CONCRETE COMPRESSIVE STRENGTH RESEARCH USING RESPONSIBLE INDUSTRIAL CERAMIC WASTE AS PARTIAL REPLACEMENT OF CEMENT

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ABSTRACT
The findings of tests testing the use of ceramic waste powder as a partial replacement for cement in concrete are presented in this publication. Environmental pollution comes from the sedimentation-based settlement and subsequent disposal of ceramic waste powder. The primary goal of this study is to substitute cement in concrete with waste ceramic powder. For M30, concrete samples with 10–40% powdered ceramic powder were created. Concrete mixtures were created, evaluated, and measured against traditional concrete in terms of strength. These tests were run to assess the mechanical qualities over the course of 7 and 28 days.
Key Words: Ceramic waste Powder, silica fume, cement concrete, compressive strength, split tensile strength and flexural strength.

INTRODUCTION

India produces 100 million tones of ceramics annually. In the ceramics business, between 15% and 30% of the overall production is wasted. Currently, there is no recycling of this garbage in any way. The ceramic waste is tough, resilient, and highly resistant to forces of biological, chemical, and physical deterioration. Even though designated sites have been marked for dumping, the Ceramic Industries continue to dump the powder near their unit in any neighboring pit or empty spaces. When the powder dries, this causes considerable environmental and dust pollution and occupies a significant amount of land, thus it is imperative to swiftly dispose of any ceramic waste and use it in the building sector. As the ceramic waste is piling up every day, there is a pressure on ceramic industries to find a solution for its disposal. The advancement of concrete technology can reduce the consumption of natural resources. They have forced to focus on recovery, reuse of natural resources and find other alternatives. The use of the replacementmaterials offer cost reduction, energy savings, arguably superior products, andfewer hazards in the environment.

WORKABILITY

The property of fresh concrete which is indicated by the amount of useful internal work required to fully compact the concrete without bleeding or segregation in the finished product. Workability is one of the physical parameters of concrete which affects the strength and durability as well as the cost of labor and appearance of the finished product. Concrete is said to be workable when it is easily placed and compacted homogeneously i.e without bleeding or Segregation. Unworkable concrete needs more work or effort to be compacted in place, also honeycombs &/or pockets may also be visible in finished concrete.

DIFFERENT TEST METHODSFOR WORKABILITYMEASUREMENT

Depending upon the water cement ratio in the concrete mix, the workability may be determined by the following three methods.
SlumpTest
Compaction FactorTest
Vee-bee Consist meterTest
In this study, the slump-cone test and compaction factor tests were carried out to determine the workability of concrete. Thetest procedures are given below:

DETERMINATION OF WORK ABILITY BY SLUMP-CONETEST:

To find the workability of concrete thoroughly mix cement, sand And coarse aggregate according to designed mix proportions to form a homogenous mix of concrete.

Equipment's required for Concrete SlumpTest:

Mould for slump test, non- porous base plate, measuring scale, temping rod. The mould for the test is in the form of the frustum of a cone having height 30 cm, bottom diameter 20 cmand top diameter 10 cm. The tampingrod is of steel 16 mm diameter and 60cmlong and rounded at one end.

Clean the internal surface of the mould andapplyoil.

Place the mould on a smooth horizontalnon- porous base plate.

Fill the mould with the prepared concretemix in 3 approximately equal layers.

Tamp each layer with 25 strokes of the rounded end of the tamping rod in auniform manner over the cross section of the mould. For the subsequent layers,the tamping should penetrate into theunderlying layer.

Remove the excess concrete and level the surface with at rowel.

Clean away the mortar or water leaked out between the mould and the base plate.

Raise the mould from the concrete immediately and slowly in vertical direction.

Measure the slump as the difference between the height of the mould and that of height point of the specimen being tested.

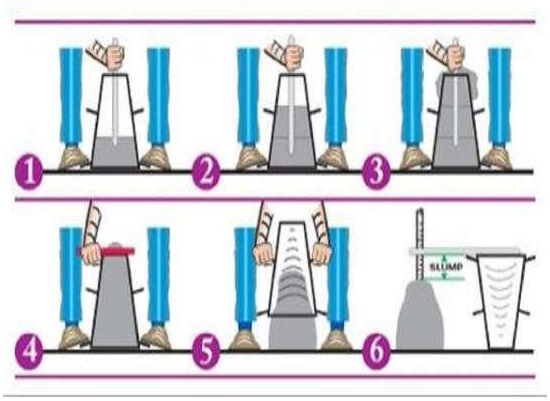


Figure-1: Concrete Slump TestProcedure

Slump for the given sample=_____mm

When the slump test is carried out, following are the shape of the concreteslump that can be observed:

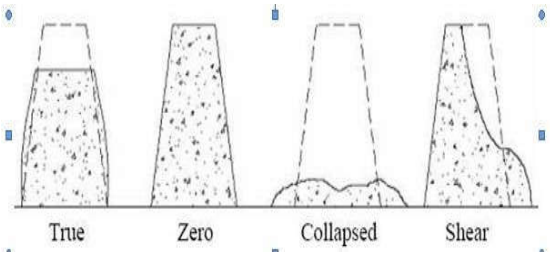


Figure-2: Types of Concrete Slump TestResults

True Slump – True slump is the only slump that can be measured in the test. The measurement is taken between thetop of the cone and the top of the concrete after the cone has been removed as shown infigure-1.

Zero Slump – Zero slump is the indication of very low water- cement ratio, which results in dry mixes. These type of concrete isgenerally used for road construction.

Collapsed Slump – This is anindication that the water-cement ratio istoo high, i.e. concrete mix is too wet or it is a high workability mix, for which aslump test is not appropriate.

Shear Slump – The shear slump indicates that the result isincomplete, and concrete to be retested.

WORKABILTY:TESTRESULTS

The ideal concrete is the one which is workable in all conditions i.e, can prepared easily placed, compacted and moulded. In this chapter, the workabilityis assessed by two methods as follows:

Slump Cone Test:. The test was conducted for fresh concrete preparedbefore the moulding process. A total of
14 concrete mixes are prepared at different times. Workability Results obtained from slump cone test for M30 grade of concrete.

Compaction Factor Test:

The compaction factor test was conducted to the same mix that testedfor workability by slump cone. The results obtained from the compaction factor test for the workability of various mixes of replacements of M30 grade ofconcrete are tabulated as follows:

Table 1: Test results of compaction factortest for workability

S.No	Mix ID	Aggregate Replacements %	Compaction Factor
1	Cw1	0	M30
2	Cw2	10	0.82
3	Cw3	20	0.85
4	Cw4	30	0.87

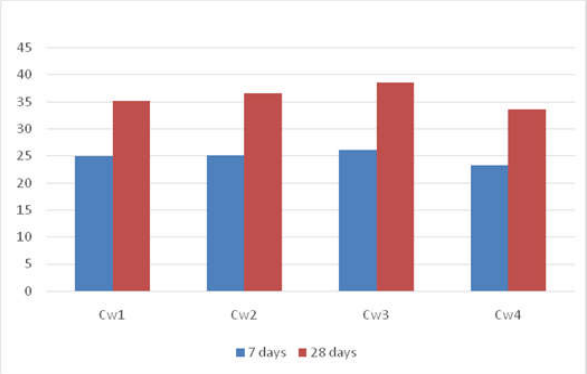
The workability of M30 grade ofconcrete by compaction factor test is similar to that of slump cone test. The pattern of increment for the mixes is quite same which will be discussed in detail further.

Compressive strength

A total of 42 cubes of size 150 x 150 x 150mm were casted and tested for 7 days, 14 days and 28 days testing eachof 13 specimens after conducting the workability tests. The results are tabulated below:

Table: 2: Compressive strength results ofM30 grade of concrete for 7and 28 days

Mix ID	Compressive Strength	
	7 Days (N/mm^2)	28 days (N/mm^2)
CW1	24.95	35.22
CW2	25.12	36.68
CW3	26.19	38.68
CW4	23.24	33.58



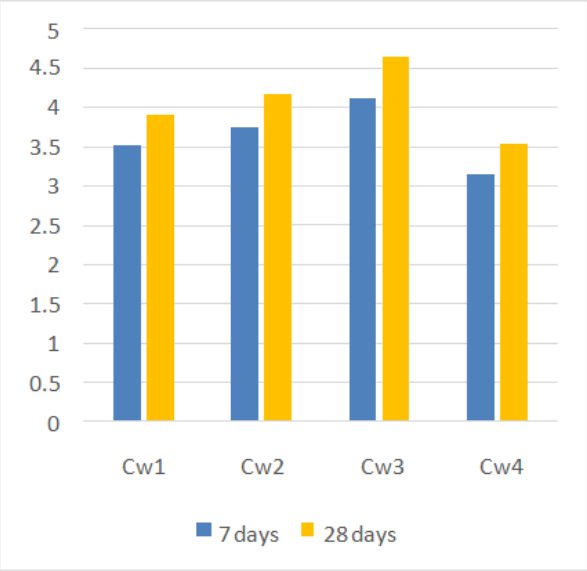
Compressive Strength of Cubes(150x150x150) for M30 Mix for Percentage Replacement of Ceramic waste.

Split Tensile strength:

The split tensile strength obtained by testing the cylindrical specimen for M30 grade of concrete to all the mixes designed for various replacements are given below:

Table 3: Split tensile strength resultsfor M30 grade of concrete

Mix Id	Split Tensile Strength	
	7 Days (N/mm^2)	28 days (N/mm^2)
CW1	3.51	3.92
CW2	3.76	4.17
CW3	4.14	4.66
CW4	3.16	3.54



Split Tensile for M30 mix for Percentage of ceramic waste

The strength i.e., the tensile strength, from the results is clearly in an increment way compared to the conventional concrete at all the curing ages of 7days, 14 days and 28 days. The replacement of aggregates by various proportions has positive effect on the strength of the concrete.

Flexural Strength

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.,M0. A Total of 6 beams were casted and tested as follows:

Flexural test results for 7, 14 and 28days

Mix Id	Relative Flexural Strength	
	7 Days	28 days
C0	1	1
CW1	1.09	1.02
CW2	1.18	1.06
CW3	1.19	1.10
CW4	0.98	0.98

Flexural for M30 Mix for PercentageReplacement of Ceramic Waste Conclusions:

The following conclusions are made based on the experimental investigationson compressive strength, split tensile strength and flexural strengthconsidering the—environmental aspects also:

The workability of concrete increases with the increase in tile aggregate replacement. The workability is further increased with the addition of granitepowder which acts as admixture due to its chemical properties. The properties of concrete increased linearly with the increase in ceramic aggregate up to 30%replacement later it is decreased linearly. M3 mix of concrete produced a better concrete in terms of compressive strength, split tensile strength and flexural strength than the other mixes. But the mixes up to 50% of ceramic coarse aggregate can be used. The usage of ceramic fine aggregate has some effect on the properties of concrete in decrement manner. Granite powder using as fine aggregate has more influence on the concrete than the ceramic fine because of chemical composition it is made of and works asad mixture. The addition of granite powder along with the ceramic coarse aggregate improves the mechanical properties of concrete slightly since mineral and chemical properties are of granite. The split tensile strength of ceramic tile aggregate is very much in a straighter path compared to the conventional grades of concrete.

CONCLUSION

To improve the qualities of the concrete and also to lessen pollution or waste production from the building sector, a study on the properties of concrete created using a combination of recycled aggregate and tile aggregate in various proportions can be conducted. The prospect of employing such waste creation from enterprises can be explored further in regards to the use of granite powder alone as a replacement for fine aggregate. To increase qualities like permeability and sound resistance, the mechanical properties of concrete containing marble aggregate (waste) from manufacturing units or building demolition can be examined. Further research can be done on ceramic tile aggregate in high strength concrete to determine whether high rise buildings might be able to employ it.

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