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STUDY OF SORPTIVITY AND WATER ABSORPTION OF TERNARY BLENDED CONCRETE WITH SUGARCANE BAGASSE ASH AND SILICA FUME

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ABSTRACT:

The utilization of waste produced by industries and agriculture has been focused, to reduce it for agriculture and economical reasons. The waste product from sugarcane factory (SUGARCANE BAGASSE ASH) is causing serious pollution which is replaced in cement concrete. Bagasse is sugar factories byproduct.

Bagasse can be used for energy generation. The ash which is obtained from the boiler is a waste product known a Sugarcane Bagasse Ash. It has high volume of Sio2. Use of SBA as partial replacement of fine aggregate will help to improve quality of concrete. SCBA is replaced by cement in concrete with 0%, 5%, to 30% ratios. In addition to this 10% silica fume is added to the composition. Due to improper compaction of concrete may have pores & capillary spaces, which leads to low strength of concrete. Tests compaction factor test and slump cone test are conducted for fresh concrete as all as harden concrete tests like compressive strength, sorptivity and water absorption are also conducted.

1. INTRODUCTION:

1.1 GENERAL:

The pozzolanic materials plays an important role to development of high performance concrete used for construction of high specifications. The use of pozzolana in concrete production gives better effects to the environment.

To minimize the environmental impact by using mineral admixtures for concrete and mortar as a partial cement replacement, which will helps to reduce costs, conserve energy, and minimize the emission of waste products.

1.2 INTRODUCTION SUGARCANE BAGASSE ASH:

The bagasse is very huge in quantity which is byproduct of the sugar factory. The generation of the electricity is possible from this byproduct. It is very useful to generate the energy from the waste. After its use for the electricity generation the waste remains. The waste material then can be useful for mixing with the cement.

1.3 SUGARCANE BAGASSE ASH:

Sugarcane contains 25-30% bagasse, whereas industry recovered sugar is about 10%.Due to its fiber texture bagasse is also used as a raw material for making of paper, and about one ton of bagasse used for making 0.3 tons of paper.

SORPTIVITY:

The sorptivity is mostly used in characterizing the soils and porous construction materials such as stone, brick, and concrete. It is an index of transportation of moisture in to unsaturated specimens, and it has also been described as an important durability property of concrete.

The various techniques has been described for the characterization of the concrete pore structure, but the advanced methods are may be not useful for daily concrete usage.

2. EXPERIMENTAL INVESTIGATIONS ON MATERIALS:

2.1 CEMENT

Ordinary Portland cement of 53grade cement (Brand-ULTRATECH Cement) was used in this study. The testing was carried out to study the characteristics of the cement.

Table 1.0: Properties of Cement

S.No	Property	Value	Code Requirements
1	Normal Consistency	29mm	33-35mm
2	Fineness of cement	6.69%	≥10%
3	Setting times		
	Initial (Minutes)	50	<≠30
	Final (Minutes)	180	>≠600
4	Specific Gravity	3.15	3.1-3.18

Grade 43 cement is used for the experiment carried out. The air tight containers were used to store the mixture. Standards IS 8122-1989 were followed for testing of the cement.

2.2 SUGARCANE BAGASSE ASH:

About 26% of bagasse is generated per ton of sugarcane. Bagasse ash when collected from the boiler is useful for the preparation of mixture with the cement.

Table 2: Physical properties of SCBA

S.No	Property	Value
1	Density	574Kg/m^3
2	Specific Gravity	2.3
3	Mean Particle size	0.1-0.2µm
4	Min specific surface area	2500m^2 /kg
5	Particle shape	Spherical

2.3: FINE AGGREGATE:

The river sand, passing through a 4.75mm size and retained on 600µm sieve, confirming to Zone-II as per IS:383-1970 was used as fine aggregate in the present study.

Table-3. Properties of fine aggregate

S.No	Particulars of test	Value
1	Specific Gravity	2.74
2	Water absorption	1.0%
3	Bulk density Rodded Bulk density Loose Bulk density	 1718kg/m^3 1518kg/m^3
4	Fineness Modulus	2.69
5	Zone	II

2.4 COARSE AGGREGATE:

Throughout the investigations, a crushed coarse aggregate of 20mm size from the local crushing plants was used. The locally available crushed granite stone is used as coarse aggregate. The aggregate was tested for its physical requirements that are given below in accordance with IS2386 (part-3)-1963, IS 2386 (Part-1)-1963, IS4031 (Part-4)-1996,IS 383-1970.

Table-4. Properties of coarse aggregate

S.No.	Particulars of Test	Value	20mm Coarse aggregate
1	Specific Gravity	2.74	2.67
2	Water absorption	0.5%	3.72%
3	Bulk density Rodded bulk density Loose bulk density	1605kg/m^3 1477kg/m^3	1605 kg/m^3
4	Fineness modules	7.357%	-
5	Impact Value	17.4%	-
6	Crushing Value	26.13%	7.357
7	Flakiness Index 20mm 10mm	12.81% 21.39%	
8	Elongation Index 20mm, 10mm	20.5% 28.92%	

2.5 WATER:

It is one of the important ingredients. It is used to carry out the chemical reaction of the mixture. Quantity of the water is always matters when mixture is prepared.

The pH of distilled water is between 5.6 and 7 various tests have been conducted on cement, sugarcane bagasse ash; fine aggregate, coarse aggregate to check their suitability in making concrete.

2.6 SUPER PLASTICIZER:

This is water reducer. It is useful of particle suspension. It helps in avoiding particle separation.

3. METHODOLOGY:

MIX DESIGN

The grade of concrete depends upon the mix design of the concrete. The Mixes up to M20 are nominal mix, i.e., M5, M15, and M20.

MIX PROPORTION

Cement by weight was replaced by sugarcane bagasse as in the range of 0%, 5%, 10%, 15%, 20%, 25%, 30%, and 10% of silica fume is used constantly at all the mixes. The optimum mix proportions have been recommended based on trial mixes.

Table5: Mix Proportion of Ternary Concrete

53 Grade OPC(Kgs)	SCBA(Kgs)	Water(Lit)	Sand(Kgs)	20mm Aggregate(Kgs)
320	-	140	896	1140

The measured slump of fresh concrete is 75-125mm.

Table6:Mix proportion of Ternary concrete for different replacements

Series	SCBA replacement of OPC	SF replacement for OPC
A	Pure cement Concrete (0%)	
B	5%	10%
C	10%	10%
D	15%	10%
E	20%	10%
F	25%	10%
G	30%	10%

1. RESULTS AND DISCUSSIONS:

SORPTIVITY:

The following are the sorptivity results for 28 days and 60 days curing.

Table 7 Sorptivity results for 28days

% Replacement	Dry wt.(w1) gm	Wet wt. (w2)gm	Chang in wt. (w2-w1)gm	Sorptivity value 10^4mm/min$^{0.5}$
A-series (0%)	775.2	889.5	3.8	0.10
B-series (5%)	815.8	819.8	4	0.10
C-series (10%)	789.5	793.2	3.7	0.09
D-series (15%)	815.8	819	3.2	0.08
E-series (20%)	787.7	790.7	3	0.08
F-series (25%)	759	762.5	2.5	0.09
G-series (30%)	746.2	749.7	3.5	0.09

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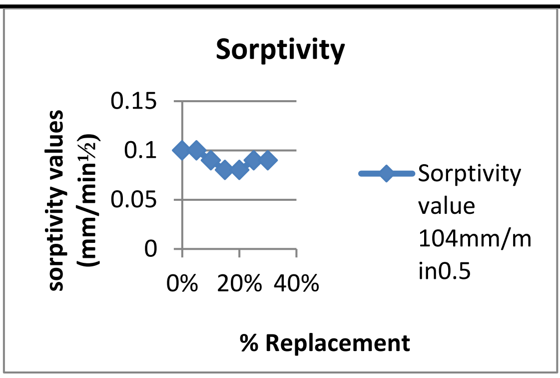
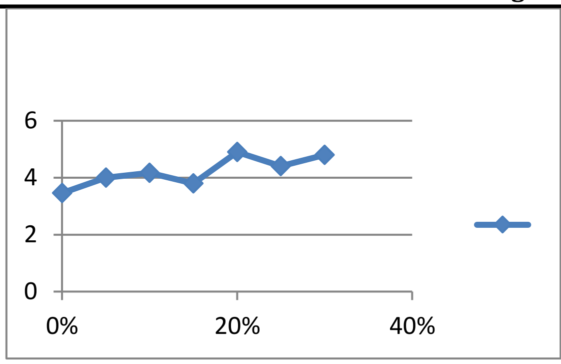


GRAPH1: SORPTIVITY VALUES FOR 28 DAYS



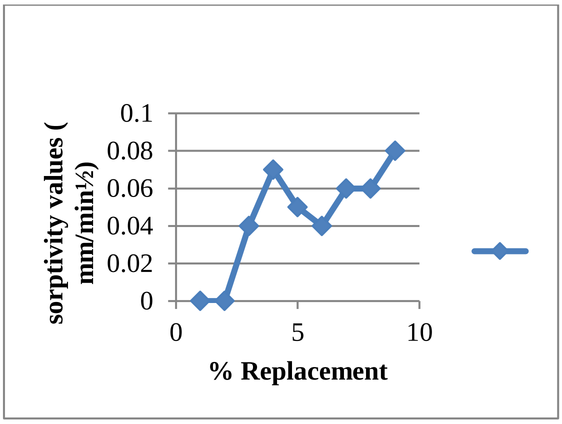
GRAPH 3: SORPTIVITY VALUES FOR 28 DAYS

Table 8: Sorptivity results for 60days

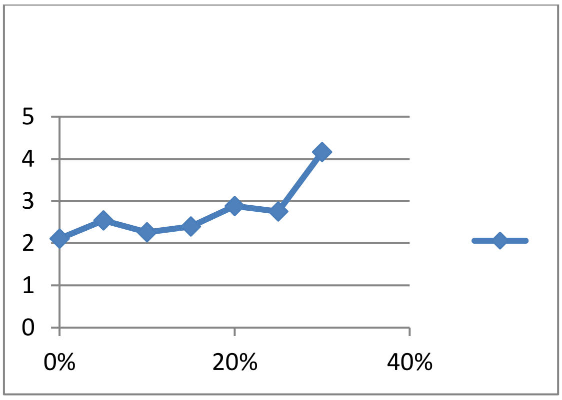
% Replacemet	Dry wt.(wl) gm	Wet wt. (w2)gm	Chang in wt. (w2-wl)gm	Sorptivity value 10^4mm/min$^{0.5}$
A-series (0%)	838	839.7	1.7	0.04
B-series (5%)	818.5	821.2	2.7	0.07
C-series (10%)	797.3	799.3	2	0.05
D-series (15%)	810.3	812	1.7	0.04
E-series (20%)	796.7	799	2.3	0.06
F-series (25%)	790.3	792.7	2.4	0.06
G-series (30%)	744	747.3	3.3	0.08

Table 10: Water Absorption result for 60 Days

% Replacement	Wt.after demolding(kg)	Wt.after Curing (Kg)	Chang in wt. (Kg)	Water absorption		
				W1	W2	[(W2-W1)/W1)*100]
A-series (0%)	2.54	2.63	0.09	2.514	2.567	2.11
B-series (5%)	2.62	2.721	0.101	2.479	2.542	2.54
C-series (10%)	2.59	2.709	0.119	2.523	2.58	2.26
D-series (15%)	2.65	2.771	0.121	2.456	2.515	2.4
E-series (20%)	2.54	2.656	0.116	2.359	2.427	2.88
F-series (25%)	2.43	2.539	0.109	2.397	2.463	2.75
G-series (30%)	2.42	2.543	0.123	2.208	2.3	4.16



GRAPH 2:SORPTIVITY VALUES FOR 60 DAYS



GRAPH 4: WATER ABSORPTION VALUES FOR 60 DAYS

WATER ABSORPTION TEST:

The following are the sorptivity results for 28 days & 60 days curing.

Table 9: Water Absorption result for 28 Days

% Replacement	Wt.after demolding(kg)	Wt.afterCurring (Kg)	Change in wt. (Kg)	Water absorption		
				W1	W2	[(W2-W1)/W1)*100]
A-series (0%)	2.523	2.546	0.088	2.539	2.627	3.46
B-series (5%)	2.59	2.439	0.097	2.424	2.521	4
C-series (10%)	2.53	2.382	0.099	2.378	2.477	4.163
D-series (15%)	2.505	2.509	0.095	2.499	2.694	3.8
E-series (20%)	2.496	2.412	0.119	2.402	2.521	4.9
F-series (25%)	2.336	2.392	0.105	2.38	2.485	4.4
G-series (30%)	2.341	2.334	0.112	2.321	2.433	4.8

5. CONCLUSIONS:

- The ternary blended concrete (SCBA+SF) shown lower sorptivity for D- series & E- Series concrete, whereas for F- Series and G- series concrete shown an increase in sorptivity for 28 days curing.
- The ternary blended concrete (SCBA+SF) shown lower sorptivity for D- series whereas for E- Series , F- Series and G- series concrete shown an increase in sorptivity for 56 days curing.
- The ternary blended concrete (SCBA+SF) shown lower water absorption for D- series whereas for E- Series , F- Series and G- series concrete shown an increase in water absorption for 28 days curing.
- The ternary blended concrete (SCBA+SF) shown lower water absorption for C- series whereas fromD- Series toE- Series ,F- Series and G- series

concrete shown an increase in water absorption for 56 days curing.

- The decrease in sorptivity at 28 days it is found to be 0.08/mm/min$^{0.5}$ for D- series and E- series concrete and for 56 days it is found to be 0.04mm/min$^{0.5}$ for D- series concrete.
- The percentage decrease in water absorption is found to be 3.8% at 28days curing for D- series & 2.4 % at 56 days curing for C- Series.
- The ternary blended concrete with replacement of cement by SCBA& SF for different percentages shows lower sorptivity and increase in water absorption levels than traditional concrete.

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