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Experimental Investigation to Substitute of Cement with Ceramic Tiles Powder in Concrete

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Abstract: ***Because of the mechanical, cultural, ecological and economic advantages of concrete production is important. Consequently it is very beneficial to accomplish the aim of sustainable building using waste material in concrete. Thus this thesis aims to use waste ceramic tile aggregates in concrete manufacturing as an alternate source to coarse aggregates. Owing to its uses in processing, ceramic waste rises day by day, so the ceramic industry needs to recover, reuse and repair concrete products to reduce the waste dump from ceramic factoriesIn this analysis, consistency testing on the strength factors of the concrete mix is obtained by fractional substitution of the cement with the material of Ceramic Tiles. Since ceramic tiles powder is used in various forms of building work, ceramic tiles powder is often used as a partial substitute for cement as a material test was conducted to determine the power and quality of the concrete mix with ceramic tiles powder in several amounts, varying from 5 % to 20%. Ceramic Tiles Powder added 5 %, 10%, 15% and 20% cement to the concrete mix and then added it to standard concrete. Examine then the discrepancy in traditional concrete outcome values.***

Keywords: Ceramic Tiles Powder, Substitution of cement, compressive strength, PPC, M20.

I. INTRODUCTION

Concrete usage is expanded as building rates rise. Concrete is used in the design of various (temporary) infrastructure and non-engineering buildings. Concrete is nothing more than a combination of assorted raw materials such as fine aggregate, coarse aggregate, water, and binder.

The use of this all raw material is expanded day by day as the pace of development increases at the same time as the supply of raw material is limited and certain material in the existing raw material omits CO2 in the atmosphere. Usage of aura of concrete spoils. But these building and infrastructure materials have to fulfil new and higher demands. Concrete building would reduce the use of natural resources and the energy base, which will also reduce the polluting burden on the environment sequentially. Their use in production is one rational approach to minimize building waste masses. Waste powder from building waste may be used to improve the conventional concrete's mechanical and physical functions. The prospect of using waste powder from building waste ceramics as cementing material in concrete preparation will also bring a respite on waste discarding matters. Currently, in developing countries, demand for cement is very strong due to rapid infrastructural expansion, leading to lack of supplies and higher material prices.

An investigation into the use of by-products to improve concrete functions has been under way for many years. For example, in concrete manufacturing and civil applications, fly ash, waste ceramic tiles, silica fume, ground granulated blast furnace slag, glass cullet, etc., the researchers have been finding out in recent years about the reuse of by-products from industry. The use of these materials in concrete is due to restrictions on the environment within the proper handling of such items. The topic of great importance is on the environment and the protection of natural resources and recycling of waste materials.

Waste ceramic materials can be a less expensive however practically similar option to metakaolin or ground granulated impact heater slag, fly debris, and different fixings as a transitional solid folio. The ceramic business additionally creates calcined dirts coming about because of the consuming of ilite-bunch muds which are regularly utilized in assembling in artistic items produced using red mud. A considerable lot of these things are disposed of as decline, and are accordingly harmful waste. Deposits of artistic blocks, floor and rooftop tiles ground to a reasonable fineness, nonetheless, will change into dynamic pozzolans. They can even be found in cement and mortar.

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II. MATERIALS AND METHODS

A. *Materials*

Various elements used to designed concrete mixture are Cement, fine aggregate, coarse aggregate and ceramic tiles powder:

1) *Testing of Cement:* Concrete is one of the coupling materials in this task. Concrete is the significant restricting material in the present development world. Normally making concrete from crude materials and regularly joining or interfacing in powderrial squander. The concrete utilized in this venture has been concrete from PPC.

Table 1: Test of Cement

Tests Performed	Results
Consistency	32%
Initial setting time (min)	110 min
Final setting time	180 min
Specific gravity	3.03
Fineness	2%
Compressive strength 7days	22 N/mm^2

2) *Fine Aggregate:* Fine aggregate is a natural resource that is mostly used in large amount for concrete construction. Rivers are the most production hub of this fine aggregate so we need to find out other substitute of fine aggregate to save natural resources. The reviewing zone of fine hard and fast was zone II as shown by IS subtleties.

Table 2: Fine aggregates

S. No.	Test	Result
1.	Region	II
2.	Sp. Gr.	2.6
3.	FM	3.75
4.	WA	0.6%

3) *Coarse Aggregate:* Locally available crushed stone of 20 mm down sizes asserting to IS: 383 have been used as coarse aggregate. The physical properties of coarse absolute like unequivocal gravity, fineness modulus, etc were attempted according to IS 2386. Table 3 gives the properties of coarse aggregates.

Table 3: Coarse aggregates

S. No.	Test	Result
1.	WA	0.22%
2.	Sp. Gr.	2.94
3.	FM	7.17

4) *Water:* Water is a major solid fixing, since it firmly contributes with concrete in the substance stage. Consumable water ought to be utilized for both drenching and blending of cement. It ought to be liberated from natural issue and the pH worth ought to be somewhere in the range of 6 and 7.

5) *Ceramic Tiles Powder:* Waste produced during, shaping, cutting and cleaning of Ceramic Tiles in the stone manufacturing industries. Approximately 15-20 percent of the ceramic waste technique is converted into the powder variety by this method.

Ceramic waste originates from the ceramics industry, where ceramic dust is considered a non-hazardous solid waste that preserves pozzolanic functions from the removal of wall and floor tiles, sanitary ware, bricks and roof tiles. Ceramic waste is tough and sturdy. Ceramic waste can be used as a replacement for cement or as a replacement for fine aggregate content.

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Table 4: Physical properties of Ceramic tiles powder

S. No.	*Properties*	Result
1.	*Specific gravity*	4
2.	*Colour*	brown
3.	*Form*	Powder
4.	*Odour*	*Odourless*
5.	*Fineness*	3%

6) Concrete mix Design: For the present work, the design mix of concrete M 20 was used. The proportion of concrete mixes was 1:1.925:3.547 and the ratio of water cement was 0.50.

III. EXPERIMENTAL PROCEDURE

The mould 's internal surface was cleaned, and the oil was added. The mould was mounted on a flat, horizontal base plate which was not porous. The mould was packed with 4 nearly equivalent layers of the prepared concrete mix. Excess concrete was stripped and a trowel was used to level the floor. Water with base plate and mould was leaking out. The mould was suddenly and steadily lifted in vertical position by the asphalt. The slump was assessed when the discrepancy was calculated between the mould height and that of the specimen 's height point.

During concrete test preparation, the measurement of the concrete with Ceramic Tiles Powder and Fine totals utilized as substitutes for total materials is cultivated. The waste powder of artistic tiles is utilized as an incomplete swap for concrete in the scope of 5 percent, 10 percent, 15 percent and 20 percent, contingent upon the weight and ideal thickness. For compression strength checking, 54 cubes on a size on 150x150x150 mm were casted to research the power of the normal and other variance mix. Six 700x100x100 mm dimensional beams are then casted for flexural resistance manufacturing. In the event that the solid examples are opened 24 hours in the wake of projecting, and endorsed for nonstop restoring in a versatile water tank. The example is taken and tried on day 7, day 14 and day 28, stress test treatment, and flexural treatment test on day 28. Think about then the qualities of the M20 highlight blends.

IV. RESULTS AND DISCUSSION

In this examination cast concrete is related with various strategies for the computation of cast solid quality and different properties. The principle motivation behind the task is to follow the quality created by the solid from restoring at various test days. Normally appropriate projecting and restoring of cement can build the nature of the solid. For this task, each test is led with 3 examples for every blend proportion, and estimated at the fitting mending time. The composite qualities are then utilized for the requests. The test demonstrations are represented in more detail below:

A. Slump Cone Test

This examination is done to affirm the operability of new cast concrete. This test was done independently on new cast concrete before subbed the concrete with Ceramic Tiles Powder so as to discover the functionality. The droop is exceptionally valuable for recognizing contrasts in the constancy of a mix of determined ostensible extents; it is a trial of the nature of the new concrete. This test is done not long after preparing of the solid.

Table 5: Slump value

% Replacement	Slump Value (mm)
0%	29
5%	28
10%	28
15%	27
20%	26

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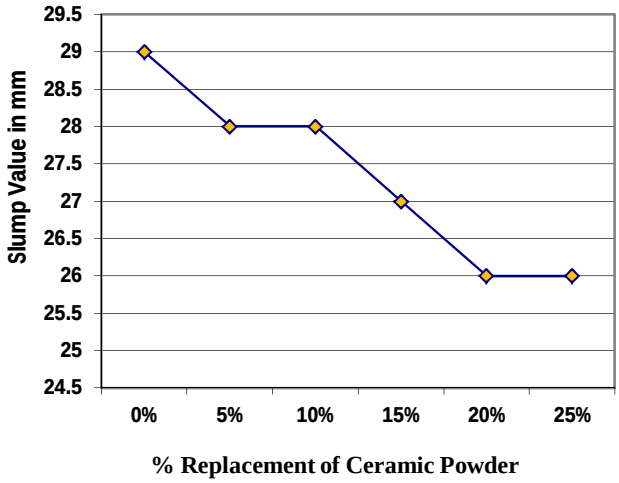


Figure 1: Slump Value of concrete mix

B. Compressive Strength Test

Compressive quality at first improves as the Ceramic tile powder is applied, however it was considerably reduced as the Ceramic tile powder is applied further. The impacts of different rates of the compressive force are summed up in Table 6. In this investigation, three-examples were tried for every blend, and the normal power is contrasted and the ostensible M20 blend. The compressive force discoveries in table 6 are seen at age 7, day 14 and day 28.

Table 6: Compressive Strength of Cubes

% Replacement	Compressive Strength (N/mm²)		
	7 Days	14 Days	28 Days
0%	13.50	19.9	29.10
5%	15.12	20.21	29.90
10%	15.37	20.77	31.15
15%	16.71	22.83	32.27
20%	14.76	21.24	30.38

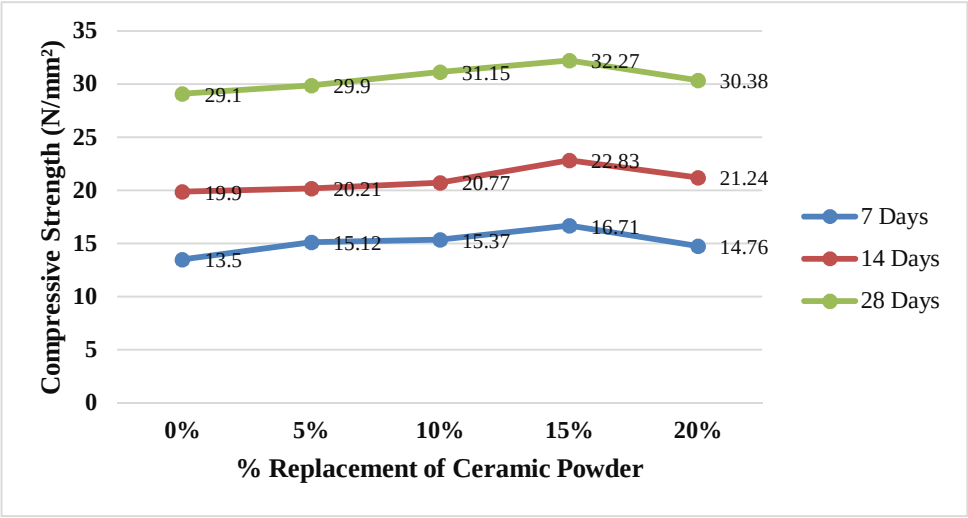


Figure.2 Compressive Strength of Concrete M20

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C. Flexural Strength

Up to 10 percent of the Ceramic Tiles Powder expansion was raised at 28th day relieving the flexural power esteems. The flexural quality qualities were decreased further with Ceramic Tiles Material. The droop is valuable to recognize contrasts in the consistency of a mix of determined ostensible extents; it is a marker of the new solid 's quality. This test is done soon after the solid is made.

Table.7: Flexural Strength at 28 days

% Replacement	Flexural Strength (N/mm²)
	M-20
0%	7.14
5%	7.44
10%	7.98
15%	8.21
20%	7.76

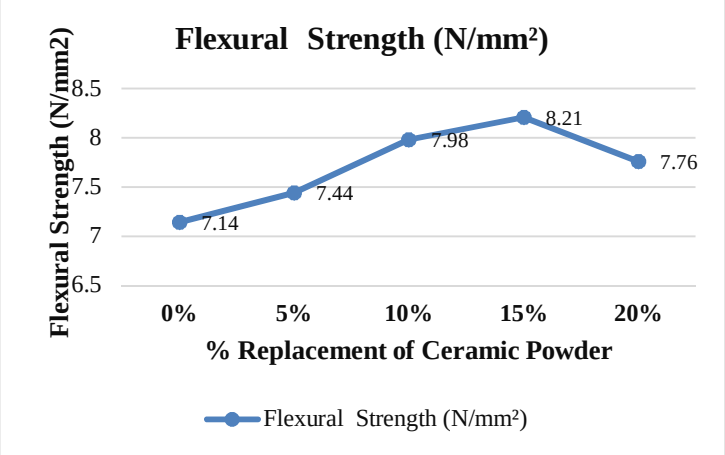


Figure.3 Flexural Strength at 28 Days

D. Determination of Weight Loss of Treated and Normal Cube

Table 8: Weight loss percentage of cube

Initial weight of concrete in Kg	Weight after 14 days in Kg	Weight after 28 days in Kg	% of weight loss in cube measured	
			14 days	28 days
8.1	8	7.95	1.23	1.87
8.1	7.89	7.9	1.483	2.46

E. Waste Management

Ceramic tiles Powder or dust is used as a substitute for mortar in concrete. It is the waste product of Ceramic tiles developed in construction buildings or industries by surface finishing or tiling shaping. Safe treatment of this waste requires a expensive process which can add pollutants to the atmosphere. The building area is the only spot where you can conveniently use soil or sand from ceramic tiles. Since it is used as a filler part of concrete it reduces noise emissions, space issues and therefore eliminates concrete costs.

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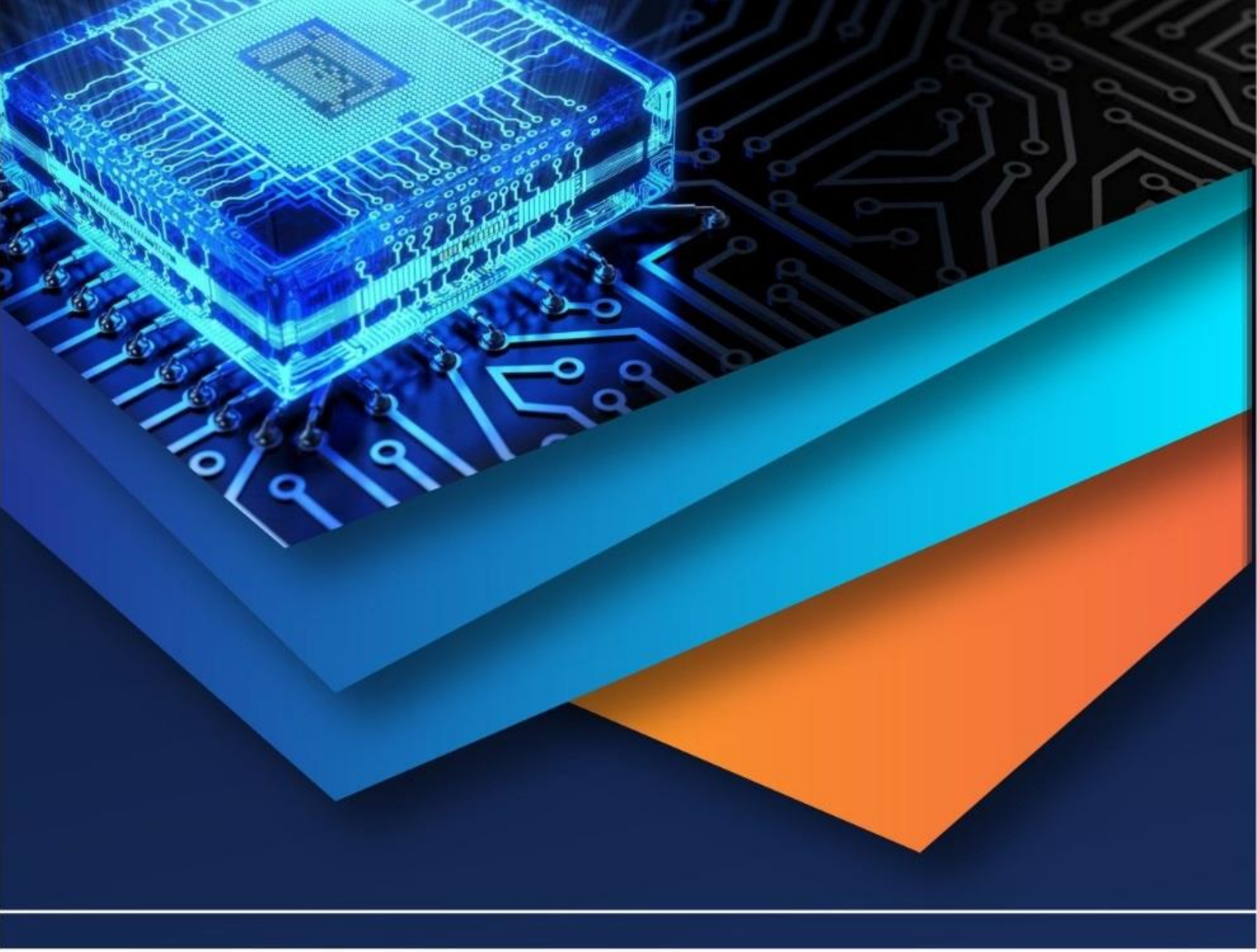
V. CONCLUSION

A. A Ceramic Tiles Powder is a form of waste which is mixed in concrete as a replacement for cement.
B. The Ceramic Tiles Powder particles from this report are waste of low-cost material that will help address the issue of solid waste disposal and protect the atmosphere from contamination.
C. Construction manufacturing costs decline as Ceramic Tiles Powder is used as a cement-bonding agent in construction.
D. The use of tile powder and its use for sustainable building industry growth is the most effective approach and also tackles the high value use of such waste.
E. The inclusion of Ceramic Tiles Powder increases the concrete density while increasing the Self-weight.
F. The compressive power of concrete content with a fractional replacement of cement with ceramic tiles Powder up to 15% can be equivalent to standard concrete.

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