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"An Experimental Study On The Self-Curing Potential Of Concrete Utilizing Coir Pith Residue As Fine Aggregate"

Rakesh Kumar[1], Meet Parmar[2], Sainath Shinde[3], Saurabh Kamble[4], Samarjit Deokar[5]

Assistant Professor APCOER[1], Student of APCOER[2], Student of APCOER[3], Student of APCOER[4], Student of APCOER[5]

Department Of Civil Engineering, Anantrao Pawar College of Engineering and Research, Pune, India.

ABSTRACT

This experimental study explores the feasibility of utilizing coir pith residue as a fine aggregate in concrete to enhance its self-curing properties. Self-curing concrete offers numerous advantages, including reduced cracking, improved durability, and decreased water consumption during curing. Coir pith residue, an organic waste material, presents an eco-friendly alternative to conventional fine aggregates. The research involves the preparation of concrete mixtures with varying proportions of coir pith residue as a replacement for traditional fine aggregate. For the aim of internal curing, coir pith is used in place of sand in this project. Water may be retained in coir pith for 30–40 days. Coir pith is utilised in agriculture because of its ability to store water. Therefore, concrete specimens that have had 1%, 3%, and 5% of coir pith added to them are changed, and concrete tests are conducted on them. Extensive laboratory testing is used to assess mechanical qualities including tensile and compressive strength. The outcomes of using coir pith in place of conventional concrete specimens and conventional concrete specimens are compared, and a conclusion is drawn. The goal of the project is to shed light on how well coir pith residue works to improve concrete's capacity for self-curing, supporting environmentally friendly building methods and waste disposal initiatives.

Keywords: Concrete, Self-Curing, Coir Pith Residue, Fine Aggregate, Compressive Strength, Flexural Strength, Workability.

1. INTRODUCTION

1.1 Self-curing concrete:

A newly developed kind of construction material called self-curing concrete has the ability to cure internally, doing away with the requirement for external water curing. It has water reservoirs in the concrete that gradually release water, allowing the cement to hydrate and strengthening the material as a whole. This method lessens the requirement for post-placement curing and shrinkage cracking and permeability. Self-curing concrete offers creative and environmentally friendly building options and is perfect for situations where conventional curing techniques are challenging, including pavements and hard-to-reach structures.

1.2 Coir pith:

Coir pith is a byproduct of the coir fibre extraction process for coconut husks. It is a soft, spongy material that is frequently used as a soil conditioner because of how efficiently it holds moisture. Enhancing soil structure, aeration, and moisture retention are some of the advantages of coir pith. It also deters compaction and provides nutrients to plant roots gradually. This lightweight, pH-neutral substitute for peat moss is sustainable and helps cut down on watering requirements. It is a multipurpose growing media that is adaptable to various growth cycles.

1.3 The use of coir pith in fine aggregate:

Using coir pith as a substitute for fine aggregate in self-curing concrete is an innovative method with numerous advantages. Coir pith, a byproduct of coconut husks, has great water absorption and retention capabilities. By replacing some fine aggregate with coir pith, the concrete can self-cure, as the coir pith acts as reservoirs that supply moisture for cement hydration. Research shows that replacing 15-20% of fine aggregate with coir pith can improve concrete strength and performance metrics. Coir pith can also prevent early-age shrinkage cracks and provide better thermal insulation. While using coir pith helps in utilizing agricultural waste sustainably, higher replacements may lead to reduced strength. Overall, coir pith offers a chance to create sustainable, self-curing concrete with advantages over traditional mixes, suitable for various concrete applications.

1.4 Advantages of coir pith in fine aggregate:

Internal curing involves the use of coir pith, which absorbs water during mixing and releases it slowly during curing to help concrete properly hydrate and gain strength. This reduces the need for external curing. Coir pith helps reduce shrinkage in concrete by providing internal moisture, making the concrete more durable and less prone to cracking. Coir pith has a lower density compared to sand, resulting in lighter concrete with slightly reduced compressive strength, suitable for specific uses. Coir pith has superior insulation properties compared to sand, thanks to its air voids and organic structure, which helps to regulate interior temperatures effectively in concrete. Coir pith is a plentiful and sustainable substance that comes from the leftovers of the coconut industry. Using it lessens reliance on aggregates that are mined. Coir pith is a commonly accessible and affordable substitute for sand in the production of concrete in locations where coconuts are collected.

2. OBJECTIVES:

1.Investigate whether it would be feasible to use coir pith as a fine aggregate in self-curing concrete.

2. Evaluate the resulting concrete mixes' mechanical characteristics, including their workability, flexural strength, and compressive strength.

3. To ensure that the self-curing concrete with coir pith has the required properties and performance, optimise the mix proportions and curing conditions.

4. Examine the sustainability and performance characteristics of standard concrete mix against self-curing concrete containing coir pith.

3. CONSTIUENT MATERIAL:

List of materials such as cement, sand, coarse aggregate, coir pith, normal water.

3.1 Cement:

In building, a cement is a binder—a compound that binds other materials together by setting, hardening, and adhering to them. The characteristics of cement are displayed in Table: Cement used in a project.

Table 3.1: Properties of Cement

Features	Specifications
Cement type	Ordinary Portland Cement
Cement grade	53
Cement brand name	Birla Super
Specific gravity	3.15

3.2 Coarse Aggregate:

Coarse aggregates are defined by IS 383-1970 as aggregates that are retained on a 4.75mm IS sieve and have a limited amount of finer material. The characteristics of coarse aggregate are displayed in the Table of coarse aggregate.

Table 3.2: Properties of Coarse aggregate

Features	Specifications
Dimension	10-20 mm
Form	Angular
Specific gravity	2.60

3.3 Fine Aggregate:

A high-quality fine aggregate should be homogeneous in size and devoid of inorganic contaminants. The fine aggregate properties of M sand are displayed in the Table.

Table 3.3: Properties of Fine aggregate

Features	Specifications
Type	M-Sand
Specific gravity	2.68
Sieve analysis	Zone -II

3.4 Water:

Water used for mixing and curing must be pure and devoid of any contaminants that might harm steel or concrete, such as oils, acids, alkalis, or salts, as per IS 456: 2000. For mixing concrete, potable water is usually regarded as adequate. The water's pH must be at least 6.

3.5 Coir Pith:

As coir fibre is extracted from coconut husks, coir pith is produced as a byproduct. It's the stuff that lies between the husk's fibres and is soft and spongy. Millions of microscopic cells that make up coir pith serve as a naturally occurring substrate for holding moisture.

3.6 Mix proportion:

Mix design for M30 grade concrete by the Indian standard recommended method of concrete mix design as per design code IS: 10262-2009. Mix proportion is 1: 1.41: 2.44: 0.40 (C: FA: CA: W\C ratio).

4 METHODOLOGY:

1.1 Test conducted:

1. Compressive Strength Test in CTM (Cube Testing Machine)
2. Flexural Tensile Strength in UTM (Universal Testing Machine)
3. Slump Cone Test

1.2 Preparation of Specimens:

For Concrete Cubes: (150x150x150mm

1. **Ordinary proportions (0% coir pith)**
   Cement = 1.58kg
   Sand = 2.48kg
   Aggregate= 4.30kg
   Coir pith = 0kg
2. **For 1% of residue as fine aggregate**
   Cement = 1.58kg
   Sand = 2.45kg
   Aggregate = 4.30kg
   Coir pith = 0.024kg
3. **For 3% of residue as fine aggregate**
   Cement = 1.58kg
   Sand = 2.40kg
   Aggregate = 4.30kg
   Coir pith = 0.074kg
4. **For 5% of residue as fine aggregate**
   Cement = 1.58kg
   Sand = 2.36kg
   Aggregate = 4.30kg
   Coir pith =0.124kg

For Concrete Beams:(700x150x150mm)

1. **Ordinary proportions (0% coir pith)**
   Cement = 7.2kg
   Sand = 11.28kg
   Aggregate= 19.52kg
   Coir pith = 0kg
2. **For 1% of residue as fine aggregate**
   Cement = 7.2kg
   Sand = 11.16kg
   Aggregate = 19.52kg
   Coir pith = 0.128kg
3. **For 3% of residue as fine aggregate**
   Cement = 7.2kg
   Sand = 9.93kg
   Aggregate = 19.52kg
   Coir pith = 1.35kg
4. **For 5% of residue as fine aggregate**
   Cement = 9.02kg
   Sand = 2.36kg
   Aggregate = 19.52kg
   Coir pith = 2.25kg

4.3 Batching of Material & Mixing Process:

Batching is the process of measuring the ingredients used to make concrete. We have used the weigh-batching approach here, and it is also the right approach. Weigh systems are used in batching processes because they are accurate, flexible, and easy to use. Weigh batchers come in a variety of forms; the one to be utilised depending on what is needed at work. Accurate water measurement is essential if weight batching is used.

To come up with a consistent course, the material must be well mixed. Cement, sand, coarse aggregate, coir pith, and water must all be well combined. The concrete specimen's mix proportions is 1:1.41:2.44, with coir replacing fine aggregate in a varying amount from cement to coarse aggregate.

Fig 1: Volume Batching

Fig 2: Machine Mixing of Concrete

4.4 Casting of concrete:

The concrete needs to be carefully poured into the appropriate moulds before heating up. The mould that will receive the fresh concrete must be thoroughly cleaned, ready, and hydrated before moulding. Don't put down big amounts of concrete all at once. If this is not the case, the concrete will begin to flow along the mould, which will cause the final concrete's composition to vary. as quickly as feasible, the concrete should be poured into the mould. The concrete surface's edges and corners should all be visible to be crisp and intact following moulding.

Fig 3: Mould cleaning & oiling Fig 4: Pouring of concrete in mould Fig 5: Casting of concrete in moulds

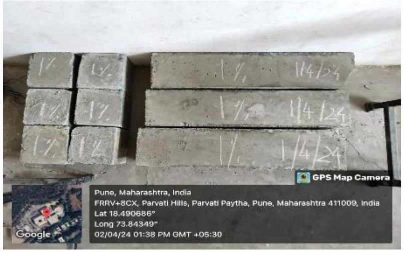

Fig 6: Compacting using tamping rod Fig 7: Casted concrete moulds Fig 8: Concrete after moulding

4.5 Curing of Concrete Internally

Internal curing, as defined by ACI 308, is the process by which cement hydrates due to the presence of extra internal water that is different from the mixed water.

4.6 Period of Curing for Conventional Cubes & Beams

The concrete specimen must be molded and then stored in a water-filled curing tank for a continuous 28 days. On the seventh and 28th days, the concrete specimen's compressive strength should be measured.

5 RESULT AND DISCUSSION

5.1 Compressive Strength Test (IS 516-1959):

The concrete specimen is positioned horizontally with its flat side facing up and carefully positioned in between the plates of the compression testing machine to conduct the compressive strength test in accordance with IS 516-1959 after it has been submerged in water at room temperature for 24 hours. On the concrete specimen, the load is delivered consistently. Noted is the load at which the concrete specimen breaks or collapses. The average strength of each of the four concrete specimens is computed by tabulating a graph of the observations.

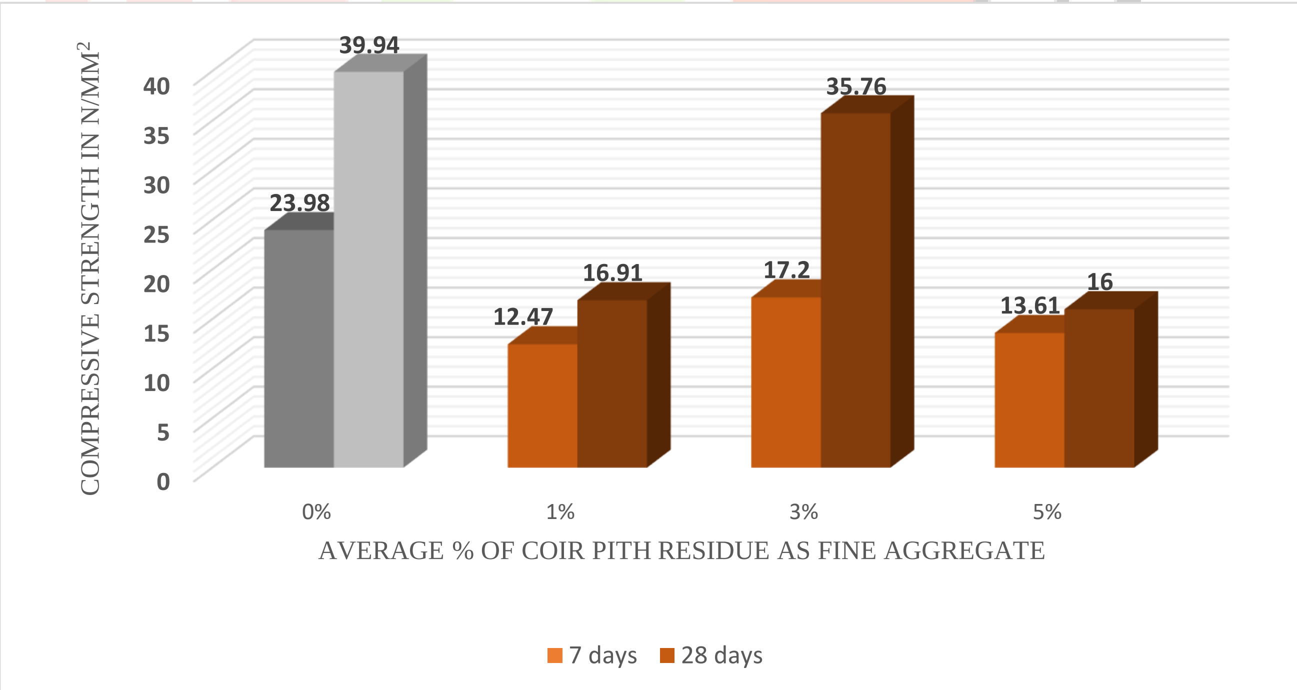

Fig 9: Comparison Graph of test result CTM

5.2 Flexural Strength Test (IS 516-1959):

Flexural strength test is significantly performed for concrete beams with dimension of 700mmx150mmx150mm. the specimen are properly placed on the support of universal testing machine. Formula used for finding the flexural strength used was,1) If 'a' is greater than 20 cm for 15 cm specimen Flexural Strength (fb) = PxL/BD^2, 2) If 'a' is less than 20 cm but greater than 17 cm for 15 cm specimen: Flexural Strength (fb) = $3PxL/BD^2$ On the concrete specimen, the load is delivered consistently. Noted is the load at which the concrete specimen breaks or collapses. The average strength of each of the four concrete specimens is computed by tabulating a graph of the observations.

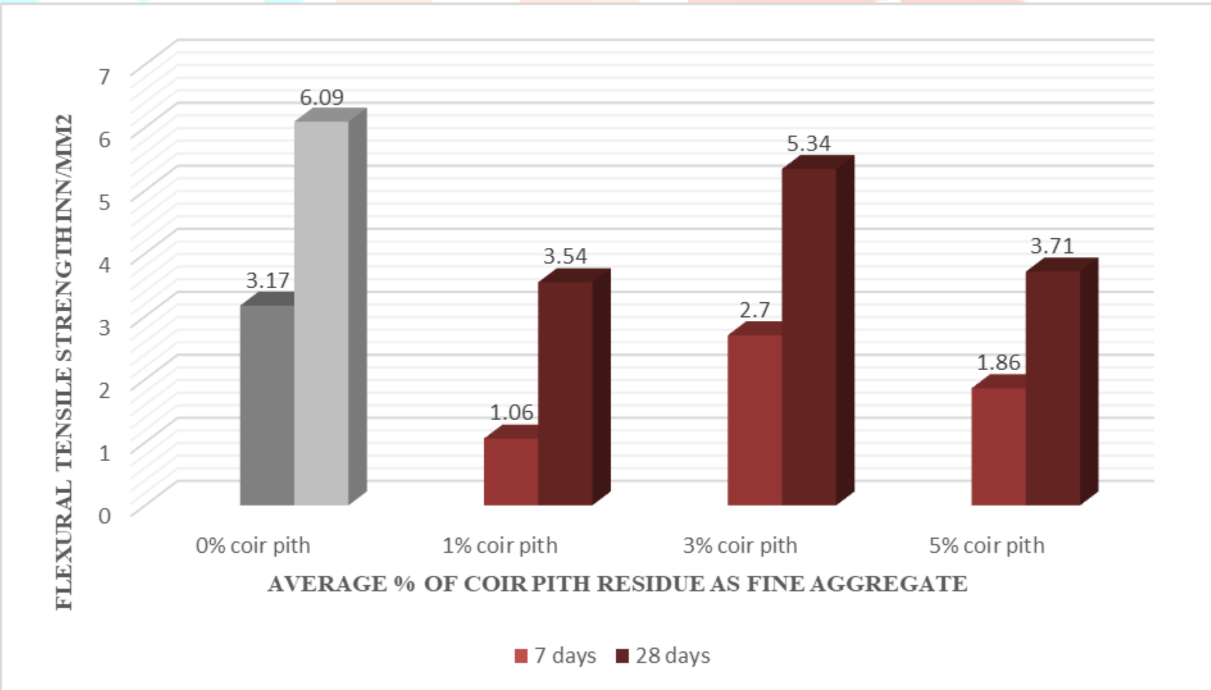

Fig 10: Comparison Graph of test result UTM

5.3 Slump cone test results: (Workability of concrete):

The slump cone test measures the workability or consistency of fresh concrete by observing the slump or downward movement of a cone-shaped sample under its own weight.

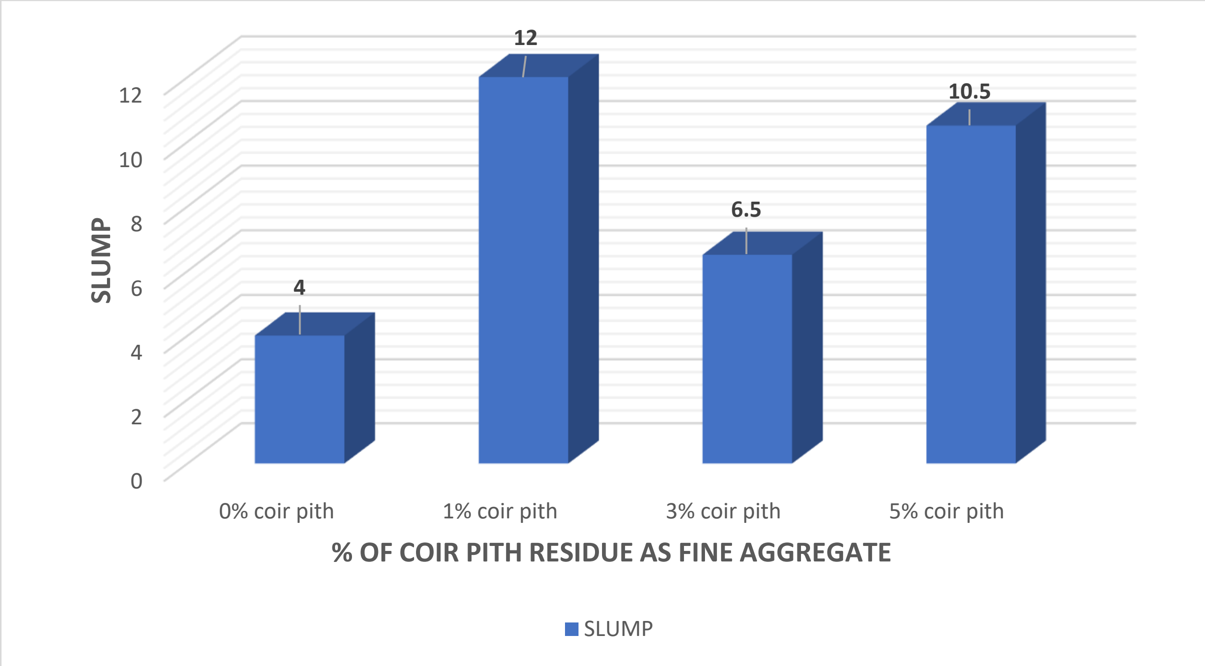

Fig 11: Test result of workability of concrete

6 COST ANALYSIS:

For manufacturing concrete specimens, you will require cement, sand, coir pith, and stone chips. Sand is used in place of coir pith in order to save money and water by not squandering high-quality water. The cost of the concrete specimen is determined by factoring in the costs of manpower, machinery, transportation, and energy. Because it doesn't require external curing or manpower costs for curing activities, coir pith replacement concrete is less expensive than traditional concrete. There is less water waste and less need for potable water as compared to ordinary concrete. The replacement of fine aggregate with coir pith results in a significant reduction in material costs.

7 CONCLUSION:

I. The maximum compressive strength obtained while incorporating coir pith residue as fine aggregate at 7th day is **17.20 N/mm^2** and at 28th day is **35.76 N/mm^2** for 3% replacement of coir pith which is enough to bare the impact loads.

II. The maximum flexural strength obtained while incorporating coir pith residue as fine aggregate at 7th day is **2.70 N/mm^2** and at 28th day is **5.34 N/mm^2** for 3% replacement of coir pith which is enough to bare the impact loads.

III. The optimum replacement of coir pith residue of fine aggregate in concrete is **3%.**

8. REFERENCES

1. Bentz, D.P., "Influence of Curing Conditions on Water Loss and Hydration in Cement Pastes with and without Fly Ash Substitution," NISTIR 6886, U.S. Dept. Commerce, July 2002.

2. S. Tyagi. An experimental investigation of self-curing concrete incorporated with polyethylene glycol as self-curing agent, IRJET. 2015; 2(6).

3. Mohan Raj A, Rajendran M, Ramesh A S, Mahalakshmi M, Manoj Prabhakar S. (2014). "An Experimental Investigation of Eco-Friendly Self –Curing Concrete Incorporated with Polyethylene Glycol". International Advanced Research Journal in Science, Engineering and Technology.

4. D.Maragatham Jeyaseeli and Samuel Paul Raj, "Physical characteristics of Coir Pith as a Function of its particle size to be used as Soilless medium", American-Eurasian Journal Agric & Environ. Sci., 8(4):431437, 2010.

5. Parhizkar.T, Najimi.M and Pourkhorshidi.A.R, “Application of pumice aggregate in structural lightweight concrete”, Asian Journal of Civil Engineering (2012), vol. 13, pp. 43-54.

6. El-Dieb A.S. (2007) “Self curing concrete water retention, hydration and moisture transport”Construction and Building Materials, Vol-21, pp1282- 1287

7. Magda I. Mousa, Mohamed G. Mahdy, Ahmed H. Abdel-Reheem and Akram Z. Yehia, “Physical Properties of Self-Curing Concrete (SCUC)”, HBRC Journal (2015) 11, pp. 167-175.

8. N. Sunanda, Shilpa.V, Experimental investigation on self-curing concrete with partial replacement of cement with metakaolin, IOSR Journal of Engineering, ISSN (e): 2250-3021, Vol. 08, Issue 6 (June. 2018), and PP 33-40.

9. Basil M. Joseph, ‘Studies On Properties of Self-Curing Concrete Using Poly-Ethylene Glycol (IOSR-JMCE)’, 2016.

10. Makendran C, SanthoshPrabhu S, PreginaK,ThirumuruganAand RajakumarS2020 Impact behavior of ferrocement slabs with high strength mortarTest Engineering and Management837352-59.

11. Ali Majid, Anthony Lin, “Mechanical and dynamic properties of fiber reinforced Concrete” Construction and building materials “.Reed Business information, Inc.(US). 2012.

12. Asasutjarit C., Hirunlabh J., Khedari J., S. Charoenvai, B. Zeghmati, U.CheulShin (2007),"Development of coconut coir-based lightweightcementboard",ConstructionandBuildingMaterialsvol.21,pp.277-288.

13. Ahmad, Shuaib H., and Surendra P. Shah. "Complete triaxial stress-strain curves for concrete." Journal of the Structural Division 108, no. 4 (1982): 728-742.
Hasan NMS, Shaurdho NMN, Basit MA, Paul SC, Sobuz MHR, Miah MJ. Assessment of the rheological and mechanical properties of palmyra fruit mesocarp fibre reinforced eco-friendly concrete.