International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 04 | April -2020 ISSN: 2582-3930

EXPERIMENTAL INVESTIGATION ON SELF COMPACTING CONCRETE USING WASTE FOUNDRY SAND AND COCONUT SHELL

Dr. J .Abdul Bari[1] , P. Jayasurya[2],M. Vignesh[3], M. Harikrishnan[4]

[1]*Associate Professor, Department of Civil Engineering, K. S. Rangasamy College of Technology, Tiruchengode, India*

[2,3&4]*UG Student, Department of Civil Engineering, K. S. Rangasamy College of Technology, Tiruchengode, India*

Abstract

The construction industry relies heavily on fine aggregate and coarse aggregate for its operation in the development of shelter and other infrastructural facilities. It then becomes extremely difficult for the majority of the people to their own houses or many collapse structures in as attempt to reduce cost. Various research workers in the past had look into the utilization of agricultural wastes that are known to be partially substitute fine aggregate and coarse aggregate that is the major component of concrete .The partial replacement of fine aggregate and coarse aggregate with Waste Foundry sand (WFS) and Coconut shell (CS) in concrete production is a welcome development in India. The cost of WFS and CS when compared with fine aggregate and coarse aggregate is very low due to the availability of Coconut shell in large quantities as agricultural farm wastes in India. The utilization of Coconut shell will promote waste management at little cost reduce pollution. Therefore it is suggested to ascertain the physical property and compressive strength and splitting tensile strength of concrete containing various proportions of WFS (0%, 10%, 20%, 30% and 40%) and CS (0%, 10%, 20%, 30%and 40%).The main objective of this study is to investigate and suitability of WFS and CS as partial replacement for fine aggregate and coarse aggregate in concrete.

Keywords:Mechanical Properties of concrete, Compressive strength, Durability.

INTRODUCTION

Concreteis a composite material consisting of the aggregate (gravel and sand), cement, and water. As a construction material, concrete can be cast in almost any shape desired, and once hardened, can become a structural (load bearing) element. Users may be involved in the factory production of pre-cast units, such as panels, beams, road furniture, or may make cast-in-situ concrete such as building superstructures, roads, dams. These may be supplied with concrete mixed on site, or may be provided with "ready-mixed" concrete made at permanent mixing sites.Coconut shell is not commonly used in the construction industry but often dumped as agricultural waste. Self-compacting concrete is important in modern construction. Combination of WFS and CS concrete is the innovative composite material used in construction. The use of WFS and CS as a substitute for fine aggregate and coarse aggregate in concrete mix is one option that can alleviate sludge disposal problem and has been studied widely in recent years. Despite of the recent studies, there

are still many unknowns with the use of WFS and CS. Study is needed to determine the contribution of WFS and CS to the performance of hardened concrete. There are great concerns on the strength and durability of the concrete being

experiments three coarse light weight aggregate types, Pumice, Volcanic tuff and diatomite and normal limestone aggregate used. In recent years, researchers have also paid produced with replacement material when used as construction materials in the construction industries. If it is proven that the concrete is durable and strong, this will lead to the use of WFS and CS to replace part of the fine aggregate and coarse aggregate in concrete. Finally, this study also aims to determine the most suitable mix proportion that can produce concrete of desirable strength without compromising engineering performance and quality. In the modern construction trends, the utilization of Aggregate plays a vital role in concrete production and hence the Aggregate is essential in the construction of Civil Engineering structures, such as building, bridge, dam, sidewalk, runway, road, etc..Therefore, our present research work was carried out to identify the efficient path of partial replacement of Aggregate with waste materials. Presently, the large amount of waste materials such as groundnut shell, ground granulated blast furnace slag, maize combs, saw dust, rice husk, millet husk, coconut shell, fly ash etc., deposited on the land are making environmental troubles. In general, the tensile strength of concrete is extremely poorer than its compressive strength; it is only about 10% of its compressive strength. Therefore, the concrete undergoes cracking mainly for its low tensile strength. In this connection, the present study was employed to investigate the best possible mix proportions of concrete by effectively replacing the Aggregate with two different waste materials, such as, WFS and CS.Hence the discussed parameters and its effects may not be independent of each others. For this reason it is necessary to study their interaction effect of mixing parameter on strength properties of concrete.

Ravindhaur Kaur Sandhu et.al.[1]have been carried out strength properties and microstructural analysis of self-compacting concrete using waste foundry sand. The partial replacement of waste foundry sand as the proportions of 5%, 10%, 15%, 20%, 25% and 30% respectively. The fresh concrete workability test was conducted by V funnel flow box test and U box test. The slump flow varies between 776 to 864mm . The slump flow values revealed that incorporating WFS in SCC decreases that workability. IlkerBekirTopku et.al.[2] have been carried out effect of aggregate type of properties of SCC. In more attention to some agriculture wastes for use asbuilding material in construction. One such alternative is coconut shell (CS), which is one of the most common agricultural solid wastes in many tropical countries. In this study, the important mechanical properties of CSC, namely compressive, flexural and splitting tensile strength and impact resistance have been measured to asses its suitability as a light weight aggregate. The crushed edges were rough and spiky and the lengths were restricted to a maximum size of 12 mm. The effect free water cement ratio of 0.42 and 0.44 was considered to study the flexural and splitting tensile strengths and impact resistance of CSC. E. A. Olanipekon et.al. [3] have been carried out the experiment of comparative study of coconut shell and palm shell as aggregate. This paper present the result of an investigation carried out on the comparative cost analysis and strength characteristics of concrete produced using crushed, granular coconut and palm kernel shells as substitutes for conventional coarse aggregate in gradation of 0%, 25%, 50%, 75% and 100%. Two mix ratios (1:1:2 and 1:2:4) were used. The results also indicates cost reduction of 30% and 42% for concrete produced from coconut shells and palm kernel shells, respectively. The particle ranges of a CS range from 5 to 20mm.Lavanya B A et.al. [4] have been carried out the experiment of Partial replacement of cement and aggregate with fly ash and coconut shell. Concrete mix of

M25 grade was designed. The coarse aggregate was replaced by 10%,20% and 30% respectively. Mix ratio 1:2.23:2.85. water cement ratio 0.45. The workability test was conducted by V-funnel flow test and L-box test. After 28 days compressive strength was various proportions 0%, 10%. 20%. 30% and 40% strength was 33.20N/mm^2, 35.25N/mm^2, 35.9N/mm^2, 31.45N/mm^2 and 16.2N/mm^2 respectively.Coconut shells can be used as partial replacement for coarse aggregate up to percentage of 10, 20, and 30. More than the 30% replacement decreases in strength. optimum result the 20% replacement coconut shell is good. B. Dhamodharareddy et.al.[5] have been carried out Experimental analysis of coconut shell as aggregate. A nominal mix was 1:2:4 was used for M20 grade concrete.For 100% replacement of coarse aggregate flexural strength was not obtained as the specimen failed under its self-weight. Coconut shell was 25%replacement of coarse aggregate suitable of self compacting concrete.Gavande Y B and P B Autade [6] have been carried out Partial replacement of sand by waste foundry sand. Experimental investigation is carried out on a self compacting concrete containing waste foundry sand in the range of 0%, 10%, 20%, 30%, 40% by weight for M35 grade self compacting concrete.20% replacement of WFS in SCC shows maximum decrease in workability of concrete.Adharsh M et.al. [7] have been carried out the experiment of partial replacement of waste foundry sand as fine aggregate. Concrete mix proportion was designed to achieve strength of M20. The mix proportion was 1:1.6:1.8.Specimen Preparation The M sand was replaced by foundry sand in the concrete mix partially by 0% 10%, 20%, 30% and 40% respectively. The workability decreases with the increase in foundry sand due to high water absorption of foundry sand.The compressive strength and split tensile strength increased with increase in foundry sand up to 30%.optimum of 30% foundry sand can be used effectively as a fine aggregate in concrete production. K.Gunasekaran et.al.[8]. Have been carried out mechanical and bond properties of coconut shell aggregate. This paper investigates an experimental study of properties of concrete. Different percentages of Super plasticizer dosage levels were prepared for the SCC mixtures. The different water-binder ratios 0.36, 0.40, 0.43, 0.46 and 0.48 to obtain different fresh stage properties. The compressive and splitting tensile strength of SCC were tested on cube specimens aged at 7, 14, 28 and 90days respectively. Compressive strength and splitting tensile strength of concretes a considerable increases depending on decrease of water binder from 0.48 to 0.36 and concrete age from 7 and 28 days.

MATERIALS AND METHODS

CEMENT:

Cement is Portland Pozzolanic Cement was used. Ppc 53 grade IS:1489-1991.

FINE AGGREGATE:

Fine aggregate is the size of 150 microns to 4.75 mm was used. M sand has been used.IS :383.

COARSE AGGREGATE:

Coarse aggregate is to fill the 60% of concrete. IS:383-1970 has been used.

FOUNDRY SAND:

Foundry sand is a finer material it's compared to the fine aggregate and it's a product of steel manufacturing industry.IS: 1918-1966

COCONUT SHELL:

Coconut shell is an agricultural waste and it's crushed to 12mm size.

M30 grade of concrete is designed. Mix ratio of concrete is 1:2.2:1.75.and shown in table1

Table1: mix proportions

Cement	FA	CA	Water
442kg	975kg	772kg	191
1	2.2	1.75	0.43

EXPERIMENTAL WORK

COMPRESSIVE STRENGTH

As stated earlier, this study focuses on the performance of concrete blended with FS and CS in term of its compressive strength. Compressive strength test usually gives an overall picture of the quality of concrete because strength is directly related to the structure of the hydrated cement paste. The compression test is an important concrete test to determine the strength development of the concrete specimens. Compressive strength tests was performance on the Cube specimens at the ages of 7 and 28 days. The compression load was applied continuously until failure using UTM machine. Three specimens were tested at each age to compute the average compressive strength. Additional specimens were tested if any individual strength result deviated substantially from the mean. A new average was computed based on the three closest strength results. The results are recorded for further analysis.

Compressive Strength =*P/A*

Where:

P = Ultimate compressive load of concrete (kN)

A = Surface area (mm^2)

Fig 1 Compressive test

Table 2 Compressive strength of 28 days

S. No	% of replacement of FS	% of replacement of CS	Compressive strength in N/mm^2			Average compressive strength in N/mm^2
			Sample 1	Sample 2	Sample 3	
1	0	0	32	34	33	33
2	10	10	35	34	36	35
3	20	20	33	35	33	33.6
4	30	30	38	37	35	36.6
5	40	40	36	34	36	35.3

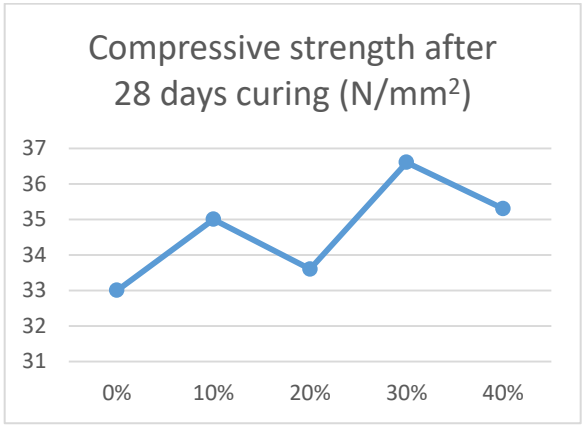

Fig 2 Strength at 28 days

SPLIT TENSILE STRENGTH TEST

Specimen of size 150 mm diameters and 300mm length were casted. The test was conducted on the Compression Testing Machine. Cylinder specimens were placed under the Compression Testing Machine in a horizontal direction perpendicular to the direction in which they are casted. The tensile strength was found by using equation,

$F = 2P/\Pi Ld$

Where, F=tensile strength in N/mm²

P = Maximum load applied

d = measured depth of specimen

L= Length of specimen

Fig 3 Split tensile strength

Table 3 Split tensile strength of 28 days

S. No	% of replacement of FS	% of replacement of CS	Split Tensile strength in N/mm^2			Average Split tensile strength in N/mm^2
			Sample 1	Sample 2	Sample 3	
1	0	0	3.22	3.12	3.1	3.15
2	10	10	3.12	3.16	3.06	3.11
3	20	20	3.03	3.11	3.23	3.12
4	30	30	3.27	3.15	3.33	3.25
5	40	40	2.98	2.8	2.91	2.88

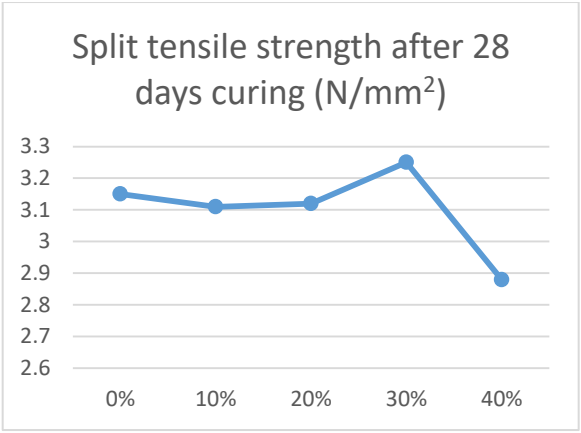

Fig 4 Strength at 28 days

CONCLUSION:

- The strength of the concrete yields upto 30% of strength as average.
- The best result is obtained by 30% of waste materials are used in the concrete.

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