Parametric Study on Strength of Light Weight Concrete by using EPS Beads and Bagasse Ash

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Abstract **- Lightweight concretes (LWCs) can be used in various construction fields. It can be used for repairing wooden floors of old buildings, carrying walls of low thermal conduction, bridge decks, floating quay, etc. The present study is aimed at utilizing sugarcane bagasse ash and EPS beads as a partial replacement of cement and coarse aggregate in concrete and its strength was checked. The concrete mix is designed for M 30 grade as per IS 10262:2009. The replacement of EPS beads is done at various percentages like 0%, 10%, 20%, 30% and 40% by volume and the percentage replacement of bagasse ash was kept constant at 10% by weight of cement. concrete mix demands chemical admixture in order to attain the desired slump. At room temperature the compressive strength decreases with increase in percentage replacement and was found that 10% replacement of bagasse ash and 10 percent replacement of EPS beads is optimum replacement in concrete which gives desired strength.**

Keywords **- *Sugarcane Bagasse Ash(SCBA), EPS Beads, Blended concrete, Compressive strength***

1.INTRODUCTION

Ordinary Portland cement is a controlled blend of calcium silicates, aluminates and ferrate, which is ground to a fine powder with gypsum and other materials. Ordinary Portland cement is the conventional building material that actually is responsible for about 5% - 8% of global CO2 emissions. This is the environmental problem will most likely be increased due to exponential demand of ordinary Portland cement. Concrete is most widely used and very necessary material which is used in all types of construction works. Concrete consists of cement, aggregates, water and admixtures. Concrete uses is over 10 billion tons per year, concrete can present good mechanical strength, and also acceptable durability performance. Out of concern for the environment, and in support of sustainable development, cement industries are improving their production through a range of pozzolonic material and it can alternatives such as the use of alternative fuels or increasing the production of blended cements. All these aspects have been contributing to reduce CO2 emissions, which can reach up to 30% of diminishing according to the Danish Centre for Green Concrete.

Researchers all over the world are focusing on ways of utilizing industrial or agricultural waste, as a source of raw materials for industry. Industrial wastes, such as blast furnace slag, fly ash and silica fumes are being used as supplementary cement replacement materials. Sugarcane cane is one of the major crops grown in over 110 countries and its total production is over 1500 million tons. In India only, sugarcane production is over 300 million tons/year that cause about 10 million tons of sugarcane bagasse as has an un-utilized and waste material.

2.OBJECTIVES:

Objectives of the study:

The present study aims at mix design of M30 grade of concrete and to find the required constitutes of it.

a) The general objectives of this research work is to make use of sugarcane industries waste products and APS beads to study the feasibility of using this material as a cement and coarse aggregate replacement material.
b) Compressive strength and split tensile tests are carried out in order to know the performance of bagasse ash and EPS beads of blended concrete subjected to various exposure conditions.
c) The attempt has been made to utilize the industrial waste of bagasse ash used as supplementary cement replacement materials.

3. MATERIALS AND METHODS

3.1 Cement

Ordinary Portland cement (OPC) confirming to IS 12269 was used for the experimental work. Laboratory tests were conducted on cement to determine specific gravity, fineness, standard consistency, initial setting time, final setting time and compressive strength. Cement is a binder, a material utilized in construction that sets and solidifies and can bind different materials together. The most significant kind of cement is utilized as a part in the production of0mortar in brick work, and of concrete which is a mixture of0cement and an aggregate to form a strong structure material. The physical properties of cement are given below.

Table-1: Physical properties of Cement

Sl. No	Test Performed	Values Obtained	Requirements as per IS269:2015	Test code
1	Specific Gravity	3.12	3 to 4	IS4031
2	Normal Consistenc y	32%		IS4031 (part 4)1998
3	Setting Time			IS4031 (part 5)1998
	Initial Setting Time	35 mins	>30mins	
	Final Setting Time	335mins	<600mins	
4	Fineness	5%	<10%	IS4031

3.2 Fine Aggregate

M sand is the alternative for the river sand produced by crushing the hard granite stones. The size of the manufactured sand is less than 4.75mm. The physical properties of fine aggregate are given below,

Table 2 : Physical properties of Fine Aggregate Coarse Aggregate

Sl.No	Tests	Results	Requirements as per IS 383:2016	IS Code
1	Specific Gravity	2.75	2.3 - 3	IS:238 6(Part 3)
2	Fineness modulus	2.34	2.2 to 3.2	IS:2386 (Part1)
3	Water absorption	3%		
4	Passing 75micron	1.5%	<15%	

3.2 Coarse Aggregate

Locally available crushed granular aggregates of size less than 20 mm was used throughout the study and it was tested as per IS 383:2016. The physical properties of coarse aggregate are given below,

Table-3 Physical properties of Coarse Aggregate

Sl.No	Tests	Results	Requirements as per IS 383:2016	Is Code
1	Specific gravity	2.7	2.5 to 3	IS 2386(Part 3)-1963
2	Water Absorption	0.50%	0.6%	IS 2386(Part3)-1963
3	Fineness modulus	5.4	5 to 8	IS 2386(Part1)-1963
4	Angularity Number	8.1	0 to 11	IS 2386(Part1)-1963

3.4 Water

Potable water available in the college campus has been used in the concrete mix design. PH value of the water used for concrete as per IS 456-2000 less than 7.

3.5 Sugar Cane Bagasse Ash

Source: Chamundeswari sugar factory, Mandya

Bagasse ash is an industrial waste or farming waste. It is a consequence which is obtained in sugarcane milling industries. Productivity of bagasse ash contains silica, aluminum, iron and calcium oxide. The bagasse ash used in the current study is obtained by burning the bagasse ash at a temperature of about 750-8500C for the purpose of generation of electricity in the factory. The ash so obtained from the discharge is sieved to obtain particles which are finer than 90µm in order to remove the unburnt particles present in the raw bagasse ash. The physical and chemical properties of the bagasse ash is obtained are given below.

Table-4: Physical Properties of Bagasse Ash

Sl.No	Properties	Results
1	Specific Gravity	2.17
2	Color	Black
3	Bulk Density Loose Compacted	520 648

Table-5: Chemical Properties of Bagasse Ash

Sl.No	Properties	Percentage
1	Silica as SiO3	76.32
2	Aluminum as Al2O3	0.20
3	Iron as Fe2O3	4.02
4	Calcium as CaO	3.68
5	LOI	6.67

3.5 EPS beads

In order to reduce the weight of the structure lightweight concrete is used. One of the methods to produce lightweight concrete is to use Expanded Polystyrene beads as a partial substitute to fine aggregate. The main objective of this investigation is to obtain lightweight concrete and also to determine the optimum dosage of Expanded Polystyrene Beads. In the present work the Expanded Polystyrene beads are added at 10% interval (by total volume of fine aggregate) and their properties such as density and compressive strength are studied.

4. RESULTS AND DISCUSSIONS

4.1 Tests on Fresh Concrete

4.1.1 Slump Test

Workability of the concrete is spotted by the slump test. The slump test values are obtained for each mixes are given in the table 6. Control mix value of slump is 100mm for designed M30 grade.

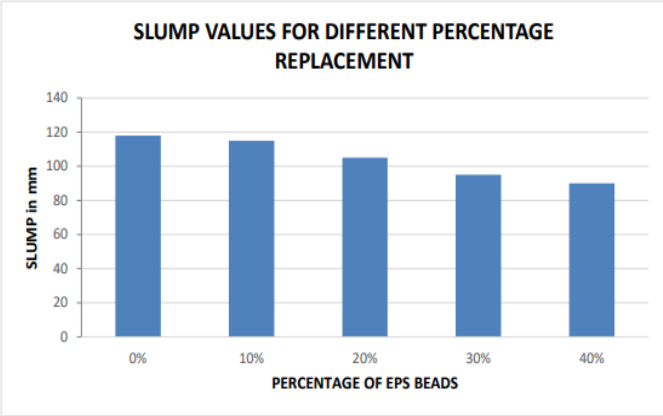

Fig 1: Variation of Slump with different percentage of SCBA

The above graph shows the variation of slump with 10% of EPS beads and different percentage of baggase ash. It is observed that the workability has decreased as the percentage of EPS beads increases. Since bagasse ash also have high loss on ignition (LOI) content which absorbs more water workability has been decreased when compared to conventional concrete.

4.2 Tests on Hardened Concrete

4.2.1 Compressive Strength

The compressive strength of concrete with the replacement of 10%, 20%, 30% and 40% EPS beads with 10% of Bagasse ash at 28 days is shown in fig 6.4. The different replacement of Coarse aggregate by EPS beads by volume and 10% replacement of cement by SCBA resulted in decrease of compressive strength. The decrease in strength for the EPS beads and bagasse ash blended concrete mix was attributed to the pozzolonic effects of bagasse ash at later ages and concrete strength mainly influnced by the strength of aggregates and it is known that the EPS beads have almost zero strength therefore strength has been decreased.

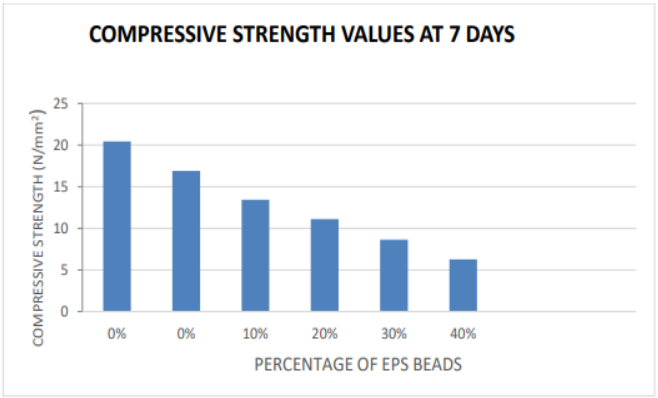

Fig 2: Compressive strength at 7 days for different percentage replacements

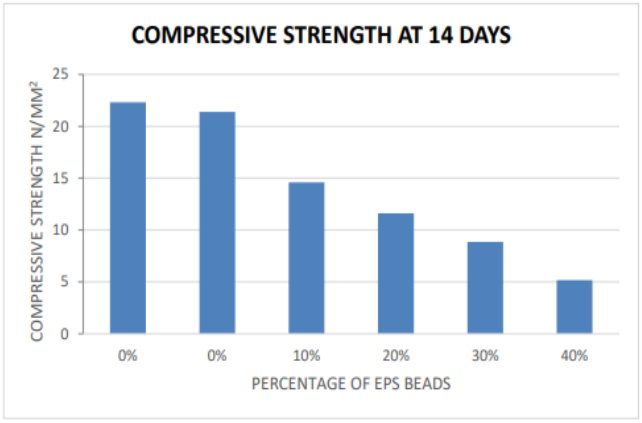

Fig 3: Compressive strength at 14 days for different percentage replacements

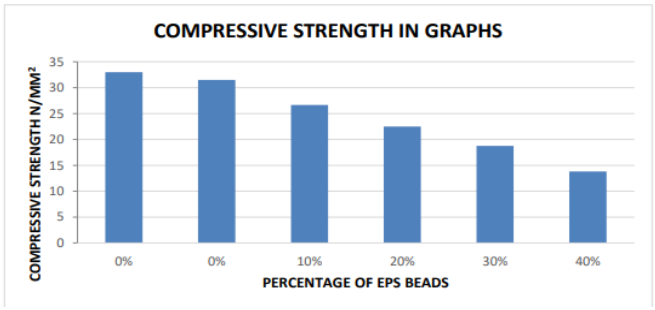

Fig 4: Compressive strength at 28 days for different percentage replacements

4.2.2 Split Tensile Strength

The Split tensile strength of concrete with the replacement of 10%, 20%, 30% and 40% EPS beads with 10% of Bagasse ash at 28 days is shown in fig 6.7. The different replacement of Coarse aggregate by EPS beads by volume and 10% replacement of cement by SCBA resulted in decrease of split tensile strength. The decrease in strength for the EPS beads and bagasse ash blended concrete mix was attributed to the pozzolonic effects of bagasse ash at later ages and concrete strength mainly influnced by the strength of aggregates and it is known that the EPS beads have almost zero strength therefore strength has been decreased.

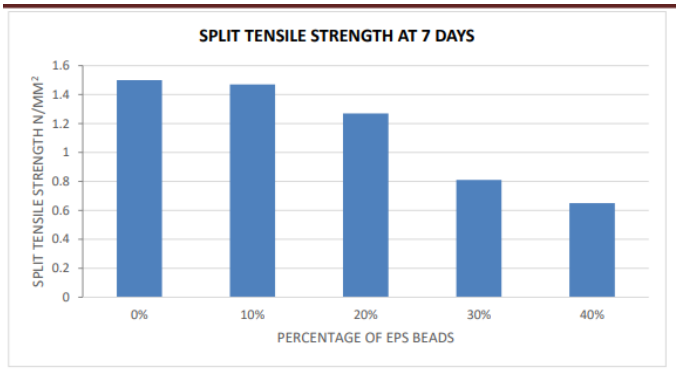

Fig 5: Split Tensile strength at 7 days for different percentage replacements

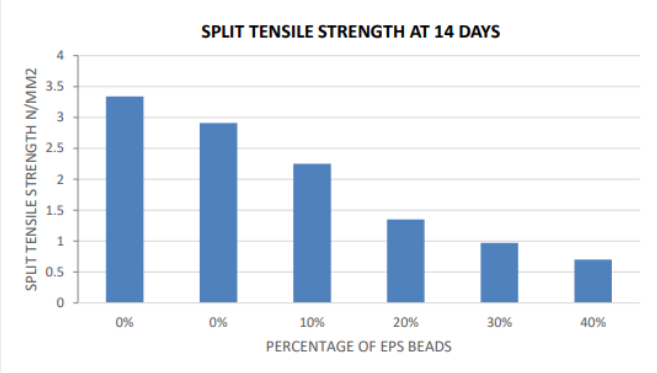

Fig 6: Split Tensile strength at 14 days for different percentage replacements

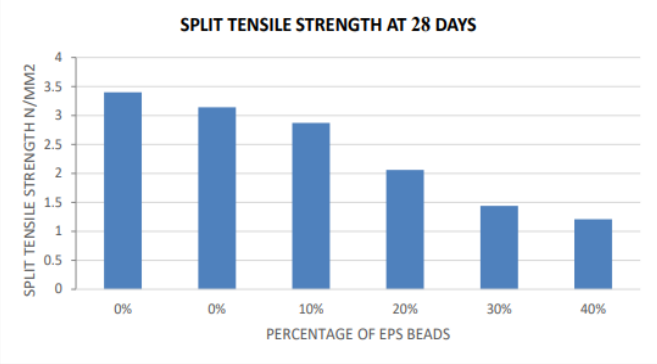

Fig 7: Split Tensile strength at 28 days for different percentage replacements

4.2.3 Density Test

Concrete cubes with different ratio of EPS beads by concrete volume were weighed at 28-days age and fixed percentage replacement of Bagasse ash (10%). They were taken out of the water tank, dried for 5 hours and then weighed. As it is mentioned before molds with dimension 100 mm x 100 mm x 100 mm were used for casting concrete; hence the volume of the samples is 0.001 m^3. Concrete density (kg/m^3) is determined by dividing the net weight of concrete in kilogram by its volume in cubic meter

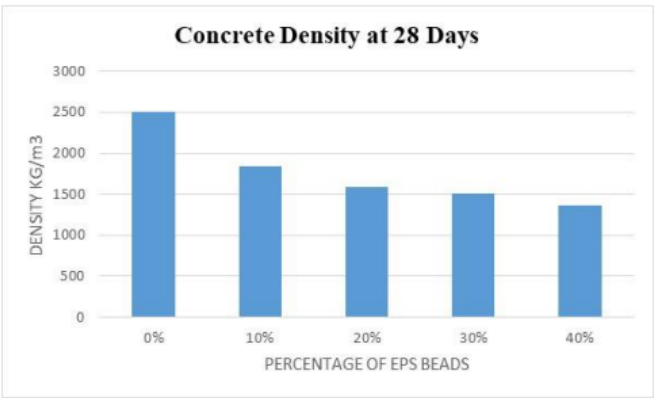

Fig 8: Concrete Density at 28 days for different percentage replacements

5 CONCLUSION

- The density of concrete has been reduced as the percentage of Expanded Polystyrene beads increases when compared to conventional concrete
- From the observation it is observed the optimum dosage of 10% replacement of Bagasse ash and 10 % replacement of EPS beads shows decrease in density and considerable weight to strength ratio.
- The increase in percentage of replacement of0cement by SCBA resulted in higher standard consistency**.**
- As the percentage of bagasse ash increases in concrete it increases the water absorption.
- It was observed that as the volume of the EPS dosage increases, the workability decreases, the compressive strength decreases, the flexural strength decreases.
- Lightweight Concrete prepared using Expanded Polystyrene beads and Sugarcane bagasse ash can be used in the upper floors of high rise buildings as well as in partition walls in order to reduce the self-weight of the structure
- The different replacement of Coarse aggregate by EPS beads by volume and 10% replacement of cement by SCBA resulted in decrease of compressive strength and tensile strength since concrete strength mainly influnced by the strength of aggregates and it is known that the EPS beads have almost zero strength therefore strength has been decreased.
- This study gives an idea to use a waste material in construction work. This study forces us to use other waste material and check for construction work.

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