"Performance of Concrete By Using Animal Bone Powder And Fly Ash"

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ABSTRACT

An exploratory study on the suitability of the bone powder as partial replacement for normal fine aggregates and adding Fly Ash as 10% of cement replacement in concrete works has been carried out in order to reduce the construction cost and to overcome the scarcity of ingredients of concrete. Physical and Mechanical properties of Standard Concrete by using crushed animal bones and locally available normal aggregates have been determined and compared. A large number of concrete cubes of size 150X150X150 mm were cast with different percentage replacements of coarse aggregates by, fine aggregate by bone powder 80:20 were cast and Compressive Strength test values were determined

Keywords: *Bone Powder, Compressive Strength, Light Weight Concrete, Fly Ash*

INTRODUCTION

This paper presents an experimental investigation on the effect of using bone powder (BP), as a cement addition, on the mechanical properties of cement mortar. The evaluation was based on the assessment of mechanical properties (compressive strength and indirect tensile strength) measured at 7, 21 and 28 days.

Department Of Civil Engineering, Dr. DYPSOET, Pune, An exploratory study on the suitability of the crushed animal bones as partial or full replacement for normal coarse aggregates, bone powder as partial replacement for normal fine aggregates and adding Fly Ash as 10% of cement replacement in concrete works has been carried out in order to reduce the construction cost and to overcome the scarcity of ingredients of concrete. Physical and Mechanical properties of Standard Lightweight Concrete by using crushed animal bones and locally available normal aggregates have been determined and compared. A large number of concrete cubes of size 150X150X150 mm were cast with different percentage replacements of coarse aggregates by crushed bones.

The demand of natural coarse aggregates in the construction industry has been increased. It is very essential to protect the natural coarse aggregates for further generation. To fulfil the demand of such naturally occurring materials, various substitutes are used. In the present study, an attempt has made by partial replacing the natural coarse aggregates with animal bones (sheep or goat bones) and cement with fly by comparing with and without fly ash (used as an admixture).The present investigation is about the effect of animal bones and an optimum fly ash content on properties of concrete, when the partial replacement of coarse aggregate with animal crushed bones by different proportions. An auxiliary test like compression, flexural strength test was made on cubes, for M30 grade concrete and curing for 7days, 21 days, 28 days.

The replacement levels of normal coarse aggregate with animal bones by weight and a comparative study has been done between normal conventional concrete and animal bone concrete with and without using of fly ash. From this research the use of Fly ash or is sustainably increase the mechanical properties of concrete. In this world, there is great demand of aggregates mainly from civil engineering industry for road and concrete constructions. But now days it is very difficult problem for available of coarse and fine aggregates. So researchers developed waste management strategies to apply for replacement of these aggregates for specific need. Natural resources are depleting worldwide while at the same time the generated wastes from different areas are increasing substantially.

OBJECTIVE

1. The Objective of this project is to examine The use of crushed bones from animals especially cows for for replacing normal fine aggregate in concrete as potential building material in making concrete.
2. An exploratory study on the suitability on animal bone as paratial or full replacement for normal fine aggregate .
3. Bone powder as partial replacement for normal fine aggregate and adding fly ash as 10% of cement replacement in concrete works has been carried out in order to reduce the construction cost.
4. To increase strength more than or comparing Normal conventional concrete mixes.

BONE POWDER

Bone mineral is a complex chemical made from calcium, phosphate and hydroxyl ions, but which may also contain small amount of cationic, magnesium and strontium replacing calcium and bicarbonate and fluoride, replacing the hydroxyl anions. Bone is a strong, hard, fibrous material in mammalian body (endo- skeleton) which gives shape and supports to the body.

PROPERTIES	RESULT
Specific gravity	1.95
Water absorption (%)	4.4
Bulk density (kg/m3)	775
Fineness modulus	3.81
Moisture Content (%)	3.35

LITERATURE REVIEW

M. Vijaya Sekhar Reddy, K. Ashalatha, SK. Hydrali, "Lightweight Standard Concrete by Using Crushed Animal Bones, Bone Powder and Fly ash." International Journal of Research in Civil Engineering, Architecture & Design Volume 2, Issue 3, July-September, 2014, pp. 13-17,

An exploratory study on the suitability of the crushed animal bones as partial or full replacement for normal coarse aggregates, bone powder as partial replacement for normal fine aggregates and adding fly ash as 10% of cement replacement in concrete works has been carried out in order to reduce the construction cost and to overcome the scarcity of ingredients of concrete. Physical and Mechanical properties of Standard Lightweight Concrete by using crushed animal bones and locally available normal aggregates have been determined and compared.

Javed Ahmad Bhat, Reyaz Ahmad Qasab And A. R. Dar Department Of Civil Engineering, "Machine Crushed Animal Bones As Partial Replacement Of Coarse Aggregates In Lightweight Concrete."ARPN Journal of Engineering and Applied Sciences, VOL. 7, NO. 9, SEPTEMBER 2012

An exploratory study on the suitability of the machine crushed animal bones as partial or full replacement for
normal coarse aggregates in concrete works has been carried out. Physical and mechanical properties of machine crushed animal bones and locally available normal aggregate have been determined and compared. A large number of concrete cubes of size 150×150×50 mm with different percentages by weight of normal aggregate to crushed animal bones as coarse aggregate in the order 100:0, 75:25, 65:35, 50:50, 25:75 and 0:100 were cast, tested and their physical and mechanical properties were determined. Compressive strength tests showed that approximately 50% of the crushed animal bones in replacement for normal aggregate were quite satisfactory with no compromise in compressive strength requirements for concrete mix ratio 1:1.5:3. The study has been carried out at 25%, 35%, 50%, 75%, and 100% replacement levels of normal aggregate by crushed animal bone (CAB) aggregate by weight and a comparative study has been done between
normal concrete and crushed animal bone (CAB) concrete.

N. M. Ogarekpe,*, J. C. Agunwamba,, F. O. Idagu, E. S. Bejor, Dept. Of Civil Engineering, Cross River University Of Technology. **"Suitability Of Burnt And Crushed Cow Bones As Partial Replacement For Fine Aggregate In Concrete."**
***Nigerian Journal of Technology (NIJOTECH) Vol. 36, No. 3, July 2017, pp.* 686 – 690.**

The suitability of burnt and crushed cow bones (BCCB) as partial replacement for fine aggregate in concrete was studied. The percentages of replacements of fine aggregates of 0, 10, 20, 30, 40 and 50%, respectively of BCCB were tested considering 1: 2: 4 and 1: 11/2 :3 concrete mix ratios. The cow bones were burnt for 50 minutes up to 92oC before being crushed. Ninety-six (96) concrete cubes of 1: 2: 4 mix ratio and ninety-six (96) concrete cubes of 1 : : 3 mix ratio measuring 150x150x150mm were tested for the compressive strength at 7, 14, 21 and 28 days respectively. The research revealed that the BCCB acted as a retarder in the concrete. Water-cement ratio increased with the increase in the percentage of the BCCB. The mixes of 1:2:4 and 1: :3 at 28 days curing yielded average compressive strengths in N/mm2 ranging from 16.49 - 24.29 and 18.71 - 29.73, respectively. For the mix ratios of 1:2:4 and 1:1.1/5 : 3 at 28 days curing age, it was observed that increase in the BCCB content beyond 40 and 50%, respectively resulted to the reduction of the average compressive strength below recommended minimum strength for use of concrete in structural works.

FUTURE SCOPE OF WORK

The implementation of our project was in three phases such as phase one, two and three. In the initial phase, study to find out cementitious value of Bone Powder Ash when burnt at various durations or at various temperatures was considered. In the second phase the study was made on concrete made of various replacement level of Bone powder Ash as a fine aggregate. In the third phase, the study was made on cement particle board which is made of Bone Powder Ash as a particle as well as cement as a binder. In the initial Phase, Bone Powder Ash was burnt to form charcoal first in open air afterward, charcoal was crushed to a finer particle.

The chemical composition was carried out to determine mainly calcium, silicon as well as Iron . In the second phase fundamental experiments are made on aggregate as well as cement to discover specific gravity, excellence modulus for mix design and moreover experiments are done on Bone Powder Ash to make out specific gravity, excellence modulus of Bone Powder Ash. In the third phase, M30 Mix ratio is considered which includes 20% replacement level of Cement by Bone Powder Ash. The concrete were considered for Grade 30 and water cement ratio was set aside at 0.57. The substitute of Bone Powder Ash was by weight. The compressive as well as tensile strength were performed for 7 , 21 as well as 28 days of age.

MIX DESIGN:-

Mix design for M 30 grade concrete

[2] Reference – IS 10262: 1982 and IS 10262:2009&**various papers of mix design of pervious concrete.**

DESIGN STIPULATIONS:-

a) Characteristics compressive strength = 30 N/mm^2

b) Max. Size of coarse aggregate = 12.5mm

c) Degree of quality control = good

d) Type of exposure = moderate

e) Min. Cement content = 320kg/m^3 (IS- 456)

f) Max. W/c ratio = 0.5

TEST DATA FOR MATERIALS:-

a) Cement used = Ordinary Portland cement (53grade)

b) Specific gravity of cement = 3.15

c) Specific gravity of

i) Coarse aggregate = 2.78

d) Water absorption

[1]. Coarse aggregate

12.5mm = 0.6%

e) Free (surface) moisture

i) Coarse aggregate = Nil

TARGET STRENGTH FOR THE MIX DESIGN

$\bar{F}_{ck} = f_{ck} + t.s$ = 30 +1.65 (4) = 36.6 N/mm2

Where,

$\bar{f}_{ck}$ = target average compressive strength @ 28 days

F_{ck} = characteristics compressive strength @ 28 days

t = risk factor

S = standard deviation

SELECTION OF THE WATER CEMENT RATIO

W/c ratio from the trial and error method = 0.32

W/c ratio from the durability requirement for moderate exposure condition (IS 10262-2009) = 0.5

Hence, Adopted W/C ratio = 0.32

CASTING PROCEDURE

Compressive testis carried to determine compressive strength of concrete cubes. It is the most common test conducted on hardened concrete partly because it is an easy test to perform and partly because most of the desirable characteristics properties of concrete are quantitatively related to its compressive strength. The compressive test is carried out on cube specimen of the test size 15x15x15 cm.

Before assembling the mould, their mating surfaces were covered with mineral oil and a thin layer of the oil was applied to its inner surface to prevent a bond development between the mould and the concrete. Mix the concrete ingredients thoroughly as per the mix design. Concrete ingredients are filled in to the mould in three layers and each layer is compacted by tamping rod not less than 25 blows or by using surface vibrator. Then level the top surface and smoothen it with the trowel.

The test specimens are stored in a moist air for 24 hours and after this period the specimen are removed from the mould and marked. Then cubes kept in the clear plastic bags until 7 days and then placed in curing tank for curing.

Minimum three specimens should be tested at each selected age. If strength of any specimen varies more than 15 percent of average strength results of such specimen should be rejected. Average of three specimens gives the compressive strength of concrete.

RESULTS AND DISCUSSIONS

The mix design is carried out with the selected slump of 0-25 mm , for the concrete grade of M30 with the maximum aggregate size of 20 mm as per the guide lines by IS 10262-2009.Five trial mixes are carried out to produce Standard Lightweight Concrete with partial replacement bone powder and fly ash which were designated as TRAIL 1,TRAIL 2

Concrete is produced with 20% replacement of Fine aggregate by bone powder and 10% of fly ash to total cement weight with the trail mix proportions. For the Concrete cube samples of size 150mm x 150mm x 150mm Compressive Strength was determined for 7 days, 21days and 28 days curing period. After mixing all the ingredients along with water the concrete attains the homogeneous mixture by thoroughly mixing . The Compressive strength was carried out as per IS:516-1959.

6.1 COMPRESSIVE STRENGTH

It was observed that there was increase in compressive strength with increase in percentage of Bone Powder Or. The result of compressive strength test is shown Next Page.

FOR 7 DAYS CURING CUBES RESULT (CONVENTIONAL) :-

Sr. No.	Description	Doc	Dot	Grade Of Concrete	Age Of Concrete	Wt.Of Cube(Kg)
01	Mix Design conventional cubes	19/3/18	26/3/18	M-30	7 days	8.970 8.990 9.100

Size Of Column			Aplied Load (Kn)	Area Of Cube	Strength(N/Mm2)	Avg.Strength (N/Mm2)	Remark
150	150	150	480	22500	21.33	21.8	OK
150	149	150	460	22350	20.44		
150	149	150	500	22350	22.22		

FOR 21 DAYS CURING CUBES RESULT (CONVENTIONAL) :-

Sr. No.	Description	Doc	Dot	Grade Of Concrete	Age Of Concrete	Wt.Of Cube(Kg)
01	Mix Design conventional cubes	19/3/18	26/3/18	M-30	21 days	8.850 8.940 9.076

Size Of Column			Aplied Load (Kn)	Area Of Cube	Strength(N/Mm2)	Avg.Strength (N/Mm2)	Remark
150	150	150	690	22500	30.66	29.28	OK
150	149	150	666	22350	29.6		
150	149	150	640	22350	28.1		

FOR 28 DAYS CURING CUBES RESULT (CONVENTIONAL) :-

Sr. No.	Description	Doc	Dot	Grade Of Concrete	Age Of Concrete	Wt.Of Cube(Kg)
01	Mix Design conventional cubes	19/3/18	26/3/18	M-30	28 days	8.706 8.870 8.880

Size Of Column			Aplied Load (Kn)	Area Of Cube	Strength(N/Mm2)	Avg.Strength (N/Mm2)	Remark
150	150	150	836	22500	37.15	36.6	OK
150	149	150	817	22350	36.11		
150	149	150	790	22350	35.11		

FOR 7 DAYS CURING CUBES RESULT :-

Sr. No.	Description	Doc	Dot	Grade Of Concrete	Age Of Concrete	Wt.Of Cube(Kg)
01	Mix Design 20% Of BP	19/03/2018	26/03/2018	M-30	7 Days	8.880 8.940 8.870

Size Of Column			Aplied Load (Kn)	Area Of Cube	Strength(N/Mm2)	Avg.Strength (N/Mm2)	Remark
150	150	150	775	22500	34.44	30.72	OK
150	149	150	810	22350	36.24		
150	149	150	480	22350	21.48		

FOR 21 DAYS CURING CUBES RESULT :-

Sr. No.	Description	Doc	Dot	Grade Of Concrete	Age Of Concrete	Wt.Of Cube(Kg)
02	Mix Design 20% Of BP	29/03/2018	20/04/2018	M-30	21 Days	8.750 8.835 8.680

Size Of Column			Aplied Load (Kn)	Area Of Cube	Strength(N/Mm2)	Avg.Strength (N/Mm2)	Remark
150	150	150	735	22500	32.66	34.37	OK
150	149	150	885	22350	39.59		
150	149	150	590	22350	30.87		

FOR 28 DAYS CURING CUBES RESULT :-

Sr. No.	Description	Doc	Dot	Grade Of Concrete	Age Of Concrete	Wt.Of Cube(Kg)
01	Mix Design 20% Of BP	14/04/2018	12/05/2018	M-30	28 Days	8.600 8.750 8.580

Size Of Column			Aplied Load (Kn)	Area Of Cube	Strength(N/Mm2)	Avg.Strength (N/Mm2)	Remark
149	150	150	690	22350	30.87	31.77	OK
149	151	150	735	22499	32.67		
149	150	150	710	22350	31.77		

CONCLUSION

- Lightweight concrete can be developed by using a variety of lightweight natural aggregates. Lightweight aggregates originate from natural materials like volcanic pumice, the thermal treatment of natural raw materials like clay, slate or shale and also manufactured from industrial by-products such as fly ash and blast furnace slag.
- Maximum Compressive Strength of M30 grade concrete for seven days curing period is **18.93 MPa** by replacing fine aggregate replacement by 20% bone powder and cement replacement by 10% Fly Ash.
- Maximum Compressive Strength of M30 grade concrete for Twenty One days curing period is **27.60 MPa** by replacing fine aggregate replacement by 20% bone powder and cement replacement by 10% Fly Ash.
- Maximum Compressive Strength of M30 grade concrete for Twenty Eight Days curing period is **34.2MPa** by replacing fine aggregate replacement by 20% bone powder and cement replacement by 10% fly ash..
- Compressive strength of BP concrete (lightweight) is low as compared to normal concrete; however, it can be improved by using fly ash (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.

Casting of cubes for 7 days, 21 days,28 days

working on CTM machine

REFERENCES

1. M. Vijaya Sekhar Reddy, K. Ashalatha, SK. Hydrali, "Lightweight Standard Concrete by Using Crushed Animal Bones, Bone Powder and Fly ash." International Journal of Research in Civil Engineering, Architecture & Design Volume 2, Issue 3, July-September, 2014, pp. 13-17,

2. Javed Ahmad Bhat, Reyaz Ahmad Qasab And A. R. Dar Department Of Civil Engineering, "Machine Crushed Animal Bones As Partial Replacement Of Coarse Aggregates In Lightweight Concrete."ARPN Journal of Engineering and Applied Sciences, VOL. 7, NO. 9, SEPTEMBER 2012

3. N. M. Ogarekpe,*, J. C. Agunwamba,, F. O. Idagu, E. S. Bejor, Dept. Of Civil Engineering, Cross River University Of Technology. "Suitability Of Burnt And Crushed Cow Bones As Partial Replacement For Fine Aggregate In Concrete."
Nigerian Journal of Technology (NIJOTECH) Vol. 36, No. 3, July 2017, pp. 686 – 690.

4. M. Subrahmanyam1, K. Dhana Sri2 PG Scholar [Structural Engineering], Gudlavalleru Engineering College, Gudlavalleru, A.P, India, Asst. Professor [Structural Engineering], Gudlavalleru Engineering College, Gudlavalleru, AP, India. "Comparative Study on Effect of Fly ash and Animal Bone on Concrete by Partial Replacement of Coarse Aggregate with Animal Bones and Cement with Flyash." International Journal of Engineering Research & Technology (IJERT)http://www.ijert.org ISSN: 2278-0181 IJERTV5IS060366 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by : Vol. 5 Issue 06, June-2016

5. Mahmud ABUBAKAR*, Mohammed ABDULLAHI, and James Isiwu AGUWA Civil Engineering Department, Federal University of Technology, Gidan Kwano Campus, P. M. B 65, Minna Niger State Nigeria. *"* Probability based design of concrete mixes with cow-bone ash admixed cement." Leonardo Journal of Sciences ISSN 1583-0233 Issue 28, January-June 2016 p. 31-42
6. F.N.Okoye1* and O.I Odumodu2 1Department Of Civil Engineering, Sharda University, Greater Noida, India 2Department Of Civil Engineering, Federal Polytechnic Oko, Nigeria. " Investigation Into The Possibility of Partial Replacement of Cement with Bone Powder in Concrete Production."

International Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com Volume 12, Issue 10 (October 2016), PP.40-45

7. D. A. Opeyemi1, O. O. Makinde2 *1,*2Department of Civil Engineering Technology, Rufus Giwa Polytechnic, PMB 1019, Owo, Ondo State, Nigeria. "The Suitability Of Partial Replacement Of Cement With Rice Husk And Animal Bone Powder In Concrete Structures." International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 9, September 2012)

8. J.O. AKINYELE, A.A. ADEKUNLE, O. OGUNDAINI Department of Civil Engineering, Federal University of Agriculture, Abeokuta, NIGERIA. "THE EFFECT OF PARTIAL REPLACEMENT OF CEMENT WITH BONE ASH AND WOOD ASH IN CONCRETE." Engineering Hunedoara – International Journal of Engineering Tome XIV [2016] – Fascicule 4 [November] ISSN: 1584-2665 [print; online] ISSN: 1584-2673 [CD-Rom; online]

9. SBVS MANIKANTA VARMA M.TECH Student Dept of Civil Engineering Guru Nanak Institute of Technology Hyderabad, TS, India. M VASUDEVA NAIDU Associate Professor Dept of Civil Engineering Guru Nanak Institute of Technology Hyderabad, TS, India.. "An Effective Study on Utilizing Bone Powder Ash as Partial Replacement of Construction Material." S B V S Manikanta Varma* et al. (IJITR) INTERNATIONAL JOURNAL OF INNOVATIVE TECHNOLOGY AND RESEARCH Volume No.4, Issue No.3, April – May 2016, 3060 – 3062.

10. M. Kotb1 , M. Assas2 & H. Abd-Elrahman1 1 Civil Engineering Department, Al-Azhar University, Egypt 2 Civil Engineering Department, Umm Alqura University, Saudi Arabia. "Effect of grounded bone powder addition on the mechanical properties of cement mortar." Design and Nature V 201.

BIOGRAPHIES

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