International Journal of Civil Engineering and Technology (IJCIET)
Volume 9, Issue 12, December 2018, pp. 252–260, Article ID: IJCIET_09_12_029
Available online at http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=9&IType=12
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

SOLIGNUM TREATED SAWDUST AS FINE AGGREGATE IN CONCRETE PRODUCTION

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ABSTRACT

The cost of construction has been on the increase which has become a concern to both individuals and government of especially developing countries, and that is why this study is aimed at using available cheap materials (sawdust) in concrete production. Concrete mix ratio of 1:2:4 was used and replaced with fine aggregate at 5%, 10%, 15% and 20% with soligum treated sawdust. From the tests conducted, it was observed that increase in sawdust resulted in decrease in the compressive strength of the concrete. Also it was observed that increase in the sawdust content resulted in the reduction of weight of the concrete. In conclusion sawdust as an air entraining agent has n appreciable positive effect on the compressive strength of concrete. The reduction in strength of concrete with sawdust as fine aggregate was due to its higher rate of water absorption because the higher the water contents in concrete, The lower the strength of the concrete.

Key words: Solignum Treated Sawdust, Fine Aggregate, Concrete Production

Cite this Article: Gana. Abu James and Yusuf Timi Daniel, Solignum Treated Sawdust as Fine Aggregate in Concrete Production, *International Journal of Civil Engineering and Technology (IJCIET)* 9(12), 2018, pp. 252–260.
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1. INDRODUCTION

Concrete being the most popular construction or building materials is largely dependent on the availability of cement and river sand which serves as the fine aggregates. Concrete is a mix of sand, cement, water and gravel. Bearing in mind sustainability, cement has greatly reduced the reserves of lime stone in the world and so also has the continuous use of river sand which is most preferred source of fine aggregate prove to be an environmental concern.

Sawdust is a by-product of cutting, grilling, drilling, sanding, or otherwise pulverizing wood or any other material with a saw or other tool; it is composed of fine particles of wood. Sawdust is the main component of particleboard. The construction industry across the world has been developing over the ages and so has the demand of newer and better structures even in Nigeria. The increase in construction cost of construction materials has led to the research of other alternative means of construction. Several efforts have been made by various researchers to reduce the cost of construction materials by determining the usefulness of certain locally available or locally sourced materials. These local materials can be gotten from agricultural or industrial wastes. Examples of this waste include sawdust, fly ash, palm knell shell, coconut shell, plastic pets, water sachet, and corncobs. Most building construction works are based around concrete or involve cement, hence the need to find alternative means of construction to reduce construction cost due to the increasing rate of construction materials especially cement. Sawdust being a wildly available local material can greatly aid the reduction in construction cost, and in turn prevent engineers from cutting corners to save extra money which in turn leads to building or construction failure. In certain countries, locally available agro wastes are used as substitutes in concrete production. Some of these agro wastes include groundnut shell ash, groundnut husk ash, rice husk ash, wood ash etc.

Others may include bagass, bamboo leaves, sawdust ash, bamboo leaves ash etc. the advantage of using these locally sourced materials are low cost of construction and it reduces the population caused by these materials which are regarded as wastes to certain individuals. It also gives the farmers who sell this wastes an addition profit. Thus, aiding the campaign of environmental consideration and promoting the optimum use of every lumber taken from nature. It will provide additional income for lumber companies while disposing their wastes materials. At the same time opening up a new business venture for others to take advantage. It will point out new paths and options to further advance this development and others alike. It also encourages the future researchers in recycling of other waste material and making them a part of new composite materials and encourage the general public to more environmentally aware, broadening their horizons towards recycling and conservation.

2. LITERATURE REVIEW

Concrete is a composite material composed of coarse aggregate bonded together with a fluid cement that harden over time. Most concrete used are lime-based concrete such as Portland cement concrete or concretes made with other hydraulic cements, such as ciment fondu. However, asphalt concrete, which is frequently used for road surfaces, is also a type of concrete, where the cement material is bitumen, and polymer concretes are sometimes used where the cementing material is a polymer. When aggregate is mixed together with dry Portland cement and water, the mixture forms a fluid mass that is easily molded into shape. The cement reacts chemically with the water and other ingredients to from a hard matrix that binds the material together into a durable stone-like materials that has many uses. Often, additives (such as pozzolans or super plasticizer) are included in the mixture to improve the physical properties of the wet mix or the finished material. Most concrete is poured with reinforcing materials (such as rebar) embebbed to provide tensile strength, yielding reinforced concrete. Famous concrete include the Hoover Dam, the Panama Canal, and the Roman Pantheon. The earliest large-scale users of concrete technology were the ancient Roman Pantheon. The earliest large-scale users of concrete technology were the ancient Romans, and concrete was widely used in the Roman Empire. The Colosseum in Rome was built largely of concrete, and the concrete dome of the Pantheon is the world’s largest unreinforced concrete dome. Today, large concrete structures (for example, dames and multi-storey car parks) are usually made with reinforced concrete.

3. AIM

The aim of this research is to investigate and determine the potential use of available cheap material like sawdust for low production and other engineering purposes.

4. OBJECTIVE

The objective of this research work include

- To determine the compressive strength of concrete made with varying percentages of sawdust
- To compare strength characteristics of normal concrete and concrete with sawdust.

5. SCOPE OF STUDY

This research work looks into the experimental laboratory investigation on the use of locally available material sawdust as a suitable replacement material in construction. The research also looks into the physical and mechanical strength of concrete. These experiments are all conducted in the Civil Engineering Laboratory Of Landmark University.

6. METHODOLOGY

Preparation of Materials

Preparation of sawdust

The sawdust will be sieve through the British standard sieves of 2mm apertures so as to enable the use of uniform size particles of the sawdust and avoid balling. After which soligum was added initially by spray but due to difficulties such as wind and light eight of the sawdust, spraying was hard. In other to ratify this, the soligum was poured directly onto the sawdust and mixed using a trowel then put under the sun to dry. I noted a slight darken of the sawdust after this process.

Preparation of Aggregates and Water

The fine aggregates were sieved through sieves of 2mm, while the coarse aggregates were sieved through sieves of 4mm and the retained the one used. The water was sourced from a supply tank behind the 1st college building of Landmark university. The water-cement ration was 0.5.

7. PHYSICAL PROPERTY DETERMINATION

Slump Test

Slump test was carried out to determine the workability and consistence of fresh concrete and between batches.

Compacting factor Test

The compacting factor test was also be performed on each freshly mixed concrete batch to determine the workability in accordance with the BS 1881-103, 1993.

8. MECHANICAL PROPERTY DETERMINATION

Compressive Strength Test of Concrete

The test required to determine the strength of concrete and therefore its suitability for the job. Out of many test applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not. Compressive strength, quality of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, and quality control during production of concrete etc. Test for compressive strength is carried out either on cube or cylinder. Various standard codes recommend concrete cylinder or concrete cube as the standard specimen for the test. American Society for Testing Materials ASTM C39/C39M provides Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

9. TEST PROCEDURES

Mixing

I mixed the concrete by hand

Hand Mixing

- I mixed the cement and fine aggregate and sawdust on a water tight none-absorbent platform until the mixture is thoroughly blended and is uniform colour.
- I added the coarse aggregate and mix with cement and fine aggregate until the coarse aggregate is uniformly distribute throughout the batch.
- I added water and mixed it until the concrete appears to be homogenous and of the desired consistency.

Sampling

- I cleaned the moulds and applied oil
- I filled the concrete into the moulds in layers approximately 5cm thick
- Compact each layer with not less than 35strokes per layer using a tamping rod
- I leveled the top surface and smoothen it with a trowel

Curing

Stored the test specimens in moist air for 24hours and after this period I marked the specimen and removed from the moulds and kept submerged in the soil until taken out prior to test. The cubes were cured using the earth curing method because of the unavailability of sufficient curing tanks as seen in plate 2 below

Procedure

- The specimen was removed from water after specified curing time and wipe out excess water from the surface.
- The bearing surface of the testing machine was cleaned
- The specimen was placed in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast as seen in the plate 3 below

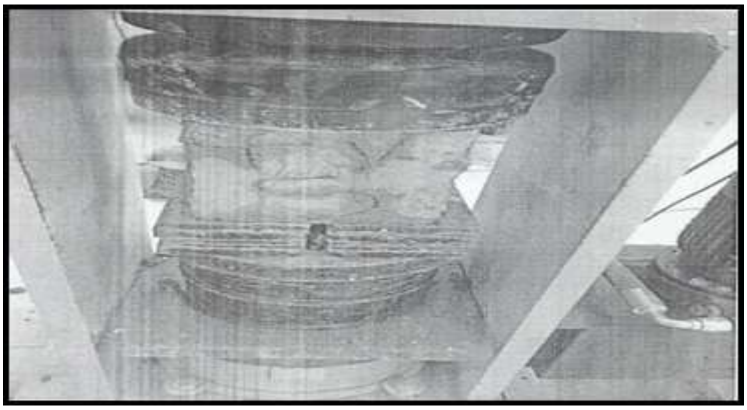


Plate 3: Concrete Cube in compressive strength test machine

- The specimen was aligned centrally on the base plate of the machine.
- The hydraulic valves of the machine was locked
- The machine was switched on
- Record the maximum load and note any unusual features in the type of failure.
- I disposed off the crushed cubes.

The analysis of all conducted test are shown. The purpose of these experiments was to test for the strength of the concrete and it workability.

Slump test

Table 4.1: Slump test result

% Replacement	Slump (mm)
Control	50
5	51
10	63
15	69
20	72

From the slump test result,. Workability of concrete observed to be decreasing as the percentage of sawdust in the mix increases. A graphical representation is shown below in fig. 4.11

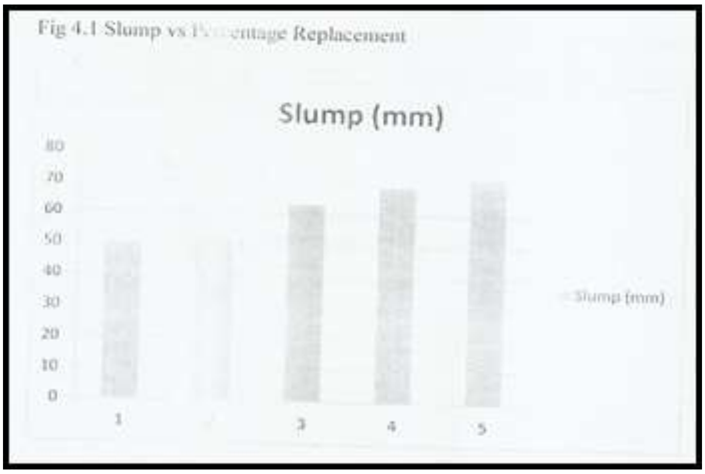


Figure 4.1 Slump vs Percentage Replacement.

10. COMPACTING FACTOR TEST

Compacting Factor test result of the concrete

% Replacement	Compacting Factor
Control	0.78
5	0.81
10	0.84
15	0.87
20	0.92

The compacting test result as in table 4.2 above shows that the control has the highest workability. The workability decrease as the percentage of sawdust increase in the mixtures. Graphical representation is shown below in fig 4.2

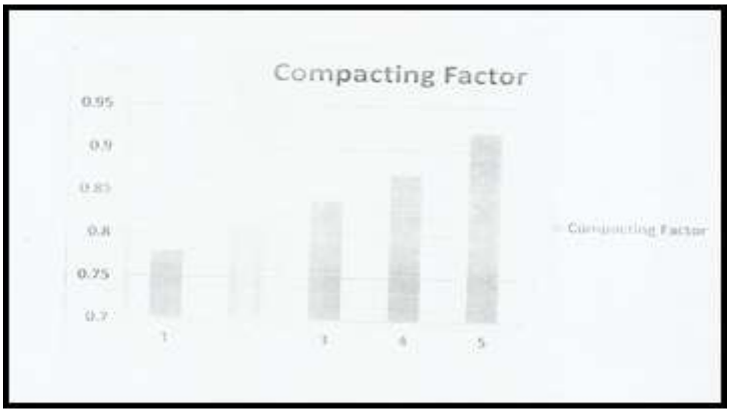


Figure 4.2 Compacting Factor

11. COMPRESSIVE STRENGTH TEST

Table 4.3: Compressive strength test after 7 days of curing.

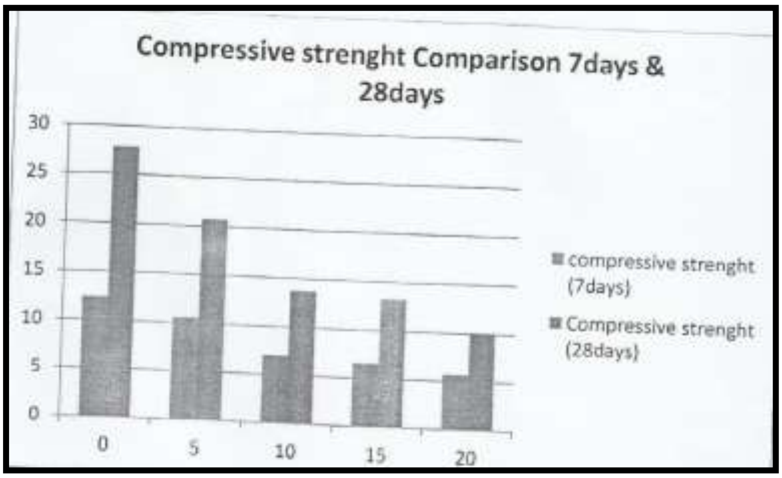
Percentage Replacement	Cube	Surface Area(A) (mm^2)	Maximum Load (p) (kN)	Compressive Strength (N.mm^2)	Average Compressive Strength (N/mm^2)
Control	Cube1	22500	281.7	12.52	12.46
	Cube 2	22500	272.6	12.12	
	Cube 3	22500	286.4	12.73	
5 %	Cube 1	22500	262.3	11.66	10.59
	Cube 2	22500	214.3	9.52	
	Cube 3	22500	238.3	10.60	
10%	Cube 1	22500	157.3	6.99	7.01
	Cube 2	22500	159.1	7.07	
	Cube 3	22500	158.2	7.03	
15%	Cube 1	22500	144.9	6.44	6.59
	Cube 2	22500	152.9	6.70	
	Cube 3	22500	148.9	6.62	
20%	Cube 1	22500	117.5	5.20	5.7
	Cube 2	22500	125.4	5.57	
	Cube 3	22500	142.9	6.35	

Table 4.4: Compressive strength test after 14 days of curing.

Percentage Replacement	Cube	Surface Area(A) (mm^2)	Maximum Load (p) (kN)	Compressive Strength (N.mm^2)	Average Compressive Strength (N/mm^2)
Control	Cube1	22500	391.0	17.38	17.61
	Cube 2	22500	398.1	17.69	
	Cube 3	22500	399.4	17.75	
5 %	Cube 1	22500	279.0	16.62	14.51
	Cube 2	22500	374.0	16.62	
	Cube 3	22500	326.5	14.51	
10%	Cube 1	22500	198.0	8.80	8.32
	Cube 2	22500	197.0	8.78	
	Cube 3	22500	188.0	7.40	
15%	Cube 1	22500	191.1	8.49	8.15
	Cube 2	22500	182.3	8.10	
	Cube 3	22500	177.2	7.87	
20%	Cube 1	22500	137.0	6.09	6
	Cube 2	22500	127.3	5.60	
	Cube 3	22500	142.0	6.31	

Table 4:4 Compressive test after 28 days of curing

Percentage Replacement	Cube	Surface Area(A) (mm2)	Maximum Load (p) (kN)	Compressive Strength (N.mm2)	Average Compressive Strength (N/mm2)
Control	Cube1	22500	625.1	27.78	27.9
	Cube 2	22500	639.4	28.42	
	Cube 3	22500	618.9	27.51	
5 %	Cube 1	22500	442.8	19.68	20.73
	Cube 2	22500	478.2	21.25	
	Cube 3	22500	315.9	21.24	
10%	Cube 1	22500	300.3	14.04	13.76
	Cube 2	22500	312.3	13.35	
	Cube 3	22500	317.6	13.88	
15%	Cube 1	22500	301.2	14.12	13.3
	Cube 2	22500	281.0	13.39	
	Cube 3	22500	211.1	12.49	
20%	Cube 1	22500	240.2	9.38	10.1
	Cube 2	22500	231.3	10.67	
	Cube 3	22500	23	10.27	



The compressive strength of all the cubes for 7,14 and 28 days are shown in the tables above. where compressive strength **(N/mm^2) = P/A**

where P = peak load or max load

A = constant area of the cube

From the above table of values it can be seen that curing helps in strength concrete although the initial curing days the concrete were a bit weak.

Also, it was noted that 5% had the highest compressive strength at testing periods as seen in fig 4.3

12. CONCLUSIONS

In conclusion, sawdust as an air-entraining agent has no appreciable positive effect on the compressive strength of concrete. The reduction in strength of concrete with sawdust as fine aggregate was due to its higher rate of water absorption because the higher the water contents in concrete, the lower the strength of the concrete. The objective of this study was to investigate the use of locally available materials (sawdust) as substitutes for fine aggregates in concrete with the overall aim of reducing the cost of construction while retaining the compressive strength. From the result, the optimum sawdust content was obtained at 5% and its corresponding compressive strength at 28 days is 20.73 N/mm^2.

13. RECOMMENDATION

I recommend that further research be deducted on this with varying percentage to find the best optimum content for use in structural applications with other local available materials.

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