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Utilization of Waste Material for the Manufacture of Light Weight Concrete

Akanksha Bhardwaj, Ahsan Rabbani*
Department of Civil Engineering, Kalinga University, Raipur (C.G)
E-mail: rabbani.ahsan@gmail.com

ABSTRACT: Concrete plays very important role in construction work, without it construction of any structures such as building, bridges, slab, column etc is difficult. But now a days, due to large amount of production of concrete, environment is more polluted. This is because if excess amount of CO_2 evolved from the production of cement. Also due to higher density of sand and cement(1.6 gm/cc and 3.2 gm/cc respectively)higher thickness of foundation required. So the cost of construction of structure becomes higher. In this research work we are using corn cob (density=0.72 gm/cc)and marble ash (density =1.36gm/cc) as a replacement of sand and cement respectively. As these are waste material so utilization of these produces low cost structure and minimization of waste. Corn cob is first crushed into powder form and then used it into concrete. The crushed powder having sand size is used as a sand replacement which gives higher durability, higher strength and light in weight. As it is lighter in weight it produces better workability of the concrete. Light weight concrete mixes are commonly used in the construction industry where weight savings is major concern.

Keywords: Compressive strength; corn cob; lightweight concrete; low cost structure; marble ash

INTRODUCTION

There are several concrete mix design processes which are widely used in industries. As large amount of concrete is used, the naturally occurring materials decreasing day by day. Focusing on the environment, waste material used for making concrete. These waste materials are light in weight, provide relatively good strength and stability, and reduce dead load and having greater design flexibility. Corn Cob powder is low cost material and can be used as a construction material. Concrete strength increases with curing age and decreases with increasing percentage of corn cob powder and that Corn cob concrete do not attain their design strengths at 28days. It is noted that reactivity of agricultural wastes as investigated usually between 500 ^{0}C to 700 ^{0}C.In place of cement using marble ash because cement is the most expensive ingredient in making concrete. The use of Corn Cob powder and Marble Ash as a replacement of sand and cement in concrete production is focused in this study. Appropriate utilization of the combination of these two materials as a replacement for cement and sand will bring ecological and economic benefits to the country.

The emission of 7 % of carbondioxide (CO_2) from the cement industry (**Olutoge, et al., 2010**). Nigeria was the second largest producer of maize in Africa in the year 2001 with 4.62 million tons. There have been various effects of using corn cob and marble ash as a replacement of groundnut husk ash to replace cement to reduce CO_2 emission in the production of concrete. Corn Cob is a readily available biomass that when not disposed properly can pollute the land, air and water (**Biello, 2008**). Since corn cob is generally considered an agricultural waste, an interesting economic and sustainable benefit may be achieved **(J. Pinto et al., 2012)**. Corn cob lightweight concrete for non-structural applications through this proposed technological solution. Utilization of corn cob in concrete is quite novel, and is only known the use of corn cob ash in blended cement concretes **(Adesanya et al., 2009)**. Because of the significant contribution to the environment pollution to the high consumption of natural resources like limestone and the high cost of cement **(Raheem, 2010)**.

MATERIALS AND METHODS

In this research various materials used are- Marble Ash, Corn Cob powder, Coarse aggregate and Water.

Marble Ash- Marble waste powder is industrial waste containing heavy metal in constituent. So, it is used as a replacement of cement. Table 1 shows various physical properties of marble ash. Figure 1 shows marble ash powder.

Table 1: Physical properties of marble ash

S.No.	Physical properties	Value
1.	Bulk density(kg/m^3)	1118
2.	Fineness modulus	2.04
3.	Effective size(mm)	0.17
4.	Coefficient of uniformity	1.58
5.	Coefficient of gradation	1.37

Corn Cob Powder-Corn cob is also an agricultural waste material, which can be reuse in concrete toprovide better strength and durability. Table 2 shows various properties of crushed Corn Cob Powder. Figure 2 shows crushed Corn cob powder.

Figure 1 Marble ash powder

Table 2: Physical properties of Crushed Corn Cob powder

Sl. No	Physical Properties	Value
1.	Specific Gravity	2.8
2.	Fineness Test (%)	8.0

Figure 2: Crushed corn cob powder

Coarse aggregate- Aggregate plays very important role for making concrete. It provides strength in structure. Table 3 shows the properties of coarse aggregate.

Water - Water is the important ingredient of concrete as it actively participates in the chemical reaction with cement. Potable water withpH value 7 is used for mixing and curing throughout the experiment.

Experimental Investigation

Mix Proportioning: The grade of concrete M20 is used further proportion of 1:1.5:3 respectively.Characteristic compressive strength required at the end of 28 days is 20 N/mm2.

Slump Cone Test: To determine consistency of concrete, Slump test was conducted with varying water content and a particular w/c is fixedaccording to the slump of 85mm from graph plotted. The various w/c for different proportions of cement as marble ash andsand as corn cob powder.

Casting of Specimen: As the aggregate of size less than 20 mm and greater than 12.5 mm are used, cubes mould of 150x150x150 mm are used.Cylindrical mould of size 150 mm diameter and 300 mm height and beam mould of size 500x100x100mm are used for castingspecimen.

Production of Concrete: Cube Mould, Cylindrical mould and beam mould of concrete were casted. They were lubricated with grease in order to reduce frictionand to enhance removal of cubes from the mould.The cubes were removed after 24 hours and were placed in a curing tank. The method use for curing in this work is the total immersion of the cubes in water for specific age of 7, 14, and 28 days fromthe day of casting.

Compressive Strength Test: The compressive strength of concrete is one of the most important properties of concrete. In this test 150 x 150 x 150 mm concrete cubes were casted. After 7, 14 and 28 days testing of concrete cube done to determine compressive strength.

Split Tensile Strength Test: The test is carried out in a cylindrical specimen of 150mm diameter and 300mm length. The cylindrical specimen is placed horizontally between the loading surface of a compression testing machine and the load is applied until failure of cylinder, along the vertical diameter as shown in figure 3.

Flexural Strength Test: Flexural strength is a measurement that indicates a material's resistance to deforming when it is placed under a load. The values needed to calculate flexural strength are measured by experimentation, with rectangular samples of the material placed under load in a two-point testing setup.

Table 3: Physical Properties of Coarse Aggregate

Sl. No.	Physical Properties	Value
1	Specific gravity	2.9
2	Impact Value (%)	28.9
3	Bulk Density (gm/cm^3)	0.72
4	Crushing Test (%)	12.4
5	Flakiness Index	39
6	Elongation Index	35
7	Abrasion Test (%)	13.4
8	Water absorption (%)	2.5

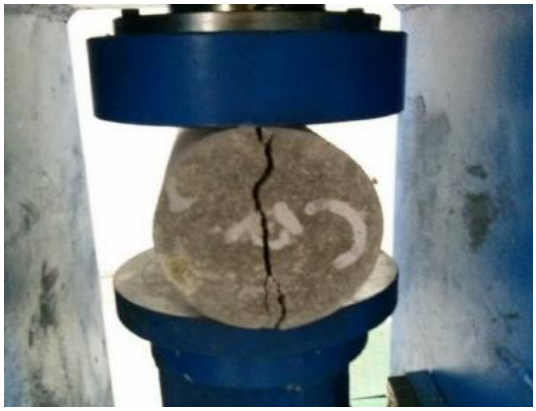

Figure 3: Split tensile strength of cylinder

RESULTS AND DISCUSSION

From Table 4 it was found that with the increase in marble ash and corn cob powder compressive strength of concrete increases. Split tensile strength of concrete also increases with percentage of waste material used in the concrete except for 10 % marble ash and 25 % corn cob powder mix.

Table 4 Compressive Strength of various Concrete Cubes

Sr. No	Mix Marble Ash & CCP (%)	Average compressive strength in N/mm^2		
		7days	14days	28days
1	0,0	18.80	27.96	31.40
2	5,20	33.27	37.18	44.55
3	10,25	21.73	27.58	32.98
4	100,100	31.45	34.09	38.48

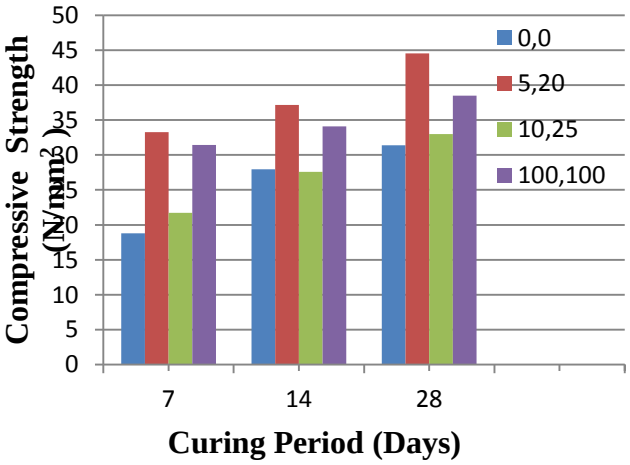

Figure 4 Graph between compressive strength v/s Curing periods

Table 5 Split Tensile Strength ofvarious Concrete Cylinder

Sr. No	Mix Marble Ash and CCP (%)	Average Split Tensile strength in N/mm2		
		7days	14days	28days
1.	0,0	2.73	3.34	3.63
2.	5,20	3.11	3.77	4.62
3.	10,25	2.40	3.39	3.62
4.	100,100	3.12	3.29	3.68

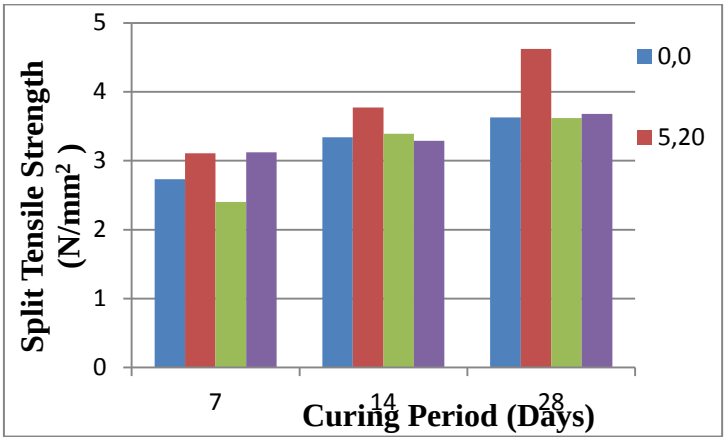

Figure 7 Graph between Split tensile strength v/s Curing periods

Table 6 Flexural Strength on Beam

Sr. No.	Mix MA and CCP (%)	Average Flexural strength in N/mm2		
		7days	14 days	28days
1.	0,0	3.97	4.78	5.65
2.	5,20	5.57	5.57	8.16
3.	10,25	3.94	5.42	5.80
4.	100,100	3.92	5.63	7.32

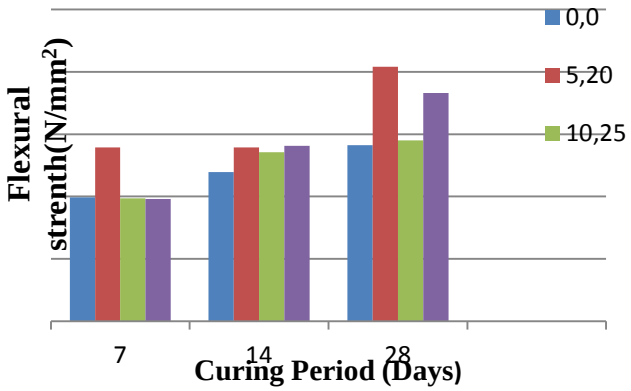

Figure 8 Graph between Flexural strength v/s Curing periods

CONCLUSIONS

From the above discussion it is concluded that:

Concrete acquires maximum increase in compressive strength at 5 % replacement of cement by marble ash and 20 % fine aggregate replacement by Corn cob powder. When compared to mix proportions conventional concrete and special concrete 10 % replacement of cement by marble ash and 25 % fine aggregate replacement by Corn cob powder. The increase in strength of special concrete 5 % replacement of cement by marble ash and 20 % fine aggregate replacement by Corn cob powder. The compressive strength increase the percentage 1.42 compared to conventional concrete and flexural strength increase the percentage1.44 compared to conventional concrete same as spilt tensile strength increase the percentage1.27 compared to conventional concrete. By total replacement of cement and fine aggregate using Marble ash and Corn cob powder the compressive strength, flexural strength and tensile strength is increased as compared to the partial replacement of cement and fine aggregate.

Moreover with the use of Marble ash and Corn cob powder, the weight of the concrete reduces, thus making the concrete lighterwhich can be used as a light weight construction materials. Water absorption of Marble ash and Corn cob powder concrete decreased as compared to the normal cement concrete.

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