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Partial Replacement of Coconut Shell Ash with Cement in Concrete

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Abstract: ***The expense of concrete utilized in solid works is on the expansion and exorbitant, yet the requirement for lodging and different developments requiring this material continues developing with increasing the cost of concrete utilized in solid works is on the increment and unreasonably expensive, yet the requirement for lodging and different developments requiring this material continues developing with expanding populace, consequently the need to discover elective restricting materials that can be utilized exclusively or in fractional substitution of concrete. Farming waste material, for this situation, coconut shells, which is an ecological contamination, are gathered and consumed in the outdoors (uncontrolled burning) for three hours to deliver coconut shell ash (CSA), which thus was utilized as pozzolana in fractional substitution of concrete in solid creation. Solid 3d squares were delivered utilizing different substitution levels of 0, 5, 10, 15, 20 and 25 percent of CSA with OPC. An aggregate of 30, 3d squares were delivered and restored by drenching them in water for 7 and 28 days individually. Properties, for example, compressive quality, thickness, setting times and pozzolanic movement file were resolved. The outcomes indicated that the densities of solid 3d shapes for 10 - 15% substitution was over 2400 kg/m^3 the compressive quality expanded from 17.85 n/mm^2 7days to 33.46n/mm^2 at 28 days relieving along these lines meeting the necessity for use in both substantial weight and light weight cementing. Along these lines, 10 - 15% supplanting of OPC with CSA is suggested for both overwhelming weight and light weight solid creation.***

Keywords: Compressive Strength, Cement, Coconut shell Ash, Course Aggregate, Fine Aggregate

1. Introduction

Concrete Is Generally Utilized as Development Material for Different Sorts of Structures Because of Its Toughness. For Quite A While It Was Viewed As Truly Strong Material Requiring Almost No Upkeep. Numerous Ecological Marvels are known Essentially the Toughness of Fortified Solid Structures. We Manufacture Solid Structures in Profoundly Dirtied Urban and Mechanical Regions, Forceful Marine Situations and Numerous Other Antagonistic Conditions Where Different Materials of Development are seen as Nondurable. In The Ongoing Correction of Is: 456-2000, One of The Significant Focuses Talked About is The Strength Parts of Cement. So the Utilization of Cement is Unavoidable. Simultaneously the Shortages of Totals are Likewise Enormously Expanded These Days. Usage of Mechanical Soil Waste or Optional Materials Has Been Supported in Development Field for The Creation of Concrete and Cement Since it adds to Decreasing the Utilization of Normal Assets. They have Been Effectively Utilized in The Development Business for Incomplete or Full Trade for Fine and Coarse Totals. The Piece of World Cement Consumption in the Year 2010 is 3,313 Million Metric Tons.

Production of Coconut

In 2018, world creation of coconuts was 62 million tons, drove by Indonesia (18.6), the Philippines (14.7), India (11.7), Sri Lanka (2.6), Brazil (2.5), Maxico (1.2) other with 74% consolidated of the Aggregate.

Conventional territories of coconut development in India are the conditions of Kerala, Tamilnadu, Karnataka, Puducherry, Andhra Pradesh, Goa, Maharashtra, Odisha, West Bengal and, Gujarat and the islands of Lakshadweep and Andaman and Nicobar. According to 2014–15 insights from Coconut Development Board of Government of India, four southern states joined record for practically 90% of the all out creation in the nation: Tamil (33.84%), Karnataka (25.15%), Kerala (23.96%), and Andhra Pradesh (7.16%). Different states, for example, Goa, Maharashtra, Odessa, West Bengal, and those in the upper east (Tripura and Assam) represent the rest of the creations. Despite the fact that Kerala has the biggest number of coconut trees, as far as creation per hectare, Tamil Nadu drives every single other state. , Coimbatore and Tirupur locales head the creation list. In Goa, the coconut tree has been renamed by the administration as a palm (like a grass), empowering ranchers and land engineers to clear land with less limitation. With this, it wills no more be considered as a tree and no consent will be required by the woods office before cutting a coconut tree. The husk and shells can be utilized for fuel and are a wellspring of charcoal. Fabricated from coconut shell is considered amazingly powerful for the expulsion of contaminations.

2. Literature Review

The Goal of This Investigation Work Is to Use the Coconut Shell Ash, husk Ash and Charcoal Ash shells can be used for fuel and are a source of Charcoal Ash a Mix Design Ratio 1: 1: 2 and water ratio 0.40, Additional of Cement. Coconut Shell Ash Is Replaced By 5%, 10%, 15%, 20% And 25% In Addition With of Weight of Cement. An Experimental Research Demonstrates The Strength Features Such As Compressive Strength, Split Tensile Strength and Flexural Strength Test of Coconut Shell Ash Based Concrete Were Investigated. It Is Found the Strength of The Concrete Rises with the Adding of Coconut Shell Ash and Finally the Comparison Is Made for the Coconut Shell Ash, husk Ash and Charcoal Ash Added to Cement Concrete**.**

Oyedepo OJ (2015). Carried out an experimental Research on Performance of coconut shell ash and Palm kernel shell ash as partial Replacement for cement in concrete. Using a mix design ratio of 1:2:4 and water binder ratio of 0.63,

concrete cubes were casted using varying ordinary Portland cement (OPC): palm kernel shell ash (PKSA) and ordinary Portland cement (OPC): coconut shell ash (CSA) ratios of 100:0, 90:10, 80:20, 70:30 , 60:40 and 50:50 respectively. Author has noticed that the partial replacement of cement with 20% PKSA and CSA in concrete gives an average optimum compressive strength of 15.4 N/mm^2 and 17.26 N/mm^2 respectively at 28 days. While, 10% replacement with CSA gives the optimum value of compressive strength which is 20.58 N/mm^2 at 28 days. Such strength is suitable for both light weight and heavy weight concrete respectively. Thus, the researcher has concluded that the use of PKSA and CSA as a partial replacement for cement in concrete, at lower volume of replacement, will enhance the reduction of cement usage in concretes, thereby reducing the production cost and the environmental pollution caused by the dumping of the agricultural waste.

Vignesh Kumar Nagarajan March (2014). Carried out an Experimental study on partial replacement of cement with coconut shell ash in concrete. Agricultural waste material, in this case, coconut shells, which is an environmental pollutant, are collected and burnt in the open air (uncontrolled combustion) for three hours and that product is incinerated in muffle furnace at 800oC for 6 hrs to produce coconut shell ash (CSA), which in turn was used as pozzolana in partial replacement of cement in concrete production. Author has produced concrete mortar cubes by replacing 0 and 5 percent of OPC with CSA. He has concluded that, the setting time increases with increase in the amount of coconut shell ash. He also noticed that, with increase in percentage replacement of OPC with CSA, the compressive strength decreases. The optimal 28 days strength for OPC-CSA mix is recorded at 10% replacement.

3. Material Used

- Ordinary Portland Cement (43 Grade)
- Coconut Shell Ash (CSA)
- Coarse Aggregate
- Fine Aggregate
- Water.

3.1 Cement

Concrete Is Utilized Right From Old Periods in Development Industry. In The Broadest Feeling Of The Word, Concrete Is A Fastener, A Substance Which Sets And Solidifies Freely, And Can Tie Different Materials Together. "Cement" Follows To The Romans, Who Utilized The Expression "Creation Caementicium" To Depict Stone Work Which Looked Like Cement And Was Produced Using Squashed Stone With Consumed Lime As Cover. Te Volcanic Debris Pounded Block Added Substances Which Were Added To The Consumed Lime To Acquire Water Powered Folio Were Later Alluded To As Cementum, Cimentum, Cament And Concrete. Concretes Utilized In Development Are Portrayed As Water Powered Or Nonhydraulic. The Most Significant Utilization Of Concrete Is The Creation Of Mortar And Cement – The Holding Of Characteristic or Fake Totals To Shape A Solid Structure Material Which Is Strong Even With Typical Natural Impacts.

Physical Properties of Cement

These physical properties are talked about in subtleties in the accompanying fragment. Additionally, you will discover the test names related with these physical properties

- Fineness of cement
- Soundness
- Consistency
- Strength
- Setting time
- Heat of hydration
- Loss of ignition
- Bulk density
- Specific gravity

Various mixes of concrete utilized in development are described by their physical properties. Some key boundaries control the nature of concrete. The physical properties of good concrete depend on.

3.2 Coconut Shell Ash

CSA Properties and Strength Analysis

Coconut shell is one of the most significant characteristic fillers delivered in tropical nations like Malaysia, Indonesia, Thailand, and Sri Lanka. Numerous works have been given to utilization of other common fillers in composites in the ongoing past years and coconut shell filler is a likely contender for the advancement of new composites since they have high quality and modulus properties alongside the additional favorable position of high lignin content. The high lignin content makes the composites made with these filler increasingly climate safe and henceforth progressively reasonable for application as development materials. Coconut shell flour is additionally widely used to make items like outfitting materials, rope and so forth. The shells likewise retain less dampness because of its low cellulose content the report centers around contemplating the adequacy of coconut shell particles as a wellspring of characteristic material for fortifying epoxy tars towards their flexural properties.

Figure 1: Coconut Shell

Coconut Shell Ashes

Numerous analysts have put forth attempts for getting ready carbon dark from farming side-effects, for example, coconut shell apricot stones, sugarcane bagasse , nutshells, timber

land build ups and tobacco stems. Coconut shells have practically no financial worth and their removal isn't just expensive yet may likewise cause ecological issues. Coconut shell is appropriate for getting ready carbon dark because of its brilliant characteristic structure and low debris content. Change of coconut shells into actuated carbons which can be utilized as adsorbents in water decontamination or the treatment of modern and metropolitan effluents would increase the value of these rural items, help decrease the expense of waste removal, and give a conceivably modest option in contrast to existing business carbons.

Figure 2: Coconut Shell Ash

Carbonization of Coconut Shell Ash

Coconut shells are modest and promptly accessible in high amount. Coconut shell contains around 65 – 75% unstable issue and dampness which are evacuated to a great extent during the carbonization procedure. The carbonization procedure includes changing over the coconut shells to burn (charcoal). The roasting procedure (creation of charcoal) is known as the Pyrolysis, which is substance deterioration of the shell by warming without oxygen. During the carbonization of coconut shells, volatiles adding up to 70% of the mass of coconut shells on dry weight premise are discharged to the climate, yielding 30% of coconut shell mass of charcoal. The unstable discharged during the carbonization procedure is Methane, CO2 and wide scope of natural fumes. The carbonization temperature run between 400 and850 once in a while comes to.

The Processing of the Coconut Shell (Carbonization)

The coconuts were secured from a close by neighborhood sanctuary. The coconuts were broken physically to deplete out the water. The 400 coconut half shells were sun-dried for three days. Sundrying was important to ease expulsion of the meat from the inward shells of the coconut pieces. In the wake of scratching the meat from the internal shells, the inward segments of the shells were cleaned utilizing blades. The strands on the external shells were additionally scratched and cleaned. Emery paper was utilized to clean the external shells.

The cleaned coconut shells got from were cut into bits of measurements of 1 sq.cm utilizing hammer and were placed in hardened steels holders. The compartments were then kept into mute heater for (carbonization is the creation of scorched carbon from a source material. The procedure is commonly cultivated by warming the source material as a rule in the nonattendance or restricted measure of air to a temperature adequately high to dry and volatilize substances in the carbonaceous material). The carbonization temperature chose as 600 and 800 degrees. After a douse time of 4 hours, the example gets carbonized. As the heater chills off, compartments were taken out. The gathered burn was ground to frame powder utilizing a granulating machine. The powder was then sieved to a size of 2 µm.

Course Aggregate

Totals are the most mined material on the planet. Totals are a part of composite materials, for example, cement and black-top cement; the total fills in as support to add solidarity to the general composite material. Coarse total of size 20mm is sieved and utilized.

Figure 3: Coarse Aggregate

Fine Aggregate

Fine Aggregate is normally happening granular material made out of finely partitioned rock and mineral particles. The most widely recognized constituent of sand is silicon dioxide, for the most part as Quartz. Typically fine total is utilized as fine total for getting ready cement. An individual molecule in this range is named as sand grain. These sand grains are between coarse total (2 mm to 4.7 mm) and sediment (0.004 mm to 0.0625 mm). Total the vast majority of which passes 4.75 mm IS sifter is utilized. It should be with fewer amounts of clay and silt i.e., (>3% by weight). The hire from silt, clay, salt and organic Material and it was clean and dry.

Water

Water Used For Mixing And Curing Shall Be Clean. Potable Water Is Generally Considered Satisfactory For Mixing Concrete.

4. Method

The materials used during the study include:

Coconut shell: This was obtained in Temple of Shiv Mander, Punjab Nagar, Rampur, and Uttar Pradesh, India. Cement: UltraTech cement, a brand of OPC available locally in Moradabad was used. The oxide composition is presented in table 1.

Water: Portable water from the Department of Civil Engineering, IFTM, Moradabad Uttar Pradesh India and was used both for the mixing of concrete as well as in curing of the cubes. The coconut shell was sun dried for 48 hours to remove moisture from it. It was then subjected to uncontrolled combustion using open air burning for 3 hours and allowed to cool for about 12 hours. The burnt ash was collected and sieved through a IS sieve (75 microns). The resulting ash, which has the required fineness, was collected for use. The oxide composition of the ash was determined

and the result is shown in table 1. Using a mix design ratio of 1:1:2 and water binder ratio of 0.5, a total of concrete cubes of size 150mmx150mmx150mm were cast using varying OPC-CSA ratio of 100:0, 95:05, 90:10, 85:15, 80:20 and 75:25 respectively, i.e., 6 cubes and 6 Core per % Replacement. The cubes were cured and crushed after 7, and 28 days respectively and strength results are presented in table.

5. Test Conducted

The Following test Were Conducted to Study the Effect of Coconut Shell ash Cement for Concrete.

- Slump Cone Test
- Compaction factor
- Compressive strength
- Split tensile strength

Compressive strength

The Cube of size 150x150x150mm are set in the machine with the end goal that heap is applied on the contrary side of the solid shape as threw and adjusted cautiously load is applied, till the example break. The equation utilized for estimation.

Compressive Strength = Absolute Disappointment Load/Region of the block.

Split Tensile Strength Test

The test carried out by placing cylinder specimen of dimension 150mm diameter and 300mm length ,horizontally between the loading surface of compression testing machine and the load is applied until disappointment of the chamber along the vertical measurement .the disappointment heap of the example is noted.

Tensile strength of cylinder is calculated using the formula

Tensile strength = $2P/\pi DL$

Where, P- Failure load of the specimen

D- Diameter of the specimen.

Figure 4: Split Tensile Test

6. Test Result

Table 1 shows the oxide composition of csa and opc respectively, while table 2 is the result of the average setting times for various opc-csa mixes. Table 3 is the result of the density and compressive strength test at 7 and 28 days respectively and table 4 give the pozzolanic activity index of various mixes at 7 and 28 days respectively.

Oxide Composition of Coconut Shell Ash (CSA) and Ordinary Portland cement (OPC-43 Grade)

Table 1: Chemical properties Cement & CSA

Oxide	Percentage Composition (%)	
	OPC	CSA
CaO	64.0	4.98
Sio_2	20.7	37.97
Al_2O_3	5.75	24.12
Fe_2O_3	2.50	15.48
MgO	1.0	1.89
MnO	0.20	0.81
Na_2O	0.60	0.95
K_2O	0.15	0.83
P_2O_5	0.05	0.32
SO_3	2.75	0.71
LOI	2.30	11.94

Slump Flow and Compaction Factor

Table 2: Slump Flow and Compaction Factor

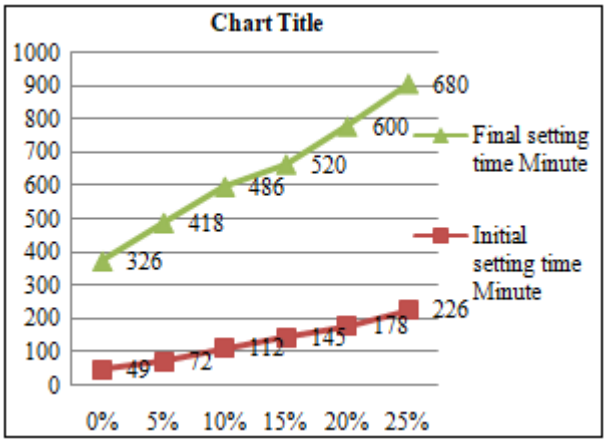
Mix No	% of CSA	Water Cement Ratio	Slump Test (MM)	Compaction Factor
1	00	0.40	85	0.83
2	05	0.40	85	0.87
3	10	0.40	90	0.92
4	15	0.40	90	0.92
5	20	0.40	80	0.85
6	25	0.40	85	0.90

Average Setting Times for OPC-CSA Mix

Table 3: Setting Time for OPC-CSA

% Replacement (CSA)	Initial setting time (Minute)	Final setting time (Minute)
00	49	326
05	72	418
10	112	486
15	145	520
20	178	600
25	226	680

Average Setting Times for OPC-CSA Mix



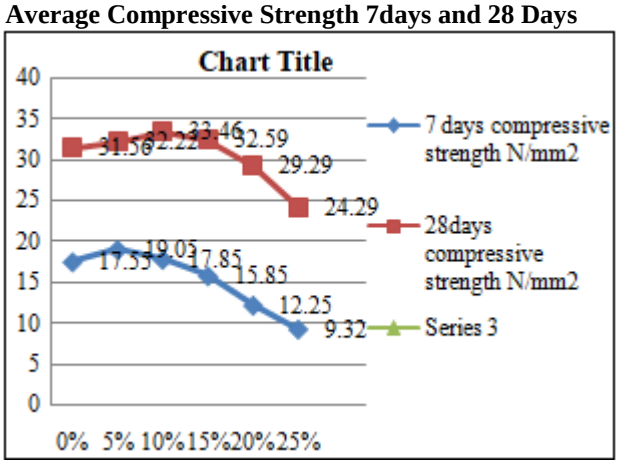
Flow Chart 1: Average Setting Times for Cement –Coconut Shell Ash Mix

Average Compressive Strength 7days and 28 Days

Table 4: Average compressive strength

% Replacement (CSA)	7days Compressive Strength N/mm^2	28days Compressive Strength N/mm^2
00	17.55	31.56
05	19.05	32.22
10	17.85	33.46
15	15.85	32.59
20	12.25	29.29
25	9.32	24.59

Average Compressive Strength 7days and 28 Days



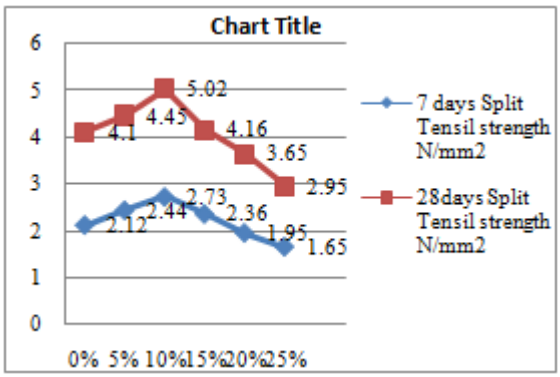
Flow Chart 2: Average compressive strength

Average Split Tensile Strength 7 Days and 28 Days

Table 5: Average Split Tensile strength

% Replacement (CSA)	7days Split Tensile Strength N/mm^2	28days Split Tensile Strength N/mm^2
00	2.12	4.10
05	2.44	4.45
10	2.73	5.02
15	2.36	4.16
20	1.95	3.65
25	1.65	2.95

Average Split Tensile Strength 7Days and 28 Days



Flow Chart 3: Average Split Tensile strength

7. Advantages

- Decrease The Cost Of Concrete.
- Decrease The Need Of Cement.
- It Can Use As Light Weight Concrete.
- This is Very Feasibility in Agriculture Area.
- It Increase The Initial Setting Time Which Is Useful For It Site Work.
- The Coconut Shell Ash Is Easily Available And Cheap.
- It Make the Coconut Plastic Limit Increase

8. Discussions of Results

Tables 1 show the oxide creation of the CSA and OPC individually. From table 1, CSA contains 37.97% SiO2, 24.12% Al2O3 and 15.48% Fe2O3. This gives 77.57% of SiO2+ Al2O3+Fe2O3 which is in accordance with ASTM C 618-78 prerequisite of 70% least for pozzolanas. In this way, CSA meets the prerequisite for a pozzolana. The LOI of 11.94 and SO3 of 0.71 all fall inside pleasant cutoff points. Table 3 shows the normal setting times of the different OPC-CSA mixes. Is a plot of the underlying and last setting time stanzas the different rate substitutions? The setting times increments with increment in the measure of coconut shell Ash. The underlying setting time increments from 49 minutes at 0% substitution to 4 hours 14 minutes at 25% substitution while the last setting time increments from 1 hour 26 minutes at 0% substitution to 4 hours 22 minutes at 25% substitution. Be that as it may, BS12 (1978) prescribes initials and last setting occasions to be not over 45 minutes and 10 hours separately of which the CSA/OPC glues takes a break. From table 4, it tends to be seen that the normal thickness decline with rate substitution from 2525.5Kg/m3 for OPC to 2314Kg/m3 at 25% substitution. This is normal, since the thickness of concrete is higher than that of the CSA. The pozzolanic movement list at different OPC-CSA substitution levels and age. The list diminishes with expanding rate supplanting of OPC with CSA. There is a decline of the pozzolanic movement list with expanded relieving age at 15% and 25% substitution however no discernable pattern is seen with increment in restoring age at 5%, 10%, 15%, 20% and 25% substitution levels. From table3, 4, we notice abatement in pozzolanic action with expanding rate substitution, which is normal, since the quality diminishing with expanding rate supplanting of OPC with CSA. The compressive quality reductions with expanding rate supplanting of OPC with CSA. This can be found in table The 7 day's quality reductions from 17.55N/mm^2 for OPC to 9.25N/mm^2 for 25% supplanting with CSA. The quality following 28 days relieving diminishes from 33.46N/mm^2 for OPC to 24.59N/mm^2 25% supplanting with CSA. The ideal 28 days quality for OPC-CSA blend is recorded at 10% substitution (33.46N/mm^2).

9. Conclusions and Recommendation

From The Outcomes Acquired, CSA/OPC Blend Gave Some Guarantee For Use In Strengthen Concrete Just As Mass Solid Structures In Building Development. The Compressive Quality of The Solid Shapes At 28 Days Restoring Demonstrates That 10% And 15% Substitution Levels Meet The Prerequisite Of BS. Taking Everything Into Account, The Investigation Uncovers That 10% To 15% Halfway Supplanting of OPC With CSA Utilizing W/C Proportion of 0.4 Are Appropriate For Creation Of Both Substantial Weight And Light Weight Concrete. Further Territories Of Examination Are Suggested. This Incorporates the

Utilization of CSA Calcined Under Controlled Conditions, Since the Calcination Temperature and Time Seems To Markedly Affect the Amorphosity of the Debris and Modifying Water/Concrete Proportion.

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