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EXPERIMENTAL INVESTIGATION ON CONCRETE WITH PARTIAL REPLACEMENT OF AGRO WASTE IN COARSE AGGREGATE WITH WAX CURING

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***ABSTRACT** : This study focus and generating the product using agro waste (or) agricultural waste has well develop and alternative construction material. Every year the world produces millions of tons of waste, the majority of which is not recyclable. Recycling garbage also require energy and emits pollution. Coconut shell are major agricultural waste that is heavily available and can be easily assessed in many tropical countries. Due to the depletion of natural resources and also increasing the water scarcity many researches have made focusing on an alternative materials of ingredients in concrete. In this row replacement of coarse aggregate by coconut shells and curing by wax were tried. Concrete cubes had casted using coconut shell as a partial replacement of the coarse aggregate in the proportion of 10%, 20%,30% replacement.*

Key Words: *Coconut Shell, Compressive Test, Fine Aggregate, Coarse Aggregate, Wax Curing*

1.INTRODUCTION

For the majority of civil engineering projects, concrete is a widely utilised building material made of cement, coarse aggregates, and fine aggregates combined with water, which hardens over time. Building construction has increased as a result of the population increase and the quick progress of globalisation, which has raised the need for construction materials.

The part of the concrete's coarse aggregate that consists of the big stones incorporated into the mixture is called coarse aggregate. Coconut shell can be used in this project to partially replace the coarse aggregate with wax curing.

1.1 AGRO WASTE

Agro debris, sometimes referred to as agricultural waste or crop residue, is a term used to describe the remnants or leftovers produced during agricultural operations. It consists of a variety of organic waste products made during farming, including crop stalks, husks, leaves, stems, shells, and other agricultural waste. Agro waste is often produced after crops are harvested, and it differs based on the type of crop and farming techniques. Rice husks, corn stalks, sugarcane bagasse, wheat straw, coconut shells and fruit peels are a few typical forms of agricultural waste. India's substantial agricultural sector makes agro waste a serious problem there.

Crop residues, coconut shells, sugarcane bagasse, cotton stalks, and oilseed residues are some of the primary agricultural waste sources in India.

1.2 COCONUT SHELL AS A AGRO WASTE

India is one of the countries that produces the most coconuts globally, which results in a big volume of garbage from coconut shells. As previously indicated, coconut shells can be used for a variety of purposes, including the manufacturing of activated carbon, charcoal, and concrete aggregates.

After the coconut has been processed to generate its final goods, manufacturers or farmers either collect the leftover garbage or coconut shells for disposal or leave them alone. The biggest hazard to our environment might not be the garbage from coconuts. The coconut shells will still be difficult to dispose of if they are not recycled. Due to its high content of lignocelluloses, which are the primary components of plant cell walls, the coconut shell degrades relatively slowly.

1.3. OBJECTIVE OF THE PROJECT

- The main objective is to encourage the use of these products as construction material in building.
- To evaluate the coconut shells with wax curing, compressive strength at 7 days, 14 days and 28 days by replacing in concrete.
- To reduce the usage of the aggregates and water requirements
- To reduce the cost of construction without compromising the quality.
- To effectively utilize the natural waste material.
- To reduce the depletion of naturel resources.

1.4 ADVANTAGES COCONUT SHELL

- Coconut shell are more resistant towards crushing impact and abrasion
- It promotes green construction.
- Recycling and reusing waste effectively thus protecting the environment from possible pollution effect.
- To introduce a new aggregate in the mix design to lower the concrete density.
- Coconut shells needs no pretreatment, except for water absorption.

1.5 ADVANTAGE OF WAX

- Easy to apply, saves labor costs
- Does not affect the setting time of concrete.
- Does not have any contaminants like chlorides, etc.,
- Eliminates use of water, hessian or polyethylene film completely
- Improved caring of concrete helps in providing a more durable concrete
- Excellent solar reflectance, which keeps the concrete temperature low,
- especially helpful during the early stages of concrete hydration.

2.MATERIALS USED

- Cement
- Fine Aggregate
- Coarse Aggregate
- Coconut Shell
- Epoxy Resin
- Water
- Wax

2.1CEMENT

Cement can be defined as the bonding material having cohesive & adhesive properties which makes it capable to unite the different construction materials and form the compacted assembly. today ordinary Portland cement is the most widely used building material in the world. the commonly used Portland cement in India is branded as 33 grade [IS: 269-1989], 43 grade [IS: 8112-1989, 53 grade [IS :12269-1987] having 28days mean compressive strength exceeding33Mpa, 43 Mpa, and 53 Mpa respectively. here we used 53 grade Ordinary Portland Cement conforming IS 12269:1987.

2.2FINE AGGREGATE

Fine aggregate generally consist of natural sand or crushed stone. Natural sand is the aggregate resulting from the natural disintegration of rock and which has been deposited by streams or glacial agencies. The code to be referred tounderstand the specification for fine aggregate is IS 383:1970. Natural sand confirmsgrading zone II. According to size, the fine aggregate may be described as coarse sand, medium sand and fine sand. The sand is generally passing through 4.75mm IS sieve and retained on 2.36mm IS sieve especially we use medium sand having a bulk density of 1680kg/m^3. The physical properties of sand are specific gravity, bulk density, sieve analysis, fineness modulus etc., were determined as

2.3 COARSE AGGREGATE

Coarse aggregate can be defined as inert granular materials obtained after crushing a stone. Coarse aggregate was used of size 20mm conforming to IS 383 is used. Coarse aggregates passing through 20 mm and retained on 12.5mm sieve are used in the experiment. Good-quality of aggregate which is clean, hard, strong, have durable particles, and be free of absorbed harmful chemicals, coatings of clay, or other contaminates that can affect hydration of cement or reduce the paste-aggregate bond.

2.4 COCONUT SHELL

Coconut shells from a nearby temple were used in the study. Before employing the coconut shells as an aggregate, they are sun-dried for five days. Sandpaper is used to clean the coconut shell, and water is used to clean the tiny abrasions on the outside face of the coconut.

The outer shell is then divided into pieces as small as 20 mm. With the use of a 30 kg hammer, coconut shells are broken. Following that, an IS 20 mm sieve is used to filter the shattered pieces, and an IS 12 mm sieve is utilised to keep the pieces.

Fig 1: coconut shell

2.5 EPOXY RESIN

Epoxy resin coats the surface and prevents it from absorbing water while also altering the aggregate's characteristics. Epoxy resin is utilised as a binder for high-friction aggregate and as an adhesive to connect it to the pavement due to its high adhesive capabilities. For further robustness, coconut fibres are naturally coated with epoxy resin. Increased flexural effects from coconut shell.

A thick coating will lubricate the skin and impair the bond with the concrete; thin coatings are required to be placed. Epoxy resin was used as the sort of coating on the coconut shell, and it was applied with a paintbrush utilising a catalyst and reagent to speed up the hardening process. To have an excellent time

Fig 2: EPOXY RESIN

2.6 Water

The strength of concrete is largely dependent on water. It needs around 3/10th of its weight in water to hydrate completely. It has been demonstrated in practise that standard concrete needs a water-cement ratio of 0.48 at the very least. Cement and water interact chemically, creating cement paste that binds with both coarse and fine particles. if additional water is utilised. The concrete weakens due to segregation and bleeding, but the majority of the water will be absorbed by the fibres. So, it could prevent bleeding. Water content that is too high might result in bleeding. The needed workability cannot be attained with less water. To utilise water in the concrete, it must be potable and suitable for drinking.

2.7 WAX

CERA POLYCURE-W is a wax based curing compound which when applied on concrete forms a seamless film and prevents the evaporation of moisture from the capillaries of concrete.

Function

Cement hydration process demands that water be present in the system Curing is adopted to prevent the loss of water from the hardening concrete, so that strength development is not impaired. Conventional curing methods like sprinkling, ponding or damp covering is not reliable because they depend heavily on environmental condition uncontaminated water and man power. CERA POLYCURE -W entrap the moisture within the concrete by formation of barrier in form of film on the concrete surface. The film does not leave moisture out of the system till hydration proceeds to its completion.

Fig 3: Cera polycure-wax

Table : 1 - Properties of wax

Appearance	**White liquid**
Specific gravity @29 C	1.02 ± 0.01
Viscosity @ 27°C Fordcup No:4	17
Water loss after 72 hours ASTM C 156	Not more than 0.48 kg/ Sqm.
Reflectance, %	80
Drying time	Less than 3 Hrs
Solid content	26%

3. PREPARATION OF MIX DESIGN

Different types of mixes were prepared by changing the percentage of replacement of coarse aggregate by coconut shell. Total 4 types of mixes are prepared along with conventional mixes. The coarse aggregates are replaced by 10%, 20% and 30% of coconut shell with wax curing.

Table: 2 - Details of Aggregate Replacement

Sl. no	Mix code	Cement %	Coarse aggregates %		Fine aggregate %
			CA	CS	
1	R0	100	100	0	100
2	R1	100	90	10	100
3	R3	100	80	20	100
4	R4	100	70	30	100

Concrete mix design is the process of finding the proportions of concrete mix in terms of ratios of cement, sand and coarse aggregates. For eg, a concrete mix of proportions 1:1.5:3 means that cement, fine and coarse aggregate are in the ratio 1:1.5:3 or the mix contains one part of cement, one and half part of fine aggregate and three parts of coarse aggregate.

Table 3: mix proportion

Description	cement	Fine aggregate	Coarse aggregate	w/c ratio
Ratio	1	1.44	2.91	0.48
Mass Kg/M^3	400	575	1164	192+10

3.1 CASTING:

The acceptance criteria of quality concrete are given in IS-456. In all the cases, for check of the criterion for acceptance or rejection of the concrete is the compressive strength at 28-days. 7 days compressive strength of concrete can also be used to get a relatively quicker idea of quality of concrete. For the compression strength testing, four castings were completed with 0%, 10%, 20% and 30% replacement of natural coarse aggregates. In every casting number of six cube specimens of dimension 150 x 150 x 150 mm were casted for testing of compression strength at 7 days and at 28 days.

Fig 4: placing materials & preparation of concrete

Table 4: Specimen Details

SL.NO	TYPES OF CURING	DAYS	0%	10%	20%	30%
1	water curing	7 days	3	3	3	3
		28 days	3	3	3	3
2	wax curing	7 days	3	3	3	3
		28 days	3	3	3	3
Total numbers of cube			12	12	12	12

Fig 5: Casting the concrete

3.2 CURING

3.2.1 WATER CURING

After 24 hours, the cube must be taken out of the moulds and submerged in clean water heated to between 240 and 300 degrees Celsius until it is 7, 14, or 28 days old and ready for testing. The cubes must undergo testing in both saturated and dry-on-the-surface conditions.

Extra cubes must be cast, stored, and cured in conditions identical to those of the structure in order to accurately represent the strength of the concrete in that structure. They must then be tested at the requisite age.

Fig 6: water Curing of concrete cubes

3.2.2 WAX CURING

When applied to concrete, CERA POLYCURE-W, a wax-based curing chemical, creates a smooth layer and stops moisture from evaporating from the concrete's capillaries.

As soon as the formwork has been removed or the element has been demolded, CERA POLYCURE -Wax should be sprayed onto all surfaces.

Make sure the concrete surface has been well cleaned with water after the formwork has been removed before applying CERA POLYCURE-W.

Make sure the treated surface is mechanically cleansed before plastering or painting to promote better adherence.

For larger parts, spray application is advised; for smaller sections, brushes and rollers can be utilised.

Fig 7: Applying of wax Curing of concrete cubes

3.3 COMPRESSIVE STRENGTH TESTS

Specimens of size 150 x 150 x 150 mm were casted for all the proportions and tested compression testing

machine. Capacity of machine is 2000KN.Compressive strength calculated by using equation

$$F = P/A$$

Where,

F= compressive strength in N/mm2

P=maximum load in Newton

A =cross sectional area in mm2

Fig 8: Compression test on cubes

Procedure

Prepare the concrete in the required proportions and make the specimen by filling the concrete in the desired mould shape of 150mm x 150mm x 150mm cube with proper compaction, a 24hours place the specimen in water for curing

- Take away the specimen from water when such as natural process time and wipe out excess water from the surface.
- Take the dimension of the specimen to the closest 0.2m. Clean the bearing surface of the testing machine
- Place the specimen within the machine in such a fashion that the load shall be applied to the other sides of the cube forged.
- Align the specimen centrally on the bottom plate of the machine
- Rotate the movable portion gently by hand so it touches the highest surface of the specimen.
- Apply the load step by step while not shock and incessantly at the speed of 140kg/cm^2/minute until the specimen fails. Record the utmost load and note any uncommon options within the form of failure
- Record the utmost load and note any uncommon options within the form of failure.

Table 5: compressive strength

Sl. no	Mix code	COMPRESSIVE STRENGTH N/mm^2			
		7days water curing	7days wax curing	28days water curing	28days wax curing
1	R0	13.24	15.13	19.75	20.6
2	R1	14.52	17.03	21.01	21.7
3	R2	10.38	12.64	15.8	16.13
4	R3	7.197	9.52	13.75	15.43

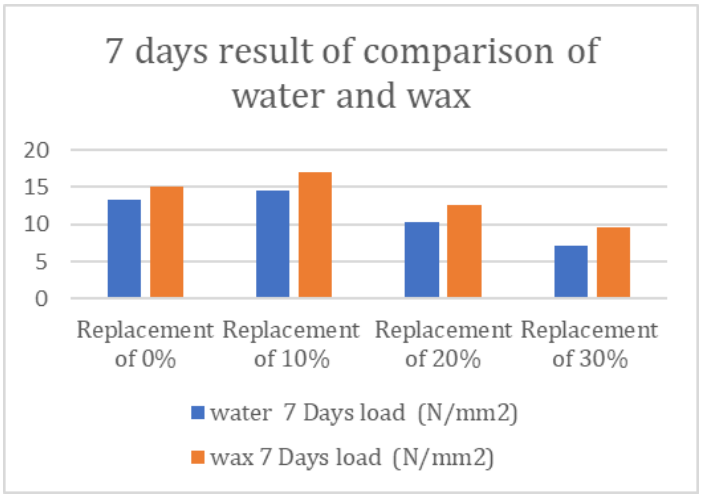

Fig 9: Average 7 days compressive strength

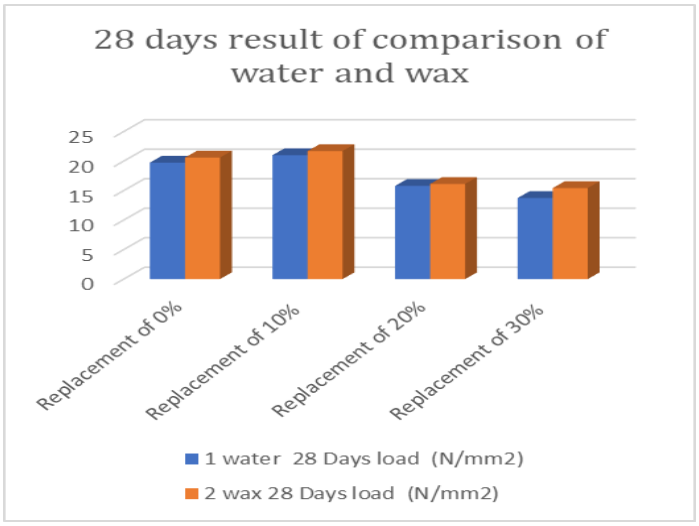

Fig 10: Average 28 days compressive strength

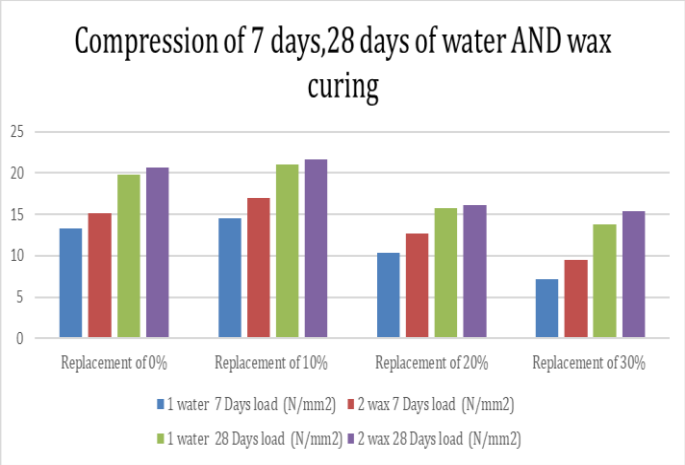

Fig 11: Average compressive strength

4. CONCLUSIONS

This study intended to find the effective ways to reutilize the waste particles as coarse aggregate and minimize the water requirement. It is also observed that the compressive strength of concrete is found to be optimum when coarse aggregate is partially replaced by coconut shell and by wax curing. In the project an attempt has been need to study the strength properties of M20 grade concrete.

The quantity of specimens and the tests to be conducted have been predetermined. The percentage of replacement 10%, 20%, 30% in coconut shell with wax curing.

From the above experimental work, the following conclusions were made.

The maximum compressive strength has been achieved by 10 % for partial replacement of coconut shell with wax curing found to be greater than the conventional concrete.

It is observed that the strength is gradually decreasing at 20% & 30% replacement of coconut shell.

So we conclude that the coarse aggregate replaced with coconut shell at 30% in concrete is not suitable for construction.

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