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To Study the Compressive Strength Behaviour of Fly Ash, Wood wool and EPS Beads-Based Material

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Abstract - *Large quantities of by-products are generated from the industries and rapid urbanization, these by-products are treated as wastes and have no particular provision for use in any other field, one of such materials is fly ash. In this project we use fly ash along with EPS beads for limiting the impact on environment.*

This project focuses on the study of behaviour of fly ash-based material under compression, it includes the physical properties and results of the test conducted on the fly ash used to create the material. The study was conducted by adding fly ash, wood wool and EPS beads together with ordinary Portland cement of grade 43 as a binding agent in different mix ratios, the mix ratios 0.2, 0.4, 0.6 and 0.8 were used. For 2 curing periods of 14 days and 28 days. The EPS beads used are or diameter 2-3 mm. The density of EPS beads used is 22kg/m3. Cubical specimen of size 70x70x70 mm was used. The results indicate the compressive strength behavior of the fly ash-based material for different mix ratios in 2 curing periods. Each sample had 2 specimen of same mix ratio and same curing period.

The compressive strength of the material is considerably influenced by percentage of wood wool and fly ash. Test results indicate that fly ash and wood wool-based material can be a good fill material and compare favorably with conventional granular fill materials.

Key Words: **EPS beads, Fy ash, wood wool, compressive strength, Mortar cube.**

1.INTRODUCTION

A good portion of the budget of a construction project and infrastructure is dependent on the geological properties of the underlying soil deposits and the foundation type that needs to be designed for the project with the properties of the soil present at the site. With the continuous demand of land, it has become necessary to use the low-lying areas with inefficient soil properties for construction, for this the soil properties need to be improved and corrected and made optimum for use in construction applications. Regarding this, a lightweight material such as fly ash can be used to create a filler material, which is economical and also dispose of fly ash without causing problem for environment.

1.1 Fly ash

Due to always increasing demand for the conventional materials, the researchers are made to find alternatives materials to successfully implement in the construction applications. One such materials is fly ash, it is produced after the combustion of pulverized coal, which results in a finely divided residue that is carried out of combustion chamber by gases exhausted during the combustion.

The fly ash was procured from a fly ash brick workshop, the fly ash had lumps and other impurities hence it was air dried for 24 hours and then sieved through 1.18 mm sieve.

1.2 EPS Beads and Wood Wool

Expanded Polystyrene beads is a plastic formed from hydrocarbon molecules that's small, lightweight and ideal for a variety of applications. EPS is lightweight, non-biodegradable, hydrophobic and chemically inert. The EPS beads are available in varying sizes and densities. The one which was used for this project had a density of 22kg/m3 and a average size of 2-3 mm.

The waste from wood processing saw is cut into the long juggle of 0.5m. Conveyer belt is delivered to juggle and is made wood wool in the excelsior cutting machine, and wood wool flows to the teeter chamber by conveyer belt again The wood wool usually has varying lengths for each unit, so for the uniformity and better workability the wood wool were cut into size of 1-2 cm..

2. CHARACTERIZATION OF MATERIALS

The material was prepared by using Fly Ash, EPS beads, Wood Wool, Cement and Water for the current study. For this we need to examine the properties of the simpler components used in its making.

Table -1: Properties of fly ash used

Description	Value
Maximum dry unit weight	13.9kn/m^3
Optimum moisture content	21.6%
Specific volume	1.9

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Coefficient of uniformity Cu	3.6
Coefficient of curvature Cc	2.6

In this project the fly ash used was tested for its physical properties such as density and specific volume and its optimum moisture content.

The EPS beads were procured from Mahesh synthetics, Gol bazaar (Raipur, Chhattisgarh, India). They are spherical in shape with diameters ranging from 2-4 mm. The EPS beads are highly compressible and have a density of 22 kg/m3.

Fig -1: Fly ash

3. MIX RATIOS AND PREPARATION OF SPECIMEN

In this study, the mix ratio is defined as ratio between weight of EPS beads and weight of Fly ash. The mix ratios calculations are based on the previous research works carried out by (Padade and Mandal, 2014), (Ram Rathan Lal and Badwaik, 2015) and (Marjive et al., 2016). These ratios were selected based on specimen of size 70 mm x 70 mm x 70 mm (343 cc). The Cement percentage is kept constant 10 % with respect to weight of fly ash. The quantity of water to be added for the preparation of specimen was calculated by multiplying optimum moisture content with weight of Fly ash. The dry weight of the fly ash WFA required to make specimen was calculated using formula-

$$W_{FA} = \Upsilon_{dmax} \times V_{FA}$$

Here, Υ_{dmax} = Maximum dry unit weight of fly ash

V_{FA} = Volume of dry Fly ash

Volume of dry fly ash was calculated by using the formula-

$$V_{FA} = V_{Beads} - V$$

Here, V_B = Volume of beads

V = Total volume of specimen

The weight of beads was calculated by using the formula-

$$W_B = \rho_B \times V_B$$

Here, ρ_B = density of beads

V_B = volume of beads

The wood wool percentage was calculated with respect to weight of fly ash given as the ratio of 1%. 1.5% and 2%.

Table -2: Mix Ratios Used

Mix ratio	Fly ash (grams)	Cement (grams)	EPS Beads	Wood wool			Volume of water
				1%	1.5 %	2%	
0.2	384.8	38.4	0.8	3.84	5.77	7.69	83.12
0.4	319.5	31.9	1.29	3.19	4.79	6/39	68.01
0.6	274.6	27.4	1.65	2.74	4.11	5.48	59.19
0.8	239.9	23.9	1.91	2.39	3/59	4.79	51.8

Fig -2: Fly ash cubes

Testing Procedure

After curing period, the specimens were air dried and weight of each specimen was measured using an electronic weighing machine, the compression test on specimens were performed to measure compressive strength. Compression tests were conducted on the universal testing machine.

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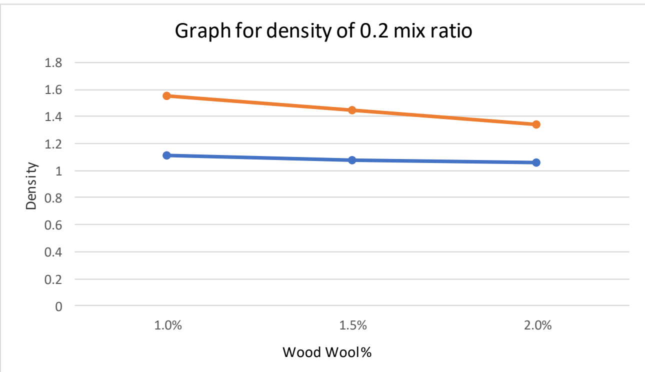
Fig-3 Fly ash cubes

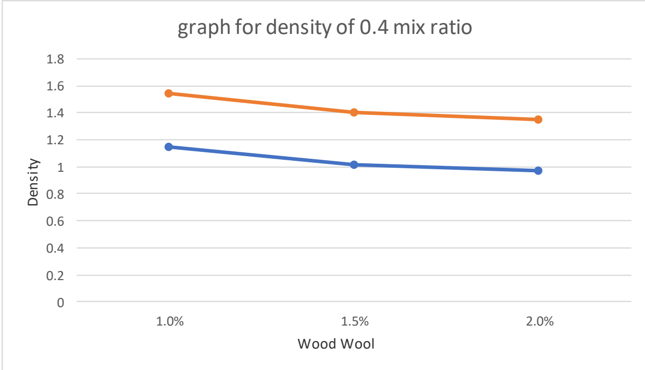
4.RESULTS AND CONCLUSION

Density

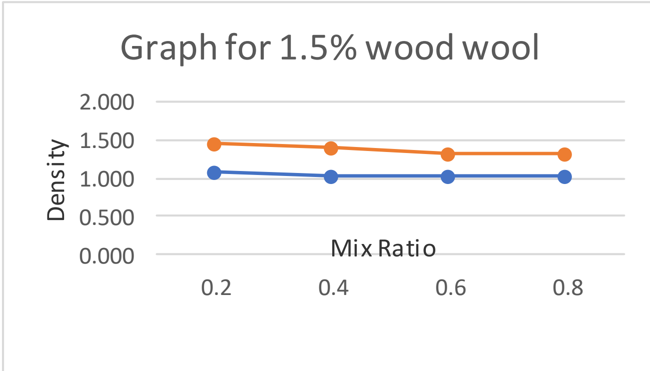
The dry density was calculated using weight of cubes taken after the curing period and air drying was done. As for the density of the material, it decreased with the increase in EPS bead percentages in the material



Graph 1 Density with mix ratio 0.2 and wood of varying %



Graph 2 Density with mix ratio 0.4 and wood of varying %

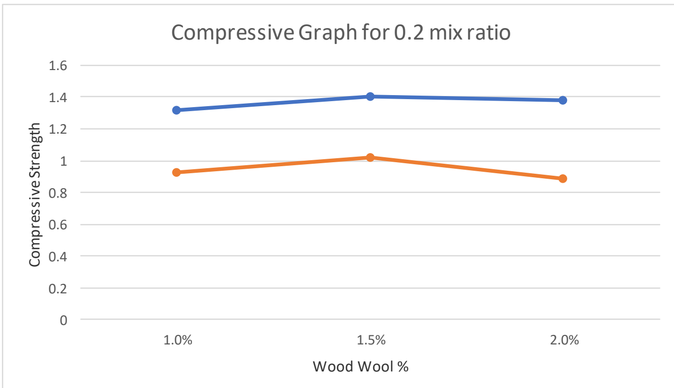


Graph 3 Density with wood wool 1.5% and ratio of varying %

The density of specimen ranges from 0.886 gm/cc to 1.633 gm/cc.

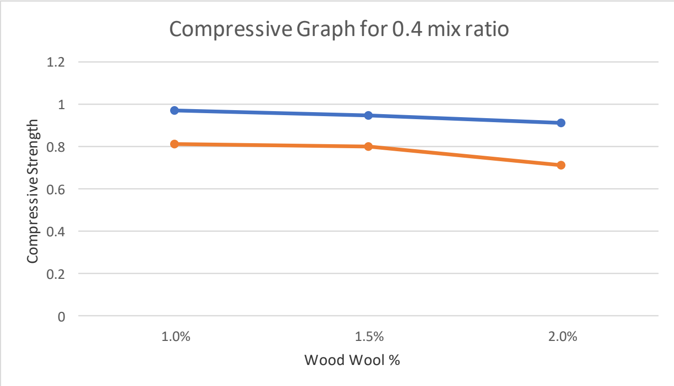
Compressive Strength

Compressive strength values were significantly affected by the mix ratio and curing period. The compressive strength values decreased with increasing mix ratio values. For a particular mix ratio, compressive strength was increased with increasing curing period, 14 days cured specimen

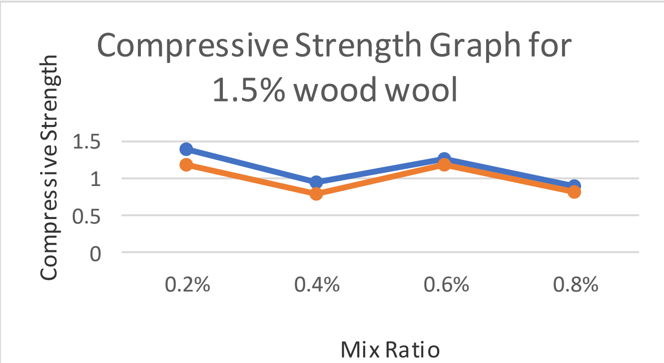


had **Graph 4** Compressive strength with 0.2 ratio lower compressive strength than that of 28 days cured specimen.

The compressive strength of specimen ranges from 0.65 N/mm2 to 1.38 N/mm2



Graph 5 Compressive strength with 0.2 ratio



Graph 6 Compressive strength with 1.5% wood wool

Failure Pattern

Failure pattern of specimen was observed under the axial compressive load. All the specimen were failed in axial strain range of 0.65% to 1.95%. The observed failure pattern shows the distinct failure planes either in vertical or diagonal pattern. Figure below shows the failure pattern of specimen.

Fig-4 Failure pattern

5. CONCLUSION

An experimental study was carried out for finding out the compressive strength of material prepared by using EPS beads, wood wool and fly ash. From the study following Conclusions can be drawn:

Compressive strength values were significantly affected by the mix ratio and curing period. The compressive strength values decreased with increasing mix ratio values. For a particular mix ratio, compressive strength was increased with increasing curing period, 14 days cured specimen had lower compressive strength than that of 28 days cured specimen. The density of the material was decreased with increasing EPS bead percentages.

The compressive strength of the material increased with curing period for a particular mix ratio. It decreased with the increasing mix ratio however. As for the density of the material, it decreased with the increase in EPS bead percentages in the material.

The compressive strength of specimen ranges from 0.65 N/mm2 to 1.38 N/mm2 and the density of specimen ranges from 0.886 gm/cc to 1.633 gm/cc.

Future Scope

The future scope of such a material can be found in the field of filling materials for weak foundation soils resulting in reduction of overburden pressures which may cause settlements.

The vibration energy absorption characteristic of this material can find another application in projects where structures are subjected to regular vibrations.

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