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Partial Replacement of Cement By Bone Ash

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Abstract: **Bone mineral is a complex chemical made up of calcium which can be used as a partial replacement for cement in concrete structures. Since the amount of carbon di oxide released during the manufacturing of cement. In order to reduce the carbon di oxide, bone ash can be used as an effective replacement of cement. This study investigated replacement of bone ash varying from 5%-20% in a mix of 1:1.5:3. The compressive strength of the cubes casted was tested and the results show that ,when the replacement is 10% then the strength of concrete is more than the actual strength. Whereas the specific gravity of bone ash in only 1.59 and hence the mixing should be done in volume basis. The results suggests that workability was within the safe permissible limit but the compressive strength of concrete dropped but it was also within the safe permissible limits for light weight concrete. The replacement of bone ash should not be more than 10%.**

Keywords: **Boneash, Cement; strength.**

I. INTRODUCTION

Bone Ash obtained from raw bone waste from meat shops which is a complex chemical made up of calcium, phosphate and hydroxyl ions. Bone ash composition is similar to that of a tri calcium phosphate. The ashing was carried out by (setting it ablaze) heating the bone at about 2500 ˚c. only the organic matter being destroy and leaving a compact while mass of bone salts.Bone ash in this condition can be easily reduced to a fine powder. It crumble when it passes through sieve, the ash was whitish in colour.The mix design is to select the optimum proportion of cement, water and aggregates to produce a concrete that satisfies the requirements of strength, workability, durability and economy. The control cube been made with pure cement and the remaining five having different percentage substitution of cement for bone powder i.e. 5%, 10%, 15%, 20% respectively. Mix ratio of 1:1.5:3 was used and the water-cement ratio was 0.45.The sizes of sand used are mainly percentage passing 5.0mm with B.S sieve the granite used is also clean and sizes are mainly percentage passing 20.00mm B.S sieve. The bone was dried, washed and ready again before being set ablaze to obtain the required ash.

II. OVERVIEW OF EXPERIMENTS:

1. Specific gravity:

Specific gravity is the ratios of the density of a substance compared to density (mass of the same unit volume) of a reference substance.Determine and record the weight of the empty clean and dry pycnometer, WP, place sample in the pycnometer. Determine and record the weight of the pycnometer containing the dry soil, WPS. Add distilled water to fill about half to three-fourth of the pycnometer. Soak the sample for 10 minutes.Fill the pycnometer with distilled (water to the mark), clean the exterior surface of the pycnometer with a clean, dry cloth, determine the weight of the pycnometer and contents, WB.Empty the pycnometer and clean it and fill it with distilled water to the mark. Clean the exterior surface of pycnometer with a clean, dry cloth. Determine the weight of the pycnometer and distilled water. WA. Empty the pycnometer and clean it.The specific gravity test on Fine Aggregate and Coarse Aggregate were done to find out the requirement of materials (Fine Aggregate and Coarse Aggregate) for the particular volume.

Formula Used:

$$\text{Specific Gravity} = \frac{(M2-M1)}{\text{----------}}$$

(M2-M1)-(M3-M4)

2. Specific Gravity for Cement:

Specific gravity of cement determines the volume of cement and its workability. Le-chatlier flask is used to calculate the specific gravity of cement and Bone Ash. Take the empty weight of flask (W1). Then fill the flask with cement and weight it (W2) and (W3) will be the weight of flask, cement and kerosene and finally the W4 is weighed with flask and kerosene

Formula used:

$$\text{Specific Gravity} = \frac{(W2-W1)}{\{(W2-W1)-(W3-W4)*0.79\}}$$

3. Slump Cone Test:

The concrete slump test is an empirical test that measures the workability of fresh concrete.More specifically, it measures the consistency of the concrete in the specific batch. This test is performed to check the consistency of freshly made concrete. Consistency is a term very closely related to workability. It is a term which describes the state of fresh concrete. It refers to the ease with which the concrete flows. It is used to indicate the degree of wetness. Workability of concrete is mainly affected by consistency i.e. wetter mixes will be more workable than drier mixes, but concrete of the same consistency may vary in workability. It is also used to determine consistency between individual batches. The test is carried out by using a mould known as a slump cone or abrams cone. The cone is placed on a hard non- absorbent surface. This cone is filled with fresh concrete in three stages, each time it is tamped using a rod of standard dimensions. At the end of the third stage, concrete is struck off flush to the top of the mould. The mould is carefully lifted vertically upwards, so as not to disturb the concrete cone. Concrete subsides. This subsidence is termed as slump, and is measured in the scale and the height is noted in mm.

4. Water Absorption Test:

Water absorption is to check the absorption tendency of aggregates in order to calculate the water cement ratio. Pycnometer is used in the experiment. Clean the aggregate thoroughly by rolling it in a dry towel or cloth and blowing away the dust and fine particles. This eliminates the major portion of the very fine material, an excess of which either introduces considerable error into the test results, or renders the testing procedure difficult and laborious. Weigh the sample once it gets dried (X1). Again place The weighed sample in a pan and cover completely with water. Let stand for a minimum of 30 minutes. Weigh the second sample which is soaked in water(X) to check the absorption percentage.Drain the water from the sample and dry the aggregate calculate the percentage of water absorption (A) based on the original mass of the sample:$A = 100 (X1 – X) / X$

5. Compression Test On Concrete:

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 that whether Concreting has been done properly or not. For cube test specimen of 15 cm X 15 cm X 15 cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15 cm x 15 cm x 15 cm are commonly used. This concrete is poured in the mould and tampered properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are put in water for curing. The top surface of these specimen should be made even and smooth. This is done by putting cement paste and spreading smoothly on whole area of specimen. These specimens are tested by compression testing machine after 7 days, 14 days and 28 days curing for their respective strength.Remove the specimen for water after specified curing time and wipe out excess water from the surface. Clean the bearing surface of the testing machine and place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.Align the specimen centrally on the base plate of the machine and rotate the movable portion gently by hand so that it touches the top surface of the specimen. Apply the load gradually without shock and continuously at the rate of 140kg/cm²/minute till the specimen fails. Record the maximum load at which the specimens fails. The compression test was conducted in Concrete and Engineering Laboratory for different samples and readings for all the samples are noted.

6. Split Tensile Test Of Concrete:

To determine the splitting tensile of concrete, the test is carried out by taking the wet specimen from water after 7 days and 28 days of curing. Wipe out water from the surface of specimen and draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial place.Note the weight and dimension of the specimen. Set the compression testing machine for the required range. Keep a plywood strip on the lower plate and place the specimen. Apply the load continuously without shock at a rate of approximately 14-21 kg/cm²/minute (Which corresponds to a total load of 9900kg/minute to 14850kg/minute). Note down the breaking load.The split tensile test was conducted in Concrete and Engineering Laboratory for different samples and readings for all the samples are noted. These specimens are tested by testing machine after 7 days and 28 days curing for their respective strengths under different combinations.

III. RESULTS AND DISCUSSION:

1. Specific Gravity:

Specific gravity of cement should ranges between 3 to 4 Here the specific gravity of cement is 3.07.Specific gravity of fine aggregate and coarse aggregate are 2.59 and 2.66 respectivelyBut Specific Gravity of Bone Ash is only 1.59 therefore mixing opf bone ash with cement should be with volume basis.

***2. Water Absorption*:**

Here the water absorption of coarse aggregate is 0.6 % and for fine aggregate is 1%.Hence water cement ratio has been considered according to the absorption rating.

***3. Slump Cone Test*:**

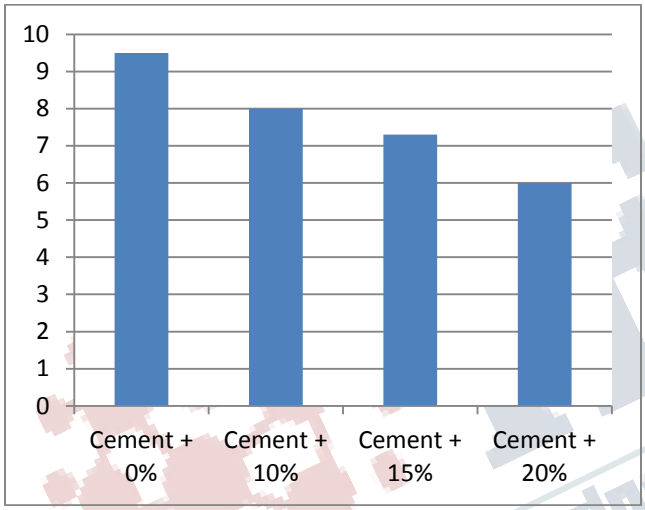

Chart showing the slump cone test results.

Slump test has been conducted to check the workability of concrete for various replacement of bone ash with cement, since the slump value ranges between 50 to 70 i.e, Medium Workability.When the percentage to bone ash increases it automatically decreases the slump rate since its contains minimum cementicious properties.

IV. COMPRESIVE STRENGTH OF CUBES FOR 7 AND 28 DAYS:

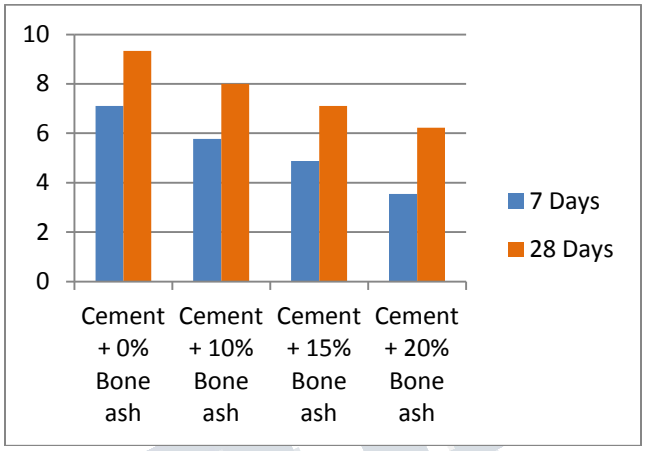

Chart Showing Values of Compressive strength of cubes.

Compressive strength for the samples by replacing 10%, 15%, 20% bone ash as been casted and tested after 7 days and 28 days with proper curing. The test results shows that 10 % replacement gives higher strength that it actual strength (0% replacement)

V. SPLIT TENSION STRENGTH OF CYLINDER FOR 7 AND 28 DAYS:

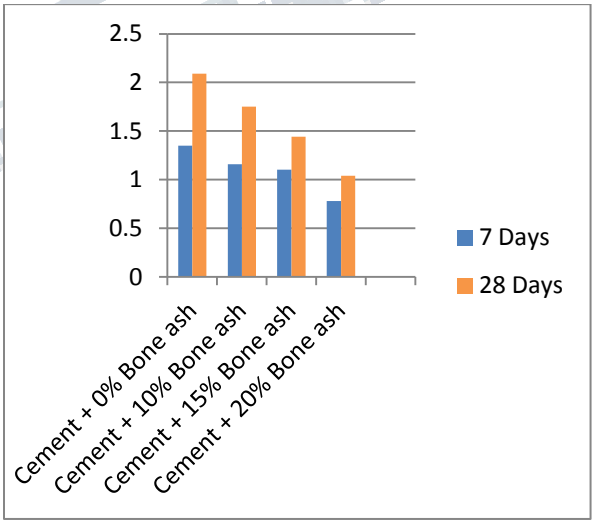

Chart Showing values of Split Tension Strength for Cylinders

Split tension test also conducted on cylinder for the above percentage and the results obtained from the test shows that replacing bone ash decreases the strength when compared to 0 % replacement.

VI. CONCLUSION

The following conclusions can be drawn based on result obtained; the substitution of Bone Powder can be used up to 10% for best results in producing plain concrete for concrete structures. There is abundance of this material in developing countries and it will help in removing thousands of tonnes of waste from the environment annually. It is observed that the compressive strength decreases with increase in percentage replacement. Graph of density against percentage replacement shows that there is reduction in density of the concrete from 0- 10 % replacement of material, and an increase in 10% - 20% which shows that the unit weight of concrete first reduced, which will lead to reduction in total self- weight of the structure.Compressive strength reduces when replacement of bone ash percentage increases when compared to traditional concrete.The split tensile strength should be decreased for the percentage of the replacement is increased.From this test, replacement of cement with this waste bone provides maximum compressive strength at 10 % replacement but it is lesser than traditional concrete. A better measure by an innovative supplementary cementatiousconstruction material is found.Cost analysis for the effective replacement has also been calculated with the standard schedule of rate for various building materials.

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