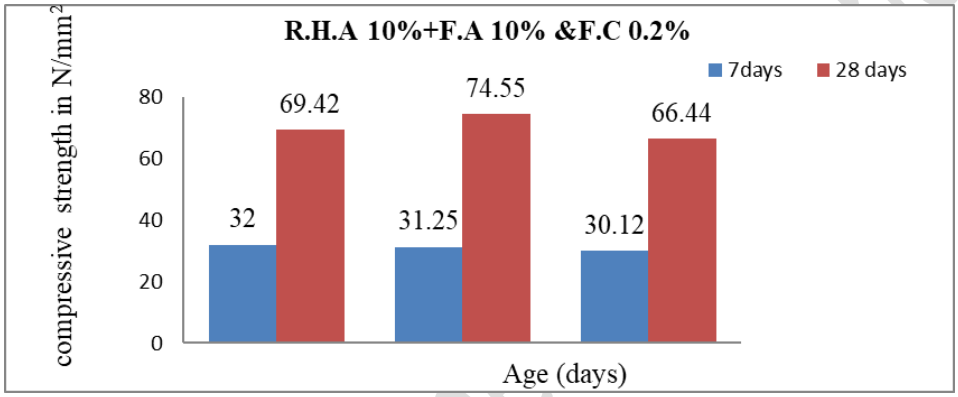
In this chapter experimental Results of M60 grade PPC concrete filled with different proportions of Rice Husk Ash, fly ash, Coconut Fiber for compressive strength and split tensile strength test are shown below.

Table 4.1: Slump Values

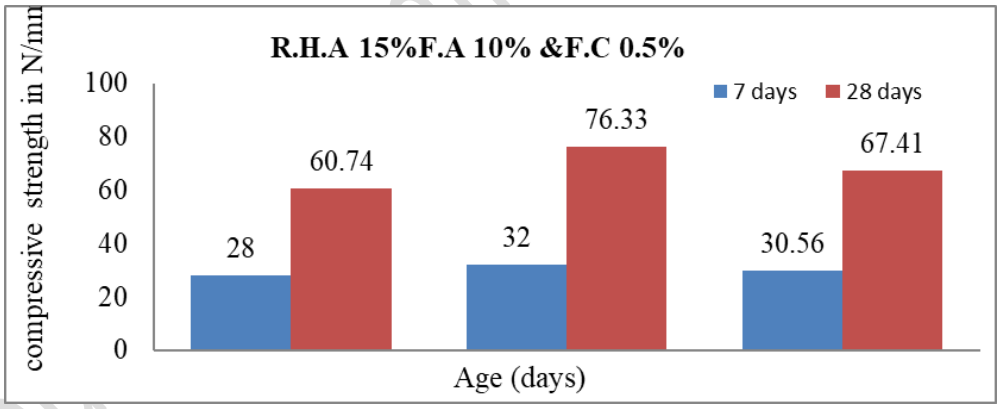
S. No	R.H.A, F.A, F.C	$\frac{W}{C}$ Ratio	Super Plasticizer	Slump Value
1.	Normal Concrete (No Ingredients)	0.3	0.8	52
2.	7.5%, 10%, 0%	0.3	0.8	53
3.	10%, 10%, 0.2%	0.3	0.8	55
4.	15%, 10%, 0.5%	0.3	0.8	52



Graph 4.1: Results of R.H.A 7.5% +F. A 10% +F.C 0%



Graph 4.2: Results of R.H.A 10% +F.A 10% +F.C 0.2%



Graph 4.3: cubes Results of R.H.A 15% +F.A 10% +F.C 0.5%

Compare to fig 7.3c and fig 7.cubes indicates the Results of R.H.A 10**%** +F.A 10% +F.C 0.2% and Results of R.H.A 15**%** +F.A 10% +F.C 0.5% using concrete specimens of M60 grade of concrete cubes were tested after 7 days and 28 days of curing for compressive strength was obtained at that proportions and strength increased by 0.94 N/mm^2 and 1.96 N/mm^2.

Conclusion

The materials like F.A, R.H.A and F.C are suitable materials for partial replacement of cement The coconut coir is increasing the Split Tensile Strength of concrete For M60 grade of concrete the mix ratios are worked out as R.H.A 7.5% +F.A 10% +F.C 0%, R.H.A 10% +F.A 10% +F.C 0.2% and R.H.A 15% +F.A 10% +F.C 0.5%. The testing of cubes

indicated strength of 30.16 N/mm^2, 66 N/mm^2, 29.10 N/mm^2, 65.52 N/mm^2, 31.12 N/mm^2, 70.13 N/mm^2, 30.18 N/mm^2, 68.17 N/mm^2 for 7days and 28 days which are acceptable limits for M60.The coir percentage is 0.2% coupled with 10% R.H.A, 10%F.A has given the required Compressive Strength for M60 grade. The Split Tensile Strength Test required for M60 grade concrete is also obtained by the above combination of 10% R.H.A+10%F.A+0.2%F.C.The combination of R.H.A 7.5% +F.A 10% +F.C 0%, R.H.A 10% +F.A 10% +F.C 0.2% and R.H.A 15% +F.A 10% +F.C 0.5% has given a high Compressive Strength of 66.24 N/mm^2 and Split Tensile Strength of 5.12 N/mm^2.Hence it's recommended that for obtaining that M60 grade concrete with the material considered the combination of 10%, R.H.A 10% may be adopted.

Future Scope

The design can be done for various concrete grades using the Fly Ash, Rice Husk Ash, Coir, Coir Pith and other Jute fibres or any agro waste products contents to get the maximum strength values and suitable proportions can be found.

Reference

[1] Jay. J. Lad, Prof. A.R. Draji, Dr. K.B. Parikh (February 2017) carried out experimental investigation at Dahod Governmental Engineering College. They investigated on "Strength and durability study of concrete by using Rice Husk Ash and Coconut Fibre". https://irjet.blog/2015/09.

[2] Hamad identified (2016/08/01) the temperature range of 500 to 700 °C as optimum for reactive ash formation. https://www.science.gov/topicpages/n/na+si+te.

[3] M.M. Prasad (July 15, 2015) investigated the effect of 17%, 22%, 27% and 32% of cement replacement by fly ash and silica fume on conventional M20 grade of concrete.

[4] Fayaz. Shaik, Malavika Chakravarthy (2015/09) investigated the effect of the performance by the using supplementary cementitious materials to achieve high strength multi blended concrete mixes. https://irjet.blog/2015/09.

[5] J. Anniepeter, N.P. Rajamani and Gopalakrishnan (December 2014) investigated concrete with 28 days compressive strength of about 85 mpa and 108 for Mpa were taken and cement replacement level(CRL) of about 25% was considered. https://irjet.blog/2015/09.