IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 19, Issue 4 Ser. II (Jul. – Aug. 2022), PP 01-05
www.iosrjournals.org

Experimental investigation on compressive strength by using stone powder and ceramic waste in concrete as partial replacement of fine aggregate

Ashu Singh and Vivek Sachan
Shri Venkateshwara University, U.P.

ABSTRACT
In recent years, rapid urbanization, the demand for natural construction materials is increasing day by day which has created a necessity for alternative construction materials. Quarry dust a waste from the stone crushing unit accounts 25% of the final product from stone crushing unit. Ceramic Waste is a waste from demolition of concrete from buildings or structures consisting of concrete. The recycled and use of waste concrete as Ceramic Wastes for new concretes, i.e., Ceramic Waste, is an important approach for achieving the sustainable concrete structure Concrete. Experimental results show that replacing 0% ,10%,20%,40% of stone/ceramic waste with the weight of partial Aggregate will increase compressive of Cubes.
KEYWORDS

Date of Submission: 14-07-2022 Date of Acceptance: 29-07-2022

I. Introduction

The recycling of Construction and Demolition Wastes has long been recognized to have the potential to conserve natural resources and to reduce energy used in production. In some countries it is a standard alternative for both construction and maintenance, particularly where there is a shortage of natural construction material. In general, the demand of natural sand is quite high in developing countries like India facing shortage in good quality natural sand. Therefore, construction industries of developing countries are in stress to identify alternative materials to replace the demand for natural sand and aggregate. The benefits and weaknesses of using Ceramic Waste in concrete have been broadly studied. The use of Ceramic Waste generally increases the drying shrinkage and creep and decreases the compressive strength and modulus of elasticity of concrete compared to those of natural aggregate concrete. The undesirable effects of Ceramic Waste on concrete quality limit the use of this material in structural concrete. However, the weaknesses of using Ceramic Waste can be mitigated by incorporating a certain amount of fly ash into the concrete mixture since fly ash is known to be able to reduce the creep and drying shrinkage of concrete.

The Waste & Resources Action Programme (WRAP) classified aggregates from primary, recycled and secondary material resources. Ceramic Wastes encompass industrial by-products and reused construction products, all of which were once considered wastes and dumped in landfill. The recently introduced European Standards for aggregates do not discriminate between different sources, and are for 'aggregates from natural, recycled and manufactured materials. The focus is on fitness for purpose rather than origin of the resource[1-11].

The purpose of research work to identify the various sources of aggregate and examine their potential.

II. Experimental Process

Experimental process was steered in four parts. in the primary part of the process, the use of stone powder and ceramic waste in concrete as partial replacement of fine aggregate. the strengthened properties of the prepared samples were determined in the subsequent part for a period of 7 and 28 days.

2. Methodology

2.1 Materials

(a) Cement

Ordinary Portland Pozzolana Cement (PPC) of KJS brand (IS – 1489:2009) grade 53 is used as a binding material. And other materials like Partial Aggregate, Fine Aggregate, Coarse Aggregate, Stone Powder, Ceramic waste, Superplasticizer,

(b) Fine aggregate

The fine aggregate was locally available river sand which is passed through 4.75 mm sieve. The specific gravity of fine aggregate is 2.2 and fineness modulus of fine aggregate 2.84.

(c) Coarse aggregate
The coarse aggregate was locally available quarry having two different sizes. One fraction is passing through 20 mm sieve and another fraction passing through 12.5 mm sieve. The specific gravity of coarse aggregate is 2.66 for both fractions. The proportion of 20 mm and 12.5 mm size aggregate was taken as 60 % and 40 %.
(d) Stone powder:
Stone powder is collected from local stone crushing units of Amroha, Moradroabad, Uttar Pradesh. It was initially dry in condition when collected and mixing in concrete. Stone powder is of muddy color and shape of particles is irregular. and Stone dust is the finest of the types of crushed stone. It is made of the same type of stone as the other types but is crushed into a powder. When used by itself stone dust forms a hard surface that is water resistant. The fines below 150 microns in crusher dust will have high affinity to water which creates high water demand and reduced strength in masonry or concrete and hence as a trial, these fines below 150 microns were removed. The micro fines below 150 microns will be about 15% of the total volume of crusher dust.
(e) Ceramic waste
The principal waste coming into the ceramic industry is the ceramic powder, specifically in powder form. Ceramic wastes are generated as a waste during the process of dressing and polishing. It is estimated that 15% to 30% waste are produced of total raw material used. Ceramic waste can be used in concrete to improve its strength and durability factors. Ceramic waste can be used as a partial replacement of fine aggregate sand as supplementary addition to achieve different properties of concrete
(f) Concrete
The concrete mix design is done in accordance with IS 10262(1982). The cement content used in the mix design is taken as 380 kg/m3 which satisfies minimum requirement of 300 kg/m3 in order to avoid the balling affect. Good stone aggregate and Natural River sand of Zone-II were used as coarse and fine aggregate respectively, Maximum size of coarse aggregate was 20mm. A sieve analysis conforming to IS 383-1970 was carried out for both the fine and coarse aggregates.

2.2 Preparation of specimen

The timing of the concrete blending course was saved consistently to present the same homogeneousness and uniformity for all of the concrete blends. During the preliminary minute, all the combination and binder blended with the use of a standard mixer. Then water as well as plasticizer was added to the mixture and mixed for an additional minute. VMA has introduced to the mixture afterward and the concrete was mixed for an extra 3-5 minutes.

After the mixing course was finished, trials were executed to determine the property of concrete by slump diameter, V-funnel flow, U box test, and L box test. Cubes of size 100 x 100 x 100 mm were cast off to evaluate the crushing strength.
(a) Mix proportioning
The mixing is an extremely important aspect of concreting and it is important to follow the recommendation, even a small deviation can have a large influence on the workability of the wet concrete and so the properties and appearance of final composite specimens (36 cubes) were cast to determine the compressed strength. The specimens were mix using a design mix 1: 1.5:3 (where 3 is the proportion of 12.5 mm and 20 mm size aggregate).
(b)Vibration of mould
In this process the mould was vibrated as the concrete mix was poured into it The vibration has two functions. It enabled the mix to fill the mould completely. It release air trapped in the mix and allows compaction to take place. After mould filling removed any excess concrete which may interfere with de molding when the concrete has set Carry out final toweling when the concrete is still green, if is easier to do this to achieve a good trowel face than grinding when the concrete has set in the present study vibration table was used for vibration.
(c) Setting time
Concrete product was usually being de-molded 12 to 18 hours after casting.
(d) De-Moulding:
It took more time to de-mould. Clean and re-apply release agent that it does to fill the mould. A steady force is quicker and more effective than hammering the mould. It also causes less damage if a product is overstressed on demoulding it may crack at a later date. Therefore, demoulding should be carried out with care. Concrete products should be carried out with care. Concrete products should not be allowed to dry out after demoulding before being put into cure. The mould was cleaned as soon as possible after demoulding.
(e) Release agent
It was considered best to use as little release agent as possible. Only a thin film is necessary. Excess release agent collecting in the bottom of the mould will cause discoloration. Release agent was applied by impregnated sponges or cloths.

(f) Curing

Concrete products with low water cement ratio can rapidly dry out it this occurs before hydration is complete. The cement never achieves its full strength and the concrete properties are adversely affected. To ensure compete hydration. It was essential that products were kept moist immediately after demoulding and during the curing period. Several methods of achieving this are currently in use, including storage in humidity chamber or fog room, sealing in polythene bags, or total immersion in water. Concrete products will achieve a substantial proportion of their ultimate strength when the main cure is carried out for 7 and 28, in humidity of greater than 95% RI-I and with a minimum temperature of 20°C. A suitable post-curing regime will allow the remainder of the strength to be achieved.

Table. 1 Layout of experimental specimen design of cubes with concrete and different replacement

Sr.No.	Specimen Design	Replacement		Size (mm) L×B×H	W/C
		C.W.	S.P.		
1	O_1	0%	0%	100×100×100	0.46
	O_2	0%	0%	100×100×100	0.46
	O_3	0%	0%	100×100×100	0.46
2	A_1	0%	20%	100×100×100	0.46
	A_2	0%	20%	100×100×100	0.46
	A_3	0%	20%	100×100×100	0.46
3	E_1	10%	20%	100×100×100	0.46
	E_2	10%	20%	100×100×100	0.46
	E_3	10%	20%	100×100×100	0.46
4	F_1	20%	20%	100×100×100	0.46
	F_2	20%	20%	100×100×100	0.46
	F_3	20%	20%	100×100×100	0.46
5	G_1	20%	30%	100×100×100	0.46
	G_2	20%	30%	100×100×100	0.46
	G_3	20%	30%	100×100×100	0.46
6	H_1	20%	40%	100×100×100	0.46
	H_2	20%	40%	100×100×100	0.46
	H_3	20%	40%	100×100×100	0.46

2.3 Testing of the specimens

Compressive, split tensile and flexure strength of cubes, cylinders and beams have been determined as per IS 516-1959 at a loading rate of about 140 kg/cm2/min (about 30 tones per minute) on 2000 tons AIMIL compression testing machine and flexure testing machine.

Figure 1 Compressive Strength Testing Machine

Figure 2 Photographic view of specimen

III. Experimental outcomes

Table 2 Compressive Strength of Cubes are shown in following table.

S.No.	Specimen Design	Replacement		Compressive Strength	
		C.W.	S.P.	In MPa	
				7 days	28 days
1	O	0%	0%	20	25
2	A	0%	20%	22.67	34.67
3	E	10%	20%	16.67	34
4	F	20%	20%	17.67	32
5	G	20%	30%	21	31.67

6	H	20%	40%	15.66	27.34

Figure 3 shows that compression of compressive strength with different compositions :o (0%,0%) a(0%,20%) e(10%,20%) f(20%,20%) g(20%,30%) h(20%,40%) of ceramic waste and stone powder. The compressive strength of specimen after twenty days are higher than seven days .

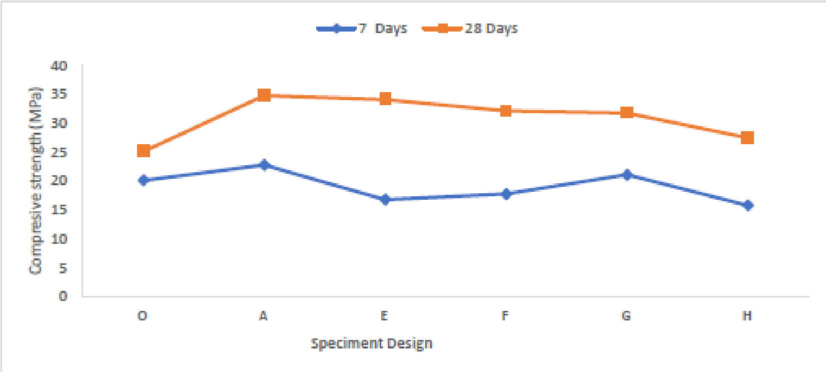

Figure 3 Varication of compressive strength on compositions of ceramic waste and stone powder

IV. CONCLUSION

Sustainable development key towards improving living conditions of the future generation thus recycling waste is only rational and logical step towards conservation of natural resources.

The results shows that ceramic waste and stone powder are suitable for usage as substitution for fine aggregate and more significantly on making of concrete.

REFERENCES

[1]. B.V.Bahoria, Dr.D.K.Parbat, Dr.P.B.Naganaik, Dr.U.P.Waghe, "Comprehensive literature review on use of waste product in concrete", IJAIEM Volume 2, Issue 4, April 2013

[2]. Chandana Sukesh, Bala Krishna Katakam, P Saha and K. Shyam Chamberlin, "A Study of Sustainable Industrial Waste Materials as Partial Replacement of Cement" , IPCSIT vol. 28 (2012) © (2012) IACSIT Press, Singapore.

[3]. A.V.S.Sai. Kumar, Krishna Rao, " Study on Strength of Concrete With Partial Replacement Of Cement With Quarry Dust And Met kaolin ", International Journal of Innovative Research in Science, Engineering and Technology Vol. 3, Issue 3, March 2014.

[4]. P.S.Kothai1, Dr.R.Malathy "Utilization Of Steel Slag In Concrete As A Partial Replacement Material for Fine Aggregates", International Journal of Innovative Research in Science, Engineering and Technology Vol. 3, Issue 4, April 2014.

[5]. Amarnath Yerramala, "Properties of concrete with eggshell powder as cement replacement", The Indian Concrete Journal October 2014

[6]. R. Kamala, B. Krishna Rao, "Reuse of Solid Waste from Building Demolition for the Replacement of Natural Aggregates", International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue- 1, October 2012.

[7]. A.M. Mustafa Al Bakri, M.N. Norazian, H. Kamarudin1, M.A.A. Mohd Salleh, and A. Alida, "Strength of Concrete Based Cement Using Recycle Ceramic Waste As Aggregate", Advanced Materials Research Vol. 740 (2013) pp 734-738 © (2013) Trans Tech Publications, Switzerland doi:10.4028/www.scientific.net/AMR.740.734

[8]. M. Iqbal Malik, Muzafar Bashir, Sajad Ahmad, Tabish Tariq, Umar Chowdhary, "Study of Concrete Involving Use of Waste Glass as Partial Replacement of Fine Aggregates", IOSR Journal of Engineering (IOSRJEN) e-ISSN: 2250-3021, p-ISSN: 2278-8719 Vol. 3, Issue 7 (July. 2013), ||V6 || PP 08-13.

[9]. Amitkumar D. Raval, Indrajit N. Patel, Jayeshkumar Pitroda, "bio-Efficient Concretes: Use Of Ceramic Powder As A Partial Replacement Of Cement", IJITEE, ISSN: 2278-3075, Volume-3, Issue-2, July 2013.

[10]. Lakshmi.R, Nagan.S, "Studies on Concrete containing E plastic waste", INTERNATIONAL JOURNAL OF ENVIRONMENTAL SCIENCES Volume 1, No 3 ,2010.

[11]. Akshay S. Shelke, Kalyani R. Ninghot, Pooja P. Kunjekar, Shraddha P. Gaikwad, "Coconut Shell as Partial Replacement for Coarse Aggregate: Review", International Journal of Civil Engineering Research. ISSN 2278-3652 Volume 5, Number 3(2014), pp. 211-214 © Research India Publications.

Ashu Singh, et. al. "Experimental investigation on compressive strength by using stone powder and ceramic waste in concrete as partial replacement of fine aggregate". *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE),* 19(4), 2022, pp. 01-05.