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Study On Compressive Strength Of Concrete With Sustainable Industrial Ceramic Waste Materials As Partial Replacement Of Cement

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ABSTRACT

Concrete is the widely used material in construction around the world and cement, a major constituent of concrete is being costly and only moderately available, researches or experiments are conducted to study the variations in the strength characteristics of concrete by replacement of cement partially or fully by cheaper or locally available materials . Ceramic waste powder is settled by alleviation and then dumped away which results in environmental pollution, in addition to forming dust in summer and menacing both agriculture and public health. Therefore, utilization of the ceramic waste powder in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the environment. In this research study the cement has been replaced by ceramic waste powder accordingly in the range of 10% 15%, 20% by weight of M30 grade. Concrete mixtures were produced, tested and compared in terms of compressive strength, split tensile strength and flexural strength to the conventional concrete. These tests were carried out to evaluate the mechanical properties for 7, 14 and 28 days. This research work is concerned with the experimental investigation on strength of concrete and optimum percentage of the partial replacement by replacing cement via 10%, 15%, 20%, of ceramic waste. Keeping all this view, the aim of the analysis is to study the performance of concrete while replacing the ceramic waste with different proportions in concrete.

Keywords: Ceramic waste powder, Compressive strength , Mechanical properties , Conventional concrete .

I.INTRODUCTION

The advancement of concrete technology can reduce the consumption of natural resources, which can be reused and find other alternatives. In India numbers of waste materials are produced by different manufacturing companies, thermal power plant, municipal solid wastes and other wastes. Solid as well as liquid waste management is one of the biggest problems of the whole world. Disposal of waste in to the land causes serious impact on environment. Now a day's large amount of tile powder is generated in tile industries with an impact on environment and humans. By using the replacement materials offers cost reduction, energy savings and few hazards in the environment. . Concrete is nothing but a combination of aggregates both fine and coarse, Cement and water. Comparing to all other ingredients in concrete, cement is considered to be the expensive material. This is because cement is manufactured using energy-intensive process. Cement is one of the major producers of carbon dioxide, which is the main cause of global warming. During the manufacturing process of cement the formation of clinker can be achieved only by heating the cement at very high temperature. This leads to the release of enormous amounts of carbon in the atmosphere. This was one among the major problems identified for climatic changes.Various research works has been carried out for the cost reduction in construction with some of the locally available materials ae partial or full replacement material for cement. Over the last few decades supplementary materials like fly ash, rice husk, silica fume, egg shell, groundnut shell, etc. are used as a replacing material. These supplementary materials have proven to be successful in meeting the needs of the concrete in construction.In India ceramic production is 100 million ton per year. The tile industry has about 15% to 30% waste material generated from the total production. The tile waste which is dumped in land filling and pit or vacant spaces causes the environmental pollution which is dangerous for human health. This waste is not recycled in any form at present. However, the tile waste is durable, hard and highly resistant to biological, chemical, physical degradation forces. The tile waste which is dumped in land filling and pit or vacant spaces causes the environmental and dust pollution which is dangerous for human health. As the ceramic waste is piling up every day, there is a pressure on tile industries to find a solution for its disposal. Concrete is considerably the world's largely adaptable and well-liked material produced each year in the construction.

II. MATERIALS

A. Cement
In this work the Ordinary Portland Cement 53 grade was used. Cement is affine, grey powder. It is mixed with water and materials such as sand, pozzolanas to make mortar and concrete. The cement and water forms a paste that binds the other materials together

B. Coarse aggregate
Locally available crushed stones confirming to graded aggregate of nominal size of 20mmas per IS 383-1970 are adopted. The physical properties of coarse aggregate like specific gravity, gradation and fineness modulus are tested.

C. Fine aggregate
Locally available river sand confirming to grading zone II of nominal size 1.18 mm as per IS 383-1970.

D. Water
The water, which is used for making concrete and for curing, should be clean and free from harmful impurities such as oil, alkali, acid, etc, In general, colorless, odorlessportable fresh water was used for mixing the concrete.

E. Ceramic tile powder
The ceramic powder is obtained from the industrial by – products or as the solid waste dumped in any major city. As the ceramic in landfill it takes thousands of years to degradable and cause land pollution. So some of not recycled ceramic can be converted into ceramic powder and used as cement replacement. The usage of ceramic in the form of r is better than using it as fine or coarse aggregate. The tile dust is obtained from RAK ceramics. The specific gravity of tile dust is found to be 2.62 and the fineness is found to be 7.5%.

III. EXPERIMENTAL PROGRAM

The aim of the experimental program is to compare the properties of concrete made with and without ceramic powder, used as partial cement replacement. The basic tests cared out on materials used for casting concrete samples are discussed in this chapter, followed by a brief description about mix design and curing procedure adopted. In this research work the Ordinary Portland Cement 53 grade, coarse aggregate with nominal size of 20mm are adopted. Various tests were conducted to check the properties of the coarse aggregate and some of the tests include the specific gravity, water absorption, fineness modulus, crushing strength tests etc. the natural sand is used as the fine aggregate in this study.Varioustestswereconductedforfineaggregateals otofindoutthefinestofsand,specific gravity of sand etc. Colorless, odorless potable fresh water was used for mixing the concrete. Here ceramic powder is used as partial cement replacement for making the concrete specimens. The test for cement was carried out to find the specific gravity, fineness, water absorption, Setting time and consistency. Initial and final setting time is founded with and without the replacement of ceramic tile powder in cement by Vicat apparatus. The percentage replacement for cement by tile powder was done in the proportion of 0, 10, 15 and 20. After the various tests done on the materials the concrete is prepared through batching. The selected materials are properly weighed and mixed as per the design mix proportion of 1:1.57:2.57 for M30 grade concrete, the water cement ratio used in the work is 0.45, which is obtained from the IS 10262. The concrete was cast in the form of cubes and cylinders with 0%, 10%, 15% and 20% replacement of cement by Ceramic tile powder. To find out the workability of concrete the slump test was carried out in the freshconcrete mix.

After 24 hours, the specimen is removed from the cube and cylinder mould and cured. The compression and split tensile test was carried out in 7, 14 and 28 days using compression testing machine. Compressive strength = Load in (N) / Area in (sqm) Split Tensile strength = 2P / πLD

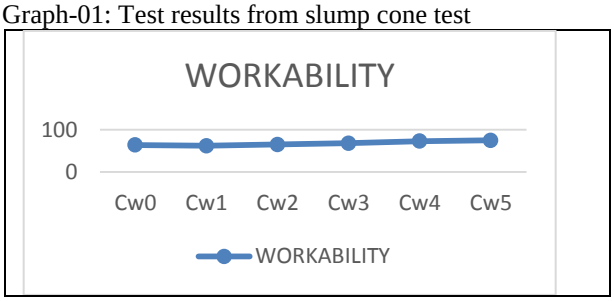
RESULTS

SLUMP CONE TEST

Table 1: Test results from slump cone test

S.No	Mix ID	cement Replacements %	Workability (mm)
1	C0	0	64
2	CW1	10	62
3	Cw2	15	65
4	Cw3	20	68
5	Cw4	25	73
6	Cw5	30	75

Graph-01: Test results from slump cone test

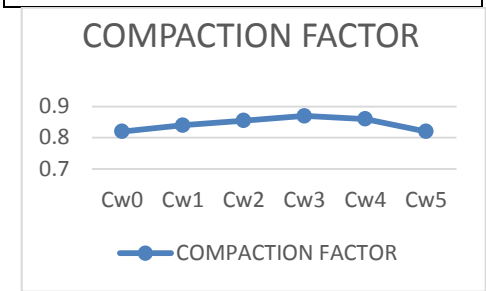


COMPACTION FACTOR TEST

Table2: Test results of compaction factor.

S.No	Mix ID	cement Replacements%	Compaction Factor
1	C0	0	0.82
2	CW1	10	0.84
3	Cw2	15	0.855
4	Cw3	20	0.87
5	Cw4	25	0.86
6	Cw5	30	0.82

Graph02: Test results of compaction factor test



COMPRESSIVESTRENGTH:

Table: 3: Compressive strength results of M30 grade

MIX ID	COMPRESSIVE STRENGTH 7-DAYS
C0	24.65
CW1	25.35
Cw2	26.85
Cw3	24.36
Cw4	22.35
Cw5	20.36

Graph: 03: Compressive strength results of M30

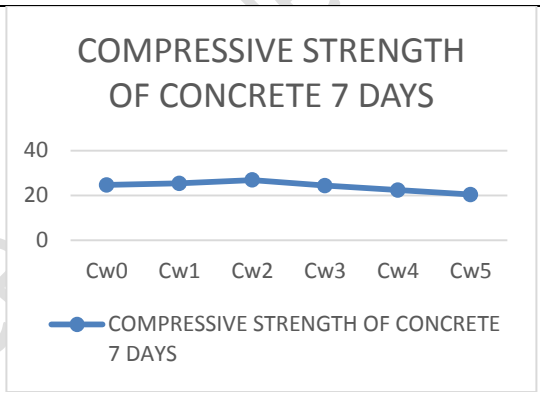


Table: 4: Compressive strength results of M30 grade

MIX ID	COMPRESSIVE STRENGTH 14-DAYS
C0	27.96
CW1	28.98
Cw2	31.05
Cw3	27.52
Cw4	24.35
Cw5	22.36

Graph: 04: Compressive strength results

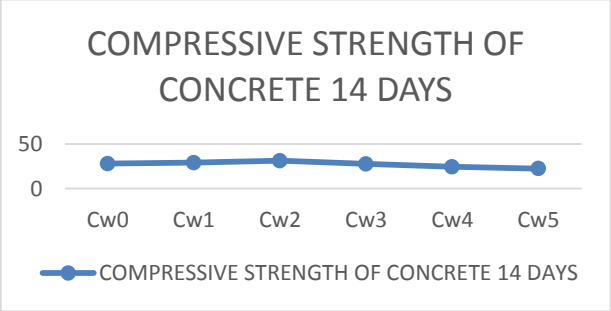


Table: 5 : Compressive strength results of M30 grade of concrete for 7,14,28 and 90 days

MIX ID	7-DAYS	14-DAYS	28-DAYS	90-DAYS
C0	24.65	27.96	34.26	41.112
CW1	25.35	28.98	35.15	42.18
Cw2	26.85	31.05	38.14	45.77
Cw3	24.36	27.52	33.27	39.92
Cw4	22.35	24.35	30.02	36.02
Cw5	20.36	22.36	28.65	34.38

Graph: 5: Compressive strength re sults of M30 grade of concrete for 7,14,28 and 90 days

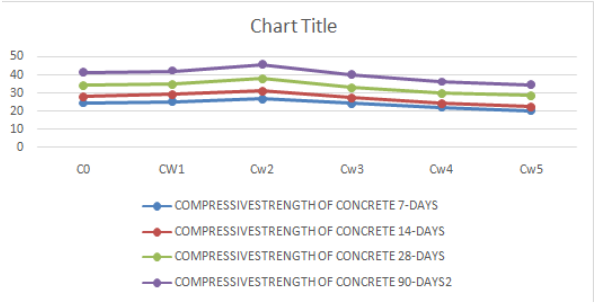
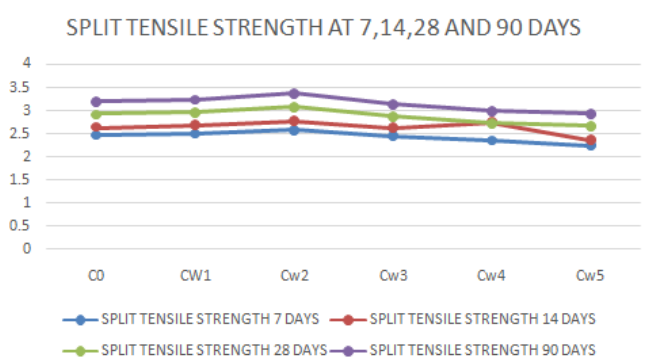


Table 6 : Split tensile strength results for M30 grade of concrete for7,14,28 and 90-days

MIX ID-	7-DAYS	14-DAYS	28-DAYS	90-DAYS
C0	2.48	2.64	2.92	3.20
CW1	2.51	2.69	2.96	3.24
Cw2	2.59	2.78	3.08	3.38
Cw3	2.46	2.62	2.88	3.15
Cw4	2.36	2.76	2.73	3.00
Cw5	2.25	2.36	2.67	2.93

Graph: 6: split tensile strength results of M30 grade of concrete for 7,14,28 and 90 days

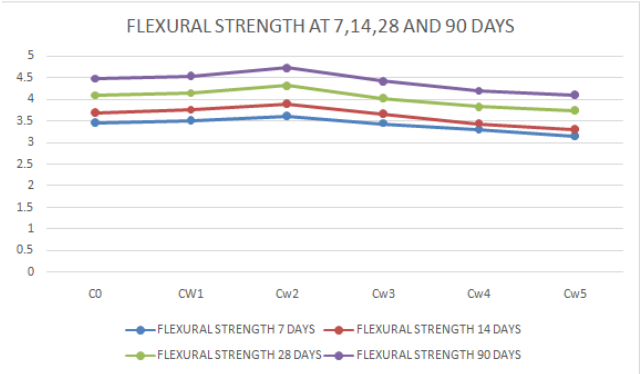


FLEXURALSTRENGTH: The flexural test was conducted for M3 mix only since it has the highest compressive and split tensile strength to compare it with conventional i.e.,M30

Table: 7 :Flexural strength results of M30 grade of concrete for7,14,28 and 90 days

MIX ID	7-DAYS	14-DAYS	28-DAYS	-90-DAYS
C0	3.47	3.70	4.09	4.48
CW1	3.52	3.76	4.15	4.54
Cw2	3.62	3.90	4.32	4.73
Cw3	3.45	3.67	4.03	4.422
Cw4	3.30	3.45	3.83	4.20
Cw5	3.15	3.31	3.74	4.10

Graph: 7: flexural strength results of M30 grade of concrete for 7,14,28 and 90 days



V.CONCLUSION

In the aristocratic plan of the solid blend, the water-bond admeasurement is accustomed low. It is important to accumulate cool plasticizers for the appropriate usefulness. At the point if the akin of mineral added substances in the alloy builds, the akin of cool plasticizer additionally increments to access the appropriate opposition.On annual of assorted mixes of akin of barter of mineral added substances, a lot of acute compressive superior is acquired for adhesive of appraisal M30 at 45.77 Mpa at 90 canicule with barter of band with 20% bowl decay powder. top attrition

Reason The acreage of use of aristocratic adhesive in our development contest is wide, to be specific pre-assembled, prestressed spans, multi-story structures, scaffolds and structures in bank foreground zones and so forth. To appulse this change, we should clean the plan of the structures by allotment the appliance of high-quality cement.When the abate calibration breach shows up, an brusque disappointment is apparent in the high-quality solid shapes.

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