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A Study on Various Properties of Concrete by Using Ceramic Dust Powder as a Partial Replacement of Cement

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***Abstract*— In this research, contemplate the customary Portland Cement has been supplanted by earthenware waste powder as needs be in the scope of 0%, 5%, 10%, 15%, 20%, 25% and 30% by weight for M30 and M-40 Grade concrete and finds compressive quality and Split elasticity. Keeping this perspective, the point of the examination is to think about the conduct of concrete while supplanting the earthenware waste with diverse extents. The Wastes utilized originated from artistic industry which had been considered unfit available to be purchased because of an assortment of reasons, including dimensional or mechanical absconds, or abandons in the firing procedure.**

***Index Terms* — Tile dust powder, Super Plasticizer, Compressive strength, Split tensile strength**

I. INTRODUCTION

Concrete is comprehensively used as a major medium for construction globally it gives relatively great resistance for applied load without any deformations and long lasting Structures. But when such concrete is exposed to aggressive environment created by the prevalence of chloride ions that are common in marine/costal environment characterized by temperature extremes it is shedding a negative impact. Hot marine and coastal environments upset the condition of concrete and making it deleterious to the strength and durability characteristics thereby causing premature deterioration of concrete structures.

Introducing Reduce-Reuse-Recycle phenomenon in this industry has extensive results in reducing the hazards of pollution. The use of replacement materials offers cost education, energy savings, arguably superior products, and minimize the hazards in the environment. Usage of recycled products also changes the microstructure of the composition by participating in the hydraulic reactions.

II. EXPERMENTAL MATERIALS

A. CEMENT

The bond acquired was tried for physical prerequisites as per IS: 12269-1987. The subtle elements are given in Table. The bond affirms to 53 Grade.

PROPERTIES OF CEMENT

S.No	Property	Result
1	Specific Gravity	3.07
2	Fineness of Cement by sieving	92.50%
3	Standard Consistency	25%
4	Setting Time	
	i) Initial Setting time	65 min
	ii) Final setting time	208 min
5	Compressive Strength	
	i) 3 days	27 Mpa
	ii) 7 days	37 Mpa

B. FINE AGGREGATE (SAND)

The fine total utilized as a part of normal sand acquired from the waterway complying with reviewing zone – II of table 3 of IS 10262:2009.

PROPERTIES OF FINE AGGREGATE

S. No	Properties	Result
1	Specific gravity	2..74
2	Fineness modulus	2.82
3	Un-compacted Bulk density	1496.29 kg/m3
4	Water absorption	1.1
5	Compacted bulk density	1614.81 kg/m3

C. COARSE AGGREGATE

Aggregates of size 20 mm and 10 mm which are obtained by crushing, angular in shape are prescribed in this regard. A well sieved sample free from dust has to be used.

PROPERTIES OF COARSE AGGREGATE

S. No	Properties	Result	IS 383:1970
1	Specific gravity	2.74	**2.6-2.8**
2	Fineness modulus	6.29	**5.5-8.0**
3	Un-compacted Bulk density	1337.78 kg/m^3	-
4	Water absorption	1.10%	**<10**
5	Compacted bulk density	1496.29 kg/m^3	-

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D. WATER

This is the slightest costly and imperative element of concrete. The water, which is utilized for making arrangement, should be perfect and free from harmful polluting influences. A well known popular yard stick about water usage in concrete is if the water is drinkable the water is usable for making concrete.

S. No	Properties	Result
1	PH	7.1
2	Taste	Agreeable
3	Appearance	Clear
4	Turbidity	1.75

E. SUPPER PLASTICIZERS

Conplast SP 430 is a dim cocoa fluid which quickly scatters in water. Conplast SP 430 having the large amounts of water decrease and enhances the quality, thickness, workability without expansion in cement. Conplast SP 430 is a high range super plasticizing admixture which conforms to IS 9103 – 1999.

PROPERTIES OF CONPLAST SP 430

PROPERTIES	RESULT OBTAINED
Type	Sulphonated naphthalene formaldehyde condensate
Specific gravity	1.18 at 30^0 c
Chloride content	Nil as per is G 456 and BS: 5075
Recommended dosage	0.6-1.5 liters per 100 Kg of cement
Approximate additional air Entrainment	1% at normal dosages

F. Ceramic waste

The tile dust is obtained from RAK ceramics Industry at Samalkot. The specific gravity of tile dust is found to be 3.02 and the fineness is found o be 92.50%.

PROPERTIES OF CERAMIC POWDER

MATERIALS	CERAMIC POWDER (%)
SiO_2	63.29
Al_2O_3	18.29
Fe_2O_3	4.32
CaO	4.46
MgO	0.72
P_2O_5	0.16
K_2O	2.18
Na2O	0.75
SO3	0.1
CL-	0.005
TiO2	0.61
SrO2	0.02
Mn2O3	0.05
L.O.I (Loss of Ignition)	1.61

III. MIX DESIGN

Bureau of Indian Standards has recommended step by step procedure for mix design. Here the mix design procedure as per IS:0262:2009. The variation of strength of hardened concrete using tile dust powder as partial replacement of cement is stu died by casting 3 cubes and cylinders for each and every repl acementThe specimens were tested for compression and split tensile strengths by using Compression Testing Machine after curing period of 7days, 28 days.

MIX PROPORTIONS OF M30 GRADE CONCRETE

Materials	Normal Concrete	Ceramic powder					
		5%	10%	15%	20%	25%	30%
Cement (kg/m3)	437.77	415.89	394.01	372.13	350.25	328.37	306.49
Ceramic powder (Kg/m3)	0	21.88	43.76	65.64	87.52	109.4	131.28
Fine aggregate (kg/m3)	767.92	767.92	767.92	767.92	767.92	767.92	767.92
Coarse aggregate (kg/m3)	1043.21	1043.21	1043.21	1043.21	1043.21	1043.21	1043.21
(Conplast SP 430) % by weight of binder	0.6	0.6	0.6	0.6	0.6	0.6	0.6

MIX PROPORTIONS OF M40 GRADE CONCRETE

Materials	Normal Concrete	Ceramic powder					
		5%	10%	15%	20%	25%	30%
Cement (kg/m3)	492.5	467.88	443.26	418.64	394.02	369.4	344.78
Ceramic powder (Kg/m3)	0	24.62	49.25	73.87	98.49	123.11	147.73
Fine aggregate (kg/m3)	747.01	747.01	747.01	747.01	747.01	747.01	747.01
Coarse aggregate (kg/m3)	1014.8	1014.8	1014.8	1014.8	1014.8	1014.8	1014.8
(Conplast SP 430) % by weight of binder	0.6	0.6	0.6	0.6	0.6	0.6	0.6

IV. RESULTS & DISCUSSIONS

Effect of replacement of ceramic powder as a partial replacement of cement the results of compression test and Split tensile Strength results are shown above. It is noticed that the compressive strength and Split tensile Strength of concrete increases for 15%, replacement with ceramic powder and the compressive strength and Split tensile Strength decreases for 15% and above replacement from the above figures.

From the above results the percentage replacement of ceramic powder the compressive strength and Split tensile Strength of concrete value will not obtained in early age, it will obtained in the lateral age. The above results 0%, 5%, 10%, 15%, 20%, 25% and 30% replacement of ceramic powder 7 days compressive strength value is low compared to 28 days compressive strength.

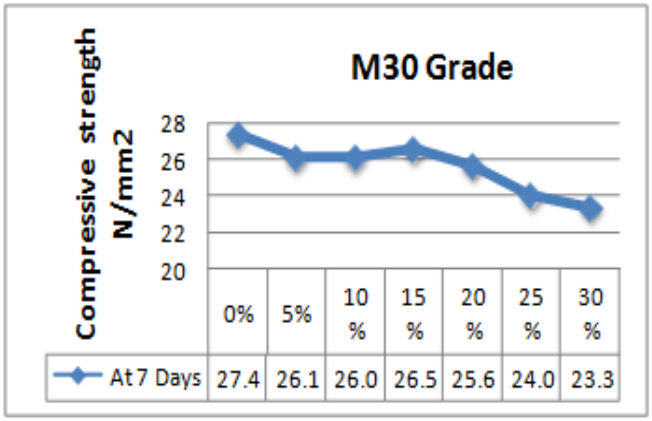
It is noticed that the compressive strength of 15% replacement of ceramic powder at 28 days strength will be higher than 0% replacement. Concrete on 15% replacement of cement with ceramic waste for M30 Grade, compressive strength obtained is 38.98 N/mm^2 and Split tensile strength obtained is 3.42 N/mm^2. Concrete on 15% replacement of cement with ceramic waste for M40 Grade, compressive strength obtained is 51.25 N/mm^2 and Split tensile strength obtained is 4.56 N/mm^2. For M30, the compressive strength of the tile dust concrete has varied from 35.09 – 38.98 MPa and the split tensile strength is varied from 2.52 – 3.42 MPa for different percentage replacements. As well as for M40, the compressive strength of the tile dust concrete has varied from 45.32 – 51.25 MPa and the split tensile strength is varied from 3.17 – 4.56 MPa for different percentage replacements.

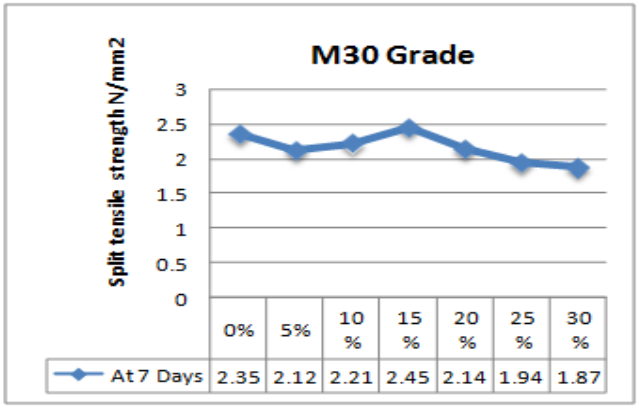
After the comparison of properties, the tile dust can be used as partial replacement for cement in concrete up to 30% replacement. But it is observed that the strength decreased slightly for 20% replacement so, the strength loss is almost negligible and the decrement of strength is more for 25% and 30% replacements. Hence up to 15% replacement of cement in concrete by tile dust is considerable.

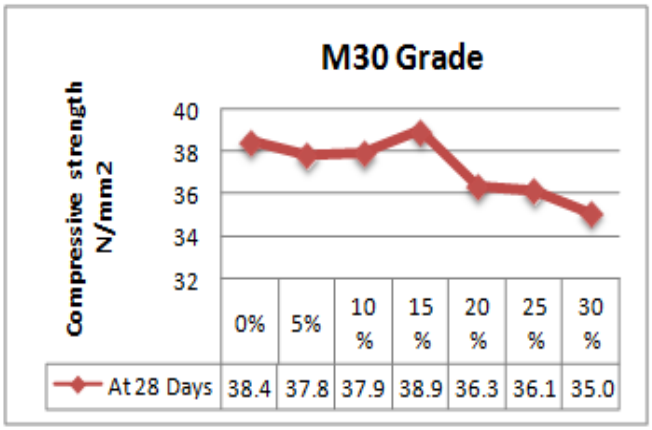
FOR M 30 GRADE CONCRETE

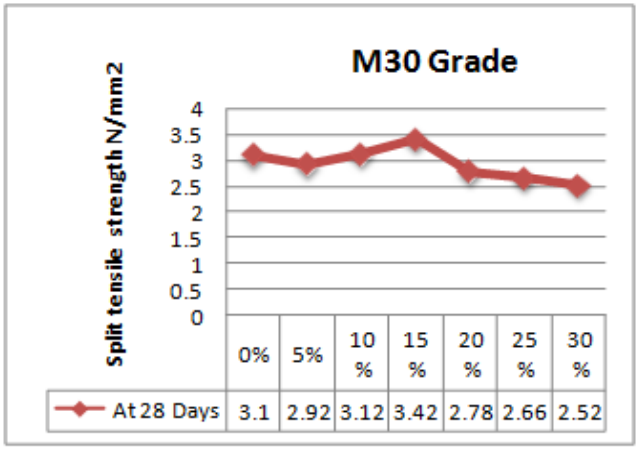
7 Days and 28 days average compressive strength (N/mm^2)

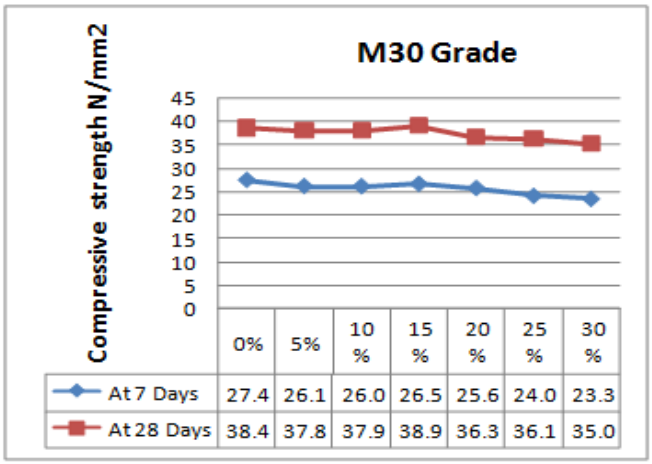
S. No	Replacement Percentage	7 Days	28 Days
1	0% replacement	27.42	38.46
2	5% replacement	26.12	37.28
3	10% replacement	26.09	37.92
4	15% replacement	26.58	38.98
5	20% replacement	25.68	36.35
6	25% replacement	24.03	36.12
7	30% replacement	23.36	35.09

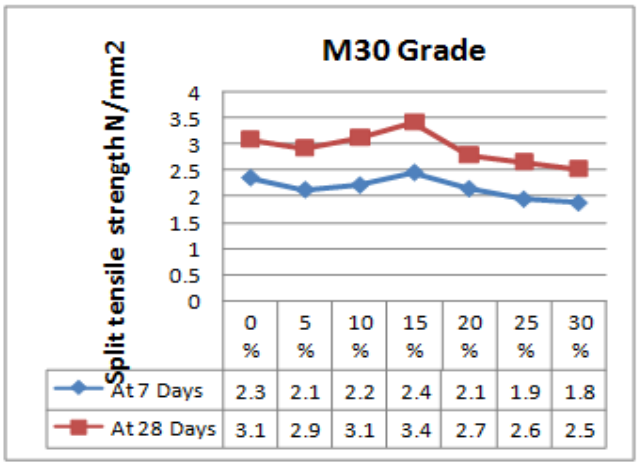










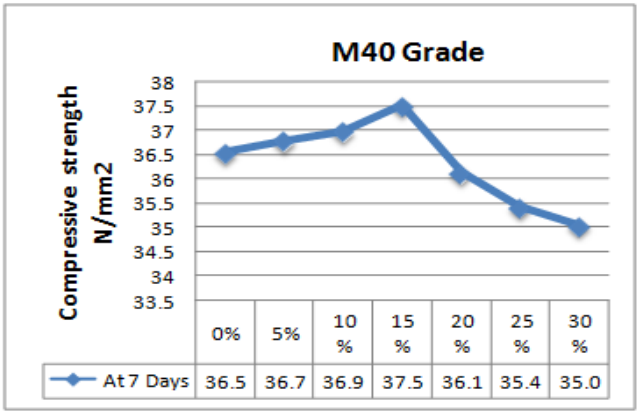


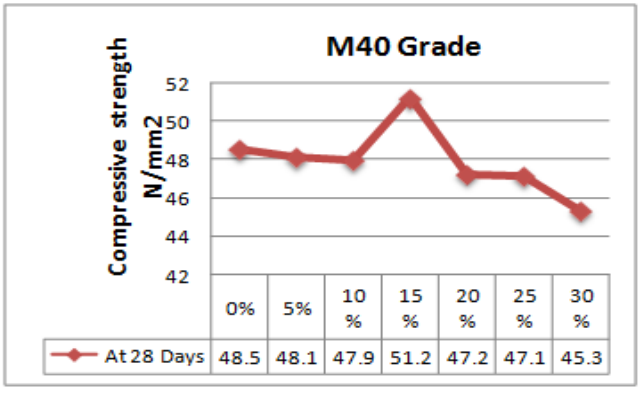
Average Split tensile strength at 7 Days and 28 days (N/mm^2)

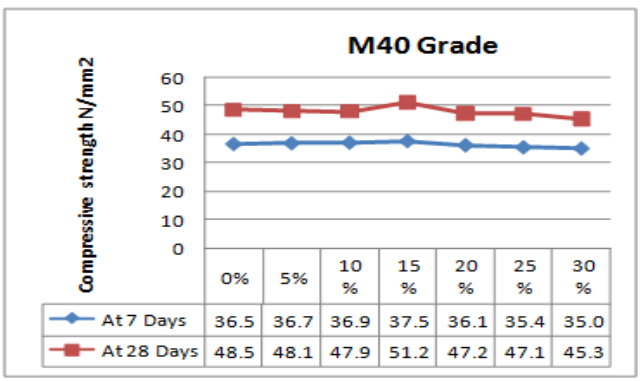
S. No	Replacement Percentage	7 Days	28 Days
1	0% replacement	2.35	3.1
2	5% replacement	2.12	2.92
3	10% replacement	2.21	3.12
4	15% replacement	2.45	3.42
5	20% replacement	2.14	2.78
6	25% replacement	1.94	2.66
7	30% replacement	1.87	2.52

FOR M 40 GRADE CONCRETE
7 Days and 28 days average compressive strength (N/mm^2)

S. No	Replacement Percentage	7 Days	28 Days
1	0% replacement	36.54	48.56
2	5% replacement	36.78	48.12
3	10% replacement	36.98	47.98
4	15% replacement	37.52	51.25
5	20% replacement	36.12	47.24
6	25% replacement	35.42	47.15
7	30% replacement	35.04	45.32







V. CONCLUSIONS

1. The chemical compositions of ceramic tile powder such as SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, P_2O_5, K_2O, Na_2O, SO_3, CL, TiO_2, SrO_2, Mn_2O_3 and L.I.O are comparable with that of cement.
2. The Compressive Strength of M30 & M40 grade concrete increases when the replacement of cement with ceramic waste is up to 15% by weight of cement, and further replacement of cement with ceramic powder decrease the compressive strength.
3. The Split tensile Strength of M30 & M40 grade concrete increases when the replacement of cement with ceramic waste is up to 15% by weight of cement, and further replacement of cement with ceramic powder decrease the Split tensile strength.
4. On 15% replacement of cement with ceramic waste, compressive strength and Split tensile strength obtained is more and the cost of the concrete is reduced, hence it is more economical without compromising concrete strength. It becomes technically and economically feasible.
5. Utilization of artistic waste and its application are utilized for the improvement of the construction.
6. Using ceramic wastes in concrete can solve several environmental problems.
7. By the use of waste material such as ceramic waste, usage of concrete industry's waste products is increased by 20%.
8. Since the quantity of binders is optimized, the cracks, shrinkage and other draw backs due to fineness can be avoided.
9. The combination of mineral admixture will improve not only strength, also workability so it is recommended to use the ceramic powder as partial replacement of Cement.
10. The compressive strength and Split tensile strength of ceramic concrete increases up to 15% replacement and it is decreased at more than 15% replacement so that the percentage of replacement is only considered up to 15%.
11. The strength was not getting at earlier stage so we go for 56 days and 90 days curing period that may be chances to increase the strength of the ceramic concrete.

REFERENCES

[1] **AmitKumar D. Raval, Indrajit N. Patel, Jayeshkumar Pitroda** led by Use of Ceramic Powder As A halfway Replacement of Cement. and concluded that Compressive strength of M25 grade concrete increases up to 30% by weight of cement.

[2] **D.Tavakolia, A.Heidari*,B andM.Karimian** Department of Civil Engineering, Najafabad Branch, Islamic Azad University, Najafabad.

[3] **ASTM C 125, Standard Terminology** Relating to Concrete and Concrete Aggregate, 1994 Annual Book of ASTM Standards.

[4] **Piccolroaz, D. Bigoni and A.Gajo,** an elastoplastic structure for granular materials getting to be durable through mechanical densification. Part I – little strain plan. European Journal of Mechanics A:Solids, 2006, 25, 334-357

[5] **Ceramic Manufacturing Industry, EUROPEAN COMMISSION, August 2007 (4) Cesar Medinal, M.ISanchez de Rojas, Moises Frias and Andres Juan**, "Using Ceramic Materialos in Ecoefficient Concrete and Precast Concrete Products", Spain

[6] **I.B.Topcu and M.Canbz,** "utilization of crushed tile as aggregate in concrete", Iranian Journal of Science & Technology, Transaction B, Engineering, Vol. 31, No.B5, pp. 561-565, 2007.

[7] **P.K. Mehta**, Puzzolanic and cementitious by products as mineral admixtures for concrete, fly ash, silica fume, slag and other mineral by products in concrete, ACI SP (79)(01)(1983)
[8] **Sustainable Development**: An Introduction, Internship Series, Volume-I, Centre for Environment Education, 2007.
[9] **Johansson, S; Andresen, P.J. (1990):**"Pozzolanic activity of calcined molder caly". Cement and concrete research. V.20,447-452.
[10] **Mielenz, R.C. (1983):** "Mineral admixtures-History and background". Concrete International, 34-42.
[11] **Binic, H.(2007).** Effect of crushed ceramic and basaltic pumice as fine aggregates on concrete mortars properties. Construction and building materials, vol.21, Issue 6, (June 2007), 1191 – 1197, 0950-0618.
[12] **Cachim, P.B. (2009)** Mechanical properties of brick aggregate concrete. Construction and building material, vol. 23, (March 2009), 1292 – 1297, 0950-0618.
[13] **Correia,J,R: de Brito.J,: Pereira, A.S. (2006).** Effects on concrete durability of using recycled ceramic aggregates. Materials and Structures, vol. 39, No.2, (March 2006), 169-177, 1359-5997.
[14] **De Brito,J.: Pereira, A.S.: Correia, J.R. (2005).** Mechanical behavior of non-Structural concrete made recycled ceramic aggregates. Cement and concrete composites, vol. 27, Issue 9 – 10, (October – November 2005), 429-433, 0958-9465.
[15] **Evangelista, I.: de Brito,J**. Mechanical behavior of concrete made with fine recycled concrete aggregates. Cement and concrete composites, vol. 29, Issue 5, (May 2007),397 -401, 0958-9465.
[16] **Guerra, I.: I.lamas, B.: Juan A.: Moran, J.M. (2009).** Eco-efficient concretes: The effects by using recycled ceramic material from sanitary installations on the mechanical properties of concrete. Waste management, Vol. 29, Issue. 2, (February 2009), 643 – 646, 0956-053X.
[17] **Koyuncu, H.: Guney, Y.: Yilmaz, G.: Koyuncy, S.: Bakis, R. (2004).** Utilization of ceracic wastes in the construction sector. Key Engineering material, vol. 264- 268,2509 -2512, 1662-9795.
[18] **Bensted, J. & Munn, J. 2001**. A discussion of the paper "The use waste ceramic tile in cement production" by N. Ay and M. Unal. Cement and Concrete Research, 31, 161-162.
[19] O. Zimbili, W. Salim, M. Ndambuki (2014), A Review on the Usage of Ceramic Wastes in Concrete Production.

CODE BOOKS

[1] IS 10**26**2-2009 Indian standard concrete mix proportioning guide lines.
[2] IS 456:2000 Indian standard plain and reinforced concrete code of practice.
[3] IS 383:1970 Specification for coarse and fine aggregate from natural resources for Concrete (Second revision)
[4] IS 2386 (Pt 1-8) Methods of tests for aggregate for concrete.
[5] IS 516:1959 Methods of tests for Testing of concrete.
[6] IS 12269 - 1987 Specifications for 53 Grade Cement
[7] IS 9103-1999 Admixtures