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Experimental Study on Partial Replacement of Sugarcane Bagasse Ash in Cement

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Abstract— *This project mainly deals with the replacement of cement with Bagasse ash in fixed proportions. Bagasse ash partially replaced in the ratio of 0%, 5%, 10%, 15% and 20%by weight of cement in four different experiment to find out maximum compressive strength and tensile strength compare it with the strength of normal concrete by using grade M-20 at 7days and 28 days. The test result indicate that the strength of concrete increase up to 20% Sugar cane bagasse ash replacement with cement.*

Keywords— Ordinary Portland cement, Sugarcane bagasse ash, M-20 Conventional concrete, Compressive strength, tensile strength.

I. INTRODUCTION

A lot of hazards are done to environment in the manufacture of cement. It involves lot of carbon emission associated with other chemicals.

Sugar Cane Bagasse Ash is difficult to dispose which in return is environmental Hazard. The Bagasse ash imparts high early strength to concrete and also reduce the permeability of concrete. The Silica present in the Bagasse ash reacts with components of cement during hydration and imparts additional properties such as chloride resistance, corrosion resistance etc.

Therefore the use of Bagasse ash in concrete not only reduces the environmental pollution but also enhances the properties of concrete and also reduces the cost. It makes the concrete more durable.

II. MATERIALS

This experimentation were locally available materials are used. It includes ordinary Portland cement and sugarcane bagasse ash as a binding material, fine aggregates, and coarse aggregates. Normal water was used for mixing and curing of entire work.

2.1 SUGARCANE BAGASSE ASH (SCBA)

Bagasse is a by-product from sugar industries which is burnt to generate power required for different activities in the factory. The burning of bagasse leaves bagasse ash as a waste, which has a pozzolanic property that would potentially be used as a cement replacement material.

Fig.1: Sugarcane Bagasse

Table .1: Physical properties of sugarcane bagasse ash

Properties	
Specific gravity	1.89
Density	2.52g/cm^3
Particle size	5140cm^2/g
Surface area	28.9µm
colour	Reddish grey

Table.2: Chemical Components of sugarcane bagasse ash

Chemical composition	**Residual bagasse ash (%)**
SiO2	65.37
Al2O3	0.22
Fe2O3	5.98
CaO	1.50
LOI	21.04

2.2 CEMENT

In this present study 53 grade Ordinary Portland Cement (OPC) is used for all concrete mixes. The cement used is fresh and without any lumps. The specific gravity, normal consistency, initial and final setting time of cement was found as per Indian standard specifications.

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Table.3: Physical properties OPC and SCBA cement

Properties	OPC	SCBA cement
Specific gravity	3.15	2.97
Initial setting time	90 min	90 min
Final setting time	210 min	210 min
Consistency	31.5%	30%

Based on the comparison between OPC cement and SCBA the properties of OPC does not changes due to the addition of SCBA, and it also enhance the properties of OPC and reduce its quantity.

2.3 FINE AGGREGATE

The sand used in this present study is ordinary river sand. The sand passing through 4.75 mm size sieve is used in the preparation of concrete mix.

Table.4: Physical properties of Fine aggregate

Properties	
Specific gravity	2.63
Fines modulus	2.58
Density	1754.3kg/m^3

2.4 COARSE AGGREGATE

The crushed aggregates used were 20mm nominal maximum size and are tested as per Indian standards and results are within the permissible limit.

Table.5: Physical properties of Coarse aggregate

Properties	
Specific gravity	2.71
Density	1692.3kg/m^3

2.5 WATER

Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions. In this project clean potable water is used. The pH value should not be less than 7.

III. PROCEDURE

3.1 BATCHING

Weight batching was done as per mix proportion. Weight batching facilitates simplicity flexibility and accuracy.

3.2 MIXING

Hand mixing was done as per mix proportion.

IV. MIX PROPORTION

4.1 MIX PROPORTION

The mixture proportioning was done according the Indian Standard Recommended Method IS 10262:2009. The target mean strength was 27MPa for OPC control mixture.

Table.6: Mix proportion

Water content	Cement	Fine aggregate	Coarse aggregate
191.6	383(kg)	546(kg)	1187(kg)
0.50	1	1.42	3.09

Hence cement was replaced by bagasse ash at various percentage of replacement 0%, 5%, 10%, 15%, and 20% by weight of cement and 150x150x150mm cube casting. Water content 0.50, Fine aggregate 1.42 parts, and coarse aggregate 3.09 parts.

Table .7: Mix proportion

Types	Cement (kg)	Sugarcane bagasse ash (kg)
Type I (0%)	1	0
Type II (5%)	0.95	0.05
Type III (10%)	0.90	0.10
Type IV (15%)	0.85	0.15
Type V (20%)	0.80	0.20

The mix was prepared manually. First all the dry ingredients are mixed thoroughly such as cement, sugarcane bagasse ash, fine aggregate, coarse aggregates mixed by adding water after it makes uniform mixture.

4.2 PLACING AND COMPACTING

Moulds are properly cleaned and oiled. The fresh concrete filled into the moulds in three layers each layers are damped at 25 blows. The entrapped air in concrete is removed by using vibrator. After the compaction, the excess mortar was removed from the mould within the help of trowel and the surface was levelled.

4.3 REMOULDING AND CURING

After placing it was allowed to set for 24 hours. Samples were removed and it was marked. Concrete samples now kept in curative tank for required time of 7 days, 14 days, 28 days after that time, concrete samples from curative tank.

4.4 TESTING

After curing the concrete sample were taken to remove excess water content for the sample. The samples are tested.

V. TEST ON CONCRETE

5.1 FRESH CONCRETE TEST

5.1.1 SLUMP CONE TEST

The slump test is used to measure workability of fresh concrete. More specifically, it measures the consistency of the concrete. Slump for conventional concrete 21.

Table.8: Slump cone

Types	Slump (mm)
Type I (0%)	21
Type II (5%)	25
Type III (10%)	27
Type IV (15%)	24
Type V 20%)	23

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5.2 HARDENED CONCRETE TEST

5.2.1 COMPRESSIVE STRENGTH TEST

Compressive strength test of the cube was carried out universal test in machine (UTM).The load applied on specimen uniformly, without any shocks up to the specimen fails.

Table.9: Compressive strength results

Types	7 Days (N/mm^2)	28 Days (N/mm^2)
Type I (0%)	13.80	21.50
Type II (5%)	9.50	14.15
Type II (10%)	11.45	15.65
Type IV (15%)	15.12	17.83
Type V (20%)	16.03	20.03

5.2.1 SPLIT TENSILE TEST

Split tensile test of the cylinder was carried out universal test in machine (UTM).The load applied on specimen uniformly, without any shocks up to the specimen fails. A set of three cylinders are tested for each concrete mix for 7 days, 14 days, and 28 days of curing. The maximum load taken by specimen was noted for each specimen. Average strength was calculated for every set of specimens was checked for cracks and aggregate distribution.

Table.10: Flexural strength results

Types	7 Days (N/mm^2)	28 Days (N/mm^2)
Type I (0%)	1.50	3.54
Type II (5%)	0.97	1.98
Type III (10%)	1.83	2.14
Type IV (15%)	2.14	3.06
Type V (20%)	2.50	3.20

VI. CONCLUSION

The following conclusions are drawn from the study.

1) Sugarcane bagasse ash concrete performed better when compared to ordinary concrete up to 20% replacement of sugar cane bagasse ash.
2) Increase of strength is mainly to presence of high amount of Silica in sugarcane bagasse ash.
3) It also enhances the properties. It makes the concrete more durable.
4) Sugarcane bagasse ash added to the mixes rate in cement reduced.
5) Bagasse ash in concrete reduces the environmental pollution.

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