Effect Of Corncob Ash As Partial Substitute For Cement In Concrete

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Abstract: This research work evaluates the effect of corncob ash (CCA) as a partial replacement for cement in concrete. Specific gravity, sieve analysis, slump test and cube test were carried out on the sample. Corncobs were collected at different locations in akure, Ondo State. The corncobs were air-dried for few days and burnt to ashes which were sieved using 75μm sieve size to produce fine ash. Concrete cubes were cast, cured and tested at curing ages of 7, 14, 21 and 28 days using 0, 5, 10 15, and 20 percentage replacement levels. The optimum compressive strength of 21.44N/mm^2 was obtained at 5% replacement at 28 days of age. The slump test results show that the workability of the concrete decreased as the CCA content increases. The Compressive Strengths of concrete reduced as the percentage CCA replacement increased but increases with curing age. Recycling of waste materials in a more useful and economical way should be encouraged by government and any organization with viable programs and adequate funds to encourage interested researchers.
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Keywords: Concrete, corncob ash, Compressive strength, Slump test

Introduction

Corncob is the hard thick cylindrical central core on which are borne the grains or kernels of corn, usually in rows. It is the agricultural waste product obtained from maize or corn. The use of corncob ash will reduces cost of production of concrete. Nowadays the knowledge of natural pozzolanic materials used as partial replacement for cement has increased. Adesanya and Raheem (2010) investigated the permeability and acid attack of corn cob ash blended cement. Jimoh and Apampa (2014) have investigated the effects of corncob ash on the index properties, California bearing ratio (CBR) and unconfined compressive strength (UCS) of a lateritic soil. The maximum dry density of the soil investigated by Jimoh and Apampa (2014), slightly reduced as the corncob ash content increases. Concrete is a construction material made by mixing of cement, fine aggregates, coarse aggregate and water in the appropriate proportions. It is a mixture of paste and aggregates, or rocks. The paste composed of Portland cement and water coats with fine (small) and coarse (larger) aggregates. Through a chemical reaction called hydration, the paste hardens and gains strength to form the rock-like mass known as concrete. Aggregate in a concrete mix consists of coarse aggregate such as granite or limestone and fine aggregate such as sand. Portland cement is the most common type of cement that consists of a mixture of oxides of calcium, silicon and aluminium (Owolabi *et al.,* 2015). We also have pervious concrete, a pervious concrete is a type of porous pavement that can be used as an infiltration process for stormwater management and contains little or no fine aggregates. Pervious concrete offers one of the most cost-effective and environmentally friendly solutions available as permeable pavement in order to control uncontrolled run-off, reduce pollution and replenish groundwater (Owolabi *et al.,* 2014). There are many materials (rice husk ash, cassava peel ash, corncob ash, Guinea Corn Husk Ash, fly ash, sawdust ash etc) that can be added to concrete mix to improve the quality and consequently the durability of concrete these materials are known as pozollanic material. Olutoge et al (2010); presented a comparative study on fly ash and ground granulated blast furnace slag (GGBS) high performance concrete. The pozzolan materials are cement replacement materials use in the production of concrete, these materials are vary in percentage it can be of 0%, 5%, 10%, 15% and 20% mix in proportion with concrete material. The cement replacement materials are also known as cementatious materials. A pozzolan is siliceous and aluminous material which itself possess little or cementatious properties but in the presence of water it react chemically with calcium hydroxide at ordinary temperature to form compound possessing cementatious properties. Glass aggregates were also used in a relatively new cementitious material called ashcrete, or chemically activated fly ash (CAFA) or water-glass activated fly ash (WAFA) (Samadi *et al.,* 1995; Silverstrim *et al.,* 1997; Xie *et al.,* 2003; Xie *et al.,* 2001)

Materials And Methods

The materials used for this research are ordinary Portland cement, water, coarse and fine aggregate. Corncobs were collected at different location in akure, Ondo State. The corncobs were air-dried for few days

and burnt to ashes which were sieved using 75µm sieve size to produce fine ash. Batching of mix ratio 1:2:4 (cement: fines: coarse aggregates) were used with water cement ratio of 0.65. Specific gravity and sieve analysis were carried out on the materials. Compressive strength tests were carried out on concrete cubes (150mm × 150mm × 150mm) in accordance with BS 1881: Part 116: 1983. Slump test were conducted on the concrete in accordance with BS 1881-102: 1993 to determine the workability of the concrete. The corncob ash were used to replace cement by weight in varying proportions of 0%, 5%, 10%, 15%,and 20%. Cubes were cured for 7days, 14 days, 21 days and 28 days. Energy dispersive X-ray spectroscopy (EDS) were carried out on the corncob ash powder in SHESTCO (Sheda Science and Technology Complex Federal Ministry of Science and Technology) to determine the chemical composition of the corncob ash.

Results And Discussion

Chemical Composition Of CCA

The chemical composition of corncob ash is given in table 1. It was observed that SiO_2 has the highest composition.

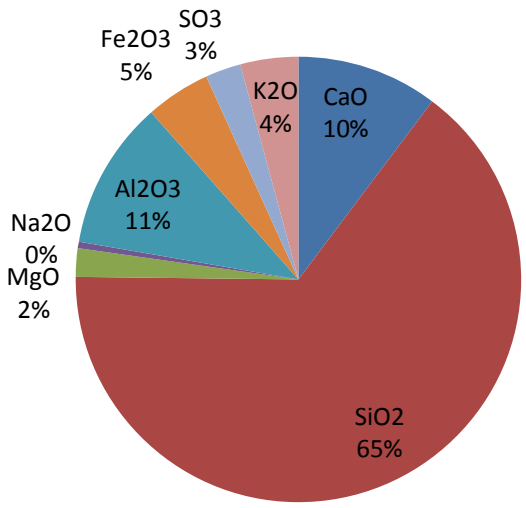

Figure 1: Chemical composition analysis of the corncob ash

Sieve Analysis

The particle size analysis conducted on the sharp sand, shows that the percentages passing number 200BS sieve is 2.40%. The soil material contains 13.23% silt and clay, 69.72% of sand and 17.05% of gravel. This result indicates that the material is sharp sand. The graph is shown in figure 2.

Table 1: Chemical composition analysis of corncob ash

Chemical constituents	% Composition
CaO	10.24
SiO_2	64.90
MgO	2.08
Na_2O	0.43
Al_2O_3	10.79
Fe_2O_3	4.75
SO_3	2.53
K_2O	4.23

Specific gravity

The result of specific gravity of the material is given table 2

Table 2: Specific gravity of the material

Materials	Specific gravity
Sand	2.53
granite	2.43
cement	3.35
Corn cob ash	1.05

The Slump Result of CCA concrete

The slump test result shows the degree of workability of corncob ash in concrete. It can be observed that the slump value decreases with increase in amount of CCA

Table 3: Slump values (mm) of the Corncob ash concrete with water-binder ratio of 0.65

S/N	% Replacement	Slump values (mm)
1.	0	53
2.	5	45
3.	10	34
4.	15	28
5	20	23

Compressive Strength result of CCA Concrete

The results of the compressive strength of the concrete cubes show that the compressive strengths reduced as the percentage of CCA increased. The strength increased as the number of days of curing increased for each percentage CCA replacement.

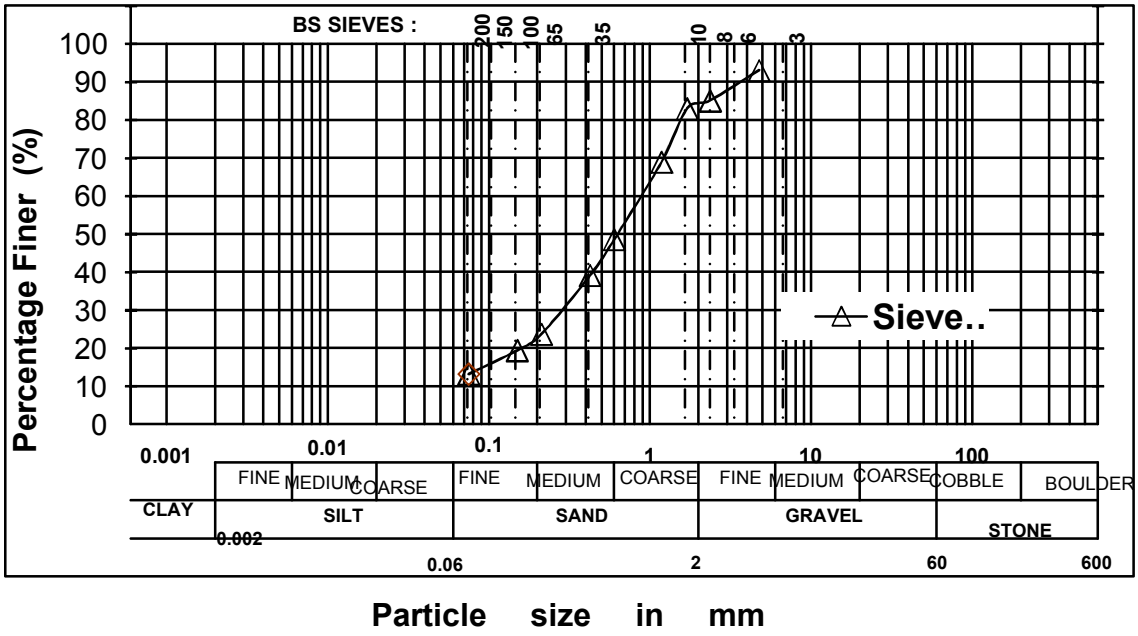

Figure 2: Particle size distribution for the sharp sand

Table 4: Compressive strength (N/mm^2) of CCA concrete at different ages

% Replacement	7 days	14days	21days	28days
0	14.1	16.8	18.03	23.80
5	13.2	15.2	16.4	21.44
10	10.6	12.4	14.05	19.23
15	9.1	10.2	12.40	17.50
20	8.4	9.7	10.06	12.90

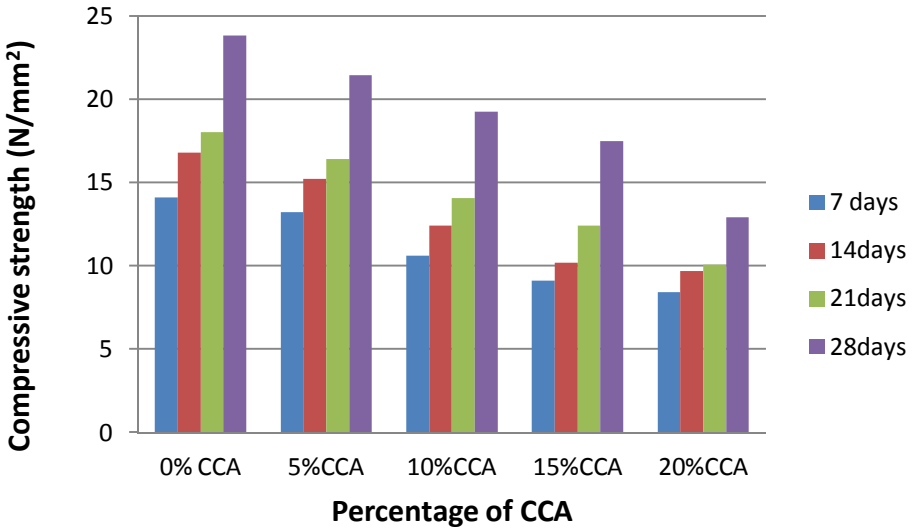

Figure 5: Compressive strength of CCA concrete at different curing days

Conclusion And Recommendation

- The workability of fresh Corncob ash concrete measured by the slump test reduces as the corncob ash content increases.
- The Compressive Strengths of concrete reduced as the percentage CCA replacement increased but increases with curing age.
- For an optimum compressive strength of concrete to be attained, a 5% replacement of cement with corncob ash is recommended.
- Recycling of waste materials in a more useful and economical way should be encouraged by government and any organization with viable programs and adequate funds to encourage interested researchers.

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