EXPERIMENTAL INVESTIGATION ON DURABILITY PROPERTIES OF PORTLAND POZZOLANA CEMENT CONCRETE BY USING CERAMIC WASTE AND QUARRY DUST AS PARTIALLY REPLACEMENT OF FINE AGGREGATE

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Abstract : ***Increase in industrialization and urbanization, the use of buildings also increased which results in continuous usage of construction material leads to scarcity of the concrete materials. To overcome the issues many research were done to use many industrial waste as alternative or substantial material for concreting. In this project control concrete is casted for M40 grade and the partial replacement of concrete materials were decided to reuse industrial waste such as ceramic waste powder as fine aggregate replacement in range of 10%,15%,20%,25%,30%,40% by weight of sand and the quarry dust as fine aggregate replacement in 10%,15%,20%, 25%,30%,40% by weight of fine aggregate. Were casted and tested for durability (acid resistance test, sulphate attack test, alkalinity test, rcpt and water permeability) at 28, 56, 90 days curing of concrete. The obtained results are compared with M40 grade conventional concrete.***

Key Words: ***Quarry dust , Ceramic powder, compressive test, durability tests, etc.***

I. INTRODUCTION

Concrete is mainly a composite material used throughout the world. It is obtained by combining adequate quantities of synthetic materials, gravel and water. The term "concrete" derives from the Latin word "concrescere", which means it develops together. Concrete consists of three basic compounds, cement, first class and coarse mixture. The best cement is made in these additives. And each quality and coarse amount is clearly taken. This is another major issue, with the destruction of the surrounding areas noticeably and the disposal of large-scale demolition waste. Therefore, these problems can be cleared by using concrete waste, rice coarse, ash, quarry waste, marble waste and ceramic waste in concrete. This can save the environment and equipment is easily available and cheaper. In this study ceramic waste and quarry dust are used in sand. Earlier studies these wastes are already being used in concrete. But in some studies they are partially used and in some studies they are used in transparent. But each section of these disciplines is used parallel, but each part of these disciplines is used in parallel.

II.LITERATURE REVIEW

N.Naveen Prasad (2016): Crushed waste tiles and Granite powder were used as a replacement to the coarse aggregates and fine aggregate. The combustion of waste crushed tiles were replaced in place of coarse aggregates by 10%, 20%, 30% and 40% and Granite powder was replaced in place of fine aggregate by 10%, 20%, 30% and 40% without changing the mix design. M25 grade of concrete was designed to prepare the conventional mix. Without changing the mix design different types of mixes were prepared by replacing the coarse aggregates and fine aggregate at different percentages of crushed tiles and granite powder. Experimental investigation is carried out. The 9 workability of concrete increased with increase in granite powder and it has been observed that the compressive strength is maximum at 30% of coarse aggregate replacement.

Parminder Singh and Dr. Rakesh Kumar Singla (2015): A research paper on utilization of ceramic waste tiles from industries. A partial replacement to coarse aggregate has been studied. Three different grades of concrete has been prepared and tested. The results are not appropriate with the conventional but considering the strength properties, it is advisable to use ceramic tile aggregate in concrete. It is finally concluded that, about 20% of ceramic tile usage in M20 grade of concrete is preferable.

Paul O. Awoyera (2016): The usage of ceramic tiles in concrete was observed in this paper. In this, both the coarse and fine aggregates are replaced with ceramic fine and ceramic coarse aggregates obtained from construction sites of Ota, Lagos and Nigeria in various percentages. The ceramic fine and coarse aggregates are replaced in conventional concrete individually and the strength parameters are studied. Finally, it states that usage of ceramic waste in concrete gives considerable increase in strength compared to conventional concrete.

P. Rajalakshmi (2016): Use of ceramic waste will ensure an effective measure in maintaining environment and improving properties of concrete. The replacement of aggregates in concrete by ceramic wastes will have major environmental benefits. In ceramic industry about 30% production goes as waste. The ceramic waste aggregate is hard and durable material than the conventional coarse aggregate. It has good thermal resistance. The durability properties of ceramic waste aggregate are also good. This research studied the fine aggregate replacement by ceramic tiles fine aggregate accordingly in the range of 10% and coarse aggregate accordingly in the range of 30%, 60%,100% by weight of M-30 grade concrete. This paper recommends that waste ceramic tiles can be used as an alternate construction material to coarse and fine aggregate in concrete irrespective of the conventional concrete, it has good strength properties i.e., 10% CFA and 60% CCA being the maximum strength.

Aneesh Thankachan ceramic materials as partial replacement for fine and coarse aggregate. The attempt has been made to compare, the 7 days and 28 days compressive strength, splitting tensile strength and flexural strength of ceramic concrete with the normal concrete of M25 grade with maintaining the water cement ratio 0.45. The objective of this study is to develop concrete with good strength, less porous, less capillarity, eco- friendly concrete. For this purpose, the experiment has been carried out on M25 grade of concrete, using ceramic materials as partial replacement in different percentage 0%, 10%, 20%, 30% to the weight of fine and coarse aggregate

Amit Kumar D. Raval, Indrajit N. Patel, Jayesh Kumar Pitroda Use of Ceramic Powder as a Partial Replacement of Cement the OPC cement has been replaced by ceramic waste powder accordingly in the range of 0%, 10%, 20%, 30% ,40%, & 50% by weight forM-25gradeconcrete**.**The Compressive Strength of

M25 grade concrete improved while the replacement of cement with ceramic waste as much as 30% by weight of cement and further replacement of cement with ceramic powder the compressive electricity reduced.

Kapugamage and Amara Siri (2009) Suggested that the loss in early energy due to the addition of 15 % fly ash may be completely negated by the addition of 30 % quarry dust. The power at 28-day age has now not been adversely affected in any respect by means of the addition of as much as 30 % fly ash. The addition of quarry dirt reasons a loss in stoop although such loss in sump can be drastically decreased with the aid of the addition of fly ash. Replacement best mixture through crusher dust as much as 50% with the aid of weight has a negligible impact at the reduction of a compressive strength, flexural electricity, cut up tensile power and so forth. Water absorption is nicely below the restriction as in step with Indian codes. Durability test shows no variation for exceptional replacements of quarry dust. The Choice of quarry dust as substitute of sand has been supported the previous examine

Divakar. (2012) have experimental on the behaviour of M20 grade concrete with use of granite fines as a partial replacement for 5%,15%,25% ,35% and based on The results obtained for Compressive Strength, split tensile and flexural tests, it was recommended 35% of sand can be replaced by granite fines

Mahzuz (2011) Have investigated on the use of stone powder in concrete as an opportunity of sand the usage of 3 concrete blend proportions,1:1.5:3, 1:2:4, and 1:2.5:5, when the effects of compressive strength have been as compared for those mixes Between use of stone crusher, it became discovered that stone powder gives better fee Than sand with the aid of approximately 14.76%,4%, and 10.44% respectively.

IV.MATERIAL DESCRIPTION

Materials:

In the present investigation the 53 grade PPC, ceramic powder, quarry dust, natural sand, crushed granite aggregates are used.

Cement :

Portland Pozzalona cement of 53 grade manufactured by Zuari cement company confirmed IS: 1489 -1 (1991) is used. The various properties of cement as shown in table-1.

Table -1 Pysical properties of materials

Materials	Properties
Cement	Specific Gravity-2.89
	Normal consistency-29%
	Initial Setting-30 min
	Final Setting -5 hours

Fine aggregate :

Sand as high-quality aggregates are amassed from domestically available river and the sieve analysis of the samples are done. Fine combination conforms to Grading Zone -II as according to IS:383-1970.Fineness modulus of fine combination is calculated from table 3.2. IS 383-1970 values shown in table 3.3. The various properties of fine aggregate as shown in table-2.

Table -2 Test Results on Fine Aggregate(IS 383-1970**)**

Properties	Results obtained	IS 383(Value)
Specific gravity	2.65	2.5-3.0
Finess modulus	2.74	2-3.5
Water absorption	0.26%	2%

Weight of fine aggregate is taken = 1000 grm

Coarseaggregate

In the present investigation locally available crushed granite stone aggregate of size 20mm passing and retainedin 10mm IS sieve used and the various tests were carried out as per IS:383-1970 part II. The coarse aggregate used contains 50% fraction between 20mm – 12.5mm and remaining 50% fraction in between 12.5mm -10mm.Specific gravity are determined found to be 2.60.

Table -3 Test Results on Coarse Aggregate (Is:383-1970)

Properties		Results obtained	Range
Shape Tests	Flakiness index	21.52%	<30%
	Elongation	26.32%	<45%

	index		
Specific Gravity Tests		2.60	2.6-2.8

Water

Ordinary potable water available locally, which is free from concentration of acid and organic substances as per IS: 456-2000, is used for all the studies and experimental investigation considered in this project.

Ceramic

Indian ceramic production is 100 Million ton per year. In the ceramic industry, about 15%-30% waste material generated from the total production. This waste is not recycled in any form at present. However, the ceramic waste is durable, hard and highly resistant to biological, chemical, and physical degradation forces. The Ceramic industries are dumping the powder in any nearby pit or vacant spaces, near their unit although notified areas have been marked for dumping. This leads to serious environmental and dust pollution and occupation of a vast area of land, especially after the powder dries up so it is necessary to dispose the Ceramic waste quickly and use in the construction industry.

Quarry Dust

Quarry dust has been used for different activities in the construction industry such as road construction and manufacture of building materials such as light weight aggregates, bricks, and tiles. The use of quarry dust in concrete is desirable because of its benefits such as useful disposal of byproducts, reduction of sand consumption as well as increasing the strength parameters and increasing the workability of concrete (Jain et. al., 1999). Attempts have been made to investigate some property of quarry dust and the suitability of those properties to enable quarry dust to be used as partial replacement material for sand in concrete.

Table -4 Chemical Properties of Quarry Dust & Ceramic Waste

Constituents	Quarry Dust (%)	Ceramic waste (%)
SiO_2	62.48	63.29
Al_2O_3	18.72	18.29
Fe_2O_3	6.54	4.32
CaO	4.83	4.46
MgO	2.56	0.72
Na_2O	Nil	0.75
K_2O	3.18	2.18
TiO_2	1.21	0.61
Loss of ignition	0.48	1.61

V.MIX PROPORTIONING

In the present investigation M40 grade concrete mixtures were used with a constant W/C ratio 0.4. M40 grade concrete and the mix proportional 1:1.4:2.65. Concrete specimens were prepared varying the percentage of replacement of fine aggreagate with ceramic waste & quarry dust by 0%,10%,15%,20% ,25%,30%,40%. Mix designations and binding materials show below table. 5

Table -5 Mix designations and binding materials

S.No	Mix	Binding materials
1	A1,B1,C1	Conventional PPC concrete.
2	A2	10% ceramic waste + 90% fine aggregate
3	A3	15% ceramic waste +85% fine aggregate
4	A4	20% ceramic waste +80% fine aggregate
5	A5	25% ceramic waste +75% fine aggregate
6	A6	30% ceramic waste +70% fine aggregate
7	A7	40% ceramic waste +60% fine aggregate
8	B2	10% Quarry Dust + 90% fine aggregate
9	B3	15% Quarry Dust + 85% fine aggregate
10	B4	20% Quarry Dust + 80% fine aggregate
11	B5	25% Quarry Dust + 75% fine aggregate
12	B6	30% Quarry Dust + 70% fine aggregate
13	B7	40% Quarry Dust + 60% fine aggregate
14	C2	10% ceramic waste+ 10% Quarry dust+80% fine aggregate
15	C3	15% ceramic waste+ 15% Quarry dust +70% fine aggregate
16	C4	20% ceramic waste+ 20% Quarry dust+60% fine aggregate
17	C5	25% ceramic waste+ 25% Quarry dust+50% fine aggregate
18	C6	30% ceramic waste+ 30% Quarry dust+40% fine aggregate

VI.EXPERIMENTAL INVESTIGATION

Casting and curing of concrete:

IS standard cube sizes of 150 mm X 150mm X 150mm were cast from each mixture to evaluate compressive strength, acid resistance test, sulphate attack test, alkalinity test, rcpt (rapid chloride penetration test) and water permeability concrete was prepared us by manual mix.

Compressive strength test :

Compression test on cube was conducted with 2000KN capacity compression testing machine available in concrete technology laboratory at AITS, Rajampet. The experimental arrangement is shown in figure no 2. The specimens were placed centrally on the base plate of the machine and the load was applied gradually at the constant rate of 140 kg/cm^2/min till the specimen failed. The maximum load applied was noted for each test. The specimen results were calculated at 28days, 56days, 90days and tabulated. The cube compressive strengths of various concrete mixtures are presented in graphical form. The crushing strength is the ratio of failure load to the area of cross section of specimen.The cube compressive strength can be calculated as follows:

$$\text{Then } f_c = \frac{P}{A} \text{ N/mm}^2$$

The Compressive strength results for various replacement levels of ceramic powder and quarry dust By fine aggregate such as 0%,10%, 15%, 20% & 25%,30%,40% are tabulated below in table. Compressive strength of the cubes when they areϖ tested under the following parameters is given below:

Acid resistance test:

The concrete cube specimens of various concrete mixtures of size 150 mm were cast and after 28 days of water curing, the specimens were removed from the curing tank and allowed to dry for one day. The weights of concrete cube specimen were taken. The acid attack test on concrete cube was conducted by immersing the cubes in the acid water for 56,90 days after 28 days of curing. Hydrochloric acid (HCL) with pH of about 2 at 5% weight of water was added to water in which the concrete cubes were stored. The pH was maintained throughout the period of 90 days. After 90 days of immersion, the concrete cubes were taken out of acid water. Then, the specimens were tested for compressive strength. The resistance of concrete to acid attack was found by the % loss of weight of specimen and the % loss of compressive strength on immersing concrete cubes in acid water.

Sulphate attack test:

The resistance of concrete to sulphate attacks was studied by determining the loss of compressive strength or variation in compressive strength of concrete cubes immersed in sulphate water having 5% of sodium sulphate (Na2SO4) and 5% of magnesium sulphate (MgSO4) by weight of water and those which are not immersed in sulphate water. The concrete cubes of 150mm size after 28days of water curing and dried for one day were immersed in 5% Na2SO4 and 5% MgSO4 added water for 56,90days. The concentration of sulphate water was maintained throughout the period. After 56,90days immersion period, the concrete cubes were removed from the sulphate waters and after wiping out the water and girt from the surface of cubes tested for compressive strength following the procedure prescribed in IS: 516-1959. This type of accelerated test of finding out the loss of compressive strength for assessing sulphate resistance of concrete Mehta and Burrows (2001).

Alkalinity test:

To determine the resistance of various concrete mixtures to alkaline attack, the residual compressive strength of concrete mixtures of cubes immersed in alkaline water having 5% of sodium hydroxide (NaOH) by weight of water was found. The concrete cubes which were cured in water for 28 days were removed from the curing tank and allowed to dry for one day. The weights of concrete cube specimen were taken. Then the cubes were immersed in alkaline water continuously for 56,90 days. The alkalinity of water was maintained same throughout the test period. After 56,90 days of immersion, the concrete cubes were taken out of alkaline water. Then, the specimens were tested for compressive strength. The resistance of concrete to alkaline attack was found by the % loss of weight of specimen and the % loss of compressive strength on immersion of concrete cubes in alkaline water.

Water permeability:

The determination of water penetration depth is specified by BS EN- 12390-8:2000. In this test, water was applied on the face of the 150mm diameter concrete specimen under a pressure of 5 kg/cm^2 constant pressure maintained for a period of 72 h. After this period, the specimens were taken out and split into halves. The water penetration contour in the concrete surface was marked and then maximum depth of penetration value was recorded as water penetration. This test was conducted after at 28,56 & 90 days age of concrete cubes.From the depth of penetration, mass of water penetrated, pressure and time the coefficient of permeability of concrete mixtures was calculated using the formula

$$K = \frac{D2v}{2ht}$$

D= depth of penetration of water
V= fraction of volume of water penetrated
t= time under pressure in m
h= hydraulic head in m
V is calculated by using the expression

$$v = \frac{1000M}{A.d}$$

M = gain in mass (mass of water penetrated)
A = Cross sectional area of concrete (mm^2)
d = depth of penetration in mm

From RCPT the total charge passed through the concrete is measured and these values indicate the quality of concrete. Electrical resistivity of concrete represents moving ions in pore solution and thus the relationship between electrical resistivity and chloride permeability can be taken as reasonable.

Rcpt (rapid chloride permeability test):

The rapid chloride permeability test is conducted as per ASTM C 1202 on water- saturated, 50mm thick, 100mm diameter concrete specimens as which were subjected to a 60v applied DC voltage for 6 hours using the RCPT apparatus. In one reservoir a 3.0% NaCl solution and in the other reservoir is a 0.3M NaOH solution were used. The electrical resistivity provides some information about the interconnected pore network in the concrete and by extension about its resistance to the penetration of chloride ions. The total charge passed is determined and this is used to rate the concrete according to the criteria furnished in table6.

Table -6 RCPT ratings as (per ASTM C1202)

Charge passed (coulombs)	**Chloride ion permeability**
>4000	High
2000-4000	Moderate
1000-2000	Low
100-1000	Very low
<100	Negligible

From RCPT the total charge passed through the concrete is measured and these values indicate the quality of concrete. Electrical resistivity of concrete represents moving ions in pore solution and thus the relationship between electrical resistivity and chloride permeability can be taken as reasonable.

VII.EXPERIMENTAL RESULTS AND DISCUSSION

The M_{40}grade of concrete with ceramic powder and quarry dust was tested for compressive strength, acid attack, sulphate attack, alkalinity attack, Chloride ion penetration and water permeability.

Effect of ceramic powder and quarry dust on compressive strength @ normal curing at 28,56 & 90 days

The results of characteristic compressive strength of concrete at 28, 56 and 90 days are given in Table 7. Normal water curing of concrete mixes are measured in terms of compressive strength. A batch of specimens after normal curing compressive test is shown in Fig.1. Characteristic compressive strength of A1, A2, B2 and C2 are found to be 50.5 Mpa, 51.8 Mpa,50.3 MPa and 52.3 MPa, respectively. It was expected that increase in aging period of ceramic powder and quarry dust will increase the characteristic compressive strength of concrete. Characteristic compressive strength of C mixes with ceramic powder and quarry dust ranged between 44.7 MPa and 53.7 MPa. It was observed that characteristic compressive strength increases as the aging period of ceramic powder and quarry dust was increased. Highest characteristic compressive strength was achieved in mix C (after 28,58,90 days of aging of ceramic powder and quarry dust), which is 11.95%, 8.85% and 20.134% more than that of conventional concrete (A1,B1,C1). lowest characteristic compressive strength was achieved in mix C6 (28,58,90 days of aging of ceramic powder and quarry dust), which is 5.71%, 7.32% less than that of conventional concrete . It is also observed that characteristic compressive strength of C5 mix attains high strength in comparing conventional concrete.

Table -7 Compression test result @ normal curing

Mix designation	Compressive strength N/mm² Duration period (Days)		
	28	56	90
A1	43.5	48.9	50.5
A2	44.2	47.6	51.8
A3	44.7	48.3	50.3
A4	45.9	46.3	48.8
A5	47.3	49.7	51.2
A6	48.1	49.8	52.1
A7	44.7	47.9	50.3
B2	45.1	48.2	52.5
B3	46.7	49.8	48.7
B4	48.4	50.5	51.4
B5	46.2	47.8	49.8
B6	48.8	51.1	52.1
B7	43.9	49.2	47.2
C2	46.1	49.6	52.3
C3	47.8	48.7	51.3
C4	47.6	50.4	53.7
C5	48.7	50.2	52.4
C6	41.6	46.1	46.8

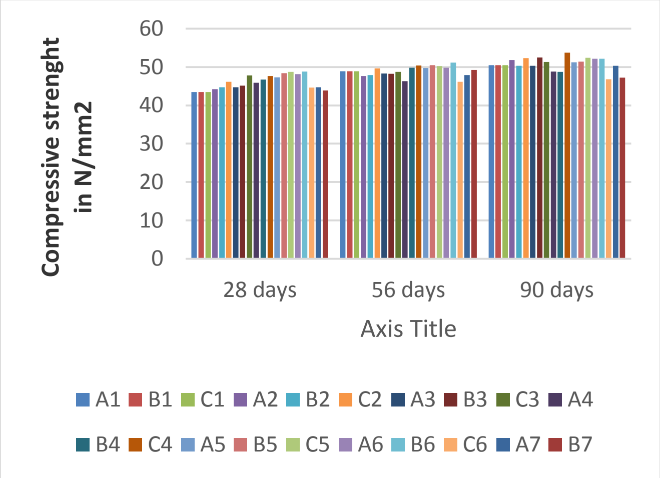

Fig:1 Compression test results (Normal curing)

Effect of ceramic powder and quarry dust on compressive strength @ acid curing at 56 & 90 days

The results of characteristic compressive strength of concrete at 56 and 90 days are given in Table 8. Acid water curing of concrete mixes are measured in terms of characteristic compressive strength. A batch of specimens after normal curing compressive test is shown in Fig.2. Characteristic compressive strength of A1, A2, B2 and C2 are found to be 50.5 Mpa, 51.8 Mpa,50.3 MPa and 52.3 MPa, respectively. It was expected that increase in aging period of ceramic powder and quarry dust will increase the characteristic compressive strength of concrete. Characteristic compressive strength of C mixes with ceramic powder and quarry dust ranged between 41.9 MPa and 49.47 MPa. It was observed that characteristic compressive strength increases as the aging period of ceramic powder and quarry dust was increased. Highest characteristic compressive strength was achieved in mix C (after 58,90 days of aging of ceramic powder and quarry dust), which is 15.62%, 18.85% more than that of conventional concrete (A1,B1,C1). lowest characteristic compressive strength was achieved in mix C6 (58,90 days of aging of ceramic powder and quarry dust), which is 4.36%, 5.5% less than that of conventional concrete . It is also observed that characteristic compressive strength of C5 mix attains high strength in comparing conventional concrete.

Table -8 Compression test result @ acid curing

Mix designation	Compressive strength N/mm² Duration period (Days)	
	56	90
A1	41.6	41.9
A2	42.4	44.2
A3	38.9	41.5
A4	39.7	42.4
A5	41.5	44.8
A6	46.2	47.2
A7	43.3	44.2
B2	41.7	44.2
B3	42.4	46.7
B4	46.7	45.1
B5	42.1	43.3
B6	47.7	48.6
B7	42.4	45.1
C2	47.8	50.5
C3	46.3	49.5
C4	47.2	46.7
C5	48.1	49.8
C6	45.3	47.3

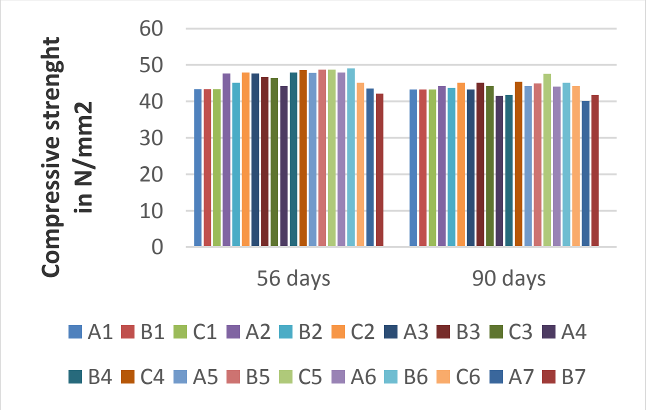

Fig:2 Compression test results (Acid curing)

Effect of ceramic powder and quarry dust on compressive strength @ alkalinity curing at 56 & 90 days

The results of characteristic compressive strength of concrete at 56 and 90 days are given in Table 9. Alkalinity water curing of concrete mixes are measured in terms of characteristic compressive strength. A batch of specimens after alkalinity curing compressive test is shown in Fig.2. Characteristic compressive strength of A1, A2, B2 and C2 are found to be 50.5 Mpa, 51.8 Mpa,50.3 MPa and 52.3 MPa, respectively. It was expected that increase in aging period of ceramic powder and quarry dust will increase the characteristic compressive strength of concrete. Characteristic compressive strength of C mixes with ceramic powder and quarry dust ranged between 43.1 MPa and 49.6 MPa. It was observed that characteristic compressive strength increases as the aging period of ceramic powder and quarry dust was increased. Highest characteristic compressive strength was achieved in mix C (after 56,90 days of aging of ceramic powder and quarry dust) which is 12.47%, 15.08% more than that of conventional concrete (A1,B1,C1). lowest characteristic compressive strength was achieved in mix C6 (56,90 days of aging of ceramic powder and quarry dust), which is 2.36%, 2.5% less than that of conventional concrete . It is also observed that characteristic compressive strength of C5 mix attains high strength in comparing conventional concrete.

Table -9 Compression test result @ alkalinity curing

Mix designation	Compressive strength N/mm² Duration period (Days)	
	56	90
A1	44.3	43.1
A2	43.3	47.9
A3	44.2	46.1
A4	42.4	47.5
A5	45.1	48.7
A6	46.1	48.3
A7	41.1	43.7
B2	44.7	47.4
B3	46.1	49.3
B4	48.7	47.1
B5	48.5	49.6
B6	47.9	47.2
B7	41.3	42.4
C2	46.9	49.7
C3	45.1	48.6
C4	47.9	48.7
C5	48.7	49.6
C6	43.3	42.8

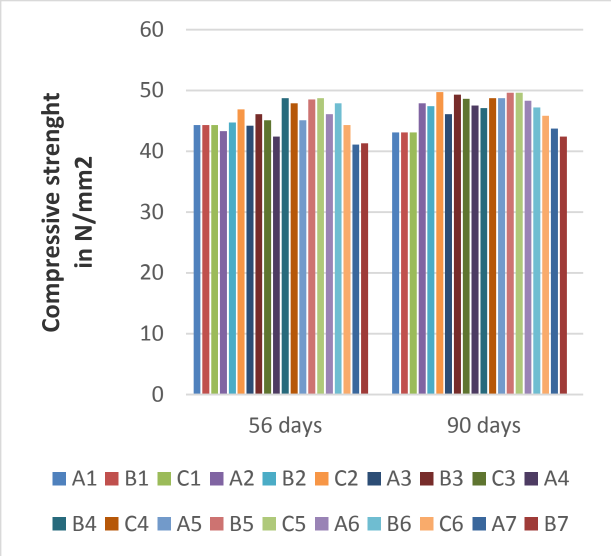

Fig:3 Compression test results (Alkalinity curing)

Effect of ceramic powder and quarry dust on compressive strength @ sulphate curing at 56 & 90 days

Table -10 Compression test result @ sulphate curing

Mix designation	Compressive strength N/mm² Duration period (Days)	
	56	90
A1	43.4	44.3
A2	47.7	44.2
A3	47.7	43.3
A4	44.2	41.5
A5	47.8	44.2
A6	47.9	44.1
A7	43.5	40.1
B2	45.1	43.7
B3	46.7	45.1
B4	47.9	41.8
B5	48.7	44.9
B6	49.1	45.1
B7	42.1	41.8
C2	47.9	45.1
C3	46.4	44.2
C4	48.6	45.4
C5	48.7	47.6
C6	42.1	43.2

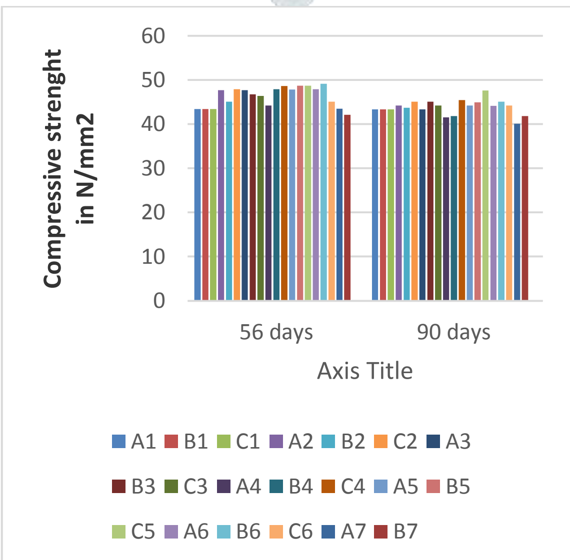

Fig:4 Compression test results (sulphate curing)

The results of characteristic compressive strength of concrete at 56 and 90 days are given in Table 10. sulphate water curing of concrete mixes are measured in terms of compressive strength. A batch of specimens after normal curing compressive test is shown in Fig.2. Characteristic compressive strength of A1, A2, B2 and C2 are found to be 50.5 Mpa, 51.8 Mpa,50.3 MPa and 52.3 MPa, respectively. It was expected that increase in aging period of ceramic powder and quarry dust will increase the characteristic compressive strength of concrete. Characteristic compressive strength of C mixes with ceramic powder and quarry dust ranged between 43.4 MPa and 48.7 MPa. It was observed that characteristic compressive strength increases as the aging period of ceramic powder and quarry dust was increased. Highest characteristic compressive strength was achieved in mix C5(after 58,90 days of aging of ceramic powder and quarry dust), which is 12.21%, 9.9% more than that of conventional concrete (A1,B1,C1). lowest characteristic compressive strength was achieved in mix C6 (58,90 days of aging of ceramic powder and quarry dust), which is 2.9%, 3.1% less than that of conventional concrete . It is also observed that characteristic compressive strength of C5 mix attains high strength in comparing conventional concrete.

RCPT:

From the fig 5 and table 11 it is observed that the chloride permeability is more in case of Normal concrete then it is decreased while adding ceramic waste powder and quarry dust 10%, 15%, 20% and 25% to the concrete for 28, 56 90 days of curing. The chloride permeability of concrete mix 25%ceramic powder + quarry dust 25% is less while compared with the all proportions for 90 days.

Table -11 Rcpt test results

Mix designation	Charge passed Duration period (Days)		
	28	56	90
A1	1164.6	1150.12	1148.34
A2	610.3	590.4	593.2
A3	510.3	500.4	430.1
A4	212.2	209.7	218.6
A5	197.1	185.4	187.4
A6	200.8	170.2	182.0
A7	170.2	165.9	175.9
B2	490.5	496.3	486.7
B3	356.9	348.4	343.9
B4	250.8	243.6	248.8
B5	253.4	249.5	234.5
B6	251.7	200.5	170.72
B7	240.4	251.2	204.4
C2	190.2	200.7	192.8
C3	150	140	139
C4	130	123	121
C5	119	105.3	94.8
C6	106	99	91

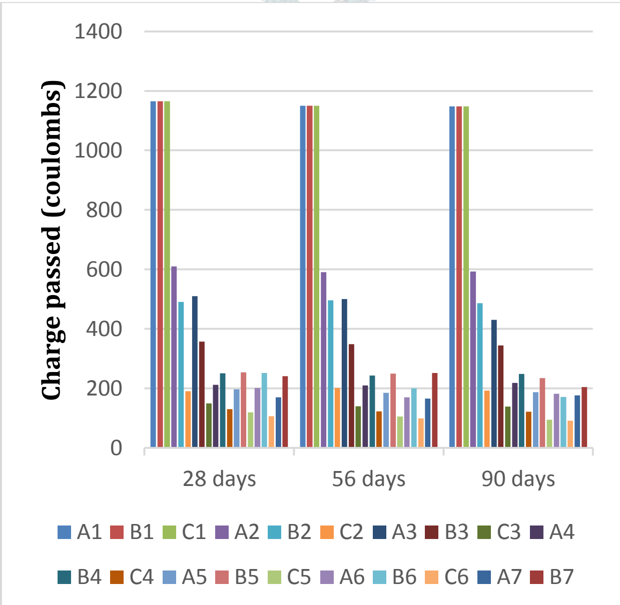

Fig:5 Rcpt test results

Water permeability:

The results of coefficient of water permeability of concrete at 28, 56 and 90 days are given in Table 12. Normal water curing of concrete mixes are measured in terms of depth of water penetration. A batch of specimens after normal curing depth of water penetration is shown in Fig.6. depth of water penetration of A1, A2, B2 and C2 are found to be 0.62×10^{-11}, 0.59×10^{-11}, 0.55×10^{-11} respectively. It was expected that dicrease in aging period of ceramic powder and quarry dust will dicrease the depth of penetration of concrete. depth of penetration of C mixes with ceramic powder and quarry dust ranged between 0.51×10^{-11} and 0.59×10^{-11}. It was observed that depth of penetration dicreases as the aging period of ceramic powder and quarry dust was dicreased. Highest depth of penetration was achieved in mix C6(after 28, 58,90 days of aging of ceramic powder and quarry dust), which is 15.21%, 17.9% more than that of conventional concrete (A1,B1,C1). lowest depth of penetration was achieved in mix C5 (28,58,90 days of aging of ceramic powder and quarry dust), which is 5.9%, 3.1% less than that of conventional concrete . It is also observed that depth of penetration of C5 mix attains low depth of penetration in comparing conventional concrete.

Table -10 Water permeability test results

Mix designation	Coefficient of permeability of water $\times10^{-11}$ Duration period (Days)		
	28	56	90
A1	0.62	0.59	0.55
A2	0.58	0.55	0.55
A3	0.59	0.57	0.58
A4	0.57	0.56	0.54
A5	0.55	0.53	0.53
A6	0.55	0.53	0.52
A7	0.63	0.61	0.55
B2	0.61	0.59	0.56
B3	0.55	0.53	0.52
B4	0.57	0.51	0.50
B5	0.54	0.53	0.52
B6	0.57	0.51	0.50
B7	0.63	0.55	0.56
C2	0.55	0.52	0.48
C3	0.56	0.58	0.48
C4	0.59	0.51	0.49
C5	0.51	0.49	0.47
C6	0.57	0.75	0.54

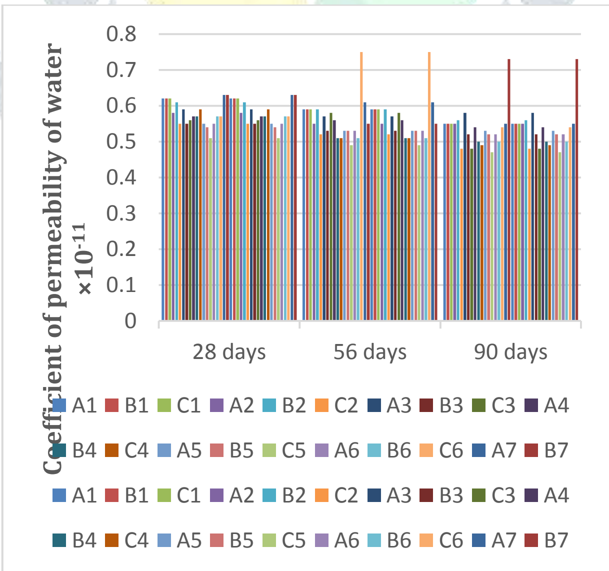

Fig:6 coefficient of water permeability

VIII. CONCLUSIONS

Here at present research M40 grade concrete is used by replacing fine aggregate ceramic powder and quarry dust with different proportion and also in combination. The durability properties are found the results are concluded as follows.

1. The characteristic compressive strength 48.7N/mm²at 28days normal mixing is maximum as C5 proportion that is 25% ceramic powder + 25% quarry dust replacing with fine aggregate compared to conventional concrete mix A1.
2. The effect of acidity is observed that for fine aggregate replacement ceramic powder. A6 is optimum that is 30% ceramic powder+ 70% fine aggregate 15.62% increased compressive strength compared to conventional concrete mix A1.
3. The effect of acidity is observed that for fine aggregate replacement quarry dust . B6 is optimum that is 30% quarry dust + 70% fine aggregate 12.47% increased compressive strength compared to conventional concrete mix A1.

4. The effect of acidity is observed that for fine aggregate replacement ceramic powder and quarry dust . C5 is optimum that is 25% quarry dust + 25% ceramic powder + 50% fine aggregate 17.47% increased compressive strength compared to conventional concrete mix A1.
5. The effect of alkalinity is observed that for fine aggregate replacement ceramic powder. A6 is optimum that is 30% ceramic powder+ 70% fine aggregate 12.62% increased compressive strength compared to conventional concrete mix A1.
6. The effect of alkalinity is observed that for fine aggregate replacement quarry dust. B5 is optimum that is 25% quarry dust + 75% fine aggregate 10.96% increased compressive strength compared to conventional concrete mix A1.
7. The effect of alkalinity is observed that for fine aggregate replacement ceramic powder and quarry dust . C5 is optimum that is 25% quarry dust + 25% ceramic powder + 50% fine aggregate 6.18% increased compressive strength compared to conventional concrete mix A1.
8. The effect of sulphate is observed that for fine aggregate replacement ceramic powder. A6 is optimum that is 30% ceramic powder+ 70% fine aggregate 10.36% increased compressive strength compared to conventional concrete mix A1.
9. The effect of sulphate is observed that for fine aggregate replacement quarry dust. B6 is optimum that is 30% quarry dust + 70% fine aggregate 8.86% increased compressive strength compared to conventional concrete mix A1.
10. The effect of sulphate is observed that for fine aggregate replacement ceramic powder and quarry dust . C5 is optimum that is 25% quarry dust + 25% ceramic powder + 50% fine aggregate 7.98% increased compressive strength compared to conventional concrete mix A1.
11. The chloride permeability of concrete mix 25%ceramic powder + quarry dust 25% is less while compared with the all proportions for 90 days.
12. The coefficient of depth of water penetration of A1, A2, B2 and C2 are found to be 0.62×10^{-11}, 0.59×10^{-11}, 0.55×10^{-11}respectively. It was expected that dicrease in aging period of ceramic powder and quarry dust will dicrease the depth of penetration of concrete.
13. Highest depth of penetration was achieved in mix C6(after 28, 58,90 days of aging of ceramic powder and quarry dust), which is 15.21%, 17.9% more than that of conventional concrete (A1,B1,C1).
14. lowest depth of penetration was achieved in mix C5 (28,58,90 days of aging of ceramic powder and quarry dust), which is 5.9%, 3.1% less than that of conventional concrete . It is also observed that depth of penetration of C5 mix attains low depth of penetration in comparing conventional concrete.

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