Experimental Study on Mechanical Properties of Waste Concrete Powder and Coconut Shell Ash

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Abstract – Use of waste concrete powder and coconut shell ash in concrete provides an encouraging solution to the problem of waste material management. Based on the survey of production and usage of waste concrete powder in Recycled concrete and the properties of this waste concrete powder is clear and that the concrete can be used in low economical cost. Waste concrete can be used for making normal structural concrete with the addition of some admixtures like fly ash, silica fume and waste materials. The main objective is to determine the compressive strength and tensile strength of concrete by varying the percentage ratio of waste concrete powder and coconut shell ash as cement. The use of waste concrete powder does not affect the strength of concrete. For each ratio, three cube specimens and three cylinder specimens are casted and cured. The specimens are cured in water at 7days, 14days and 28days respectively. The mechanical properties are determined such as compressive strength, tensile strength. The waste concrete powder and coconut shell ash are replaced as cement with varying proportions. For each mix preparation, specimens are casted and cured for 7days, 14days and 28days in water and the mechanical properties (compressive strength and tensile strength) were determined.

Index Terms – Waste concrete powder, Coconut shell ash, Recycled aggregate, Admixtures.

1. INTRODUCTION

Concrete is the most generally utilized construction material in the world. This concrete is made from a mixing of Cement as binding material, Fine aggregate as filler material, Coarse aggregate as bonding material and Water. Utilization of admixtures is expanding quickly, and this admixtures of concrete give physical just as monetary advantages. Because, the cement has low elasticity and should not be used as tension member and the coarse aggregate is one of the essential components of concrete and occupies the largest volume in the mix. Waste materials are used to replacing the concrete ingredients it will change the properties of the concrete materials

1.1 Waste Concrete

Waste concrete is a new method crushing, cleaning and grading these waste concrete blocks, then blending them according to certain proportion into aggregate of new concrete. This new concrete made of recycling wholly or partly is called recycled concrete (RC). Recycling, being one of the key strategies in minimization of waste, offers three benefits. The introduction of recycling in a waste management program mainly offers three benefits such as, softening new material resource demands, reducing transport and production energy costs, and preventing landfill use. (De-jian YANG et.al 2010)[1]. Here we are using waste concrete powder as cement for different ratio.

1.2 Coconut shell ash (CSA)

It is an agricultural biodegradable waste found in most of tropical countries especially in Asia. India manufacture 15,730 million nuts annually, which is next to Indonesia with 16,498 million. Coconut shells dumped improperly to the environment provide breeding places for disease vectors such as rats and mosquitoes. It is a light weight material which is becoming much popular nowadays because of its easy handling and low dead loads. And it is a good alternative to wood and helps to prevent deforestation and also inexpensive. Coconut shell exhibits more resistance against crushing, impact and, compared to crushed granite aggregate. It can be grouped under lightweight aggregate. There is no need to treat the coconut shell before use as an aggregate except water absorption. Coconut shell is compatible with the cement.(V. P. Kumbhar.et.al 2018)[2]

1.3 Objectives

To find out the different amount of concrete materials ratio for construction. To diminish the effect of waste materials on condition.

To carry out different tests on waste materials and cement and compare their results. To reduce the amount of construction waste materials going into landfill and dumping pits.

2. METHODOLOGY

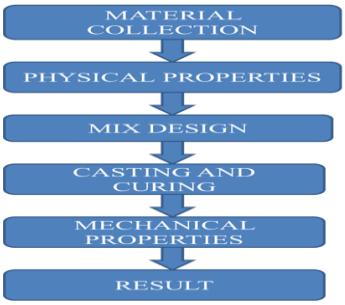


Figure:2.1 Flow chart

3. MATERIAL COLLECTION

3.1 Cement:

Cement is the binding material of the concrete. This is the main proof as to why cement and water mix is used as a bonding agent. Cement is a water-based binder used to bind other building materials (i.e. sand, aggregate) together. It is used in the production of mortar and concrete during the construction process.

3.2 Fine aggregate:

Sand and gravel in concrete serve several purposes. Because they act as a filler, they also add more volume to the concrete. More volume means less air and a stronger product. The size of the gravel also helps to determine the concrete's strength.

3.3 Coarse Aggregates:

Coarse aggregates are passing through 20mm IS sieve.Aggregate' is a term for any particulate material. It includes gravel, crushed stone, sand, slag, recycled concrete and geo-synthetic aggregates. Aggregate may be natural, manufactured or recycled.

3.4 Waste Concrete Powder:

Waste concrete powder crushed from demolition concrete retained on 90 µ sieve as shown in figure 3.1

Figure:3.1 Recycled Aggregate Powder

3.5 Coconut Shell Ash:

Coconut shells have better durability characteristics, high toughness and abrasion resistant property. In coconut shell lignin content is more and the cellulose content is less, coconut shells are having similar chemical composition to hard wood. (Anviti.et.al)[3]. The sample is prepared from heating to normal temperature then burned it to ashes.

4. PHYICAL PROPERTIES

The main physical properties of ingredients and the results are as shown in

Concrete Ingredients	Physical Properties	Results
Cement	Standard Consistency	36%
	Initial Setting Time	25mins
	Final setting time	520mins
	Fineness of Cement	4%
Coconut shell ash (CSA)	Standard Consistency	24%
	Initial Setting Time	15mins
	Final setting time	430mins
	Fineness of CSA	5%
Waste Concrete Powder (WCP)	Standard Consistency	28%
	Initial Setting Time	18mins
	Final setting time	450mins
	Fineness of WCP	2%
Coarse Aggregates	Bulk Density	1.35 kg/lit
	Specific Gravity	2.97
Fine aggregate	Specific Gravity	2.56
	Sieve Analysis	C_u = 2.05

Table:4.1 Results on Physical properties

5. MIX PROPORTION

The ratioof concrete components (Table 5.1 Mix ratio) is carried out from the IS 10262:2009 and the provisions of IS 456:2000.

Item	Cement	Waste concrete	Coconut shell ash
Ratio	1	0.15	0.15
Mass kg/m^3	437	65.55	65.55

Table: 5.1 Mix ratio

6. MECHANICAL PROPERTIES

6.1 Compressive Strength Test

Compressive strength is the limit of a material or structure to resist the loads having a tendency to decrease the size. It is tested by using the Universal Testing machine. Here the compressive strength of concrete cubes for the plain concrete and this waste materials concrete are found out using Compression testing machine. Three cubes were cast for each percentage of waste materials and the average of the three compressive strength values were taken.

Figure:6.1 Compressive strength of concrete cube

6.2 Tensile Strength Test

Tensile strength is the resistance of a material or structure to breaking under the load in tension. It is evaluated on concrete cylinders of standard dimensions using a Universal Testing machine. Both conventional and waste materials concrete specimens were tested at varying percentages of waste materials and the average values was obtained.

Figure:6.2 Tensile strength of concrete cylinder

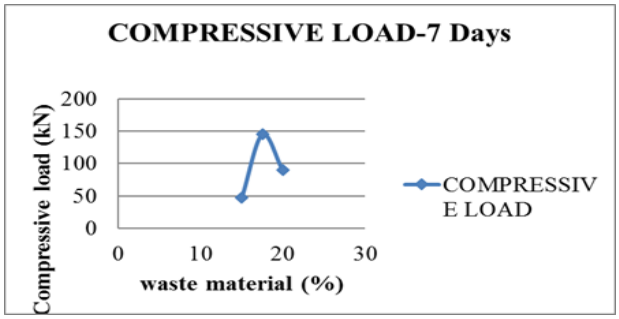
7. RESULTS AND DISCUSSION

Following tables and graphs shows the compressive strength of cube specimens and tensile strength of cylinder specimens for 7days, 14days and 28days curing respectively.

Compressive strength:

Waste Concrete Powder (%)	Coconut Shell Ash (%)	Compressive Strength(Kn)
15	15	130
17.5	17.5	338
20	20	290

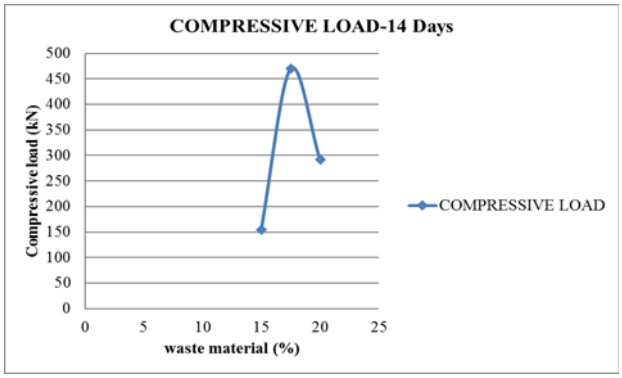
Table:7.1.1 Compressive Strength-7days



Graph :7.1. 1 Compressive Strength-7days

Waste Concrete Powder (%)	Coconut Shell Ash (%)	Compressive Strength (kN)
15	15	234
17.5	17.5	608
20	20	522

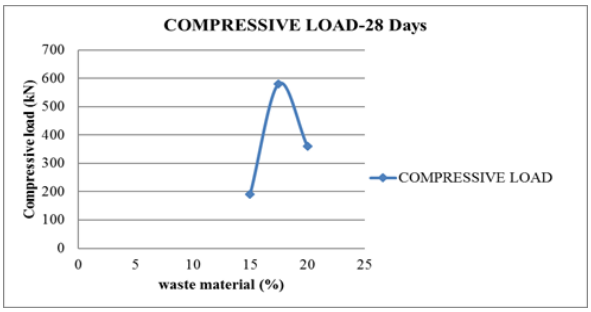
Table:7.1.2 Compressive Strength-14days



Graph :7.1.2 Compressive Strength-14days

Waste Concrete Powder (%)	Coconut Shell Ash (%)	Compressive Strength(kN)
15	15	260
17.5	17.5	675
20	20	580

Table:7.1.3 Compressive Strength-28days

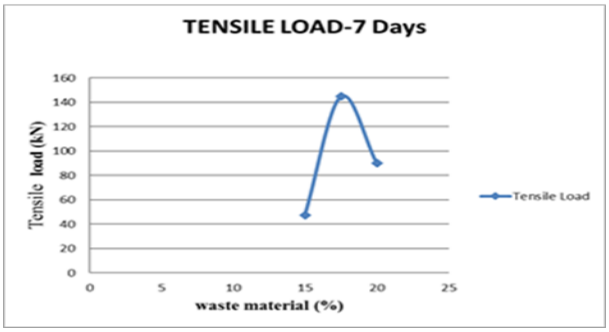


Graph :7.1.3 Compressive Strength-28days

Tensile strength:

Waste Concrete Powder (%)	Coconut Shell Ash(%)	Tensile Strength (kN)
15	15	95
17.5	17.5	290
20	20	180

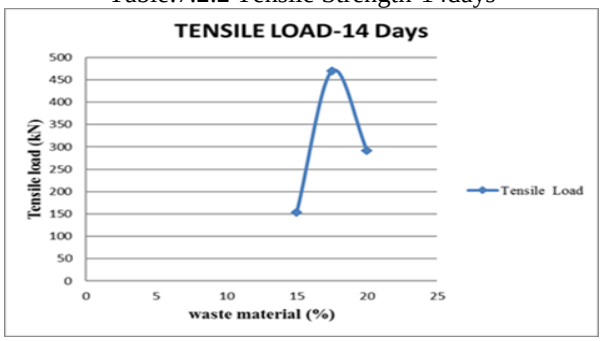
Table:7.2.1 Tensile Strength-7days



Graph :7.2.1 Tensile Strength-7days

Waste Concrete Powder (%)	Coconut Shell Ash(%)	Tensile Strength (kN)
15	15	171
17.5	17.5	522
20	20	324

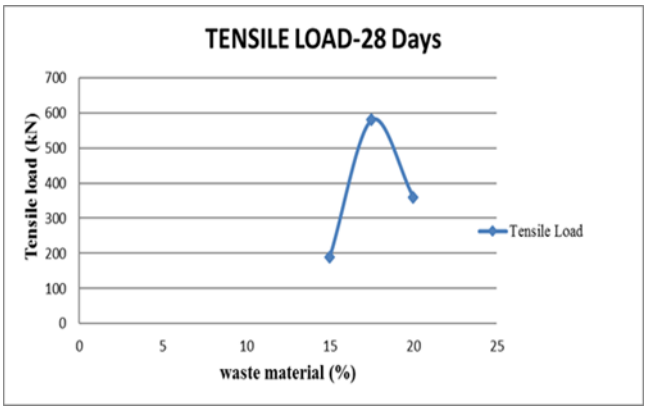
Table:7.2.2 Tensile Strength-14days



Graph :7.2.2 Tensile Strength-14days

Waste Concrete Powder (%)	Coconut Shell Ash(%)	Tensile Strength (kN)
15	15	190
17.5	17.5	580
20	20	360

Table:7.2.3 Tensile Strength-28days



Graph :7.2.3 Tensile Strength-28 days

8. CONCLUSION

Coconut Shell Ash (CSA), Waste Concrete Powder (WCP) and OPC mix showed some promise for use in reinforce concrete as well as mass concrete structures in building construction. The compressive strength of the cubes at 28 days curing indicates that 17.5% replacement levels meet the requirement of BS EN 206-1: 2000 In conclusion, the study reveals that 17.5% replacement of OPC with CSA and waste concrete powder using W/C ratio of 0.45 are suitable for production of both heavy weight and light weight concrete. Further areas of research are recommended. This includes the use of CSA calcined under controlled conditions, since the Calcinations' temperature and time appears without a clearly defined shape or form of the ash and altering water/cement ratio and the use of waste concrete powder reduce the concrete waste and economical too.

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