Utilisation of Sugercane Bagasse Ash And Coal Fired Boiler Ash In Concrete

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Abstract- *Energy is the foremost backbone of modern society of the world and the electric power from thermal power stations is a major source of energy, in the form of electricity. India stands sixth in energy demand and depends on thermal power plants for its major energy needs. About 70% of energy consumption is from the thermal power plants, which in turn produces coal combustion products (CCP) as by-products, as they burn coal for energy production. Coal ash consist of fly ash and bottom ash. Bottom ash establishes 20% of total coal fed in the boiler. There have been numerous investigations on the use of fly ash as construction materials but when it comes to bottom ash, it is very few.It is now a global concern, to find a social, economical and environmental friendly solution to sustain a cleaner and greener environment. Today Study has been conducted to recycle valuable material and reduce the volume of hazardous solid waste and other pollutants, which is harmful for living organisms. The use of Coal Fired Bottom ash and Sugarcane Bagasse Ash can improve various properties in fresh and hardened state of concrete and also decreases the cost of construction.*

I. INTRODUCTION

One of the major challenges with the environmental awareness and scarcity of space for land-filling is the wastes/by-products utilization as an alternative to disposal. We are aware that a lot of damage is done to environment in the production of cement. It contains lot of carbon release associated with other elements. The researches have shown that every one ton of cement manufacture releases half ton of carbon dioxide, so there is an immediate need to control the usage of cement. On the other hand materials wastes such as Sugar Cane Bagasse Ash is tough to dispose which in return is environmental Hazard. Bagasse is the fibrous matter that remains after sugarcane stalks are crushed to extract their juice. The burning of bagasse leaves bagasse ash as a waste, that incorporates a pozzolanic property that would potentially be used as a cement replacement material. Coalash is produced from burning coal for electrical power generation. A supplementary cementing material, when used in concrete, contributes to the properties of the hardened concrete through hydraulic or pozzolanic activity, or both. The use of bottom ash also improves the cohesiveness and reduces segregation.

II. FORMATION AND COLLECTION MECHANISM

Formation mechanisms of coal ash under pulverized-fuel firing conditions have been described extensively in the literature. In the burning process of coal, minerals undergo thermal decomposition, fusion, dissolution, and agglomeration. Many elements present in a volatile form may vaporize and non combustible material present in it results in production of coal ash.

Bagasse is the fibrous matter that remains after sugarcane stalks are crushed to extract their juice. Therefore, 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, that incorporates a pozzolanic property that would potentially be used as a cement replacement material.

III. EXPERIMENTAL INVESTIGATION

Initially, Control mix was designed to have 28-day compressive strength of 25 MPa (M25 grade of concrete). The concrete mixes were designed with cement, fine aggregate, coarse aggregate and water. The cement content was replaced with Sugarcane Bagasse Ash content varying from 5% to 15% at equal intervals of 5% and fine aggregates were replaced with Bottom Boiler Ash varying from 10% to 30% at the equal interval of 5%, to study the effect on the strength and durability properties of concrete.

A total of sixteen concrete mix proportions M-0 for Control Mix of M-25 Grade (in which there is no replacement of material), M-1, M-2, M3, M-4 and M-5 for M25 grade of concrete (in which natural sand was replaced with five percentage (10%, 15%, 20%, 25%, 30%) of Boiler Bottom Ash by weight and cement with Sugarcane Bagasse Ash by 5% by weight) and M-6, M-7, M-8, M-9 and M-10 for M25 grade of concrete (in which natural sand was replaced with five percentage (10%, 15%, 20%, 25%, 30%) of Boiler

Bottom Ash by weight and cement with Sugarcane Bagasse Ash by 10% by weight) and M-11, M-12, M-13, M-14 and M-15 for M-25 grade of concrete (in which natural sand was replaced with five percentage (10%, 15%, 20%, 25%, 30%) of Boiler Bottom Ash by weight and cement with Sugarcane Bagasse Ash by 15% by weight) were cast

IV. TESTING

Workability of concrete is the ease with which concrete can be properly mixed, transported, compacted and finished, with minimum loss in homogeneity. Workability of the concrete was evaluated by slump test as per Indian Standard Specifications given in BIS 1199:1959. A mould in the form of frustum of a cone with bottom diameter 200mm, top diameter 100mm and height 300mm was filled with four approximately equal layers, tempering each layer with a standard tempering rod with 25 strokes. After filling and leveling the surface, mould was removed by lifting it in vertical direction, allowing concrete to subside. Results of the workability testing were reported as slump in mm, which is the difference between height of the mould and that of highest point of subsided concrete mass. Compressive strength is regarded as the most important property of hardened concrete.

Compressive strength test was done as per Indian Standard Specifications, according to the procedure given in BIS 516:1959. Compressive strength of concrete was evaluated at age of 7 days; 28 days using standard cube specimens of 150mm×150mm×150mm. Compression Testing Machine (CTM) of 5000 KN capacity was used for the testing of compressive strength of concrete. Concrete specimen were remolded 24 hours after the casting and placed in the curing tank to ensure sufficient curing. At each specified age, specimen was placed centrally between the bearing plates of CTM and load was applied continuously and uniformly at specified loading rate of 140 kg/cm2/min. the load was increased until the specimen broke and the maximum load taken by each specimen was noted down.

The sorptivity can be determined by the measurement of the capillary rise absorption rate on reasonably homogeneous material. Water was used as the test fluid. This test is conducted to measure the capillary absorption which indirectly measures the durability.

SPECIMEN MIX PROPORTION

- CONTROL MIX

Control Mix	Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregate (Kg)		Water (Ltrs)
			20 mm	10 mm	
Cubic meter content	400	655	697	464	200

- BATCH MIX -1

INGRADIENTS	M-1	M-2	M-3	M-4	M-5
Cement(Kg/m3)	380	380	380	380	380
SCBA(kg/m3)	20	20	20	20	20
Natural sand (Kg/m3)	589.5	556.75	524	491.25	458.5
Bottom Ash	65.5	98.25	131	163.75	196.5
Coarse Aggregate	1161	1161	1161	1161	1161
W/C Ratio	0.5	0.5	0.5	0.5	0.5
Water kg/m3	200	200	200	200	200
Slump	90	86	78	70	62

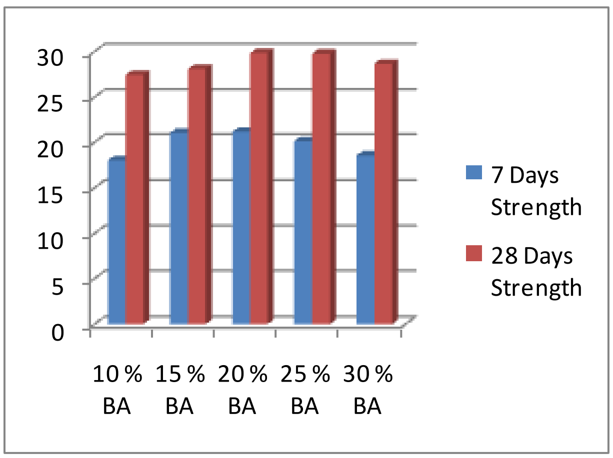
- BATCH MIX- 2

INGRADIENTS	M-6	M-7	M-8	M-9	M-10
Cement(Kg/m3)	360	360	360	360	360
SCBA(kg/m3)	40	40	40	40	40
Natural sand (Kg/m3)	589.5	556.75	524	491.25	458.5
Bottom Ash	65.5	98.25	131	163.75	196.5
Coarse Aggregate	1161	1161	1161	1161	1161
W/C Ratio	0.5	0.5	0.5	0.5	0.5
Water kg/m3	200	200	200	200	200
Slump	112	107	100	96	90

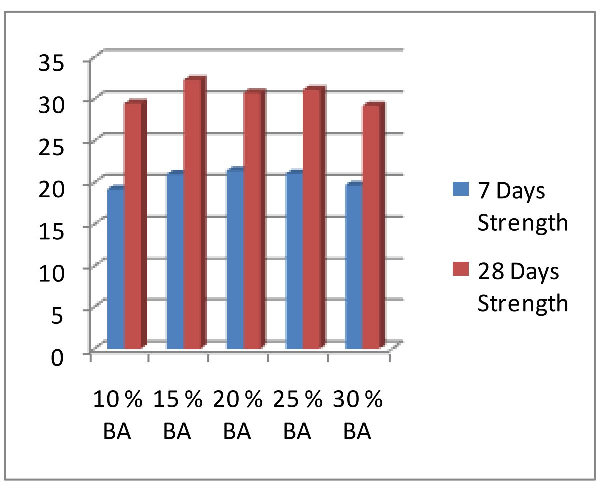
- BATCH MIX- 3

INGRADIENTS	M-11	M-12	M-13	M-14	M-15
Cement(Kg/m3)	340	340	340	340	340
SCBA(kg/m3)	60	60	60	60	60
Natural sand (Kg/m3)	589.5	556.75	524	491.25	458.5
Bottom Ash	65.5	98.25	131	163.75	196.5
Coarse Aggregate	1161	1161	1161	1161	1161
W/C Ratio	0.5	0.5	0.5	0.5	0.5
Water kg/m3	200	200	200	200	200
Slump	125	118	115	110	106

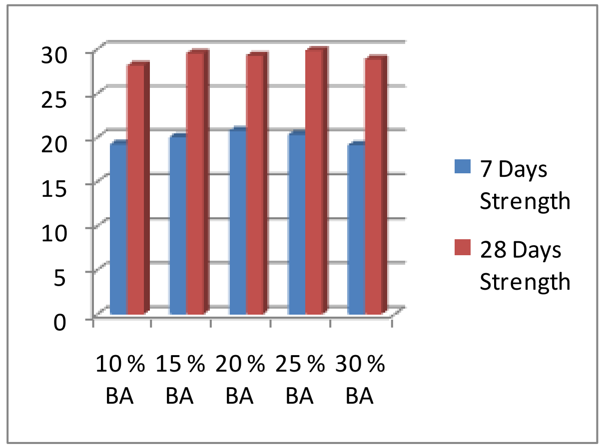
V. RESULT



Strength v/s Replacement chart for Batch mix -1



Strength v/s Replacement chart for Batch mix -2



Strength v/s Replacement chart for Batch mix -3

Sr. No.	W/C ratio	SCBA Content	Bottom ash ratio	Slump in mm
1	0.50	10 %	10 %	112
2	0.50	10 %	15 %	107
3	0.50	10 %	20 %	100
4	0.50	10 %	25 %	96
5	0.50	10 %	30 %	90

<u>Workability test</u>

BATCH MIX	SCBA/BA CONTENT In %	Dry Wt. gm W1	Wet Wt. gm W2	Sorptivity value in mm/min0.5
BATCH MIX - 1	5/10	979	980	2.32
	5/15	948.5	950	3.48
	5/20	908.5	910.25	4.07
	5/25	885.5	887.5	4.65
	5/30	918	920.25	5.23
BATCH MIX - 2	10/10	979	979.5	1.16
	10/15	965.5	966.25	1.74
	10/20	877	878.25	2.90
	10/25	906	907.5	3.48
	10/30	896	897.75	4.07
BATCH MIX - 3	15/10	905	906.35	3.132
	15/15	912	913.25	2.90
	15/20	889	890.30	3.016
	15/25	910	911.90	4.40
	15/30	925	927	4.64

<u>Capillary absorption test</u>

VI. CONCLUSION

- It has been observed that, as the replacement of cement to BA increase, the workability of concrete mix was decrease compared to normal mix.
- It has observed that, 10% replacement of SCBA with cement content with 15% replacement of Fine Aggregate to BA gives best result both in 7 days and 28 days.
- As the percentage of B.A. increase, huge amount of water or admixture is require to maintain Water/Binder ratio.
- Use of Sugar Cane Baggase Ash increase the workability of mix.
- Concrete gains strength at a slower rate in the initial period and acquires strength at faster rate after 28 days due to pozzolanic action of bottom ash.
- A good correlation was observed between the sorptivity and the strength values

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