USE OF INDUSTRIAL WASTE IN CONVENTIONAL CONCRETE

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Abstract- *The main focus of this research is to study on the strength of concrete with ceramic waste with instead of cement. For mass quantity of concreting large amount of conventional material required so we use ceramic waste instead of cement to achieve strength as well as economy. In India the textile industry is known to generate large amount of ceramic wastes in each year. Large quantity is used in landfills. Reusing these wastes in concrete could be a within situation. We prefer ceramic waste to increase the strength and stability of concrete. We will conduct tests to find out the compressive strength, flexural strength on cube & beam for 7 days and 28 days. This research work is concerned with the experimental investigation on strength of concrete and minimum percentage of the partial replacement by replacing cement with 0%, 5%,10%,15%,20%,25%,30%and35% of ceramic waste. The aim of this project is to study the behavior of concrete while replacing the ceramic waste with different proportions in concrete.*

Keywords: Industrial waste, Reuse, Pollution, Conventional concrete, Compressive strength.

1. INTRODUCTION

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. 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 replacement materials offer cost reduction, energy savings, arguably superior products, and fewer hazards in the environment.

2. EXPERIMENTAL WORK

The grading of ceramic waste for use as a replacement of cement material begins with the concrete testing. Concrete contains cement, water, fine aggregate and coarse aggregate. With the control concrete, i.e. 5%, 10%, 15%, 20%, 25%, 30% and 35% of the cement is replaced with ceramic waste, the data from the ceramic waste is compared with data from a standard concrete without ceramic waste. Three cube samples were cast on the mould of size 150*150*150 mm for each 1:1.72:3.48 concrete mix with partial replacement of cement with a w/c ratio as 0.52 were also cast. After about 24 hr the specimens were de-molded and water curing was continued till the respective specimens were tested after 7 and 28 days for compressive strength test.

2.1 Compressive Strength

Compressive strength tests were performed on compression testing machine using cube samples per batch were tested with the average strength values reported in this paper. The loading rate on the cube is 13.73 N/mm^2 per min.

Fig -1: Compressive strength Test

2.2 Flexural strength

Flexural strength is considered as an index of tensile strength of concrete. In a flexure test will be perform on the beam. In this test theoretical maximum tensile stress

reaching at bottom fibre of the test beam is known as the modulus of rupture. For the specified mix, allowable modulus of rupture is calculated by the following formula

Modulus of Rupture = $0.7\sqrt{fck}$

Fig -2: Flexural strength Test

A beam of 55x10x10cm will be casting with suitable proportion and applying centre point load system. The value of the modulus of rupture depends on the dimensions of the beam and the arrangements of the loading.

Flexural Strength = $\sigma = \frac{3FL}{2BD^2}$

3. MATERIALS

3.1 Ceramic waste

The principle waste coming into the ceramic industry is the ceramic powder, specifically in the powder forms. Ceramic wastes are generated as a waste during the process of dressing and polishing. It is estimated that 15 to 30% waste are produced of total raw material used, and although a portion of this waste may be utilized on-site, such as for excavation pit refill, the disposals of these waste materials acquire large land areas and remain scattered all around, spoiling the aesthetic of the entire region. It is very difficult to find a use of ceramic waste produced.

Ceramic waste can be used in concrete to improve its strength and other as a partial replacement of cement or as a partial replacement of fine aggregate sand as a supplementary addition to achieve different properties of concrete

Fig -3: Ceramic Waste

3.2 Cement (OPC)

The Ordinary Portland cement of 53 grades conforming to IS: 8112 is being used.

Fig -4: OPC 53 Grade cement

Table No-1: Physical Properties Of (OPC) Cement

Property	IS CODE IS: 8112 - 1989
Specific Gravity	3.15
Consistency	34 mm
Initial setting time	35 min
Final setting time	580 min

3.3 Aggregate

Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is a good gradation of aggregates. Good grading implies that a sample fraction of aggregates in required proportion such that the sample contains minimum voids. Samples of the well graded aggregate containing minimum voids require minimum paste to fill up the voids in the aggregates. Minimum paste means less quantity of

cement and less water, which are further mean increased economy, higher strength, lower shrinkage and greater durability.

3.4 Coarse Aggregate

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 is being use. The Flakiness and Elongation Index were maintained well below 15%.

3.5 Fine aggregate

Those fractions from 4.75 mm to 150 microns are termed as fine aggregate. The river sand is used in combination as fine aggregate conforming to the requirements of IS: 383. The river sand is washed and screen, to eliminate deleterious materials and oversize particles.

Table No-2: Properties of Fine Aggregate, Course Aggregate

Property	Fine Aggregate	C.A. 20mm	C.A. 10mm
Fineness modulus	4.67	7.56	3.21
Specific Gravity	2.46	2.80	2.72
Bulk Density (gm/cc)	1740	1730	1708
Water absorption (%)	5.66	1.0	1.0

3.6 Water

Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to from the strength giving cement gel, the quantity and quality of water are required to be looked into very care after reading following conclusion are get.

Table No-3: Design Mix Proportions M20 for various Concrete

Sr. no.	Concrete Type	Replacement of Cement
1	A-0	Conventional concrete
2	A-1	5%
3	A-2	10%
4	A-3	15%
5	A-4	20%
6	A-5	25%
7	A-6	30%
8	A-7	35%

Table No -4: Concrete Design Mix (M20) Proportions

Sr. No	Concrete Type	W/C ratio	Cement	F.A	C.A.
1	A-0	0.52	1.0	1.72	3.48
2	A-1	0.52	0.95	1.72	3.48
3	A-2	0.52	0.90	1.72	3.48
4	A-3	0.52	0.85	1.72	3.48
5	A-4	0.52	0.80	1.72	3.48
6	A-5	0.52	0.75	1.72	3.48
7	A-6	0.52	0.70	1.72	3.48
8	A-7	0.52	0.65	1.72	3.48

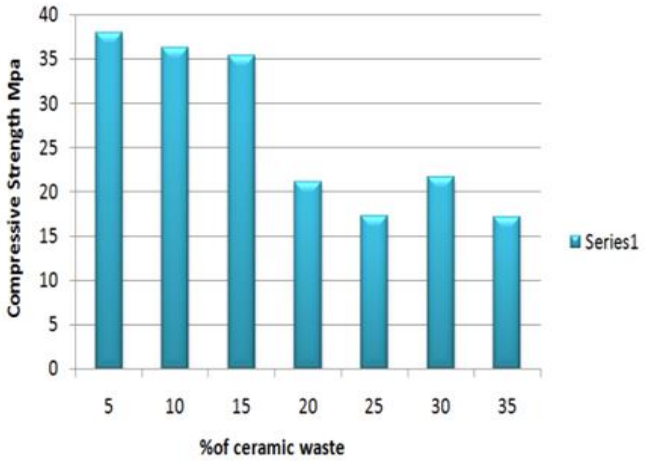

Chart -1: Compressive strength (N/mm²).

Table N -5: Compressive strength results

% of Ceramic Waste	Compressive Strength at 28 days N/mm²
5	38.09
10	36.33
15	35.47
20	21.18
25	17.32
30	21.7
35	17.18

Above fig shows that, when cement is replace by 5 to 15 % by ceramic, the compressive strength is gradually decreases but it is greater than target mean strength. On the other hand when cement is replaced by 20 to 35% the compressive strength varying from 21.18 N/mm² to 17.18 N/mm² which is less than target mean strength. Thus it is clear that, when cement is replaced by 15% of ceramic waste powder, better result of compressive strength is obtained which is also economical.

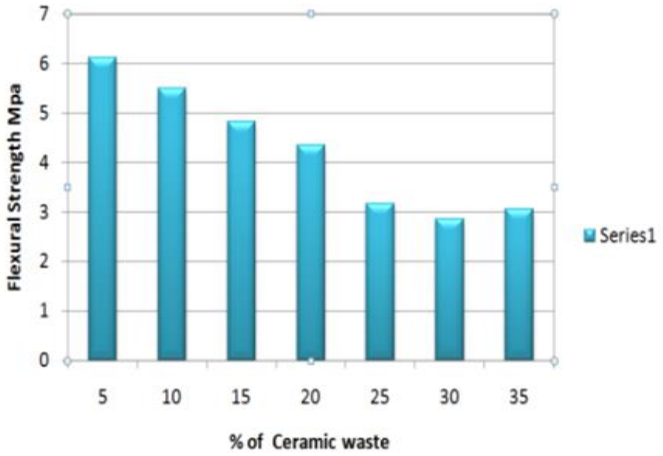

Chart -2: Flexural strength (N/mm²).

Above fig shows that, when cement is replace by 5 to 20 % by ceramic, the flexural strength is gradually decreases. On the other hand when cement is replaced by 25 to 35% the compressive strength varying from 3.173 N/mm² to 3.071 N/mm². Thus it is clear that, when cement is replaced by 10% of ceramic waste powder, better result of flexural strength is obtained which is also economical.

Table No -6: Flexural strength results

% of ceramic waste	Flexural strength At 28 days N/mm²
5	6.12
10	5.5
15	4.827
20	4.35
25	3.173
30	2.87
35	3.071

CONCLUSION

On the basis of experimental investigation the following observations are made:

- 15% of partial replacement of cement with ceramic waste powder gives good result of compressive strength than target mean strength.
- 10% of partial replacement of cement with ceramic waste powder gives good result of flexural strength.
- Use of 15% replacement of cement with ceramic waste powder, good economy can be achieved.

FUTURE SCOPE

- Minimize cost of construction.
- Ultimately utilizes ceramic waste.
- Controls pollution such as soil pollution, water pollution & air pollution.
- Formation of Leachate will reduce.

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