

## AN EXPERIMENTAL STUDY ON BEHAVIOUR OF CONCRETE WITH COCO-PEAT

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**Abstract:-** In this project, it is proposed to study the behavior of concrete while adding coco-peat as partial replacement for sand. Generally waste materials obtained from industries are used as a replacement materials. Like this, coco-peat is an organic material which is a waste material obtained from coconuts. Like a sponge, coco-peat can hold large quantities of water, it will reduce the rate of curing. The features of using the coco-peat in concrete are reduction in construction cost, minimum curing rate, light weight concrete, thermal insulating property etc. The M25 concrete specimens of conventional are made and the comparison of compressive strength between conventional concrete to the coco-peat concrete at 7 and 28 days of curing is also done in this project.

**Keywords:-** Coco-peat or coco-pith, light weight concrete, organic waste, curing time, thermal insulating property.

### I. INTRODUCTION

Conventional concrete consist of sand as fine aggregate and gravel or limestone as coarse aggregate. Using there is a growing interest in materials as alternative fine aggregate materials and significant research is made on the use of many different materials as aggregate substitutes such as coal ash, blast furnace slag, coconut fibers and coco-peats. This type of use of waste material can solve problems of lack of aggregates in various construction sites and reduce environmental problems related to aggregate mining and waste disposal. The use of waste aggregates can also reduce the cost of the concrete production. The coco-peat has the capability to holds water itself for a long period of time. Using this property the curing time and amount of water required for curing process may become decrease. Compared to sand, coco-peat is a light weight material and hence the light weight concrete has to be made while using this coco-peat, as a partial replacement of sand. The river sand is one of the non-renewable source. But the coco-peat is one on the waste material. Hence it is eco-friendly in nature.

### II. LITERATURE REVIEW

Noor Md.Sadiqul Hasan et.al [1], "The use of coconut fibre in the production of structural lightweight concrete", Journal of applied sciences 2012, Linton university college, Malaysia. In all cases, the compressive strength of concrete decreased as the volume percentage of coconut fibers increased in the concrete mix. Concrete compressive strength with 3% coconut fiber volume is between 18.85 Nmm<sup>-2</sup> at the curing age 28 days and it satisfies the structural requirement of lightweight concrete.

G.Vinoth kanna et.al [2], "Experimental investigations on bricks with the replacement of coconut fibre", International Research journal of Engineering and Technology Volume: 05 Issue 02 Feb 2018. There is a positive effect of river sand and coconut fibre partially on clay brick samples that reach its optimum at 50% clay, 35% river sand and 15% coconut fiber by weight can be incorporated into raw clay minerals of brick chambers, without degrading their mechanical properties.

Dana konakova et.al [3], "Treated coconut coir pith as component of cementitious materials", Hindawi publishing corporation, volume 2015, Article ID 264746. Utilization of 5% coir pith led to bulk density decrease, matrix density decrease and almost no changes in open porosity. Mechanical properties were also decreased by utilization of coir pith. Thermal properties show high dependency on moisture content.

Dr.S.chithra et.al [4], "Study on cement mortars made with coir pith particles", International journal of Engineering research & Technology ISSN: 2278- 0181, 2017. This mortar can be used for flooring, making pavement blocks and street road pavements etc. Reducing the usage of non-renewable resource of sand, so that cost of construction also reduced.

Dhandhanian VA' and Sawant S [5], "Coir fiber reinforced concrete", Journal of textile science & Engineering, DOI : 2165-8064.1000163. Use of coir fiber gives natural cooling effect due to its near to zero thermal conductivity. Cost wise, natural fibers like coir is very cheap in places like India and could be potentially used in construction work. It is obvious that coir will not have any risk of getting corroded like steel so that is an added advantage.

### III. OBJECTIVE OF THE PRESENT WORK

- The main objective of the present work is that to check the possibility of incorporating the usage of coco-peat to replace a part of a fine aggregate to attain the target mean strength of 30 Mpa it is proposed.
- To study the material properties.
- To study the conventional and modern mix design with various percentage of coco-peat as a replacement of fine aggregate.
- To prepare the test specimen to determine the mechanical properties.

From the test result, check the possibility of incorporation the usage of river sand to replace a part of fine aggregate to attain required strength.

### IV. MATERIALS USED

#### ✓ CEMENT:

Ordinary Portland cement is the most common type of cement in general use around the world as a basic ingredient of concrete, mortar, stucco, and most no specialty grout. It developed from other types of hydraulic lime in England in mid-19<sup>th</sup> century and usually originates from limestone. It is a fine powder produced by heating materials to form clinker. After grinding the clinker we will add small amounts of remaining ingredients. Many types of cements are available in market. When it comes to different grades of cement, the 53 Grade OPC Cement provides consistently higher strength compared to others. As per the Bureau of Indian Standards (BIS), the grade number of a cement highlights the minimum compressive strength that the cement is expected to attain within 28 days. For 53 Grade OPC Cement, the minimum compressive strength achieved by the cement at the end of the 28th day shouldn't be less than 53MPa or 530 kg/cm<sup>2</sup>. The cement thus procured was tested for physical requirements in accordance with IS: 169-1989 and for chemical requirement in accordance IS: 4032-1988.

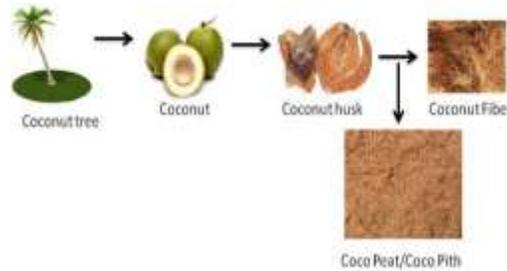
#### ✓ FINE AGGREGATE:

River sand is a natural granular material which is mainly composed of finely divided rocky material and mineral particles. The most common constituent of sand is silica (silicon dioxide, or SiO<sub>2</sub>), usually in the form of quartz, because of its chemical inertness and considerable hardness, is the most common weathering resistant mineral. Hence, it is used as fine aggregate in concrete. In the present work, the concrete mixes were prepared using locally available river sand free from silt, organic matter and passing through 4.75mm sieve.



**COCO-PEAT:**

The coco-peat is a waste material obtained from coconuts. In India, Tamilnadu has the first rank in the production of coconuts in the financial year of 2019. In the estimate of production of coconut – 2016-17, there are 6570.63 Million nuts were produced in Tamilnadu. The least waste material obtained from coconut fibre industries is known as coco-peat / coco-pith.



Coco-peat is an organic waste material and hence it is an eco-friendly material. Compared to sand, coco-peat is a renewable waste material and has high density and light weight material. Coco-peat the capability to hold water itself for a long period, which can help in reduction in curing time and amount water required for curing processes.

✓ **COARSE AGGREGATE:**

Coarse aggregate is an important constituents in concrete, it forms the body of the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is by using well graded aggregate. Crushed aggregates of less than 20mm size produced from local crushing plants were used. The aggregate exclusively passing through 22.5mm sieve size and retained on 19mm sieve is selected. The aggregates were tested for their physical requirements such as gradation, fineness modulus, specific gravity and bulk density in accordance with IS: 2386-1963. The individual aggregates were mixed to induce the required combined grading.

✓ **MIXING OF MATERIALS:**

The percentage of replacement of coco-peat as fine aggregate in 0%, 10% and 20% was serve as control for other samples.

✓ **CONCRETE MIX DESIGN:**

The mix ration used in this experiment is M25 (1:1:2).

**V. PHYSICAL PROPERTIES OF COCO-PEAT**

✓ **SIZE OF COCO-PEAT**

Here, the coco-peat is used as a replacement material for fine aggregate and hence the size of the coco-peat is also taken as size of the fine aggregate used in concrete. The coco-peat is sieved well with 4.75mm sieve. The particles passes through the 4.75mm sieve is taken for the experiment.

✓ **HUMIDITY OF COCO-PEAT**

At first, the specific quantity of coco-peat is open air dried for the periods of 24 hours and then the same coco-peat is dried in oven at 80°C for 1h. The weights of coco-peat after air dried and oven dried carefully noted with the precision of 0.01g. The Humidity of coco-peat is determined by using the following equation.

$$H = \frac{W_d - W_o}{W_o} \times 100\%$$

Where,  $W_d$  and  $W_o$  are the weight of air dried and oven dried coco-peat. It is found that the humidity of the coco-peat is 14.2%.

✓ **WATER ABSORPTION**

The coco-peat has the property as the absorbent medium of water. When the coco-peat has contact with water, it will absorb and holds itself. The water absorption nature of the coco-peat can be obtained by observing the weights of soaked coco-peat ( $W_{sw}$ ) and air dried coco-peat ( $W_{ad}$ ).

The water absorption can be determined from the following relation.

$$W = \frac{W_{sw} - W_{ad}}{W_{ad}} \times 100\%$$

✓ **DENSITY**

The density of coco-peat is founded as 0.05 g/cm<sup>3</sup> (lower bulk density) by Yahya et al.(2009) and 0.2 g/cm<sup>3</sup> ( higher bulk density) from cho et al. (2006) for the coco-peat perlite mixture (3:1).It was observed that densities of coco-peat are almost same for different type's samples.

$$\rho = \frac{mf}{\frac{mw}{\rho_w} - \frac{mw^*}{\rho_w}}$$

✓ **THERMAL CONDUCTIVITY**

The thermal conductivity of concrete with coco-peat is determined by making 3X3feet slabs of ordinary and coco-peat concrete. The observation are carried out for both concrete slabs and these are tabulated.

The concrete with coco-peat has less thermal conductivity than the ordinary concrete.

**VI. MECHANICAL PROPERTIES OF COCO-PEAT WITH CONCRETE**

Time	Normal room temperature (°C)	Temperature inside co-co-peat concrete roof (°C)
10.00am	36.37	28.76
11.00am	39.24	30.04
12.00am	40.28	32.11
1.00pm	43.6	32.87
2.00pm	42.05	33.56
3.00pm	40.14	27.98
4.00pm	36.25	25.8

➤ **Compressive Strength:**

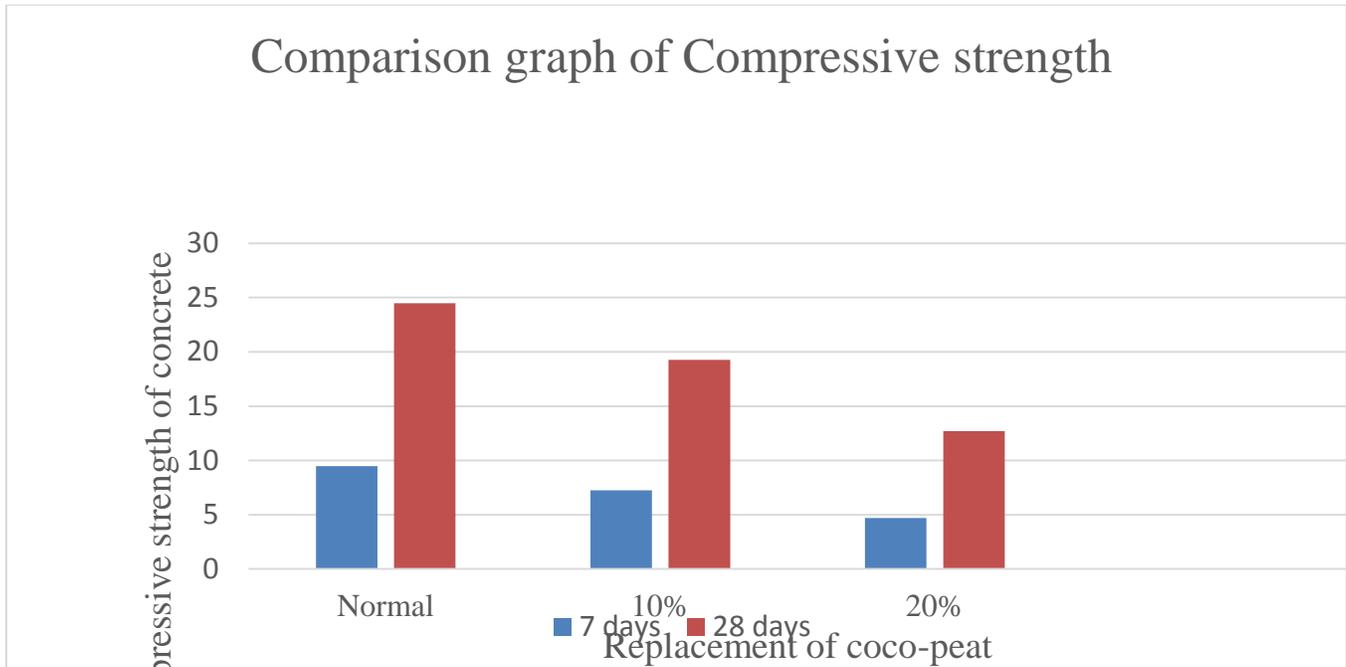
Prepare the concrete in the required proportions and make the specimen by filling the concrete in the desired mould shape of 15cm x 15cm x 15cm cube with proper compaction, after 24 hours place the specimen in water for curing. After curing cubes are placed in CTM one by one between bearing plates and load is applied gradually in kilo Newton.

**Compressive Strength of Cube = Applied load (p) / Surface Area (L\*B)**

**Table 6.1 Compressive Strength Test**

Replacement of Coco-peat	Cube No.	Compressive Strength in N/mm <sup>2</sup> for 28 Days	Average Compressive Strength in N/mm <sup>2</sup>
0%	1	25.77	26.11
	2	26.44	

10%	1	22.11	22.34
	2	22.56	
20%	1	18.87	19.05
	2	19.23	



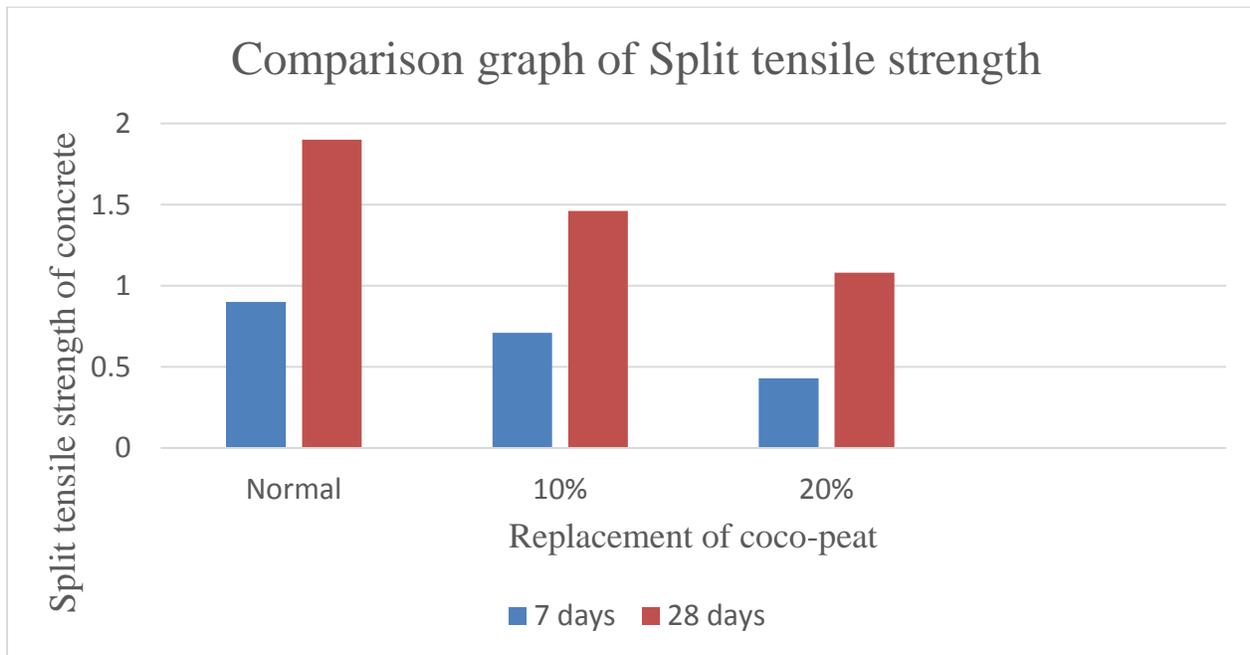
➤ **Split Tensile Strength:**

Prepare the concrete in the required proportions and make the specimen by filling the concrete in the desired mould shape of 15 cm x 30 cm cylinder with proper compaction, after 24 hours place the specimen in water for curing. After curing cylinders are placed in UTM one by one between bearing plates and load is applied gradually in kilo Newton.

*Spilt Tensile Strength of Cylinder* =  $2(P)/\pi LD$

**Table 6.2 Split tensile Strength Test**

Replacement of Coco-peat	Cylinder No.	Split tensile Strength in N/mm <sup>2</sup> for 28 Days	Average Split tensile Strength in N/mm <sup>2</sup>
0%	1	2.77	2.61
	2	2.44	
10%	1	2.11	2.10
	2	2.06	
20%	1	1.87	1.90
	2	1.93	
	2	1.39	



## VII. CONCLUSION

- In all cases, the compressive and tensile strength of concrete decreased as the percentage of coco-peat increased in the concrete mix.
- The 10% replacement of coco-peat gives the compressive and tensile strength as relatively acceptable for a light weight concrete.
- Use of coir fiber gives natural cooling effect due to its near to zero thermal conductivity. Cost wise, natural fibers like coir is very cheap in places like

India and could be potentially used in construction work.

## VIII. REFERENCE

- [1] Noor Md.Sadiqul Hasan et.al, "The use of coconut fibre in the production of structural lightweight concrete", Journal of applied sciences 2012, Linton university college, Malaysia.
- [2] G.Vinoth kanna et.al, "Experimental investigations on bricks with the replacement of coconut fibre", International Research journal of Engineering and Technology Volume: 05 Issue 02 Feb 2018.
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