iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** IV **Month of publication:** April 2019

DOI: https://doi.org/10.22214/ijraset.2019.4107

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue IV, Apr 2019- Available at www.ijraset.com

Effect of Coir Pith in Concrete

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Abstract: ***The most commonly used fine aggregate is natural river sand. The demand for natural sand in the construction industry has consequently increased due to extensive use of concrete resulting in the reduction of sand resources and increase in price. The government has already banned sand mining due to environmental problems in some identified area for major rivers. Thus an investigation is needed to identify a suitable substitute. In general, industrial wastes are used as replacement of sand. The commonly used materials are slag, foundry sand, and quarry dust etc. In our project we use coir pith as a replacement of sand. The coir pith is a by product of the coconut based industry. Coir pith primarily consists of coir fiber pith or coir dust which is obtained by processing coconut husk and removing the long fibers. The coir pith can hold large quantities of water, like a sponge. It is a special type of material used for mortar, lightweight materials, sound, thermal insulating, good air porosity and reduction in construction cost. In this study M25 grade concrete was investigated by adding 0%, 3%, 5%, 10% and 15% of coir pith with replacement of sand. Coir pith as been chemically treated with NAOH to remove the dust particles, which also gives better results.***

I. INTRODUCTION

Fine aggregate is an essential component of concrete. The most commonly used fine aggregate is natural river sand. The global consumption of natural river sand is very high due to the extensive use of concrete. In particular, the demand of natural river sand is quite high in developed countries owing to infrastructural growth. The non-availability of ordinary river sand for making cement concrete is affecting the growth of construction industry in many parts of the country. Recently, Tamil Nadu Government has imposed restrictions on sand removal from the river beds due to its undesirable impact on the environment.

II. MATERIAL USED

A. Cement

A **cement** is a binder material, the substance used for construction that hardens, and stick fast to other materials to bind them together. Cement with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. Cement is a basic ingredient of concrete. Concrete is formed when cement creates a paste with water that bind with sand and rock to harden. Cement is finely milled mineral powder usually grey in colour.

1) Chemical Composition

S.No	Characteristics	Requirement	IS code
1.	Loss of ignition	5%	4032-1985
2.	Magnesia	6%	4032-1985
3.	Sulphuric anhydrate	3%	4032-1985

2) Physical Components

S.No	Characteristics	Test result as per IS 1489-1991(PART 1)
1.	Initial setting time	30min
2.	Final setting time	600min
3.	Specific gravity	3.15

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III. FINE AGGREGATE

Sand is a granular material composed of finely divided rock and mineral particles. Sand is defined by size,that isfiner than gravel and coarser than silt. Sand is a non-renewable resourceand sand suitable for making concrete is in high demand. River sand is locally available near uthukottai near thiruvallur district in the market was used in investigation.

A. Physical Properties

S.No	Description	Value
1.	Sand zone	Zone-2
2.	Bulk density	2.60
3.	Specific gravity	1385.16kg/m^3

IV. COARSE AGGREGATE

The coarse aggregate is sourced from the outskirts of Chennai where lot of granite quarries were present. The uncrushed, crushed, or partially crushed gravel or stone most of which is retained on 4.75 mm IS sieve. They should be hard strong dense durable clear and free from veins and adherent coatings and from injuries amount of disintegrated pieces, alkali, and organic matter.

A. Physical Properties

Sl.No	Description	As per IS code : 2386 (part.4) 1963 Value
1	Aggregate crushing value	Not exceed45% aggregate is used for concrete other than wearing surface. Not exceed 30% aggregate is used for wearing surface (runway, roadway, pavements)
2	Aggregate impact value	Not exceed45% aggregate is used for concrete other than wearing surface. Not exceed 30% aggregate is used for wearing surface (runway, roadway, pavements)
3	Aggregate abrasion value	Aggregate used in concrete wearing surface = 30% Aggregate used in concrete wearing surface = 50%
4	Nominal size used	20 mm
5	Soundness of aggregate	12% when tested with sodium sulphate 18% when tested with magnesium sulphate

B. Water

It plays a vital role in achieving the strength of concrete. It is practically proved to be that water cement ratio 0.50 is required for conventional concrete. Water undergo chemical reaction with cement and cement paste is formed and bind with fine and coarse aggregates. If more water is used, segregation an bleeding take place so that concrete become weak, but most of the water will absorb by the fibres. Hence it may avoid by bleeding If water content exceeds permissible limits it may cause bleeding. If less quantity of water is used means required workability will not be achieved. Portable water fit for drinking is used in concrete and it should have ph value ranges 6 to 9.

C. Coir Pith

The coir pith is a by product of the coconut based industry. Coir pith primarily consists of coir fibre pith or coir dust which is obtained by processing coconut husk and removing the long fibres. The coir pith can hold large quantities of water, like a sponge. It is a special type of material used for mortar, lightweight materials, sound, thermal insulating, good air porosity and reduction in construction cost.

D. Physical Properties Of Coir Pith

SI.No	Test	Value
1.	Finesses modulus	4.12
2.	Specific gravity	2.3
3.	Moisture content	5%

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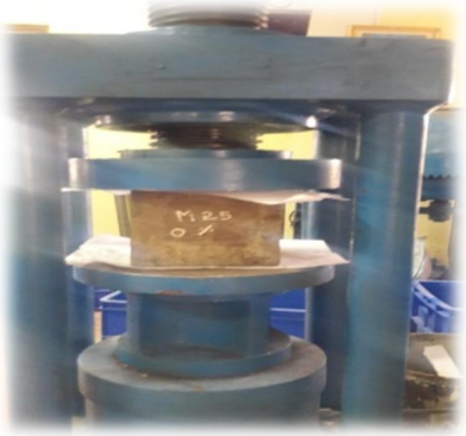
V. COMPRESSION STRENGTH TEST

Compressive strength is the ability of material or structure to carry loads on its surface without any crack or deflection. A material under compression tends to reduce the size, but in tension it elongates. This test is to determine the response or behaviour of a material while it experiences a compressive load by measuring fundamental variables. Such as stress, strain and deformation.

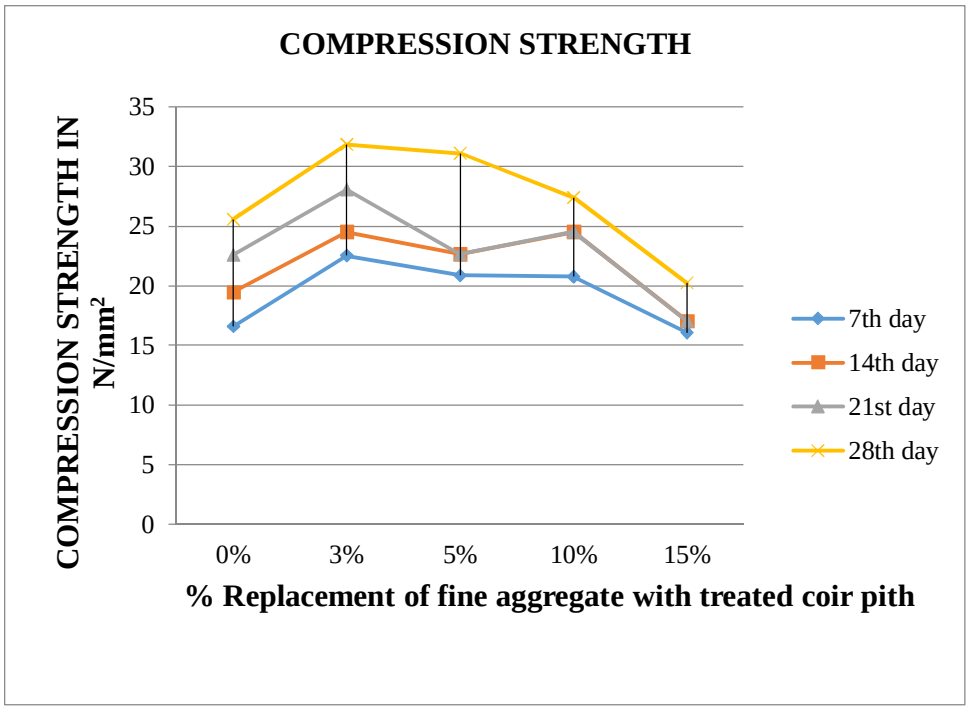
Compressive strength=Load/Area

A. Size of Specimen (150mm x 150mm x 150mm)

Replacement % of coir pith	7th day	14th day	21st day	28th day
	Compression strength in N/mm^2			
0%	16.59	19.48	22.59	25.55
3%	22.52	24.51	28.07	31.85
5%	20.88	22.66	22.66	31.11
10%	20.74	24.51	24.51	27.40
15%	16.07	17.03	17.03	20.22







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VI. RESULT OF COMPRESSION TEST

We conclude that still 10% replacement of treated coir pith we get the value greater that the control mix. Therefore this test shows that upto 10% of replacement of coir pithfor sand can be done.

A. Flexural Strength Test

It is the ability of a beam or slab to resist failure in bending. It is measured by loading unreinforced 150x150 mm **concrete** Load the specimen continuously without shock till the point of failure at a constant rate (Indian standard specified loading rate of 400 Kg/min for 150mm specimen and 180kg/min for 100mm specimen The most common purpose of a flexure test is to measure flexural strength and flexural modulus.

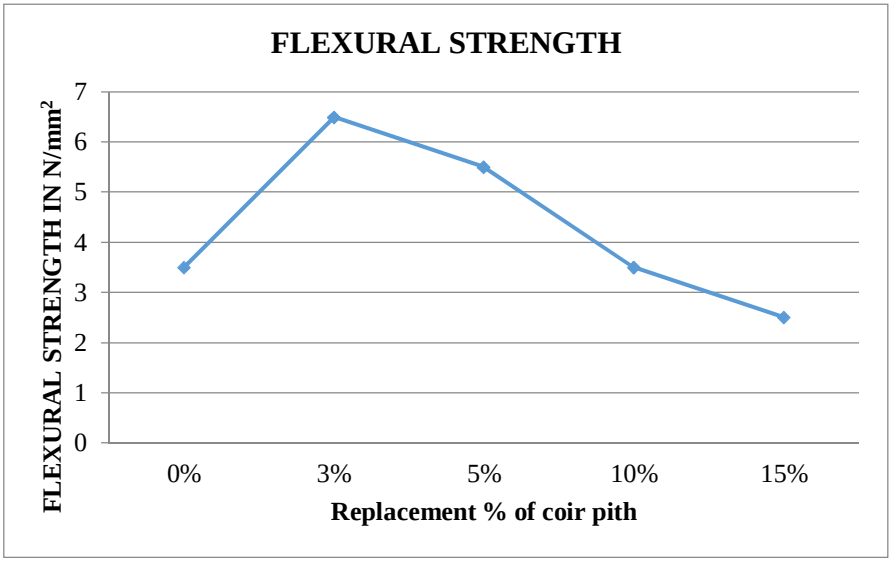
$F_{bt}=PL/bd^2$

B. Size of Specimen (450mm x 100mm x 100mm)

SI.No	Replacement % of Coir pith	Flexural strength at 28^{th} day (N/mm^2)
1	0%	3.5
2	3%	6.5
3	5%	5.5
4	10%	3.5
5	15%	2.5







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VII. RESULT OF FLEXURAL STRENGTH TEST

We conclude that still 10% replacement of treated coir pith we get the value greater that the control mix. Therefore this test shows that upto 10% of replacement of coir pithfor sand can be done.

A. Split Tensile Strength Test

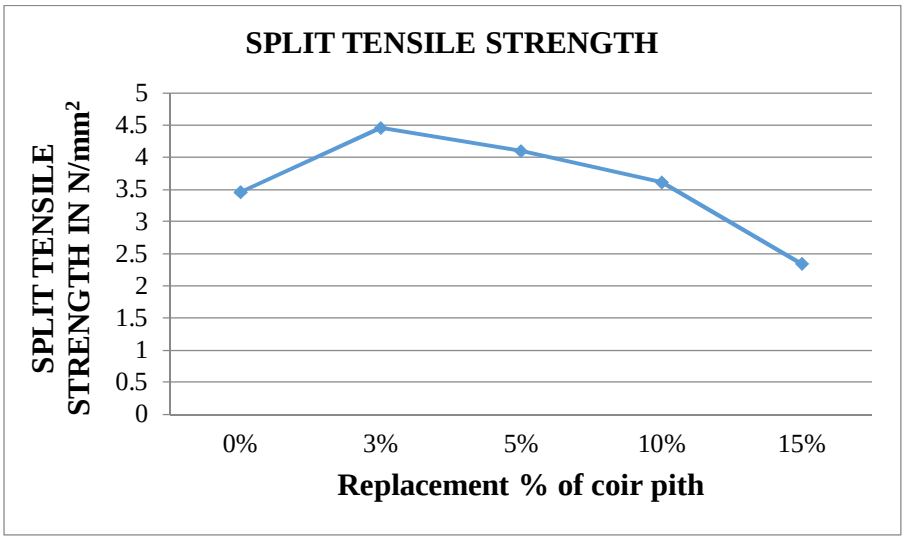
A method of determining the split tensile strength of concrete using a cylinder which splits across the vertical diameter.

$T=2P/\pi Ld$

B. Size of Specimen: Diameter = 150mm, length = 300mm

SI.No	Replacement % of Coir pith	Split tensile strength at 28^{th} day (N/mm^2)
1	0%	3.46
2	3%	4.46
3	5%	4.10
4	10%	3.61
5	15%	2.34





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VIII. RESULT OF SPLIT TENSILE TEST

We conclude that still 10% replacement of treated coir pith we get the value greater that the control mix. Therefore this test shows that upto 10% of replacement of coir pith for sand can be done.

A. Acid Test

1) Hydrochloric Acid Attack Test: To conduct this test, 5% by volume of hydrochloric acid was mixed with ordinary potable water. The specimens were cured for 28 days in ordinary potable water and then immersed in the solution for a period of 28 days. The percentage of weight loss is found out after 28 days.

2) Tabulation

Weight	**5% cube**	**10% cube**
Initial weight	2.20	1.98
30th day	2.0	1.80
60th day	1.98	1.73

B. Sulphate Attack Test ($MgSO_4$)

Sulphate attack on concrete is a chemical breakdown mechanism where sulphate ions attack components of the cement paste. The compounds responsible to sulphate attack on concrete are water-soluble salts, such as alkali-earth (calcium, magnesium) and alkali (sodium, potassium) sulphates that are capable of chemically reacting with components of concrete. Such attack can occur when concrete is in contact with sulphate containing water e.g. seawater, swamp water, ground water or sewage water. The external sulphate attack may cause concrete to crack and scale.

1) Tabulation

Weight	5% cube	10% cube
Initial weight	2.11	1.75
30th day	2.0	1.70
60th day	1.96	1.66

C. Chloride Attack Test (NaCl)

Chloride Attack on Concrete Structures is one of the most important phenomena we consider when we deal with the durability of concrete. Among the failure of concrete structures, chloride attack accounts 40% contribution.The main effect of chloride attack is corrosion of reinforcement that induces the strength of the structure drastically.

1) Tabulation

Weight	5% cube	10% cube
Initial weight	2.156	2.0
30th day	2.05	1.95
60th day	1.98	1.89

D. Rapid Chloride Penetration Test(RCPT)

Each RCPT cell will be made up of transparent acrylic material of 150mm x 150mm x 50mm thick as per ASTMC1202.It will hold the specimen of 100mm diameter 50mm thick. It will be provided with rubber gasket and washers to avoid leak proof. Stainless steel bolts with washersand nuts are provided to hold the specimen. The power supply will be applied to each cell and the current will be distributed through the brass mesh. Each cell will be provided with openings at top for pouring chemicals and the temperature sensors. The opening can be closed with lids. The volume of chemicals in the chamber shall be 250ml.

$I=900x\ (I_0+I_n)+2(I_{cummulative})$

$I_{cummulative}=I_{30}+I_{60}+I_{90}+I_{120}+I_{150}+I_{180}+I_{210}+I_{240}+I_{270}+I_{300}+I_{330}\ (mA)$

1) Calculation

$I=900x\ (I_0+I_n)+2(I_{cummulative})$

$I = 2580$

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IX. CONCLUSION

Due to high absorbing capacity of coir pith internal curing was achieved successfully. The maximum compressive strength obtained at 28th day for control mix is 25.55N/mm^2 and for 3% replacement of coir pith is 31.85 N/mm^2.The maximum flexural strength obtained at 28th day for control mix is 3.5N/mm^2 and for 3% replacement of coir pith is 6.5 N/mm^2.The maximum split tensile strength obtained at 28th day for control mix is 3.46N/mm^2 and for 3% replacement of coir pith is 4.46N/mm^2. The10%Replacement of coir pith gives the same strength as the control mix so that the optimum percentage is 5% to 10%.

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IS codes

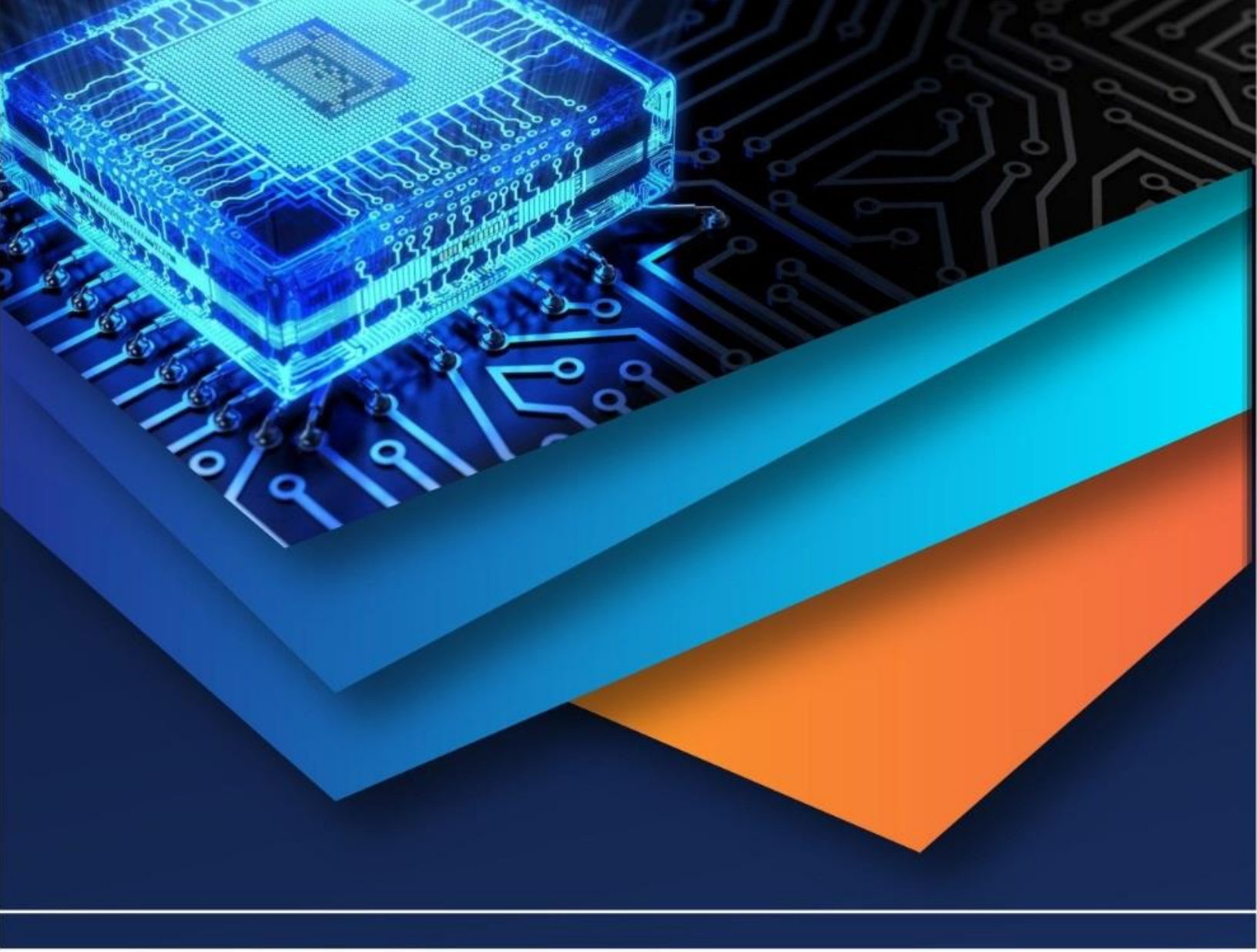
[6] Aggregate code book: As per IS 383 and IS 2683 (PART 3)

[7] Mix design:As per IS 10262

[8] Rapid penetration test : As per ASTMC 1202

[9] Mechanical test: As per 516-1959

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