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A LIGHTWEIGHT CONCRETE USING GRANULATED CORN COB

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ABSTRACT

A lightweight concrete using granulated corn cob (without corn) as an aggregate is proposed in this research work. Taking into account that corn cob, after extracting the corn, is generally considered an agricultural waste, an interesting economic and sustainable benefit may result by using it as a buildingmaterials. Therefore, it can be an alternative sustainable lightweight aggregate solution in comparison to the most currently applied ones such as expanded clay, particles of cork, particles of expanded polystyrene (EPS), among others. The density, the compressive strength and the thermal insulation propertiesof a corn cob concrete were experimentally quantified. An expanded clay concrete was also studied as reference. The main results obtained are presented and discussed showing that the proposed corn cob concrete may have the adequate material properties required for a lightweight concrete for non structural application purposes.

INTRODUCTION:

Cement concrete - most widely used construction material in the world over, commonly consists of cement, aggregates (fine and coarse) and water. It is the material, which is used more than any other man made material on the earth for construction works. In the concrete, cement chemically reacts with water and produces binding gel that binds other component together and creates stone type of material. The reaction process is called 'hydration' in which water is absorbed by the cement. In this process apart from the binding gel, some amount of lime [Ca (OH) $_2$] is also liberated. The coarse and fine aggregates act as filler in the mass.

The main factors which determine the strength of concrete is amount of cement used and the ratio of water to cement in the concrete mix. However, there are some factors which limit the quantity of cement and ratio of water / cement to be used in the

concrete. Hydration process of cement is exothermic and large amount of heat is liberated. Higher will be the cement content greater will be the heat liberation leading in distress to concrete.

Water is the principal constituent of the concrete mix. Once the concrete is hardened, the entrapped water in the mass is used by cement mineralogy for hydration and some water is evaporated, thus leaving pores in the matrix. Some part of these pores is filled with hydrated products of cement paste. It has been observed that higher the ratio of water / cement, higher is the porosity resulting in increased permeability.

The use of lightweight (LWAC) can be traced to as early as 3,000BC, when Mohenjo-Daro and Harappa were built during the Indus Valley civilization. In Europe, the use of LWCA occurred 2,000 years ago when the Romans built Pantheon, the aqua ducts, and the Colosseum in Rome. The pumice（軽石） is still used today in certain countries, such as Germany, Italy and Japan. In some places, like Malaysia, palm oil shells are used for making LWAC. Nearly all LWAC's are fire resistant. In addition, depending upon the densities and strength, the concrete can be easily cut, nailed, drilled, and chased with ordinary wood working tools.

Lightweight concrete is expensive, but the cost is calculated not just on the basis of aggregates or LWAC. The bond between the aggregate and the matrix is stronger in the case of LWAC than in normal concrete. Cement paste penetrate inside the aggregates due to their porous nature. Thus, there is very little or no ITZ between the aggregates and the matrix.

Materials and methods:

The methodology deals with the collection of materials from Agricultural land and Thermal Power Plant, and also involves collection of journals from various institutions. Then the physical properties of the material are determined. The Fly Ash is replaced by fine aggregate with partial percentages and Corn Cob fiber is used in Coarse aggregate. The mix design can be arrived for each percentage ranging from

0%, 20%, 30% and 50 % of Corn Cob Fiber. Then the specimen cubes were casted. After 28 days of curing, the specimens were tested to determine the durability of the concrete. Finally, the results are compared with the ordinary conventional concrete.

Cement	**Coarse Aggregates**	**Fine aggregates**	**Fly Ash**	**Corn Cob Fiber**
Grade -53 Ordinary Portland cement from ultra cement Company India Limited	Coarse aggregates of 20mm size	Fine aggregate were taken of Zone-II were procured from Tuticorin District	Fly Ash from Thermal Power Plant, Tuticorin	Corn Cob Fiber were taken from Sivskasi.

Table 1: Materials used in the concrete

MIX PROPORTIONS:

CEMENT	**FA**	**CA**	**WATER**
1	1.5	3	0.6

Table 2: Mix proportions for conventional concrete

Cube Id	Replacement of Fly Ash in %	Replacement of Corn Cob in %
N	0	0
A	50	20

B	50	30
C	50	50

Table: 3 Specimen details of partially replaced fly ash and corn cob fibre concrete

RESULT AND DISCUSSION:

WORKABILITY:

Workability of normal concrete with fly ash at 50% had little bit higher amount of slump value while replacing with corn cob up to 50% instead of coarse aggregate will reduce the slump up to 80mm from 120mm.From this we can conclude that the replacement of corn cob will improve the workability with increment of the replacement level.

Cube Id	Replacement of Fly ash (in %)	Replacement of Corn Cob (in %)	Slump value (mm)	Type of Slump
N	50	0	120	TRUE
A	50	20	100	TRUE
B	50	30	90	TRUE
C	50	50	80	TRUE

Table: 4 Test result for workability

COMPRESSIVE STRENGTH:

Compressive strength is the most common property used to describe a concrete. Sinceother properties of concrete often correlate well with the compressive strength, it

is used as an indicator of the other mechanical properties. The results of the compressive strength tests of OPC and light weight concrete samples are given in Table 4. These are the mean values of the results obtained from three identical specimens

While comparing to the conventional concrete the replaced concrete with 50% of fly ash in fine aggregate and corn cob upto 20% in coarse aggregate will increase the strength. But further increasing the corn cub instead of coarse aggregate will reduce the strength. Table 3 revealed an increase in the characteristic strength of concrete cubes as per curing age and decreased as per ash content. It implies that 20% corn cob ash concrete might develop the required strength over a longer period of time

Curing Period	**Compressive Strength in N/mm^2**			
	N	**A**	**B**	**C**
7 Day	16	16.7	13.11	11.25
14 Day	19.65	20.05	16.52	14.02
28 Day	23.80	24.52	19.50	16.03

Table: 5 Value of compression machine value

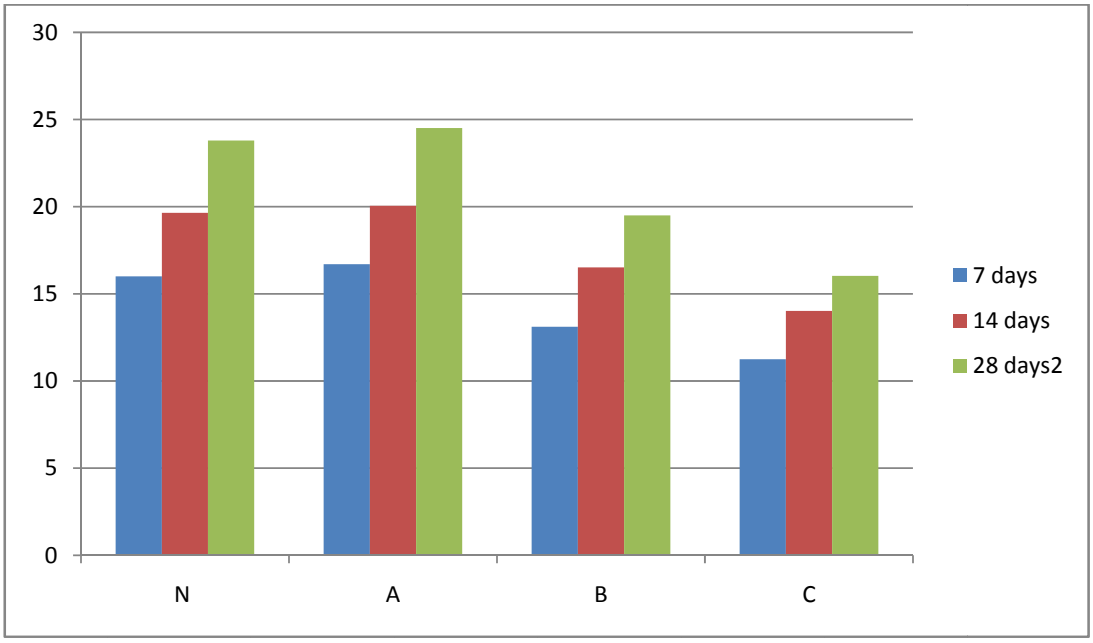

Fig 1:Comparison of weight of fly ash at 50% with corn cob fiber at 20%,30% and 50% replacement an normal concrete

Density of concrete:

The results generally revealed in Table 6 that density decreased with respect to increasing percentage of corn cob ash replacement in concrete samples. The density of Ordinary concrete is 8.150 Kg while replacing with fly ash at 50% and Corn cob at 50% is reduced to 5.370 Kg.

Cube Id	Weight of Concrete in kg
N	8.150
A	6.790
B	6.390
C	5.370

Table: 6 Comparison of weight between corn cob fiber and normal concrete

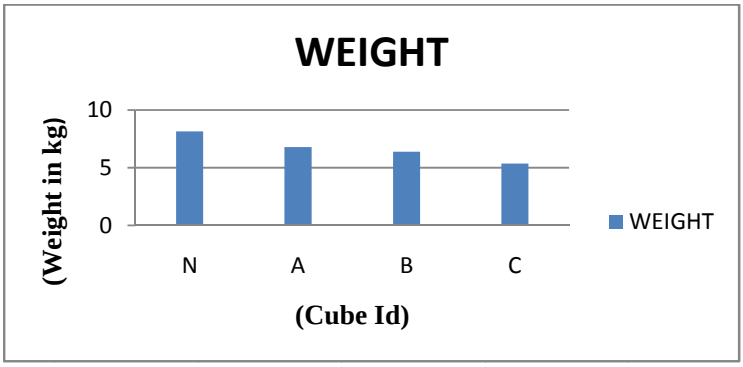

Fig 2 :Comparison of weight of fly ash at 50% with corn cob fiber at 20%,30% and 50% replacement an normal concrete

CONCLUSIONS

The following conclusions are derived based on the present research.

- Since the sliced corn 20mm sized particles are most active, the strength of concrete with corn cob fiber materials was found to be higher than that of Normal Cement Concrete.
- The workability of the concrete with corn cob fiber with fly ash was found to be higher than that of Normal Cement Concrete.
- The workability of concrete increases with the increase in fly ash in concrete. Fly ash use improves the workability of the mix and thus allows a decrease in the amount of water used.
- The compressive strength increases with the increase of **Corn cob in concrete up to 20%** replacement. Therefore it is an optimum percentage of replacement.
- As the fly ash contents increases in 53 grade OPC there is reduction in the strength of concrete. This is expected, as the secondary hydration due to pozzolanic action is slower at initial stage for fly ash concrete. The reduction is more at earlier ages as compared to later ages.
- The weight of corn cob fiber concrete absolutely reduces the dead weight of concrete.

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