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DEVELOPMENT OF CEMENT BRICKS WITH COIR, ARECA FIBRE & PLASTIC WASTE

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Abstract : As the world population is increasing day by day, the usage of the resources also increasing, with which different varieties of wastes are being generated, creation of non-decaying and low biodegradable waste materials, combined with a growing consumer population has resulted in waste disposal crisis. The solution to the waste disposal crisis is to recycle the waste into useful products. Variety of research projects concerning the environmental suitability and performance of waste plastics in construction and reuse of waste plastics to save our world from pollution. At present situation, the concrete being the area of high interest leads to the most frequent use of concrete in sustainable construction material. The usage of natural fibre as well as artificial fibre in the concrete mixture as fibre reinforcement effectively improved strength and durability requirements of high performance cement composites. The agricultural waste [natural fibre], which are dumped on the lands available at low cost are utilized in the cement bricks to increase its performance. The increased productivity of waste leads to imbalance and irreparable damage to the environment. This project deals with the reuse of waste plastics, coir fibre and Areca. The waste plastic, coir fibre and Areca Fibre were incrementally added in 1%, 2%, 3%,4% in the cement block mixture, tests were conducted on compressive strength of cement blocks.

I. INTRODUCTION

Brick is made using locally available clay. Clay is the common material used for construction all over the world from ancient times. The industry which deals with construction has always shown receptive attitude towards the research of new inventions. Due to increasing awareness and importance in the conservation of natural resources and recycling of industry by-products, has created a need for research to discover or invent new construction materials. One such research area is the utilization of different textile fibres in brick manufacturing. Fibre-Reinforced Concrete (FRC) is a mixture of hydraulic cement, water, fine and coarse aggregate and discontinuous discrete fibres. Here, both synthetic and natural fibres of various shapes and sizes are used, among them steel fibre is the most common one for both structural and non-structural purposes. FRC is used in a wide range of applications.

Current consumption rates of plastic have increased the necessity of plastic recycling. The ever expanding plastic industry, the hazards posed by the use of disposable plastic at the current consumption rates leads to severe public and environmental safety concerns. Waste plastic utilized in the cement brick reinforcement.

The agricultural waste [Natural fibre; Areca, Coir etc.,], which are dumped on the lands available at low cost are utilized in the cement bricks to increase its performance. The increased productivity of waste leads to imbalance and irreparable damage to the environment.

II. OBJECTIVE OF STUDY

To manufacture reinforced bricks by using coir fibre, Areca fibre & plastic waste.

To test the manufactured reinforced bricks.

To compare the manufactured reinforced bricks.

III. MATERIALS & METHODOLOGY

Pozzolana Portland cement; The cement used in this study is 43 Grade

Table 3.1: Properties of the cement used for the study

Cement Properties	
Normal consistency of cement	32%[33 to 35 mm penetration]
Setting time of cement	30 minutes
Fineness of cement	0%
Specific gravity of cement	3.05

Water: The water being essential element which is being used in the the construction work, it should be clean from injurious quantity of alkalis, oils, acids , salt , sugar, organic materials, vegetable growth and other substances that might be deleterious to bricks , stone , steal or concrete. Potable water is the most commonly or generally considered for satisfactory mixing .The PH value of water should not be less than 6.

Aggregates:70 to 80% of the volume of concrete occupied by the aggregates and it has got important influence on its properties.

Table 3.2: Properties of aggregates used for the study

Properties of Aggregates	
Aggregates crushing value	23.57%
Aggregates Impact value	12.29%
Aggregate combined Flakiness index & Elongation	2.18% & 8.47%
Angularity number(Density)	2.32

Coir fibre:Coir fibre is one of the most abundantly available natural fibres, which has got wide range of applications, due to its number of good properties. The coconut fibre is extracted from the husk of the coconut, which is the outer shell of coconut. The length of the fibre varies depending upon the size and locality of the coconut which is grown. Here the coir fibre is been cut into 2 to 3cm to ensure proper mixing with the cement components and to ensure proper moulding.

Table 3.3: Properties of coir fibre used for the study

Properties	**Values**
Length(cm)	7 to 10cm
Fineness(Tex)	62
Thickness(mm)	0.5
Density(gm/cm^3)	1.20

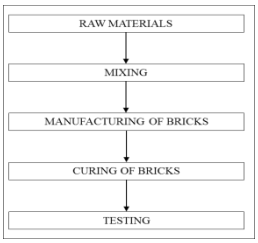
Areca fibre:Areca is one of the promising natural fibres, which shows wide applications in fibre reinforcing, since it is inexpensive, abundantly available. It is gaining immense applications in medicine, chocolate, paint, chewable gutka etc., The areca fibre is been extracted from areca husk and it has got minimal length of 2 to 3cm.

Table 3.4: Properties of areca fibre used for the study

Properties	**Values**
Length(cm)	2 to 3cm
Diameter(mm)	0.89
Density(g/cm$^{3)}$	1.05

Plastic waste: The plastic waste here considered, thermoplastic which can be moulded & remoulded into different shapes, the plastic here considered in flakes form, which is collected from factory.

IV. EXPERIMENTAL METHODS



Flow chart of brick manufacturing process

Mix proportion: The mixed proportion will have a direct impact on the brick strength

Table 4.1: Proportions mixed for each brick

Sl. No.	Mixed materials	Proportion for one cube(According to Mix Design)
1	Cement	1.19kg
2	M Sand	3.05 kg
3	Aggregate	3.88 kg
4	Fibre & Plastic waste	1%, 2%, 3%, 4%
5	Water	476ml

Manufacturing process of cement brick: Calculated amount of cement, jelly, M sand is taken in a tray and mixed properly.

Fig.4.1 cement, jelly, M sand is taken in a tray and mixed properly

Fig 4.2Mixing of coir fibre,areca fibre,& plastic waste with cement and other ingredients

Fig 4.2 coir fibre,areca fibre,& plastic waste with cement and other ingredients

Moulding process;The cement mixture is poured into the iron moulds and tapping is done to get the better shape of moulds and to avoid some cracks in middle after demoulding.

Fig. 4.3 Moulding process

Fig 4.4 Demoulded bricks from the iron mould after one day

Curing: The demoulded bricks are kept in water tank for curing about 14days,curing also plays a vital role and strength also varies with the duration of curing.

Fig 4.5 Curing process of the manufactured bricks

Fig 4.6 After 14 days of curing the bricks are removed from the water tank and kept for drying,

V.Testing of Bricks

The bricks are tested for its compressive strength in UNIVERSAL TESTING MACHINE

Fig 5.1 Testing of bricks for compressive strength

VI. Results, observation and discussion

Compressive Strength Test Results:

Table showing the average compressive strength of concrete cubes with coir, plastic, areca incrementally added 1%, 2%,3%,4% respectively.

Table 5.1 Results of compressive strength test

Sl.no	Brick Type	Brick size	Cross sectional area in mm^2	Failure load in (kN)	Compressive strength in($N\backslash mm^2$)
1	Plain Brick	15cm×15cm×15cm	22500	527.33	23.43
2	Brick with coir	15cm×15cm×15cm	22500	441.33	19.61
3	Brick with coir	15cm×15cm×15cm	22500	440	19.55
4	Brick with coir	15cm×15cm×15cm	22500	285.66	12.69
5	Brick with coir	15cm×15cm×15cm	22500	268.66	11.94
6	Brick with plastic waste	15cm×15cm×15cm	22500	325.33	14.45
7	Brick with plastic waste	15cm×15cm×15cm	22500	447.66	19.89
8	Brick with plastic waste	15cm×15cm×15cm	22500	450.33	20.01
9	Brick with plastic waste	15cm×15cm×15cm	22500	591.66	26.29
10	Brick with Areca fibre	15cm×15cm×15cm	22500	482.66	21.45
11	Brick with Areca fibre	15cm×15cm×15cm	22500	352.33	15.65
12	Brick with Areca fibre	15cm×15cm×15cm	22500	321	14.26
13	Brick with Areca fibre	15cm×15cm×15cm	22500	292	12.97

Observation and discussion:

In this present study, it is observed the compressive strength of the brick with Coir & Areca kept decreasing with the addition of fibres, compared to normal brick.

Whereas when it comes to waste plastic it has shown that the compressive strength which kept increasing with the incriminate in addition of plastic. At 4% of waste plastic in the concrete brick has given the more compressive strength when compared to normal brick[22].

The raw materials here used are without any surface coating, without pre-treatment, without soaking in the water, without any chemical addition to it to improve any of the fiber properties. The materials are used without any of the treatments. And the cement mixture is not added with any of the super plasticizers which will facilitate binding and setting time, because it may react with the fibres which are used in the concrete mix.

The study was to observe the things how it will work with all the above mentioned conditions unlike other study.

Many researches have stated that, it is possible to enhance the properties of fibre reinforced composites through fibre surface modification.
It is also proved that chemically treated areca shows better results than natural untreated fibres[3].
There are so many factors which will affect the fibre reinforced concretes, the results which are arrived in the different researches have given different results, its due to the factors which choose to do the project with.
The factors that will mainly affect the reinforced concrete are most likely, the fibre type, fibre geometry, fibre form, fibre maturity level, fibre surface, mix proportion, mix methods, placing methods, casting technique, curing methods,[6] usage of river sand and M-sand, environmental conditions & different chemical treatments or chemicals used during the procedure.[8]

The research have done keeping the fibre length as deciding factor to test the strength, and it is proved that the optimum length of fibres can only get the good strength, not too short or too long fibres could get the good strength in fibre reinforcement[10] .
Some of the researches have shown that the addition of fibre in minimal amount will gives good results than addition of more fibre in the concrete matrix. The compressive strength of concrete decreases as the volume percentage of coconut increases[7]. If the fibre is added to concrete and tested for compressive strength, the addition of fibre may increase the compressive strength to certain level, only if it is added in minimal quantity[24]. And in some cases it may not increase or it may show decrease in compressive strength also when it is compared to normal brick without any fibre[15]. But in most of the cases the researchers have found increase in fibre addition will certainly increase the tensile strength in general, but it is also upto optimum level. More fibres in the fibre reinforcement will results in decrease in tensile strength as well[7].

The probable reasons for less compressive strength may be due to the, water absorption capacity of natural fibres (Moisture content), inability for binding may be due to surface texture, balling of fibres, that is determined by the type and length of fibre used, and size of the aggregates. It is also may be due to the chemical reaction with the cement paste and fibres used in the concrete mix.
So the natural fibres used are should be undergone for pre-treatment, to remove the surface dust or dirt or to remove the unwanted things, like alkaline treatment of fibres[9], water proofing treatment to the areca fibres[8], to increase bonding. To reduce balling, material handling is important. With some chemical treatment we can reduce water absorption capacity of natural fibres.

Conclusion

In this present study, it is observed the compressive strength of the brick with Coir & Areca kept decreasing with the addition of fibres, compared to normal brick.
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The raw materials here used are without any surface coating, without pre-treatment, without soaking in the water, without any chemical addition to it to which will improve fiber properties. The materials are used without any of the treatments. And the cement mixture is not added with any of the super plasticizers which will facilitate binding and setting time, because it may react with the fibres which are used in the concrete mix.
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