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Evaluation of Compressive Strength of Concrete Produced With Cow Bones as Partial Replacement for Coarse Aggregates

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Abstract: *This work focused on the evaluation of compressive strength of concrete produced with cow bones as partial replacement for coarse aggregates. Cow bones were cut to 20 mm size manually to same size with coarse aggregates used. The mixing ratio used was 1:2:4. The percentage replacements were 0%, 5%, 10%, 15%, and 20%. The slump values were 36.0mm, 42.7mm, 45.2mm, 47.8mm and 52mm for 0%, 5%, 10%, 15%, and 20% replacement respectively The concrete cubes of size 150mmx150mmx150mm were cast and cured for 7, 14, 28 , 56 and 112days and the compressive strength for each curing age was determined. Compressive strength obtained for different replacements of cow bones varied between 11.39N/mm^2 and 59.55 N/mm^2 for 0%, 8.86N/mm^2 and 30.92N/mm^2 for 5%, 7.99N/mm^2 and 28.51N/mm^2 for 10%, 7.30N/mm^2 and 20.33N/mm^2 for 15%, 7.15N/mm^2 and 19.98N/mm^2 for 20% replacement at 7, 14, 28, 56 and 112 days of curing respectively. The strength increased as the curing age increased but decreased with increase in percentage replacement. This research therefore recommends that cow bones can be used to replace coarse aggregates up to 20%.*

Key words: *evaluation, compressive, cow, bones, replacement,*

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I. Introduction

In the present scenario, no construction activity can be imagined without using concrete (Suchithra *et al*, 2015). A broad spectrum of lightweight concretes is being manufactured nowadays- initially, Oman's established durability of lightweight concrete by using natural aggregates from volcanic deposits (Javed *et al*, 2012). After the development of Portland cement in the early 1800s, though, it took the discovery and development of manufactured lightweight aggregates in the early 1900s to bring structural lightweight concrete to full maturity (Javed *et al*, 2012). The main reason behind its popularity is its high strength and durability (Suchithra *et al*, 2015). Today, the world is advancing too fast and our environment is changing progressively and attention is being focused on the environment and safeguarding of natural resources and recycling of wastes materials (Suchithra, *et al*, 2015).

Suchithra, *et al*, (2015) investigated the use of E-waste in production light weight concrete and concluded that the addition of E-waste shows increase in compressive strength up to 15% replacement. Increase in split tensile strength is almost insignificant whereas gain in flexural tensile strength have occurred even up to 15% replacements. E-waste seems to have a more pronounced effect on the flexural strength than the split tensile strength. From the durability study the sulphate attack and chloride attack, which does not affect the strength of concrete and the optimum mix is more durable than the control mix. It can be used in marine conditions. The use of E-waste in concrete is possible to improve its mechanical properties and can be one of the economical ways for their disposal in environment friendly manner.

Javed *et al*, (2012) worked on machine crushed animal bones as partial replacement of coarse aggregates in lightweight concrete. The following were conclusions drawn: Lightweight concrete using CAB aggregate can be achieved by replacing normal aggregate by CAB aggregate approximately 50% or more. The average unit weights corresponding to 50%, 75%, and 100% of CAB aggregate inclusion in concrete are 19.60 KN/m^3, 17.65 KN/m^3, and 16.55 KN/m^3 respectively, for nominal concrete mix 1:1.5:3. Compressive strength of CAB concrete (lightweight) is low as compared to normal concrete; however, it can be improved by using silica fume (SF). Besides achieving economy in construction, by reducing the weight of the structure, the catastrophic earthquake failures caused due to inertia forces (earthquake forces are proportional to the weight of the structure) that influence the structures can also be ultimately reduced.

Fapohunda *et al*, (2016) investigated on the Suitability of Crushed Cow Bone as Partial Replacement of Fine Aggregates for Concrete Production. The results of obtained shown that there was a reduction in concrete workability with an increase in the percent replacement of sand with CCB. The use of CCB also resulted in

harsh mixes with attendant low slump. The density of the concrete specimens reduced as the percent increase in sand replacement with CCB increased. Using CCB as partial replacement of sand can result in different types of concrete based on the density attainable. The compressive strength of the specimens decreased with increase in the percent replacement of sand with crushed cow bone. The compressive strength of the specimens increased with curing ages. Replacement of sand with CCB up to 20% by weight will result in compressive strength development that is not significantly different from those of the control samples. The use of CCB in the replacement of cement up to 20% by weigh in the production of concrete will have a positive impact on the environment, and encourage the use of bio-concrete in structural engineering.

Most of the previous researches focused on the machine cut cow bone and cow bone crushed as coarse and fine aggregates respectively. The use of machine to cut and crush cow bone may influence cost of concrete production; therefore, this research aims at evaluating compressive strength of concrete using manually cut cow bone in replacing coarse aggregate.

II. Materials And Methods

Materials

The following materials were obtained and used for the research work:

Cement

The Dangote brand of ordinary portland cement grade 42.5 conforming to BS EN 197-1: (2000) requirements was used. .

Fine Aggregate (River Sand**):**

The fine aggregate used was river sand retained on a 600microns sieve acting as fillers. It was obtained from a local supplier in Ado – Ekiti, Ekiti State, Nigeria.

Coarse Aggregate: The coarse aggregates used was Granite of 20 mm size. It was sourced from a quarry site in Ikere-Ekiti, Ekiti State, Nigeria.

Water: The water used was potable, clean and free from any visible impurities conforming to BS EN 1008 (2002) requirement

Cow Bone (CB)

The CB was obtained from Poli venture of Federal Polytechnic Ado-Ekiti abattoir, Ekiti State, Nigeria. These bones were cut after drying; the muscles, flesh, tissues, intestines and fats were removed prior to washing and drying. The cow bone was cut into the required 20 mm.

Methods

The following tests were carried on out for the purpose of this research work:

Slump test:

This was conducted in accordance with BS 1881-116 (1983). It was performed on fresh concrete with percentage replacement for coarse aggregates by cow bones varied from 0%, 5%, 10%, 15% and 20%. It was done at Civil Engineering department, Federal Polytechnic, Ado-Ekiti, Nigeria

Compressive strength: This was conducted in accordance with BS 1881-116 (1983). It was performed on hardened concrete with percentage replacement for coarse aggregates by cow bones varied from 0%, 5%, 10%, 15% and 20%. It was done at Civil Engineering Department of Afe Babalola University, Ado-Ekiti. Nigeria.

III. Results And Discussion

The following results were obtained from the research tests conducted:

Slump values (workability)

Slump test is the most commonly used method of measuring consistency of concrete which can be employed either in laboratory or at site of work. It is used for the determination of ease of application of concrete. The concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows. It can be used as an indicator of an improperly mixed batch. The table 1 below shows that as percentage replacement increased, the slump value increased. The addition of cow bone to the concrete made it more workable.

Table 1: Slump Values

% replacement	0	5	10	15	20
Slump value (mm)	36.0	42.7	45.2	47.8	52.0

Compressive strength

Compressive strength of concrete depends on many factors such as water cement ratio, cement strength, quality control during production of concrete etc. The compressive strengths were determined at different percentage replacements at different curing ages; the effects of cow bones on compressive strength were studied. The figure 1 below shown that as the quantity of cow bones increased, the compressive strength obtained reduced, this was because cow bones were less dense than coarse aggregates, but the compressive strengths increased as curing days increased.

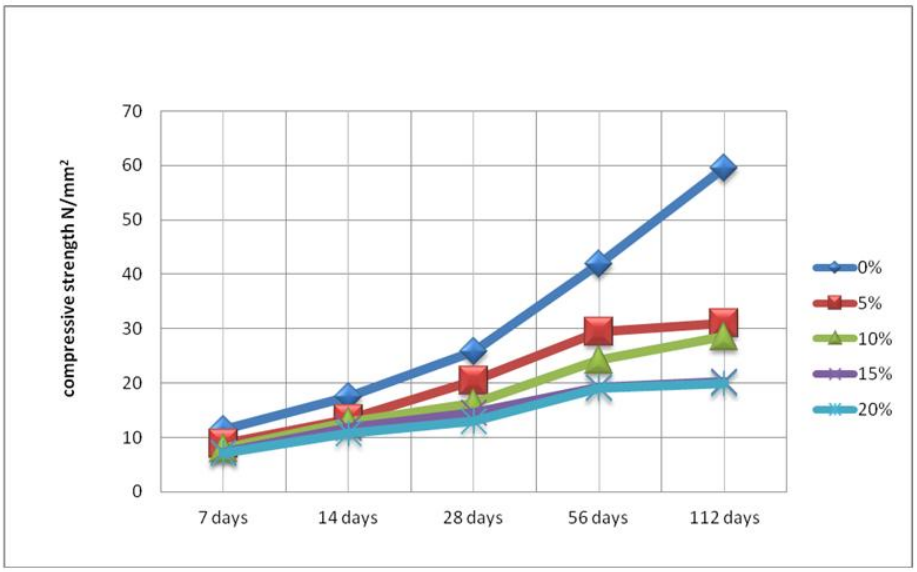

Fig 1: Compressive Strength

IV. Conclusions

The following conclusions were drawn from this study:

- Concrete produced with cow bones as partial replacement for coarse aggregates shows good workability
- Compressive strength of concrete produced with cow bones as partial replacement for coarse aggregates reduced as percentage replacement increased
- Curing ages increased the compressive strength of concrete produced with cow bones as partial replacement for coarse aggregates
- The production of cow bone concrete reduced wastes and made our environments more friendly
- Cow bone concrete is cheaper than conventional concrete
- Cow bone should replace coarse aggregates up to 20%.

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