REPLACEMENT OF FINE AGGREGATES USING COCONUT SHELL POWDER AND E – WASTES

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ABSTRACT:

In this study, combination of coconut shell and E- waste aggregate concrete blocks were produced and tested for the parameters suggested in IS 2185 -1(2005). The conventional mix practiced in the field was adopted for the production of combination of coconut shell and E-waste aggregate concrete blocks. For comparison purposes, conventional aggregate concrete blocks were produced and tested in parallel. Test parameters such as workability of mixes, density of mixes, dimensions of blocks such as length, breadth, thickness an aspect ratio, compressive strength, water absorption and abrasion resistance results were discussed and presented. As suggested in IS 2185-1 2005, tested for each parameter studies and presented. Test results and performance of combination of coconut shell and E-waste concrete blocks encourage the use of coconut shell and E-waste as aggregate in concrete blocks production.

Key words: Coconut shell, E- waste, Aggregate, concrete blocks, Application.

1. INTRODUCTION

The demand for sandand other fine aggregates are highly increasing in the modern constructions which leads to various problems like increase in the cost of fine aggregates, reduction in the availability of materials, delay in finishing the project on time, use of less amount of fine aggregates that weakens the structure and various similar problems. As a solution we can use other materialsinstead of using river sand and M- sand. In this project we employ the idea of using 50% of coconut shells and 50% of E – wasteas fine aggregates instead of sand as fineaggregates.

2. MATERIALS USED:

2.1 CEMENT:

Cement is formed by heating lime stone (calcium carbonate) with small quantities of other materials (like clay). During this project ordinary hydraulic cement of 53 grade conforming to IS456 – 2000 was used tests were administered on various physical

properties and therefore the results areshown in test data of materials .Cement will act as a binding material.

PHYSICAL PROPERTIES OFCEMENT

S. No	Test	Obtained Result	Standards (IS:8112)
1	Initial setting time	32 minutes	30 minutes
2	Final setting time	580 minutes	600 minutes
3	Fineness	96 %	Not Less than 90%
4	Specific gravity	3.14	3.10 – 3.15
5	Standard consistency	34%	30 – 35%

CHEMICAL PROPERTIES OF CEMENT

S. No	Oxide	Present (%)
1	CaO	60-67
2	SiO_2	17-25
3	Al_2O_3	3.0-8.0
4	Fe_2O_3	0.5-6.0
5	MgO	0.1-4.0
6	Alkalies (K_2O, Na_2O)	0.4-1.3
7	SO_3	1.3-3.0

2.2 COARSE AGGREGATE:

Coarse aggregate of size ranges from 20mm to 25mm are used here. They are made up ofrocks quarried from ground deposits like river gravel, crushed stone from rock quarries etc.

2.3 WATER:

Water is used for mixing cement, fine aggregates and coarse aggregates, and it alsoplays a major role in curing. The proportion of water is determined through water cementratio. The pH of water generally lies between 6- 7. The water should neither be alkaline nor acidic. If the water is alkaline it may causes corrosion to reinforcement in concrete. If thewater is acidic it may affect the strength of the concrete.

2.4 COCONUT SHELLS:

Coconut shells are known for its better workability due to the smooth surface onside of the shells. The coconut shell concretehas high impact resistance when compared with conventional concrete. It has more moisture retaining and water absorbing capacity compared to conventional aggregate.

2.5 SPECIFIC GRAVITY OFCOCONUT SHELL POWDER:

SPECIFIC GRAVITY OF COCONUT SHELL POWDER

SPECIFIC GRAVITY OF E WASTE POWDER

G = (M2-M1)/((M2-M1)-((M3-M4))

S.no	Weight in gms	Trial 1	Trial 2
1	Weight of empty pycnometer (M1)	634	635.4
2	Weight of pycnometer+ weight of half filled aggregates (M2)	903.1	903.8
3	Weight of pycnometer+ weight of half filled aggregates + weight of water (M3)	1610	1612
4	Weight of pycnometer + weight of water (M4)	1506	1508
Specific gravity		1.630	1.632

Average specific gravity 1.631

SPECIFIC GRAVITY OF COCONUT SHELL POWDER

G = (M2-M1)/((M2-M1) - ((M3-M4))

S.no	Weight in gms	Trial 1	Trial 2
1	Weight of empty pycnometer (M1)	634	635.4
2	Weight of pycnometer+ weight of half filled aggregates (M2)	1400	1402
3	Weight of pycnometer+ weight of half filled aggregates + weight of water (M3)	1687	1698
4	Weight of pyvnometer + weight of water (M4)	1506	1508
Specific gravity		1.31	1.33

Average specific gravity 1.32

2.6 E-WASTE:

E-wastes are the electrical wastes that are been discarded from any kind of electronic devices. They may be either working or in broken state. E-waste contains a list of chemicals that are harmful to people and the environment, like: mercury, lead, beryllium, brominated flame retardants, and cadmium. When electronics are mishandled during disposal, these chemicals end up in pollutingour soil, water, and air.

SPECIFIC GRAVITY OF E WASTE POWDER

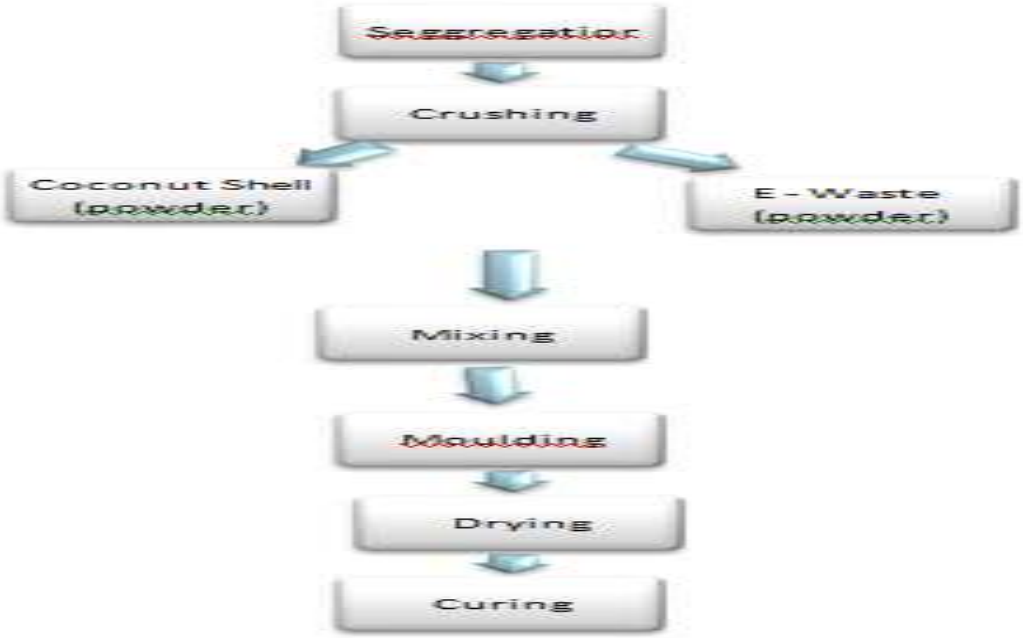
2.7 FINNESS MODULUS OF E-WASTE

FINENESS MODULUS OF E WASTE

IS SIEVE	WEIGHT RETAINED (g)	CUMULATIVE WEIGHT RETAINED (g)	CUMULATIVE % WEIGHT RETAINED	CUMULATIVE % PASSING
4.75 mm	8	8	1.6	98.4
2.36 mm	47	55	11	89
1.18 mm	85	140	28	72
600µ	104	244	48.8	51.2
300	116	360	72	28
150	72	432	86.4	13.6
75	45	477	95.4	4.6
pan	23			
Total	500		3.43	

Fineness modulus of E Waste = 3.43
Based on the fineness modulus test the fine aggregate is graded as zone II

3. METHODOLOGY



3.1 SEGREGATION

The plastics are separated from the e-waste like remotes, laptops, gadgets, etc. and the coconut shells are collected from the environmental wastes. Then collected wastes should be cleaned from dirt, dustsand sand.

3.2 HEATING

The cleaned plastics wastes are placed in a vessels and heated at 100°C. Stir it gently tillit melts completely.
The coconut shells are placed in vessels and heated at 100°C to make it as ash.

3.3 MIXING

Mixing is of two types

- Hand mixing
- Machine mixing

The powdered coconut shell and melted plastics are then mixed immediately with theriver sand before the melted plastics getsharden.

3.4 MIX DESIGN

Powdered coconut shell and melted plastics are then mixed with river sand in the ratio(1:2), which represents the proportion of combination of powdered coconut shell and melted plastics with river sand.

3.5 MOULDING

Moulding is classified into:

- Table moulding
- Hand moulding

The mixture is placed in the square mould of
15 x 15 cm. Moulds were used to get concrete blocks at uniform size. Before moulding the moulds should be applied withmould oil and it should be well compacted with 25 rampings at 3 intervals to fill the concrete in the mould so that we can avoid the formation of airvoids in the concrete.Keep it for 24 hours.

3.6 DRYING

Drying is of two types

- Oven drying
- Sun drying

Generally oven drying takes less period of time to dry than sun drying. The concrete blocks are removed from the moulds and placed under the sun for 2-3 days for drying.The temperature is gradually maintained below 100ºC to prevent the melting of plastics.

3.7 CURING

The dried concrete blocks were allowed to immersein the curing for 7-14 days. The concrete blocks were taken from the curing tank aftercuring and allowed to dry 24 hours. After the curing the each ages of 3 days, 7 days, 14 days and atmost 28 days compressive strength were tested and also all the test parameters were tested with the several blocks after the completion of curingprocess.

4. TESTING OF CONCRETE BLOCKS:

For testing of concrete blocks, the following tests were conducted on two types of concrete.

- Fresh concrete
- Hardened concrete

4.1 TEST ON FRESH CONCRETE

- Workability
- Initial and final setting time

4.2 TEST ON HARDENED CONCRETE

- Compressive strength
- Fire resistance test
- Permeability test on concrete
- Water absorption test
- Tensile strength

4.3 WORKABILITY

The test is conducted to check the workability of concrete. The workability testing methods such as slump cone test, compacting factor and vee bee test are used in this process. It gives the homogeneity andconsistency of the concrete.

Volume = π/3 (R2 + r2 + R.r) h

= π/3 (0.12 + 0.052 + (0.1 x 0.005)) x 0.3

= 5.49 x 10-3 m3

SLUMP CONE TEST OF CONVENTIONAL

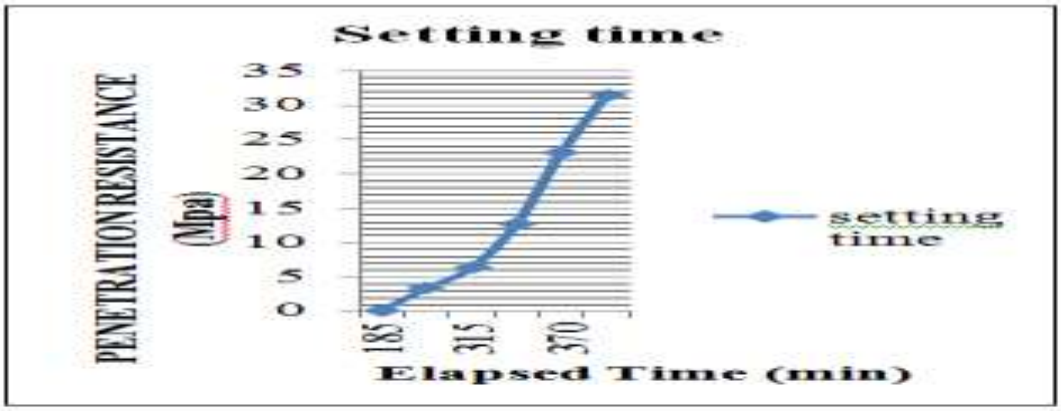
S.no	Description	Trial 1	Trial 2
1	Weight of cement (kg)	2.39	2.39
2	Weight of fine aggregate (kg)	3.58	3.58
3	Weight of Coarse aggregate (kg)	6.50	6.50
4	w/c ratio	0.44	0.44
5	Weight of water (lit)	1.05	1.05
6	Initial Slump value (mm)	300	300
7	Final slump value (mm)	250	247
8	Slump (mm)	50	53
9	**Degree of workability**	**Medium**	**Medium**

4.4 INITIAL AND FINAL SETTINGTIME

Initial setting time of concrete is that theperiod between addition of water to cement untill the time at 1 mm square section needlefails to penetrate the cement paste, placed within the Vicat'smould 5mm to 7mm from the bottom of the mould. Final setting timeis that the point amount between the time water is added to cement and also the time atwhich 1 mm needle builds an impression on the paste in the mould but 5 mm attachment doesn't make any impression.

INITIAL AND FINAL SETTING TIME TEST OF CONVENTIONAL CONCRETE

S.NO	BEARING AREAS OF NEEDLE	TIME TAKEN TO ATTAIN 25MM DEPTH	PENETRATION RESISTANCE (Mpa)
1	645	185	0.18
2	323	275	3.43
3	161	315	6.4
4	65	357	12.8
5	32	370	23.2
6	16	390	31.5

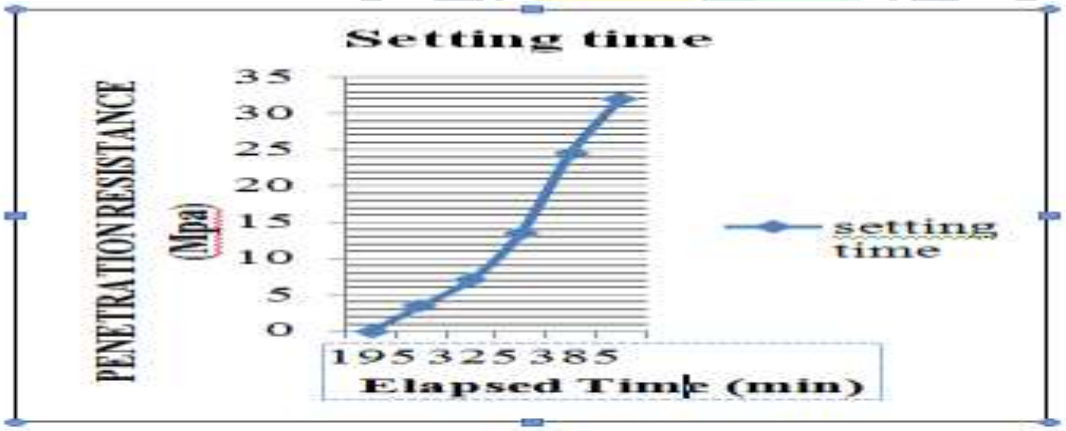


INITIAL SETTING TIME CORRESPONDING TO 3.5 MPA RESISTANCE – 278 MIN

FINAL SETTING TIME CORRESPONDING TO 27.6 MPA RESISTANCE – 382 MIN

INITIAL AND FINAL SETTING TIME TEST OF CONCRETE WITH E WASTE AND COCONUT SHELL

S.NO	BEARING AREAS OF NEEDLE	TIME TAKEN TO ATTAIN 25MM DEPTH	PENETRATION RESISTANCE (Mpa)
1	645	195	0.2
2	323	290	3.5
3	161	325	7.1
4	65	360	13.5
5	32	385	24.5
6	16	400	32



INITIAL SETTING TIME CORRESPONDING TO 3.5 MPA RESISTANCE – 290 MIN

FINAL SETTING TIME CORRESPONDING TO 27.6 MPA RESISTANCE – 393 MIN

4.5 COMPRESSION STRENGTH

The test was conducted to check the compressive strength of the concrete block. The concrete block was taken and placed in the compression testing machine and load is applied at the rate of 150kg/cm2 min until there is no formation of cracks.

Compressive strength = Load applied/ area

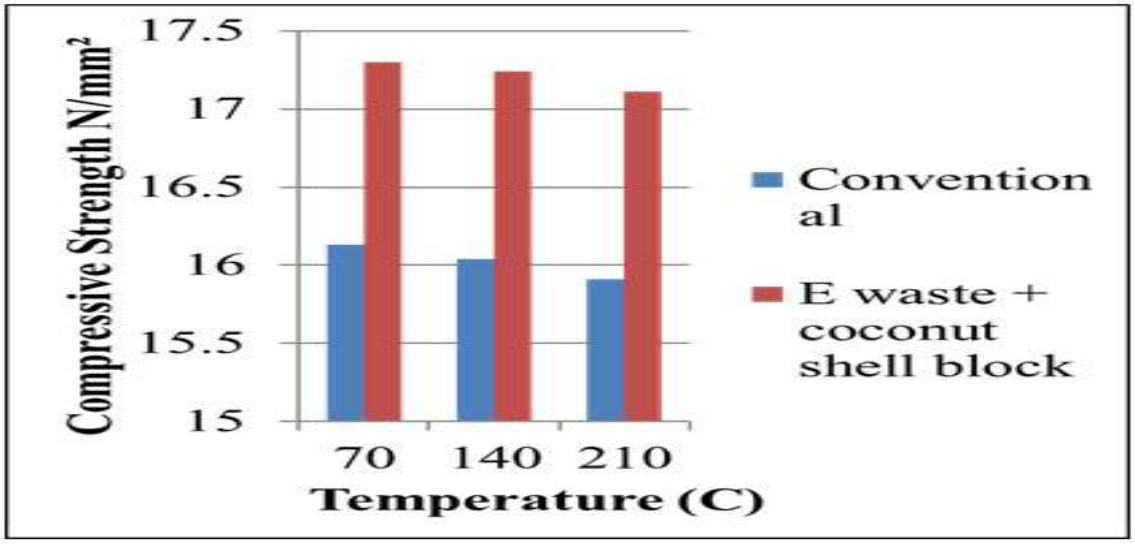
COMPRESSION TEST RESULTS

4.6 FIRE RESISTANCE TEST

It is used to test the ability of the concrete material resistant to fire. In this the temperature is applied and heating the concrete in various temperature and the results are observed.

FIRE RESISTANCE TEST RESULTS

Compression strength test	Curing period	Temperature (C)	Ultimate load Applied (KN)	Area (mm^2)	Compressive strength (N/mm^2)
Conventional concrete	7th day	70	363	22500	16.13
		140	361		16.04
		210	358		15.91
Concrete with E Waste and Coconut shell	7th day	70	391	22500	17.3
		140	388		17.24
		210	385		17.11



to determine the tensile strength of concrete to determine the load at which the concrete members could crack.

4.7 PERMEABILITY OF CONCRETE

The test is done to check if concrete is permeable, deleterious materials like water, CO2, SO2 & Cl which permeates through the pores of the concrete and reacts with the reinforcement forms rust which increases the volume of the reinforcement and damages the structure. The coefficient of permeability can be calculated using the formula

$$K=QL/AH$$

K – Coefficient of permeability (m/s) Q – Volume of flow rate (m^3/s)
A – Cross sectional Area (m^2)
H – Specimen thickness in the direction of flow m

PERMEABILITY TEST – CONSTANT FLOW METHOD

Mix Sample	Discarge Q (ml)	Time T (Hrs)	Head of water H (m)	Coefficient of permeability K(m/s) x 10^{-12}	Average K(m/s) x 10^{-12}
Conventional Concrete	16	18	68.67	23.97	25.01
	18		71.12	26.04	
E waste + Coconut shell concrete	12	18	73.58	16.78	17.86
	14		76.03	18.94	

4.8 WATER ABSORPTION TEST

Water absorption test was conducted by saturating concrete cube specimens by immersion in potable water for 24 hours. The saturated specimen were then oven- dried at a temperature of 105°C for not less than 24 hours but until a constant dry mass is obtained. The water absorption was calculated using the following expression:

Absorption (%) = ((Weight of Wet sample • Dry Sample)/Weight of Dry sample) X 100

WATER ABSORPTION TEST RESULT

Compression strength test	Weight of Dry Sample (Kg)	Weight of wet sample (kg)	Water Absorption (%)	Average
Conventional concrete	8.14	8.32	2.25	2.22
	8.142	8.323	2.23	
	8.144	8.323	2.2	
Concrete with E Waste and Coconut shell	8.129	8.299	2.1	2.132
	8.125	8.298	2.13	
	8.132	8.30	2.14	

4.9 SPLIT TENSILE STRENGTH

The tensile strength of concrete is one of the basic and necessary properties which greatly have an effect on the extent and size of cracking in structures. Moreover, theconcrete is extremely weak in tension due toits brittle nature. Hence. it is not expected to resist the direct tension. So, concrete develops cracks once tensile forces exceed its tensile strength. Therefore, it's necessary

SPLIT TENSILE STRENGTH RESULTS

Split tensile strength test	Curing period	Load applied	Area (mm2)	Split tensile strength (N/mm2)
Conventional concrete	7 days	393	45000	2.82
Concrete with E waste and Coconutshell	7 days	360	45000	0.66

5. CONCLUSION

The experimental results of coconutshell and e-waste concrete are presented in this paper. The comparison of mechanical properties and structural behaviour of the coco block and conventional concrete block is discussed. The crack width, deflection, ultimate strength, concrete and steelstrains are analysed and compared forboth blocks. Based on the result the following conclusion may be drawn. Theoverall behaviour of the concrete studiedclosely resembles that equal to the conventional concrete

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