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ASSESSMENT OF PROPERTIES OF CONCRETE WITH PARTIAL REPLACEMENT BY COCONUT CONSTITUENTS

Akhil Parwal [1], Prof. G. K. Verma [2], Mr. Abhishek Shrivastava [3]

[1]*P.G. Student, Department of Civil Engineering, Sri Aurobindo Institute of Technology, Indore, India*
[2]*Professor/Head, Department of Civil Engineering, Sri Aurobindo Institute of Technology ,Indore, India*
[3]*Asst. Professor, Department of Civil Engineering, Sri Aurobindo Institute of Technology, Indore, India*

Abstract - *The high price of standard construction materials may be a dominating issue affecting housing system round the world. This has necessitated research work into alternative materials in the construction field. We are using coconut shell ash as cement and coconut shell as coarse aggregate, along with these coconut fibre is also used to improve the split tensile strength of concrete. In this study M 20 grade of concrete is prepared in which cement is partially replaced by 0, 5, 10, 15 & 20 percent with coconut shell ash, coarse aggregate is partially replaced by 0, 5, 10, 15 & 20 percent with coconut shell and adding fibre content to be 4 percent (by weight of cement). A total of 30 cubes, 20 cylinders and 30 cubes with 16mm bar were made and cured by immersing them in water for seven and twenty eight days severally. And these specimens are tested for Compressive Strength, Split Tensile Strength, Bond Strength and also the density of concrete.*

Key Words: **Coconut Shell Ash, Coconut Shell, Coconut Fibre, Coir, Compressive Strength, Split Tensile Strength, Bond Strength.**

1. INTRODUCTION

Following a traditional growth in population, the number and kind of waste materials have enhanced consequently. Many of the non-decaying waste materials can stay within the surroundings for hundreds, maybe thousands of years. The non-decaying waste materials cause a waste disposal crisis, thereby tributary to the environmental issues. However, the environmental impact will be reduced by making a lot of sustainable use of this waste, this is often called the Waste Hierarchy. Its aim is to cut back, reuse, or recycle waste, the latter being the well-liked possibility of waste disposal. Coconut waste is available in large quantity around the world so its constituents can be used in concrete in different forms.

2. METHODOLOGY

In the first stage of work cement is partially replaced by CSA & coarse aggregates is partially replaced Coconut Shell in different percentages as shown in the table below. 5 batches are prepared in different proportions. Cubes and Cylinders are casted for determining Compressive Strength, Split Tensile strengths & Bond Stress respectively at 7 & 28 days. 30 cubes, 20 Cylinders & 30 cubes with 16 mm bar in centre of the cube are casted in total 5 batch mixes.

Table -1: Formulation of Work

Batch Mix	Cement (%)	Coconut Shell Ash (%)	Coconut Shell (%)	Coconut Fiber (%)	Sand (%)	Natural Coarse Aggregates (%)
1	100	0	20	4	100	80
2	95	5	15	4	100	85
3	90	10	10	4	100	90
4	85	15	5	4	100	95
5	80	20	0	4	100	100

In the second stage of work density of concrete of all five types of mixes is also calculated & checked whether it is considered as light weight concrete or not. Density of light weight concrete is less than 2000 kg/m3. Cubes are casted for determining Density of different mixes respectively at 7 & 28 days.

3. RESULTS & DISCUSSIONS

As work is carried out in two stages, result of stage1 is presented in graphical form. Tests are performed on cubes, cubes with bars & cylinders and their 7 days & 28 days strengths have been determined. A comparison based on strength of different mix proportions is carried out. A comparison of strengths for 7 days and 28 days are also formulated.

3.1 Compressive Strength

Compressive strength test is performed on 3 cubes of each batch mix for 7 days & 28 days. There are 5 batch mixes and each one having 6 cubes. Of these 6 cubes, 3 cubes are tested for 7 days & 28 days each. An average of 3 values as tabulated in subhead results, are considered for discussions.

Table -2: Compressive Strength Result for 7 & 28 days

S.NO.	COMBINATION	AVG COMPRESSIVE STRENGTH (7 Days) (N/mm²)	AVG COMPRESSIVE STRENGTH (28 Days) (N/mm²)
Mix-01	C+S+NCA(80%)+CF(4%)+CS(20%)	13.61	21.62
Mix-02	C(95%)+CSA(5%)+S+NCA(85%)+CS(15%)+ CF(4%)	16.55	25.41
Mix-03	C(90%)+CSA(10%)+S+NCA(90%)+CS(10%)+ CF(4%)	17.37	25.8
Mix-04	C(85%)+CSA(15%)+S+NCA(95%)+CS(5%)+ CF (4%)	16.90	25.8
Mix-05	C80%)+CSA(20%)+S+NCA+ CF (4%)	12.99	21.6

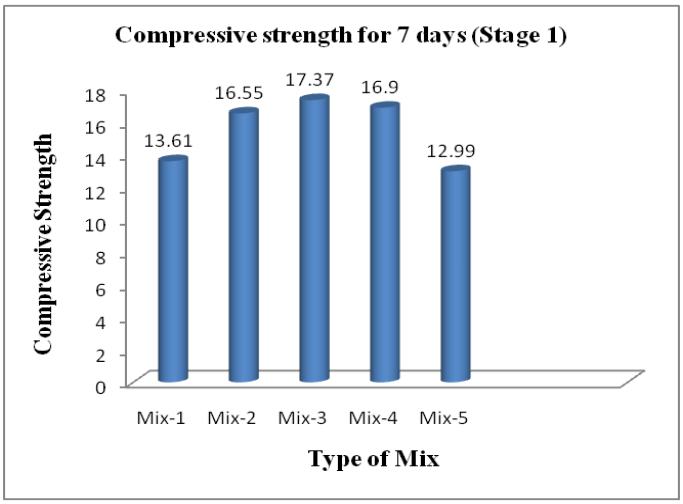

Chart -1: Compressive Strength at 7 days (Stage-1)

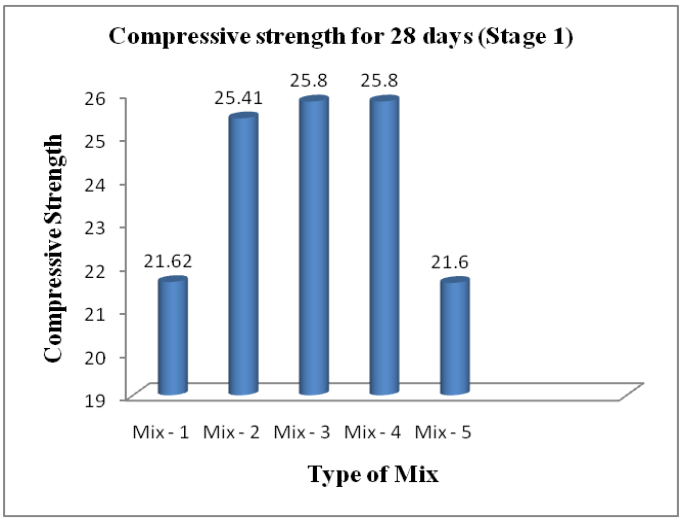

Chart -2: Compressive Strength at 28 days (Stage-1)

As shown in the chart : 1 (7 days strength), when cement is partially replaced 10% by CSA, compressive strength is increased by 21.74%. Afterwards when addition of % of CSA is replaced, strength starts decreasing, a minimum strength is achieved.

28 days strength in chart : 2 show an increment of 16.85% of strength of 10% replacement of CSA as compared with conventional concrete. Again strength is decreased when addition of percentage of CSA increase.

3.2 Split Tensile Strength

Split Tensile Strength is performed on 2 cylinders of each batch mix for 7 days & 28 days. There are 5 batch mixes and each one having 4 cylinders. Of these 4 cylinders, 2 cylinders are tested for 7 days & 28 days each. An average of 2 values as tabulated in subhead results, are considered for discussions.

Table -3: Split Strength Result for 7 & 28 days

S.NO.	COMBINATION	AVG TENSILE STRENGTH (7 Days) (N/mm²)	AVG TENSILE STRENGTH (28 Days) (N/mm²)
Mix-01	C+S+NCA(80%)+CF(4%)+CS(20%)	2.74	4.01
Mix-02	C(95%)+CSA(5%)+S+NCA(85%)+CS(15%)+ CF(4%)	2.56	3.71
Mix-03	C(90%)+CSA(10%)+S+NCA(90%)+CS(10%)+ CF(4%)	2.35	3.38
Mix-04	C(85%)+CSA(15%)+S+NCA(95%)+CS(5%)+ CF (4%)	2.92	4.01
Mix-05	C80%)+CSA(20%)+S+NCA+ CF (4%)	2.70	3.74

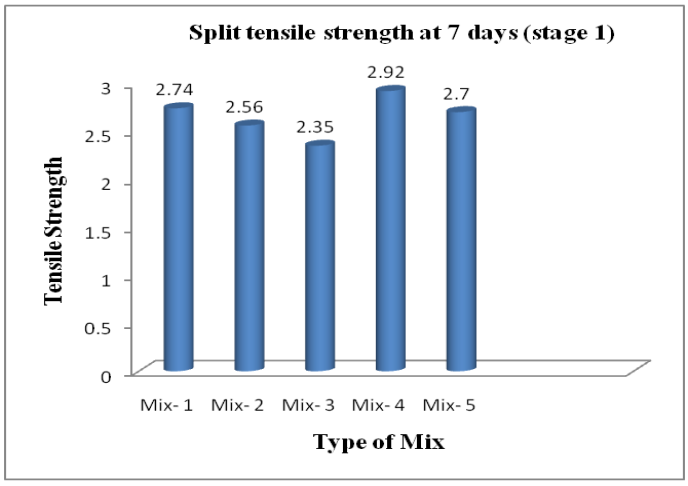

Chart -3: Split Tensile Strength at 7 (Days) (Stage-1)

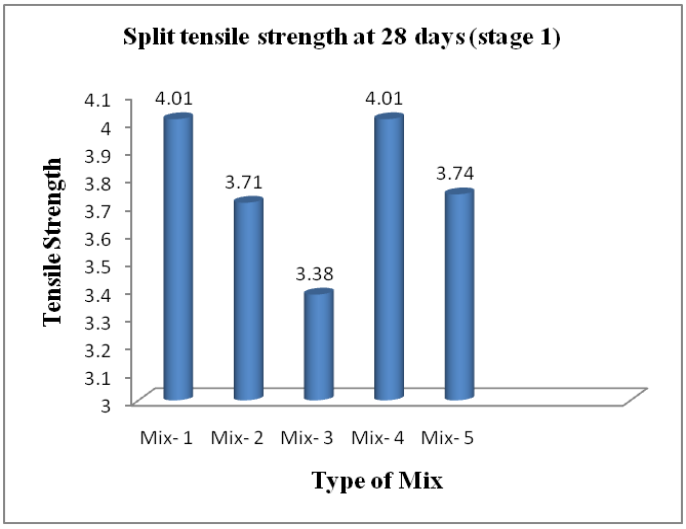

Chart -4: Split Tensile Strength at 28 (Days) (Stage-1)

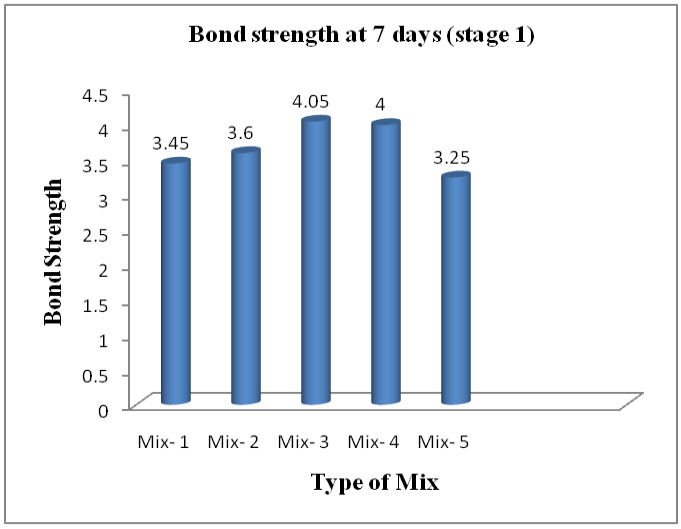

Chart -5: Bond Strength in N/mm^2 at 7 (Days) (Stage-1)

As shown in the chart : 3 (7 days strength), when cement is partially replaced 15% by CSA i.e., Split Tensile strength is increased by 25%. Afterwards when % of CSA is increased the strength starts decreasing.

28 days strength in chart : 4 shows and increment of 35% of strength of 15% replacement of CSA as compared with conventional concrete. Again strength is decreased when % of CSA is increased.

3.3 Bond Strength

Bond Strength is performed on 2 cubes of each batch mix for 7 days & 28 days. There are 5 batch mixes and each one having 4 cubes. Of these 4 cubes, 2 cylinders are tested for 7 days & 28 days each. An average of 2 values as tabulated in subhead results, are considered for discussions.

Table -4: Bond Strength Result for 7 & 28 days

S.NO.	COMBINATION	AVG BOND STRENGTH (7 Days) (N/mm^2)	AVG BOND STRENGTH (28 Days) (N/mm^2)
Mix-01	C+S+NCA(80%)+CF(4%)+CS(20%)	3.45	5.05
Mix-02	C(95%)+CSA(5%)+S+NCA(85 %)+CS(15%)+ CF(4%)	3.6	4.95
Mix-03	C(90%)+CSA(10%)+S+NCA(9 0%)+CS(10%)+ CF(4%)	4.05	5.8
Mix-04	C(85%)+CSA(15%)+S+NCA(9 5%)+CS(5%)+ CF (4%)	4	5
Mix-05	C80%)+CSA(20%)+S+NCA+ CF (4%)	3.25	5.25

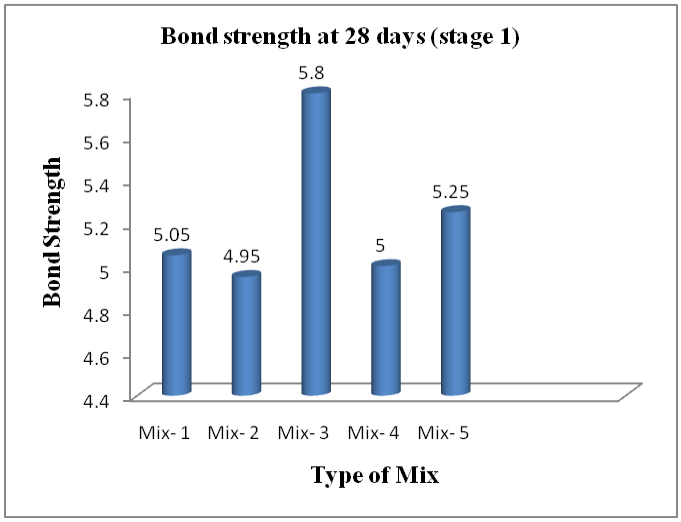

Chart -6: Bond Strength in N/mm^2 at 28 (Days) (Stage-1)

As shown in the chart : 5 (7 days strength), when cement is partially replaced 10% by CSA i.e., Split Tensile strength is increased by 23%. Afterwards when % of CSA is increased the strength starts decreasing.

28 days strength in chart : 6 shows and increment of 29% of strength of 10% replacement of CSA as compared with conventional concrete. Again strength is decreased when % of CSA is increased.

3.4 Density

Density of concrete of all five types of mixes is also calculated & checked whether it is considered as light weight concrete or not. Density of light weight concrete is less than 2000 kg/m3. Cubes are casted for determining Density of different mixes respectively at 7 & 28 days.

Table -5: Density of Concrete for 7 & 28 days

S.NO.	TYPE OF MIX	CURING AGE (Days)	DENSITY (kg/m3)	AVG DENSITY (kg/m3)
1	Mix - 01	7	1915	1909
		28	1903	
2	Mix - 02	7	1930	1928
		28	1926	
3	Mix - 03	7	2106	2051.5
		28	1997	
4	Mix - 04	7	2202	2207.5
		28	2213	
5	Mix - 05	7	2310	2312.5
		28	2315	

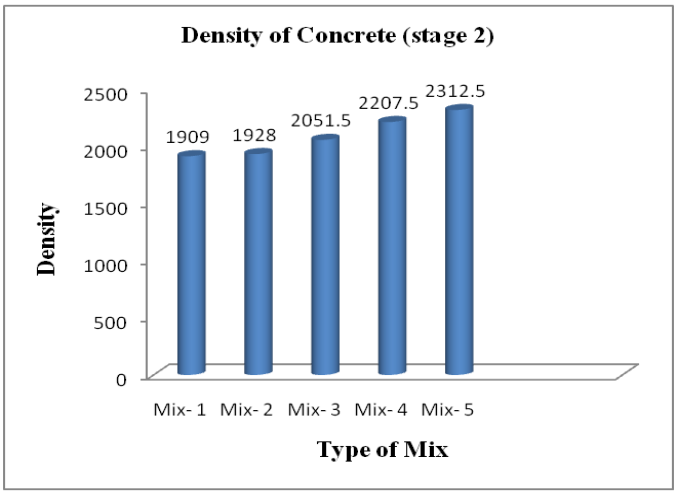

Chart -7: Density of Concrete in Kg/m³ (Stage-2)

As shown in the chart : 7 when coarse aggregate is partially replaced by 20% CS i.e., Density of concrete is decreased to 1909 Kg/m3. Afterwards when % of CS is decreased the density starts increasing.

4. CONCLUSIONS

After performing all the tests and analyzing their result, the following conclusions can be derived:

1. Maximum increase in compressive strength of concrete occurred when 10% cement and 10% coarse aggregate replacement was done with coconut shell ash and coconut shell.

2. Maximum increase in bond strength of concrete occurred when 10% cement and 10% coarse aggregate replacement was done with coconut shell ash and coconut shell.

3. Split tensile strength is maximum when 0% cement and 20% coarse aggregate & 15% cement and 5% coarse aggregate replacement was done with coconut shell ash and coconut shell with addition of 4% coconut fibre by weight of cement.

4. Concrete is considered as light weight concrete when 0% cement and 20% coarse aggregate & 5% cement and 15% coarse aggregate replacement was done with coconut shell ash and coconut shell, as density of these two types of concrete mixes is less than 2000 kg/m3.

Using the coconut shell ash as cement and coconut shell as aggregate in concrete can reduce the material cost in construction because of the low cost and abundant agricultural waste. This type of concrete we named "Coco Concrete" can be used in rural areas and places where coconut is abundant and may also be used where cement and conventional aggregates are costly. Thus, economy can be achieved in construction. Coco concrete is also classified as structural lightweight concrete. By reinforcing the concrete with coconut fibres which are freely available, we can reduce the environmental waste and split tensile strength increases in case of 4% fibre mix.

REFERENCES

[1] Vignesh Kumar Nagarajan, S. Aruna Devi, S. P. Manohari, M. Maria San, "Experimental Study on Partial Replacement of Cement with Coconut Shell Ash in Concrete" IJSR, Volume 3 Issue 3, March 2014.

[2] Utsev, J. T., Taku, J. K. ,"Coconut Shell Ash As Partial Replacement of Ordinary Portland Cement In Concrete Production"International Journal Of Scientific & Technology Research Volume 1, Issue 8,September 2016.

[3] J. P. Ries, J. Speck, (2014), "Lightweight Aggregate Optimizes the Sustainability of Concrete", Concrete Sustainability Conference, National Ready Mixed Concrete Association.

[4] Adeyemi AY.,(2015) ," An investigation into the suitability of coconut shells as aggregates in concrete production" ,Journal of Environment, Design and Management.

[5] Reis J.M.L (2013),"Fracture and flexural characterization of natural fiber-reinforced polymer concrete", Construction and Building Materials 20 (2005) 673–678.

[6] Vijay Chavada, A.A Parikh (2013), "An application review of coir fibre reinforced concrete", Vol. 2 Issue 4 ISSN: 2278-7844.