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Sugarcane Baggase Ash and Pozzocrete as an Techno-Economical Solution in Design Mix Concrete

KEYWORDS: Sugarcane Bagasse Ash, Compressive strength, Low-cost, Pozzocrete (P60)

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ABSTRACT *Utilization of industrial waste and agro waste by industrial process has been focus on waste reduction.One of the agro waste sugarcane baggase ash which is fibrous waste product obtained from sugar mills as by product.Similarly fly ash resulting from the combustion of coal at electricity generating power station is highly processed and tested, through this a pozzolanic material is obtained known as Pozzocrete.In this experimental study SBA is used as partial replacement of fine aggregate in the ratio of 10% at which the optimum strength of concrete is obtained and then with such replacement, cement is replaced with Pozzocrete (P60) at ratio of 10%, 20% and 30%. The specimens of 150*150*150* mm were casted and tested at 7, 14 and 28 days and compare with traditional concrete in terms of strength and cost.Through experimental result we conclude that compressive strength of concrete increase with increase in partial replacement of pozzocrete.*

INTRODUCTION

In modern era construction sector is expanding rapidly on large scale and this involves large consumption of concrete. Concrete generally consist of cement, gravel, sand and water. All the component plays an important role but the major component of concrete is cement. The production of cement is one of the most environmental unfriendly processes due to the release of CO_2 gases to the atmosphere. Also in some country areas the availability of natural sources such as sand may be low or expensive. In addition to all these negative impacts the expert are enforced to find the solution of these problems. Now a days the generation of Industrial or Agro waste is increasing rapidly and it affects our environment. The utilization of these waste material as an alternative in concrete may be one of the solution.

In this experimental investigation Sugarcane Bagasse Ash and Pozzocrete (P60) are used for establishment of low cost concrete.By consumption of these materials, there is reduction in content of $CO_2$and land pollution.

EXPERIMENTAL MATERIALS

[a] Sugarcane Bagasse Ash

Sugarcane Bagasse Ash (SBA) is one of the Agro-waste which is by-product of sugarcane industry. Bagasse is a fibrous residue after crushing and juice extraction from sugarcane. This bagasse is used as a biomass fuel in the boilers to generate power in the sugar industry or in the power station. The ash which is obtained from the boiler is a waste product known as Sugarcane Bagasse Ash. It contains high volume of Sio_2. Use of SBA as partial replacement of fine aggregate will help to achieve different properties and behavior of concrete.

Figure 1: Sugarcane Bagasse Ash (SBA)

Source: Concrete Lab, Sigma Institute of Engg.

TABLE-1
CHEMICAL PROPERTIES OFBAGASSE ASH

Constituent	Percentage
Nitrogen	0.2- 0.3%
P_2O_5	1.5 -2%
K_2+Na_2	5-10 %
CaO	1-2%
MgO	0.07%
SiO_2	85-90%
Heavy Metals	NA
Fe	2-4%

Source: Shree Ganesh KhandUdhayog

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[b] Pozzocrete (P60)
Pozzocrete(P60) is a high efficiency pozzolanic material, obtained by selection, processing and testing of power station fly ash resulting from the combustion of coal at electricity generating power stations. It is subjected to strict quality control procedures. In the production of Pozzocrete 40™, 60™, 63™, and 83™ high quality PFA were selected and industrially processed in order to obtain maximum performance as a cement replacement product. In this study P60 pozzocrete is used.

Figure 2: pozzocrete(P60)

Source: Concrete Lab, Sigma Institute of Engg.

[b] Cement
Cement in concrete acts as a binder for binding the other materials together. It hardens and set independently on addition of water. In this study Ordinary Portland Cement of 53 grade (Wonder Cement) is used according to IS 1489-1991.

[c] Aggregate
Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy.Aggregate comprises about 85% volume of mass concrete. It acts as reinforcement and introduce strength to concrete. For increasing the density of concrete aggregate of different sizes are used.

[d] Coarse aggregate
Coarse aggregate of 20mm and 10 mm are used in this study. As per Indian Standard 383 coarse aggregate are tested. Bulk density, Fineness modulus, water absorption and specific density are 1744 gm/cc and 1714 gm/cc, 7.52 and 3.20, 1.80% and 1.36%, 2.76 and 2.69 respectively.

[e] Fine aggregate
Aggregate of size less than 4.75 mm are used in this study. As per Indian Standard 383 fine aggregate are tested.Bulk density, Fineness modulus, water absorption and specific density are 1752 gm/cc, 3.30, 1.25%, 2.38 respectively.

[f] Water
Water plays an important role in the formation of concrete as it participates in chemical reaction with cement. Due to the presence of water the gel is form which helps in increase of strength of concrete.

MIX DESIGN
According to IS: 10262-1982 mix design was prepared for M25 grade and same design was used in preparation of the specimens. Mix Design proportion is shown in TABLE-1.

TABLE-2
MIX DESIGN PROPORTION FOR M25 grade

	Water (lit.)	Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)
By weight (gms)	191.60	479	485.75	1197.03
By volume (m^3)	0.40	1	1.01	2.50

TABLE-3
CONCRETE MIX DESIGN PROPORTION (M25 grade)

Sr no.	Type of concrete	Concrete mix design proportion					
		w/c ratio	C	FA	CA	SBA	PZ
1.	B0 (Traditional concrete)	0.40	1	1.01	2.5	0.00	0
2.	B1 (10% SBA)	0.40	1	0.91	2.5	0.10	0
3.	B2 (20% SBA)	0.40	1	0.81	2.5	0.20	0
4.	B3 (30% SBA)	0.40	1	0.71	2.5	0.30	0
5.	B4 (40% SBA)	0.40	1	0.61	2.5	0.40	0
6.	P0(0% Pozzocrete)	0.40	1	0.91	2.5	0.10	0
7.	P1(10%Pozzocrete)	0.40	0.90	0.91	2.5	0.10	0.10
8.	P2(20%Pozzocrete)	0.40	0.80	0.91	2.5	0.10	0.20
9.	P3(30% Pozzocrete)	0.40	0.70	0.91	2.5	0.10	0.30

C=Cement, FA=Fine Aggregate, CA=Coarse Aggregate, SBA=Sugarcane Bagasse Ash, PZ= Pozzocrete (P60).

EXPERIMENTAL METHODOLOGY
[a]Compressive strength test
According to IS 516-1959, Compressive strength tests were performed on compression testing machine of 2,000 KN capacity.

Concrete specimens consists of cement, coarse aggregate, fine aggregate, water and bagasse ash is prepared. Specimens consist of sugarcane bagasse ash as a partial replacement in the range of 10%, 20%, 30% and 40% by weight of fine aggregate. The mixture was prepared and three standard cubes of 150*150*150 mm for each replacement were casted and subjected to curing for 7, 14 and 28 days then tested by means of compression testing machine. After obtaining the optimum replacement of SBA at which compressive strength is maximum, three cubes of standard size with the optimum content of SBA and partial replacement of cement with Pozzocrete (P60) in the range of 10%,20%,30% by weightare casted and tested after curing of 7, 14 and 28 days.

RESULTS
TABLE-4
COMPRESSIVE STRENGTH OF CUBES AT 7,14,28 DAYS

Type of concrete	Average compressive strength		
	7days (N/mm^2)	14 days (N/mm^2)	28days (N/mm^2)
B0	30.22	32.59	39.85
B1	23.70	25.78	36.30
B2	15.11	17.04	24.89
B3	12.59	15.85	23.41

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B4	10.37	14.22	19.70
P0	23.70	25.78	36.30
P1	25.19	25.63	35.85
P2	25.33	28.89	36.15
P3	28.89	32.15	42.22

ECONOMIC FEASABILITY
TABLE-5
MATERIALS COST

Sr no.	Material	Rate (Rs/Kg)
1.	Cement	6.00
2.	Fine aggregate (sand)	0.60
3.	Coarse aggregate (> 20mm)	0.65
4.	Grit	0.65
5.	Sugarcane bagasse ash	0.15
6.	Pozzocrete (P60)	4.3

TABLE-6
TOTAL COST OF MATERIALS FOR M25 grade per m^3.

CT	Consumption of mix design proportions for M25 grade					PZ	TOTAL COST
	C	F.A	C.A	G	SBA		
B0	479.0	485.7	718.2	478.8	0.00	0.0	4135.12
B1	479.0	437.2	718.2	478.8	48.6	0.0	4110.83
B2	479.0	388.6	718.2	478.8	97.1	0.0	4086.54
B3	479.0	340.0	718.2	478.8	145.8	0.0	4062.26
B4	479.0	291.5	718.2	478.8	194.3	0.0	4037.97
P0	479.0	485.7	718.2	478.8	0.00	0.0	4110.83
P1	431.1	437.2	718.2	478.8	48.6	47.0	3753.02
P2	383.2	437.2	718.2	478.8	48.6	95.8	3682.61
P3	335.3	437.2	718.2	478.8	48.6	143.7	3612.19

CT=Concrete type, F.A=Fine Aggregate, C.A=Coarse Aggregate, G=Grit, SBA=Sugarcane Bagasse Ash

CONCLUSION

On the basis of above study the following remarks are made regarding the properties of concrete on addition of sugarcane bagasse ash and Pozzocrete (P60) as partial replacement of fine aggregate and cement respectively:

(1) Use of Argo-waste i.e. SBA in the production of concrete leads in the development of eco-friendly building material.
(2) Compressive strength increases when replacement of pozzocrete (P60) percentage increases when compared to traditional concrete.
(3) By consumption of pozzocrete in such way there is reduction in content of CO_2.
(4) Stress on environment is reduced along with reduction in wastage of land and maintenance cost of land filling.
(5) The optimum amount of sugarcane bagasse ash at which concrete attains the higher strength is 10%.
(6) From this research, replacement of (OPC)cement with this pozzocrete (P60) material provides maximum strength at 30%
(7) Establishment of concrete by replacing sand and cement with SBA at optimum amount and Pozzocrete (P60) at 30% respectively the cost reduces up to **522.93**Rs (i.e cost reduces up to**13%)**for 1m^3

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