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Partly Substituted Cement in Concrete through Sawdust Ash: Influence in Strength and Cost

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Abstract **Editorial Article**

The research work was to examine the strength of concrete by using sawdust ash (SDA) for partly replaced of cement and the influence on the component cost of concrete. The purposes of the study was to determine the appropriateness of sawdust ash by partly substituted, at zero (0%), twenty- five (25%), fifty (50%) and seventy – five (75%), by 150 x 150 x 150mm cubes and the influence of cost examination in cement. Entire quantity of thirty- six (36) cubes of concrete stayed casted by proportion of SDA was substituted; the concrete cubes on blend quantity of 1:2:4 remained verified at days of 7, 14, and 28days. The consequences display that the slump reductions by way of the sawdust ash rises definite that concrete can be fewer condensed as the sawdust ash rises. The strength of concrete with sawdust ash was solid at initial periods and better at 28days. The maximum assessment of 17.99N/mm2 on 28days remained grown for concrete with 25% sawdust auxiliary in concrete and up to 25% SDA can be castoff for non-load manner concrete works. The cost also cheap comparatively.

Keywords: Compressive Strength, Cement, Concrete and Cost.

I. INTRODUCTION

Concrete is an essential substantial and a major component in construction works, it stand one of the key elements of construction work (Sujitha et al 2018). The main component of concrete is cement. Cement has great quantity of Greenhouse blasts like CO_2 whereas its making, which details hurtful possessions to the situation around it is significant to fewer its custom in the concrete through substitute materials (Naidu and Edukondalu 2020) Concrete contains cement, sharp sand, granite and water. Cement is the mandatory proxy of concrete and actual exclusive, utmost particularly, in developed countries such as Nigeria (Olawale et al 2018). It is actual significant to decrease the rise in price of cement in a mode to offer housing for the individuals has studied into the use of indigenous materials that can be cast-off as slight fresh cement (OPC) in Civil Engineering and Building Mechanisms (Alefiya,Arti & Amit 2015).

Numerous researchers in Nigeria has inspected the suitable of agricultural left-over materials as pozzolanic content which can improve the asset of concrete and low-priced the cost of cement wanted and the outcome of CO_2 releases (Oyejobi et al 2016; Raheem & Kareem 2017 and Tijani et al 2018). The main component of concrete is cement. Cement yields great volume of Greenhouse gasses similar CO_2 although its manufacture, which roots damaging things to the location, its practice in the concrete through substitute materials (Naidu and Edukondalu 2020) Concrete contains cement, sharp sand, granite and water.

Cement is the required proxy of concrete and very classy, most particularly, in emergent countries for example Nigeria (Olawale et al 2018).

Complementary connection materials has remained active to meet the regular condition of concrete toughness and mixed materials for cement were now optional to be used at parts of the world, Bakar and Putrajaya (2010). The price of building materials stays to move up as the populace are dropping below the poverty link. Thus, it is significant to look for a spare of material which are native materials as some alternatives for the construction works in together the rural and urban of the country. Approximately of the materials that are locally used, like earth sand (Svoboda & Prochazka, 2012), joining paving slabs made with lateritic Raheem, Falola, and Adeyeye, (2012) like Palm kernel shell Raheem (2008). Numerous trashes produced from industrial and agricultural artefact, give eco-friendly threat together in terms dealing and removal. Construction industry could be recognised Mixture scopes (kg/m3) by way of the one that engages numerous of the materials are second-hand as putty in concrete Antiohos, Maganari and Tsimas, (2005). Altered industrial trashes has been observed, used as additional cementing materials and Fly ash as also been used and corn cob ash (Siddique, 2004; Wang and Baxter, 2007; Wang, 2008), Silica fume Lee, Moon and Swamy (2005), Pulverized petroleum ash Balendran and Martin Buades,(2000), Volcanic ash (Hossain, 2005), Rice husk ash (Waswa-Sabuni, Syagga, Dulo and Kamau, (2002) and Corn cob ash (CCA) (Adesanya and Raheem, 2009; 2010; Raheem and Adesanya, 2011; Raheem, 2010). Elinwa and Ejeh (2004) measured the effect of the combination of left-over burning fly ash in cement adhesives & grout. Cheah and Ramli, (2011) examined the execution of wood waste ash as a part cement spare solid. Elinwa, (2008) studied that the used of new concrete assets in self-compacting concrete encompass sawdust ash. Elinwa & Mahmood (2002) thoughtful ash from sawdust left-over as cement spare substantial. The toughness, single partiality and financial reflection. Due to the difficult of handling modifications and supporting the specific material rest on largely on its accessibility, countryside of project waste, study in the area of diminishing waste accretion finished recovery and reprocessing has been just burned seeing beautiful and environmental hitches initiated by the inappropriate discarding of waste. Parts of study meant at dropping waste comprise the use of rice-husk ash and groundnut-husk ash to produce cement as well as the use of sawdust ash to incompletely substitute cement in concrete manufacture. Aimed at sand satisfying trenches in which case it establishes ecological irritation. Adapting the leftover produce – saw dust, addicted to a significant consequence – saw dust ash (SDA), has double assistances.

II. MATERIALS AND METHODS

Cement

The cement (Dangote, Brand) castoff was gotten in Ilaro.

Sawduct Ash (SDA)

The dust rummage-sale for the investigation was together from sawmill points at Gbogidi in Ilaro, Ogun State, Nigeria. The Sample of the sawdust sustained composed from the saw mill was guardedly depressed of sand. Together trial was well-done addicted to ashes by exposed scorching in a steel vessel. The saw duct ash particles fleeting over sieve of opening 600µm was used for the study. Sawdust ash was castoff to substitute OPC at 25%, 50% & 75% by weightiness of cement. Concrete made with no of sawdust ash existing 0% as the control. The blend ratio used was 1:2:4 (cement, sharp sand & granite) with water cement ratio of 0.5 which was advanced enlarged correspondingly for each mix till it became 0.96. The materials used in the checks were Sawdust Ash (SDA), Ordinary Portland Cement (Dangote product), Sand (fine aggregate), granite (3/4 coarse aggregate) and water. The core tools castoff were plastic mould (150mm x 150mm x

150mm). 250g of cement was stately, and wisely mixed with related amount of water

Aggregates

Sharp sand was castoff as fine aggregates & granite with extreme extent of 20mm as coarse aggregates. The fine and coarse aggregates used stood got from Owode, Nigeria.

Slump test

Experiment was agreed to perceive changes in workability of concrete for class control determination. It is not appropriate for very dry or wet mix. The regular slump device is only appropriate for concrete in which the supreme aggregates mass does not surpass 40mm. the greater the slump, the improved the workability (Sengul, 2005). An adequate amount of concrete was set in the important extent by weight (1:2:4) with a water cement ratio 0.55; 0.72; 0.88 and 0.96 similarly for the different combinations. The aggregate for all blend as collected in magnitudes fine passing over 4.75mm sieve; and coarse transient done 25.00mm sieve. The required weigh of the constituents was assorted collected by pointer and unchangeable colour and stability was grown. The pointed mould was correct lubricated oblique with the base dish for calmer removal and earlier placed on the secure non-absorbent vile container with the minor original at the greater and held unbendingly in place. The slump was become at the temporary between its altitudes after electrifying the mould (300mm) and extra the pinecone upright upturned (upside down) near the slumped concrete. A conformist governor was then positioned slantwise the upturned cone and the slump concrete however evaluating the slump assessment with a steel instruction. The method of batching decided with the concrete materials was batching by mass. The blend capacity used for this work was 1:2:4. The part of cement to ash (in proportion) in the concrete continued as thus: 100:0% as governor, 75:25%, 50:50% and 25:75% singly. The concrete materials – cement, fine and coarse aggregates (and saw dust ash SDA) remained methodically varied by using hand mixing technique with the use of shovel and with a water/cement ratio of 0.55 by weight. The moulds remained methodically greased with engine oil to stop the expansion of tie among the mould and the concrete and permit relaxed de-moulding of the casted cubes. The mixed was casted into the mould, each formwork was occupied with concrete in three coats; each butted 35times with a filling bar. The mix were at troposphere for 24 hours. For each cement: ash sizes, nine (9) cubes of concrete were cast. Consequently, a total of 36 cubes were formed for testing – 9 boxes for control; 9 cubes for 25% SDA (with 30% increase in water content); 9 cubes for 50% SDA (with 60% increase in water content) and 9 cubes for 75% SDA content (with 75% increase in water content). Remedial of the concrete cubes was complete by whole soaking in a fresh water curing tank gauging 1640mm x 840mm x 530mm occupied with water only for ages of 7, 14, & 28 days individually.

III. PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

First and last Setting Time Tests

Table 1: Preliminary and Ultimate Setting Times

Specimen Identification	Wt of Mixture (g)	Vol. of Water (ml)	Mix time (min)	Preliminary Setting Time	Ultimate Setting Time

Control	400	220	4.00	11:05am to 12:30pm	11:05am to 5:46pm
25% SDA	400	288	4.00	8:15am to 11:.35am	8:15am to 3:25pm
50% SDA	400	352	4.00	9:35am to 1:30pm	9:35am to 6:25pm
75% SDA	400	384	4.00	9:20am to 2:45pm	9:20am to 8:15pm

From Table 1 above, it can be inferred that the early setting times are 85 minutes (1hr.25mins), 200 minutes (3hrs.20mins), 235 minutes (3hrs.55mins) and 325 minutes (5hrs.25mins) for Control, 25% SDA, 50% SDA and 75% SDA respectively though the finishing setting times are 401 minutes (6hrs.41mins), 430 minutes (7hrs.10mins), 530 minutes (8hrs.50mins) and 655 minutes (10hrs.55mins) for Control, 25% SDA, 50% SDA and 75% SDA respectively.

Table 2: Summary of Average Compressive Strength at 7, 14 and 28 days respectively

Specimen Identification	**Ave. Strength at 7 days (N/mm^2)**	**Ave. Strength at 14 days (N/mm^2)**	**Ave. Strength at 28 days (N/mm^2)**
Control	15.10	22.70	24.50
25% SDA	7.00	13.00	17.99
50% SDA	2.90	4.20	8.90
75% SDA	1.10	1.80	3.57

From Table 2: above, the result of curing ages and SDA gratified on the compressive strength of SDA concrete. The table indicates that compressive strength generally high when curing age and decreases with high statistics of SDA.

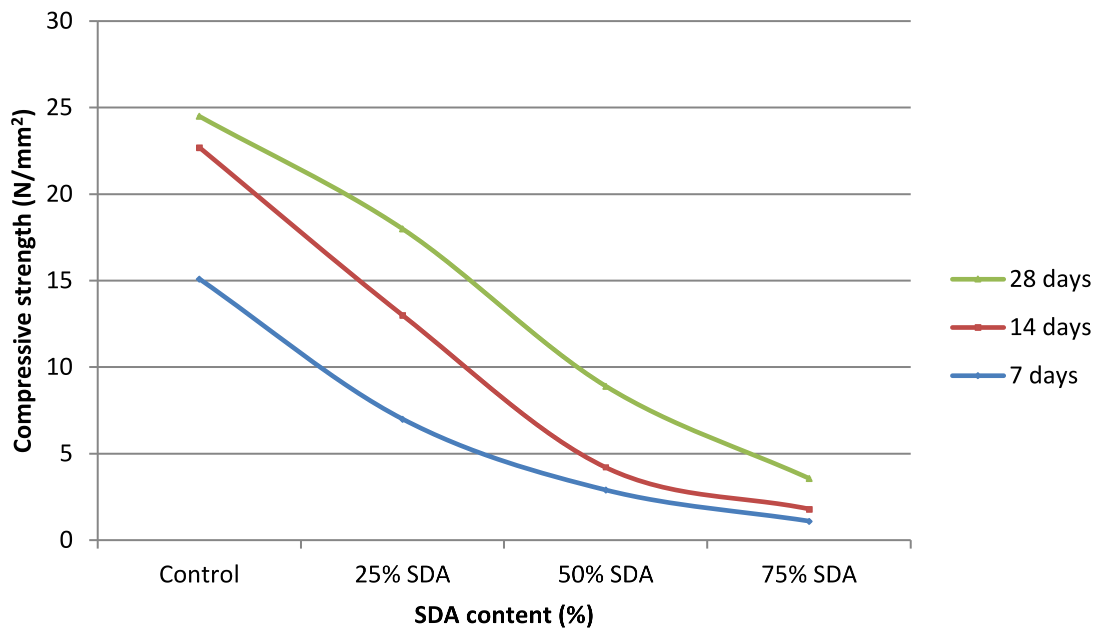

Figure 1: Effects of Sawdust ash on the Compressive strength of concrete

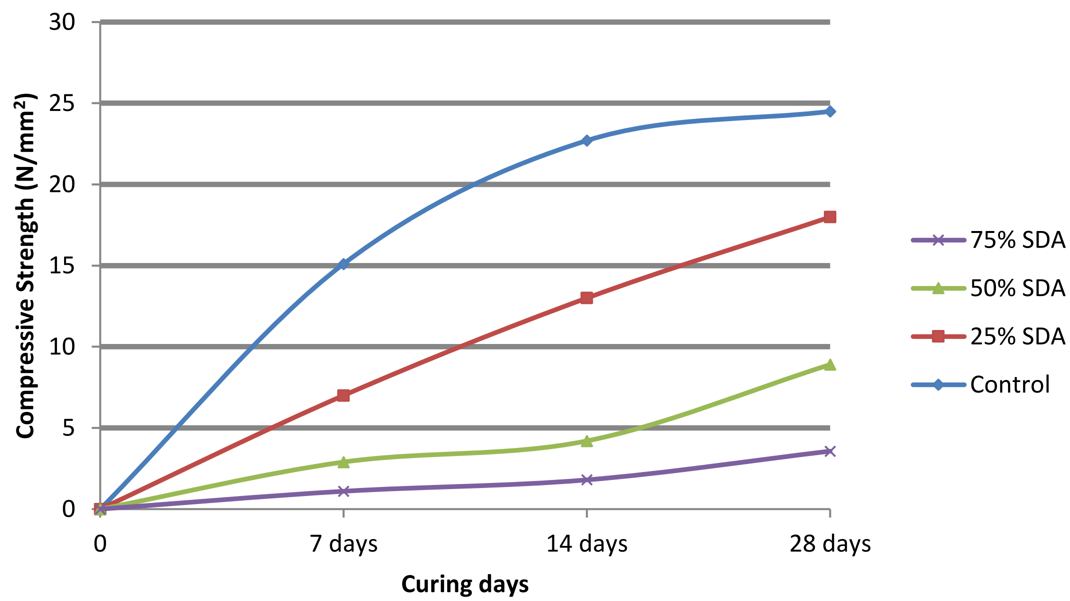

Figure 2: Effects of curing age on the Compressive strength of concrete

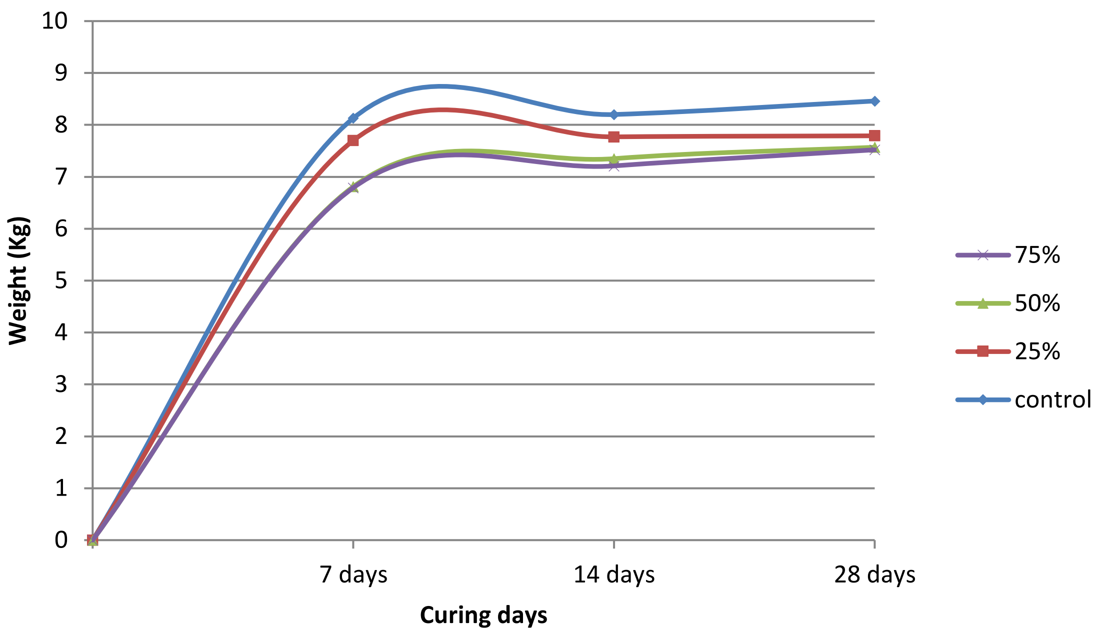

Figure 3: Effects of curing age on the weight of cubes

Figure 1 above demonstrates the compressive strength of SDA concrete, the graph designates that compressive strength usually decreases with improved quantity of SDA with the strength dropping from that of the control (pure cement) at many curing ages while Figure 2 demonstrates the effect of curing age at the stage of compressive strength of SDA concrete. It specifies that compressive strength usually surges as the curing surge with the strength cumulative after 7 days to the 28 days at variance period of the combination.

IV. DISCUSSION OF RESULTS

All tests carried out on cement are inside edges as specified by BS 4450: part 3 (1978). It instructs that lowest edge from end set time of 45 minutes and extreme of 2 hours though the determined limit from finishing setting time is 10 hours which parenthetically did not surpass the average limit. These consequence as revealed in Table 2 designated that concrete comprising SDA can improvement strength steadily at initial age of curing phase from 15.10N/mm^2 for regulator to 1.10N/mm^2 for 75% SDA extra. Like movement was real at 14 days as revealed in the table. These results designate that concrete covering SDA advance strength leisurely at primary curing phase. This is in streak through preceding results that concrete holding pozzolanic materials increased strength gently at prompt curing eternities (Hossain, 2005; Adesanya & Raheem, 2009). At 28 days, there was rise in strength at slightly clusters of concrete with standards reaching from 24.50N/mm^2 for the control, to 3.57N/mm^2 for 75% SDA spare. The control static has the extreme compressive strength at this stage. It can be gotten that the compressive strength improved gradually as the integer of days of curing was improved consuming the minimum curing daytime at daytime 7 to the maximum day strength at 28 days for the 1:2:4 mix ratio. The results illustration that at the similar stage, the compressive strength decreases as the fraction of ash surges. This is since the ash retains slight cement belongings associated to Portland cement. Conferring to BS 8110 (1985), a grade 20 concrete of 1:2:4 mix intention deprived of any combination of the cement would have developed a strength of 13.5N/mm^2 inside the initially seven days of wet curing and 20N/mm^2 inside 28days. Built on the overhead and the results acquired from this research, only the OPC/SDA ratio of 75/25 wanted be appropriate for concrete.

Cost Analysis

Cost of concrete importantly be contingent upon the magnitude, feature and section of materials used. Extra of cement by other material not only instabilities the strength belongings of cement but also instabilities the cost of that particular design. Unit cost of concrete is calculated as the component cost of Cement, Fine Aggregate (Sand), Coarse Aggregate (Granite), Machine/Equipment, Labour, Overhead and Profit. Decrease or rise in cost of also the Materials, Machine/Equipment or Labour will repeatedly lessen or rise the unit cost of concrete. The compressive strength study shown that 25% and 50% of SDA extra realized rational and appropriate strength though 75% SDA extra unsuccessful. The unit cost of concrete per cubic time disadvantaged of SDA extra is therefore associated with the unit cost of concrete with SDA at 25% and 50% extra. The material cost calculation was founded on the main market fees as specified under:

1. Ordinary Portland Cement per 50kg cost N9,500.00k
2. Fine Aggregate (Sand) per 5Tonne Lorry Load cost N45,000.00k
3. Coarse Aggregate (Granite) per Tons cost N8,500.00k.

Approximating of respectively mix is founded on total capacity of 0.0304m3 which signify 9pcs of 150 x150 x 150 cubes (3cubes each for setting time of 7days, 14days and 28days respectively).

Table 3: Approximation of cost for various concrete mix.

Material	Control 0%SDA	25% SDA	50%SDA	75% SDA
Cement	7.5kg N1,425.50k	5.63kg N1,067.51k	3.75kg N703.75k	1.88kg N357.2
Fine Aggregate	3.3kg N30.06K	3.3kg N30.06K	3.3kg N30.06K	3.3kg N30.06K
Coarse Aggregate	6.9kg N58.65k	6.69kg N58.65k	6.69kg N.58,65	6.69kg N58.66k
Total Material Cost	**1,514.21k**	**N1,156.22k**	**N792.46k**	**N445.91k**

V. CONCLUSIONS AND RECOMMENDATION

The subsequent conclusions were haggard: Concrete converts less practical as the SDA (Saw-Dust Ash) proportion upsurges sense that more water is required to make the mixes more workable which implies that SDA concrete has higher water demand. The compressive strength generally increases with curing period and decreases with increased amount of SDA (Saw-Dust Ash). Only 25% SDA (Saw-Dust Ash) substitution is adequate to gain extreme strength. The compressive strength standards of the OPC-SDA (Saw-Dust Ash – Ordinary Portland Cement) mixed cement amalgams at all fraction extra of OPC were ample inferior than the regulator standards from 7-28 days. The strength difference of OPC-SDA amalgams recommends that with good excellence regulator of the concreting procedure, 25% spare can be used for light weight concrete works (floors or walkway), and 50% replacement can be used for plain concrete works though the 75% extra unsuccessful due to the strength not passable to transmit the weight with 25 - 50% reduction in cost of cement.

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