International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 12, pp: 435-443 www.ijaem.net ISSN: 2395-5252

Behaviour of Bottom Ash on Ceramic Waste Aggregate Concrete

ZAHID HAMID DAR
Student

Sumit sharma
AP in Civil Deptt.
(PKG COLLEGE OF ENGG. AND TECH PANIPAT HARYANA)

Date of Submission: 20-11-2021 Date of Acceptance: 05-12-2021

Abstract – It has been evaluated that around 30% of the day by day creation is disposed of as waste in an artistic industry. The garbage removal has been a significant issue for the artistic enterprises as the waste stacks up consistently. This has been found as an ecological contamination which should be coordinated by tracking down available resources of utilizing this modern waste for advantageous purposes in mass amount. There has been an unhindered utilization of normal assets in concrete-production, bringing about their exhaustion to a disturbing rate. Thus, for the manageable improvement of substantial innovation just as for safe climate, the utilization of modern waste as an option for the regular elements of cement gives the most ideal choice. Base debris is a side-effect of the ignition of pounded coal in power plants. By and large power plants produce base debris roughly 20% of the all out cinders. A large portion of it is arranged in landfills leading to ecological and different issues. Thusly base debris can be utilized as a fine total in substantial making to lessen colossal utilization of regular asset. Silica smolder is a loss result of the assembling of silicon from high virtue quartz and coal in a lowered circular segment electric heater. It is an exceptionally receptive pozzolanic material. As indicated by IS: 456-2000, silica smolder was added to substantial blend 10% by weight of concrete, to upgrade the impermeability of cement.

In this review an intentional endeavor is made to discover the reasonableness and ampleness of the artistic waste as a potential substitute for ordinary squashed stone coarse total and base debris as a fractional substitution of customary fine total in the substantial organization. Substantial utilizing artistic waste as coarse total and base debris as fine total is named as CWBA aggregate cement.

Keywords: CWBA, Ceramic waste, Compressive strength.

I. INTRODUCTION

In view of the ever-growing population and with expanding urban centers, escalating levels of construction are forecast in the forthcoming years in India as a developing country. The construction Industry has the largest drain of natural materials. Like water the construction materials cannot be recycled naturally. The construction industry needs to be suggest the measures with the approval of environmentally good natured and more sustainable technology. Industrial wastes have continued to increase due to the continued demands of resource used by humans and increasing amount of pollution But also to the problem of the high cost of building materials is currently faced by our nation. It is essential to effectively use the industrial waste in order to conserve the non-renewable natural resources.

USE OF INDUSTRIAL WASTE IN CONCRETE MAKING

The main hope of the use of waste materials is to minimize environmental impact and reduce the huge consumption of natural resources used for concrete applications. A review of earlier research showed that industrial as well as other wastes have been used in concrete making to improve the properties of concrete and to reduce cost. The use of recycled aggregates for concrete-making has been successfully implemented and gaining wider acceptance. Another important aspect to consider is the depleting nature of the concrete aggregates has led to recycling of waste aggregates will prove to be economically beneficial and sustainable. In this study the use of the ceramic waste as coarse aggregate and bottom ash fine aggregate as a partial replacement of river sand of its suitability and mechanical properties of concrete were investigated.

SUSTAINABLE CONCRETE TECHNOLOGY

Taking the concept of sustainable development into consideration, the concrete industry has to implement a variety of strategies with regard to future concrete use, for illustration, improvements in the durability of concrete and the better use of recycled materials. According to the living planet report" (WWF) Taipei the concrete industry globally consumes 8 — 12 billion tones, annually of natural aggregates after the year 2010. More recently there has been a growing social and political awareness of environmental issues, particularly where this relates to the deterioration of the environment. This has lead to the passing of laws and regulations of all kinds in an attempt to control and reduce the amount of natural aggregates extracted from quarries and to encourage recycling and reuse. [6] proposed a principle in which another NN yield input control law was created for an under incited quad rotor UAV which uses the regular limitations of the under incited framework to create virtual control contributions to ensure the UAV tracks a craved direction. Utilizing the versatile back venturing method, every one of the six DOF are effectively followed utilizing just four control inputs while within the sight of un demonstrated flow and limited unsettling influences. Elements and speed vectors were thought to be inaccessible, along these lines a NN eyewitness was intended to recoup the limitless states. At that point, a novel NN virtual control structure which permitted the craved translational speeds to be controlled utilizing the pitch and the move of the UAV. At long last, a NN was used in the figuring of the real control inputs for the UAV dynamic framework. Utilizing Lyapunov systems, it was demonstrated that the estimation blunders of each NN, the spectator, Virtual controller, and the position, introduction, and speed following mistakes were all SGUUB while unwinding the partition Principle.

II. METHODOLOGY

MATERIALS

Ceramic Waste Coarse Aggregate: Ceramic waste obtained from ceramic electrical insulator industry has a glassy outer skin. Initially the glazed surface was removed manually and it was broken in to 100 mm to 150 mm size by a hammer. Then it was fed into the jaw-crusher to get 20 mm graded aggregate.

FIG: WASTE CERAMIC AND CERAMIC AGGREGATES

BOTTAM ASH FINE AGGREGATE

Bottom ash is the byproduct of coal fired furnace used in thermal power plants. It is sand like material with granular structure with the same upper and lower particle size limits as river sand. Large size bottom ash particles have a porous inner core, and it can be very easily crushed between fingers. But smaller size particles of bottom ash exhibit higher strength.

BOTTAM ASH FINE AGGREGATE

RIVER SANDSILICA FUME

In this study the physical properties and chemical composition of silica fume are given by the supplier M/s Elkem India (Pvt) Limited. Silica fume is a by-product in the manufacture of silicon. This is a very fine pozzolanic material composed of amorphous silica. The properties of silica fume to be used in cement concrete are specified in ASTM C 1240. Silica fume undergoes pozzolanic reaction with calcium hydroxide in cement paste to improve the mechanical properties of concrete.

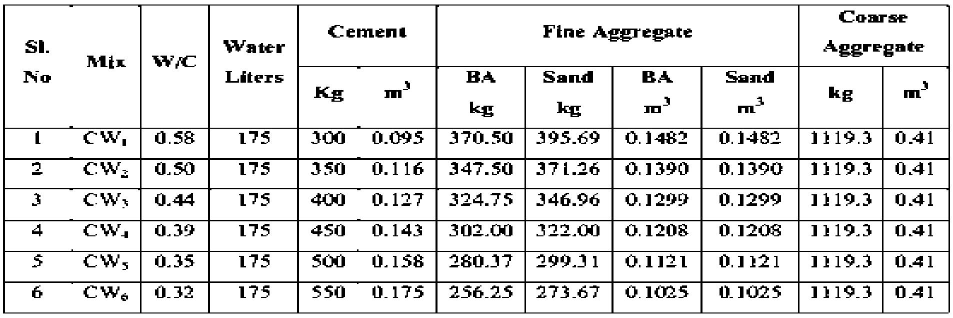
SILICA FUME

Another improvement achieved by the addition of silica fume in concrete is the reduction in permeability of concrete, which effectively stops the ingress of chloride ions and protects the reinforcing steel from corrosion. This reduction in permeability of concrete makes it suitable for marine environment with salt content in water.

MIX PROPORTIONS

The conventional mix design methods cannot be applied to multiple mineral admixtures with artificial ceramic waste aggregate. Hence, in general, it is recommended that the trial mixes are to be made with suitable adjustments in grading and proportioning to achieve the desired properties of concrete. Considering the above factor and the properties of ceramic waste, bottom ash aggregates, silica fume and sand, mix proportion was carried out by absolute volume method.

CWBA AGGREGATE CONCRETE MIX PROPORTIONS PER CUBIC METER



Sl. No	Mix	W/C	Water Liters	Cement		Fine Aggregate				Coarse Aggregate	
				Kg	m^3	BA kg	Sand kg	BA m^3	Sand m^3	kg	m^3
1	CW_1	0.58	175	300	0.095	370.50	395.69	0.1482	0.1482	1119.3	0.41
2	CW_2	0.50	175	350	0.116	347.50	371.26	0.1390	0.1390	1119.3	0.41
3	CW_3	0.44	175	400	0.127	324.75	346.96	0.1299	0.1299	1119.3	0.41
4	CW_4	0.39	175	450	0.143	302.00	322.00	0.1208	0.1208	1119.3	0.41
5	CW_5	0.35	175	500	0.158	280.37	299.31	0.1121	0.1121	1119.3	0.41
6	CW_6	0.32	175	550	0.175	256.25	273.67	0.1025	0.1025	1119.3	0.41

CRUSHED STONE COARSE AGGREGATE CONCRETE MIX PROPORTIONS PER CUBICMETER

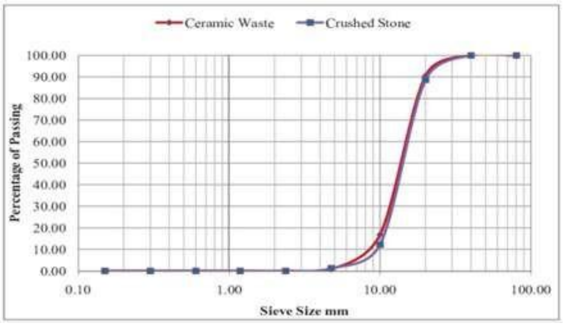
Sl.No	Mix	W/C	Water Liters	Cement		Fine Aggregate		Coarse Aggregate	
				Kg	m^3	kg	m^3	kg	m^3
1	CC_1	0.58	175	300	0.095	827.7	0.31	1119.3	0.41
2	CC_2	0.50	175	350	0.116	784.98	0.294	1119.3	0.41
3	CC_3	0.44	175	400	0.127	742.26	0.278	1119.3	0.41
4	CC_4	0.39	175	450	0.143	699.54	0.262	1119.3	0.41
5	CC_5	0.35	175	500	0.158	659.49	0.247	1119.3	0.41
6	CC_6	0.32	175	550	0.175	614.00	0.230	1119.3	0.41

III. RESULTS AND ANALYSISCOARSE AGGREGATE PROPERTIES

Sl. No	Property	Ceramic Waste	Crushed Stone
1	Density (g/cm^3)	2.73	2.78
2	Maximum size (mm)	20	20
3	Fineness modulus	6.92	6.98
4	Water absorption 24 hrs. (percent)	0.71	1.26
5	Surface texture	Smooth	Rough
6	Bulk density (N/m^3)		
	Loose	14100	15430
	Compacted	15230	16710
7	Voids (percent)		
	Loose	48.0	44.00
	Compacted	44.32	39.81
8	Crushing value (percent)	25	23
9	Impact value (percent)	17	16
10	Soundness tests (percent): weight loss after 5 cycles	0.70	1.22
	Weight loss after 30 cycles	3.7	5.5

PARTICLE SIZE DISTRIBUTION OF COARSE AGGREGATE

Sl. No.	Sieve Size	Cumulative Percentage of Passing	
		Ceramic Waste	Crushed Stone
1.	80 mm	100	100
2.	40 mm	100	100
3.	20 mm	90.47	88.63
4.	10 mm	16.83	12.19
5.	4.75 mm	0.7	1.2
6.	2.36 mm	0	0
7.	1.18 mm	0	0
8.	600µm	0	0
9.	300µm	0	0
10.	150µm	0	0

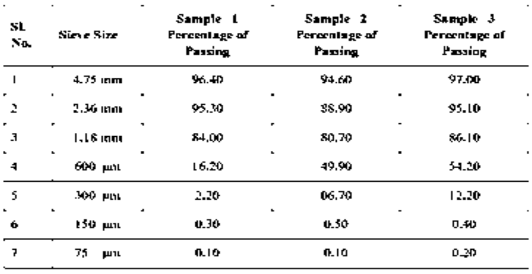


PROPERTIES OF FINE AGGREGATES

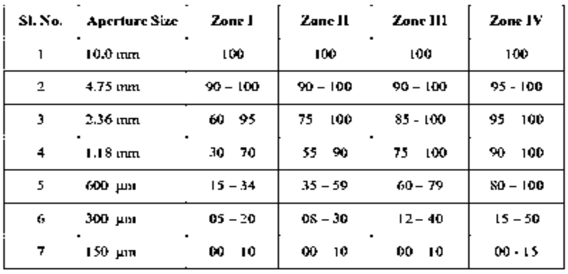
Sl. No	Property	Bottom Ash	River Sand
1	Density (g/cm^3)	2.52	2.67
2	Fineness modulus	2.80	2.72
3	Bulk density (N/m^3)		
	Loose	14160	16200
	Compacted	16030	18300
4	Voids (percent)		
	Loose	43.2	36.52
	Compacted	38.42	30.71
5	Water absorption (percent)	2.1	1.8

SIEVE ANALYSIS

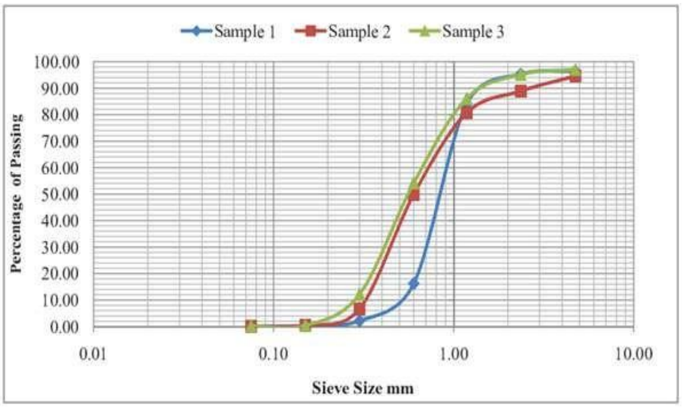
PARTICLE SIZE DISTRIBUTION OF BOTTOM ASH ZONE OF RIVER SAND



Sl. No.	Sieve Size	Sample 1 Percentage of Passing	Sample 2 Percentage of Passing	Sample 3 Percentage of Passing
1	4.75 mm	96.40	94.60	97.00
2	2.36 mm	95.30	88.90	95.10
3	1.18 mm	84.00	80.70	86.10
4	600 µm	16.20	49.90	54.20
5	300 µm	2.20	06.70	12.20
6	150 µm	0.30	0.50	0.40
7	75 µm	0.10	0.10	0.20

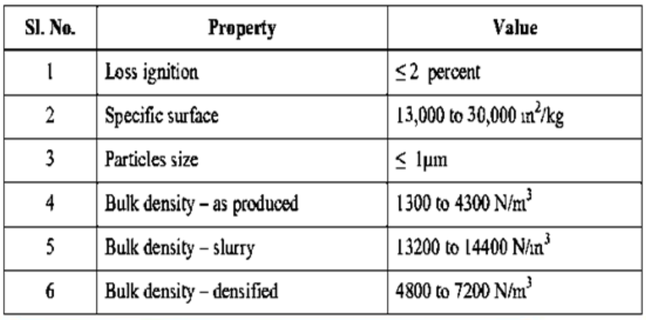


Sl. No.	Aperture Size	Zone I	Zone II	Zone III	Zone IV
1	10.0 mm	100	100	100	100
2	4.75 mm	90 – 100	90 – 100	90 – 100	95 - 100
3	2.36 mm	60 95	75 100	85 - 100	95 100
4	1.18 mm	30 70	55 90	75 100	90 100
5	600 µm	15 – 34	35 – 59	60 – 79	80 – 100
6	300 µm	05 – 20	08 – 30	12 – 40	15 – 50
7	150 µm	00 10	00 10	00 10	00 - 15

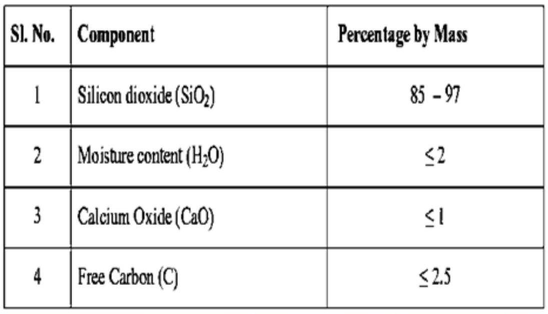


SILICA FUME

PHYSICAL AND CHEMICAL PROPERTIES



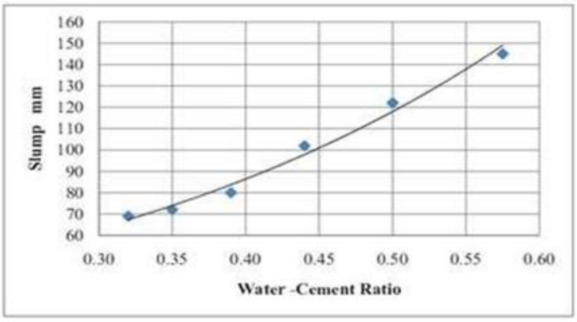
Sl. No.	Property	Value
1	Loss ignition	≤2 percent
2	Specific surface	13,000 to 30,000 m^2/kg
3	Particles size	≤ 1µm
4	Bulk density – as produced	1300 to 4300 N/m^3
5	Bulk density – slurry	13200 to 14400 N/m^3
6	Bulk density – densified	4800 to 7200 N/m^3

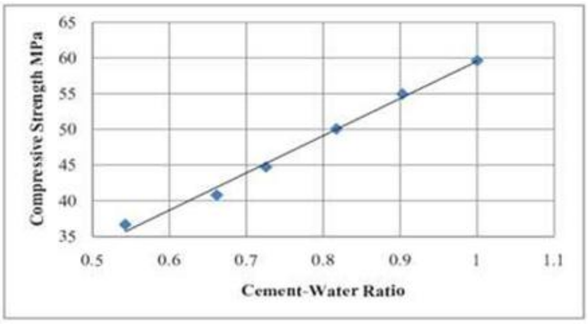


Sl. No.	Component	Percentage by Mass
1	Silicon dioxide (SiO_2)	85 – 97
2	Moisture content (H_2O)	≤2
3	Calcium Oxide (CaO)	≤1
4	Free Carbon (C)	≤2.5

CWBA AGGREGATE CONCRETE

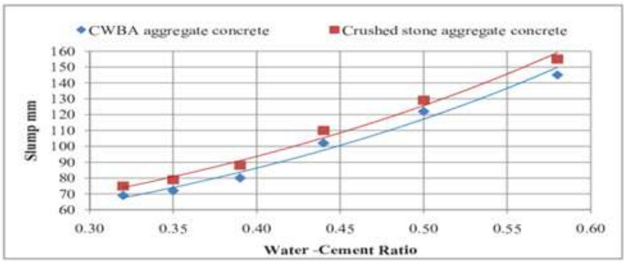
CRUSHED STONE COARSE AGGREGATE CONCRETEMIX DESIGN

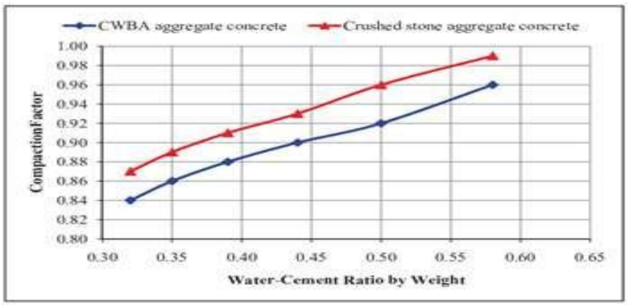




SLUMP CONE TEST

Sl.No	W/C	Slump mm		Compaction Factor	
		CWBA Aggregate Concrete	Crushed Stone Coarse Aggregate Concrete	CWBA Aggregate Concrete	Crushed Stone Coarse Aggregate Concrete
1	0.32	69	75	0.84	0.87
2	0.35	72	79	0.86	0.89
3	0.39	80	88	0.88	0.91
4	0.44	102	110	0.90	0.93
5	0.50	122	129	0.92	0.96
6	0.58	145	155	0.96	0.99





COMPACTION RESULTS

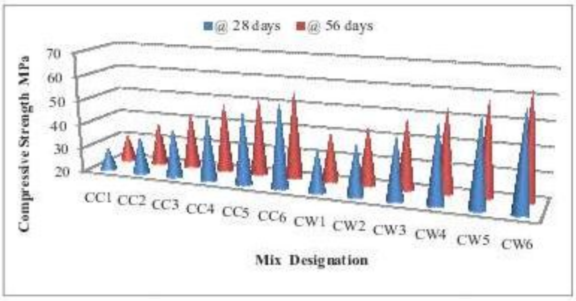
COMPRESSIVE STRENGTH

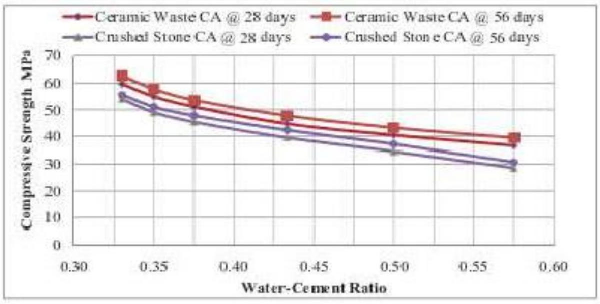
CWBA AGGREGATES CRUSHED STONE AGGREGATE

Sl.No	Mix	Average Compressive Strength MPa		Average Split Tensile Strength MPa		Average Modulus of Rupture MPa		Average Modulus of Elasticity MPa	
		@28 d	@56 d	@28 d	@56 d	@28 d	@56 d	@28 d	@56 d
1	CW1	36.63	39.84	4.25	4.30	5.68	5.75	30,261	31,559
2	CW2	40.48	42.25	4.40	4.45	5.88	5.95	31,812	32,500
3	CW3	44.72	45.79	4.68	4.72	6.26	6.31	33,437	33,834
4	CW4	50.14	51.61	4.92	4.98	6.58	6.66	35,405	35,920
5	CW5	53.95	56.69	5.16	5.20	6.90	6.95	36,725	37,646
6	CW6	59.63	62.57	5.31	5.33	7.10	7.13	38,610	39,551

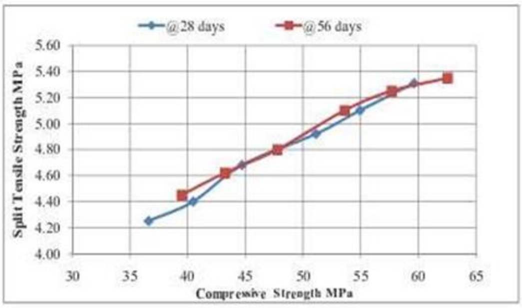
SL No	Mix	Average Compressive Strength MPa		Average Split Tensile Strength MPa		Average Modulus of Rupture MPa		Average Modulus of Elasticity MPa	
		@28 d	@56 d	@28 d	@56 d	@28 d	@56 d	@28 d	@56 d
1	CC1	28.48	29.68	3.51	3.80	4.69	5.08	26,683	27,240
2	CC 2	35.56	37.17	3.98	4.11	5.32	5.50	29,816	30,484
3	CC 3	40.55	42.38	4.46	4.48	5.86	5.99	31,839	32,550
4	CC 4	46.39	47.20	4.68	4.74	6.26	6.30	34,055	34,351
5	CC 5	50.00	51.07	4.80	4.91	6.42	6.52	35,355	35,732
6	CC 6	54.42	55.62	4.98	5.00	6.66	6.69	36,885	37,289

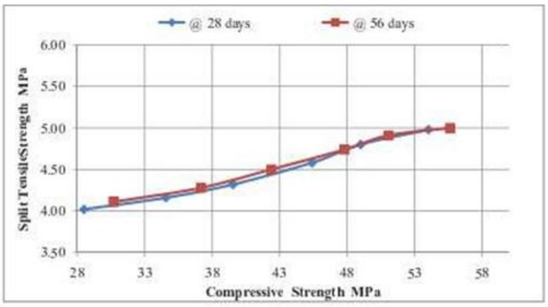
COMPRESSIVE STRENGTH

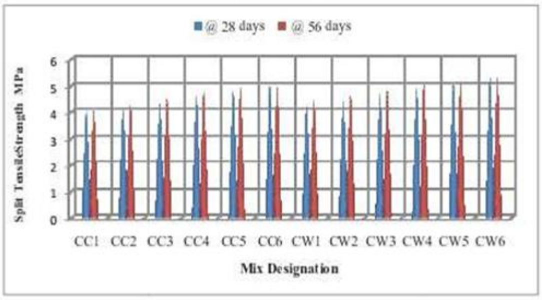


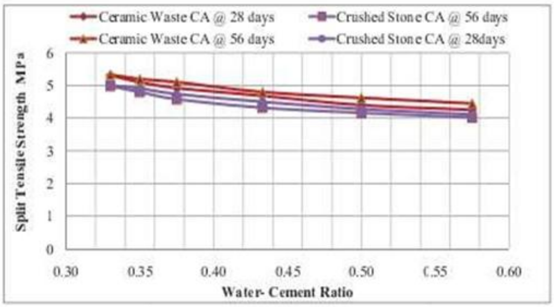


SPLIT TENSILE STRENGTH

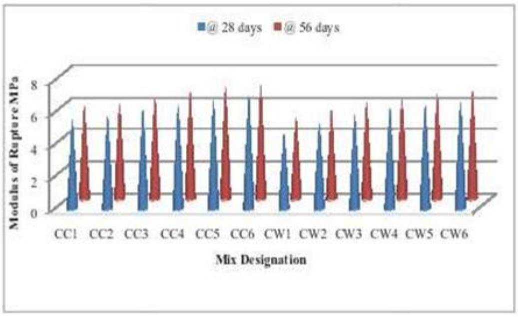


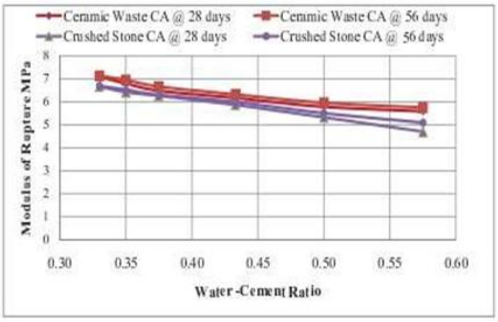


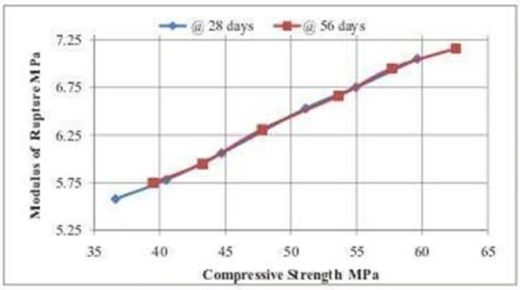


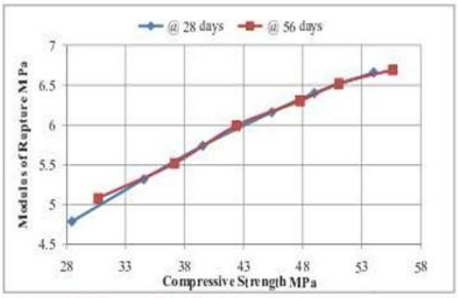


MODULUS OF RUPTURE

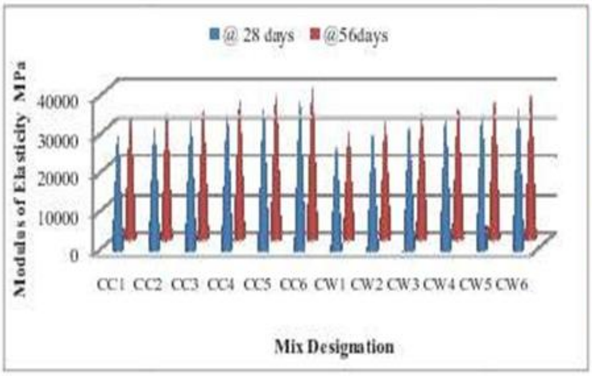


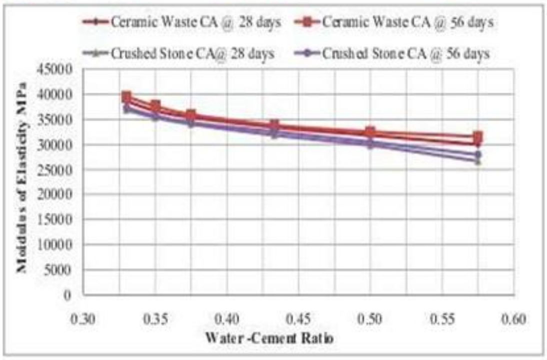


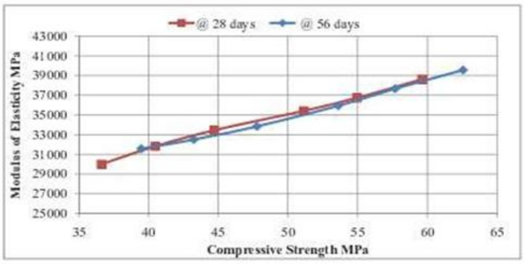


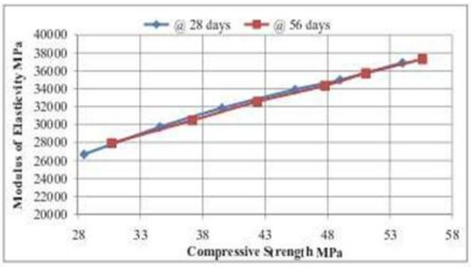


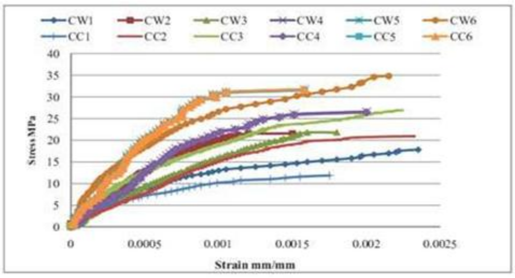
MODULUS OF ELASTICITY

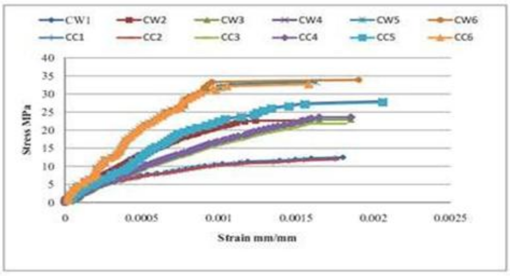






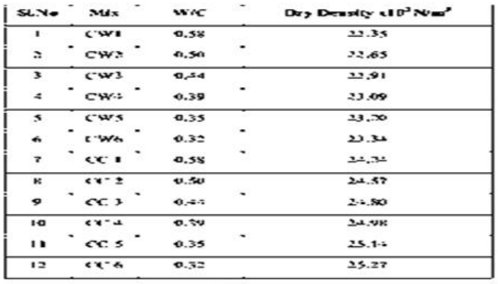




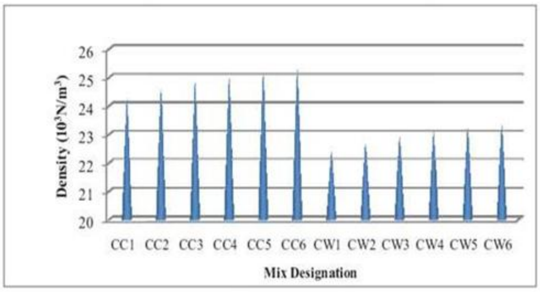


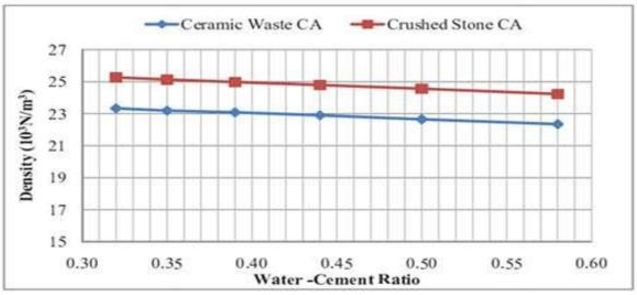
DURABILITY PROPERTIES

DENSITY



Sl.No	Mix	W/C	Dry Density x10³ N/m³
1	CW1	0.58	22.35
2	CW2	0.50	22.65
3	CW3	0.44	22.91
4	CW4	0.39	23.09
5	CW5	0.35	23.20
6	CW6	0.32	23.34
7	CC 1	0.58	24.34
8	CC 2	0.50	24.57
9	CC 3	0.44	24.80
10	CC 4	0.39	24.98
11	CC 5	0.35	25.14
12	CC 6	0.32	25.27





IV. CONCLUSIONS

1. Ceramic waste and bottom ash could be transformed into useful coarse aggregate and fine aggregate respectively for concrete making through proper processing.
2. The specific gravity of bottom ash fine aggregate is 5.6 percent less than that of river sand.
3. The bulk density of bottom ash fine aggregate is 12.40 percent less than that ofriver sand.
4. Water absorption of bottom ash fine aggregate is 16.60 percent higher than that of river sand.
5. The specific gravity of ceramic waste coarse aggregate and that of crushed stone coarse aggregate is more or less same.
6. The water absorption of ceramic waste coarse aggregate is 43.61 percent less than that of crushed stone coarse aggregate.
7. The mechanical properties of ceramic waste coarse aggregate are well within the range of the values of concrete making aggregate.
8. The slump values of CWBA aggregate concrete are lower than those of crushed stone coarse aggregate concrete at the respective water-cement ratio.
9. As far as the strengths are concerned, the basic trend in behaviour of CWBA aggregate concrete is not significantly different from those of crushed stone coarse aggregate concrete.
10. There is no much difference in the rate of development of compressive strength of CWBA aggregate concrete when compared to crushed stone coarse aggregate concrete at 28 and 56 d.

REFERENCES

[1]. ACI Committee 211.1, (1991), Standard Practice for Selecting Proportions for Notrnal. Heavy weight and Mass Concrete, AC Manual of Concrete Practice Pan 1.1991. American Concrete Institute. Detroit.

[2]. Aminul Islam Laskar and Sudip Talukdar (2008). Rhelogical behaviour of high performance concrete with mineral admixtures and their blending. Journal of Consuuction and Building Materials. Vol.22, pp. 2345-2354.

[3]. Angulo. S.C. Ulsen. C. John. V.M. Kahn. H and Cincotto. M.A (2009). Chemical-mineralogical characterization of C&D waste recycled aggregates from Sao Paulo.Brazi I. Journal or Waste Management. Vol.29.pp.721-730.

[4]. ASTM C 642 (1997). Standard Test Method for Density. Absorption and Voids in Hardened Concrete. American Society for Testing and Materials. Annual Book of ASTM Standards. Vol. 04.02. pp. 315-316. Philadelphia.

[5]. ASTM C 1202 (1997). Standard Test Method for Electrical Indication of Concnne's Ability to Resists Chloride Ion Penetration. American Society for Testing and Materials. Annual Book or ASTM Standards. Vol. 04.02. pp. 618-621 Philadelphia.

[6]. Christo Ananth,"A Novel NN Output Feedback Control Law For Quad Rotor UAV",International Journal of Advanced Research in Innovative Discoveries in Engineering and Applications[IJARIDEA],Volume 2,Issue 1,February 2017,pp:18-26.

[7]. Anna Halicka. Pawel Ogrodolk and I3anosz Zegardlo. (2013). Using ceramic sanitary ware waste as concrete aggregate. Journal or Construct ion and Building Materials. Vol.48. pp. 295-305.

[8]. An•nd. K, Su ryavanshi and Narayan Swamy. R, (2002), Development of lightweight mixes ming ceramic microspheres as fillers. Journal of Cement and Concrete Rmarch Vol. 32. pp. 1783-1789.

[9]. Baoshan Huang. Quiao Dong and Edwin C.Burdette, (2009), Laboratory' mho ion of incorporating waste ceramic materials into Ponland cement and asphaltic concrete. Journal of Corstruction and Building Materials. Vol.234. pp. 3451-3456.