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# An experimental analysis over partial replacement of coarse aggregate by Ceramic Waste.

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**ABSTRACT**

In both developed and undeveloped nations, it has been a specialized test to configuration minimal effort and strong bond concrete. The fundamental focal point of this exploration is to examine the strength of concrete with ceramic waste. The ceramic industry inevitably generates wastes, irrespective of the improvements introduced in manufacturing processes. In the ceramic industry, about 15%-30% creation goes as waste. In this examination contemplate the coarse aggregate has been supplanted by ceramic waste total appropriately in the scope of 0%, 5%,10%,15%, 20% by weight for M-20 review concrete. Compressive Strength test was completed on solidified solid 3D squares after 3rd, 7th, 14th and 28th day of curing in water. In this test the conduct of ceramic mixed in concrete as a coarse aggregate in enhancing its compressive quality has been contemplated. For this examination 3 cubes each for 0%, 5%,10%, 15% and 20% separately is utilized and the compressive quality following 3rd, 7th, 14th and 28th day was dictated by taking 3 blocks of every rate.



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## Introduction:

Indian earthenware (i.e. Ceramic) creation is 100 Million tons for each year. India positions in the main 3 rundown of nations regarding tile generation on the planet. In the fired business, around 15% to 30% waste material is created from the aggregate generation. Despite the fact that the reutilization of ceramic has been practiced, the measure of ceramic reused in that way is as yet irrelevant. Thus, the need for its application in other industries is becoming absolutely vital. We can think about the mechanical quality properties of M20 review concrete with the fractional substitution of coarse total by utilizing earthenware (i.e. Ceramic). So as to investigate the mechanical properties, for example, compressive quality, the examples ought to threw with 5%,10%,15% and 20% substitution of coarse aggregate utilizing earthenware waste and test for various times of curing like 3 days, 7 days, 14 days and 28 days. The ideal of rate expansion of Ceramic waste is investigated by thinking about the prerequisites of mechanical properties.

## Literature Review:

**Brito** studied the suitability of ceramic waste as a possible substitute for conventional coarse aggregates in the production of artificial nonstructural concrete and found that the ceramic waste aggregates have a potential to be used as a replacement of natural coarse aggregates but in elements where the primary requirement is tensile strength and resistance to abrasion and not compressive strength.

**Senthamarai and Manharan** also checked the suitability of ceramic waste as replacement of crushed stone aggregate and found that the workability of ceramic waste coarse aggregate made concrete is good and that the strength characteristics are comparable to that of the conventional concrete.

**Abdullah** also examined the strength of concrete with ceramic waste as coarse aggregate and found that the ceramic waste aggregate satisfies the aggregate requirement of concrete; the surface texture of ceramic waste aggregate was smoother, 2.63, the waster absorption of ceramic waste was 1.45% and that of natural aggregate was 1.25%. The compressive strength of ceramic waste aggregate concrete was 85% to 100%

that of conventional concrete thus it is comparable to conventional concrete.

**Daniyal and Ahmad** also investigated and commented that the effect of addition of crushed waste ceramic tiles as a replacement for natural coarse aggregates with 10%, 20%, 30%, 40% and 50% of substitution and analyzed that the optimum value of waste ceramic tile to be used within the concrete mix with a water/cement ratio of 0.5 was about 30%. The compressive and flexural strength of optimal concrete was found 5.43%and 32.2 % higher than reference concrete respectively.

**Materials Required:**

**Cement:**

Cement is a fine powder, which use for sets, hardens and adheres to other materials and binding them together. It is usually characterized as either hydraulic or non-hydraulic depending upon their ability to set in presence of water. The Pozzolana Portland cement is used in this.

**Fine aggregate:**

Generally, the fine aggregates ranges between 4.75mm to 150 microns. The river sand was used as fine aggregate. After sieving by using 2mm sieve, the sand was used. The river sand was washed and screened, to remove unwanted material and over size particle.

**Coarse aggregate:**

The coarse aggregate ranges above 4. 75mm.The aggregates which passing through 20mm sieve and retaining in 10mm sieve were used in this.

**Water**:

The local fresh tap water was used for mixing the all of the materials with a proper proportion. The amount of water taken as 45% of cement.

**Ceramic Tiles:**

Ceramic tiles are uniformly crushed into 20mm size and sieve through 20mm. Ceramic waste can be used as a partial replacement of coarse aggregates in concrete for improve the strength and other durability factors.

**Fig. 1:** Waste ceramic

**Methodology:**

We conducted the various test in this experiment. The various tests are as follows:

**1. Test on cement**

a. Fineness
b. Soundness
c. Consistency
d. Initial and final setting time
e. Compressive strength of cement

**2. Test on aggregate**

a. Sieve analysis
b. Los Angeles abrasion test
c. Specific gravity of fine aggregate

**Embellishment of ceramic waste concrete:**

Followed by the different trial of materials with extent of review M20 in the proportion of 1:1.5:3, Water is taken as 45% of cement. The greater part of the materials was blended with water, at that point the blend filled in the shape having measurements 15cm*15cm*15cm and legitimately compacted by damping rod for 25 times for every three layers. One days from now the solid cubes were unmolded and put into the water tank for curing. After 3 days the solid cubes were taken out and left for couple of minutes for drying. Subsequent to drying the solid cubes were weighed and their compressive quality was tested by utilizing Universal Testing Machine. Essentially, the compressive quality test after $7^{th}$, $14^{th}$ and $28^{th}$days was resolved.

**Fig. 2:** Mixing of cement, sand, aggregate & ceramic with water.

**Fig. 3:** Cubes after compaction.

**Fig. 4:** Cubes put into tank for curing**.**

**Fig. 5:** Cube after curing

**Results and Discussion:**

Compressive Strength (in N/mm2) of cubes using 5%, 10%, 15% and 20% ceramic at 3RD, 7TH, 14TH and 28TH day:

**Table: 1.** Result of compressive strength of different days

| % | DAY 3 | DAY 7 | DAY 14 | DAY 28 |
|---|---|---|---|---|
| 0% | 10.37 | 16.14 | 22.54 | 27.89 |
| 5% | 11.07 | 16.87 | 23.07 | 28.16 |
| 10% | 12.16 | 17.52 | 23.73 | 29.46 |
| 15% | 11.97 | 17.23 | 23.47 | 28.70 |
| 20% | 10.83 | 16.32 | 22.91 | 27.60 |

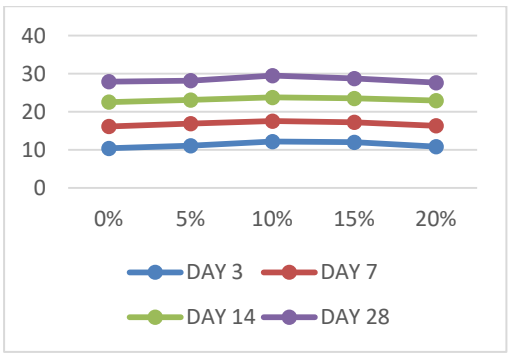


**Fig. 6:** Graph of compressive strength of different days

From the above tables and graph the following points can be inferred:

Concrete having 0% ceramic i.e. plain concrete results in a compressive strength which nearly equal to the characteristic strength i.e. 25 N/mm$^2$.

When ceramic was added up to 5% of aggregate the compressive strength obtained after 28 days was 28.16 N/mm$^2$ which is much more than the characteristic strength as well as the strength obtain by plain concrete. The compressive strength after 3$^{rd,}$ 7$^{th}$, 14$^{th}$ and 28$^{th}$ days in case of 5% ceramic addition is more than that of the plain concrete.

The compressive strength after 3$^{rd}$, 7$^{th}$, 14$^{th\ and}$ 28$^{th}$ day is highest in case of 10% ceramic addition.

After 10% addition of ceramic, addition of ceramic by 15% and 20% result in lesser compressive strength but higher that plain concrete result.

**Fig.7:** Testing the Compressive strength of the cubes.

**Fig. 8:** Cracks formed in the cube after compression.

**Conclusion:**

In the wake of directing compressive strength test on various rates of ceramic it has been seen that 10% earthenware (i.e. ceramic) gives the most extreme compressive strength among every other rate on all the four days of testing.

The compressive strength using 5% ceramic is over 0% ceramic but slightly below 15% ceramic after 3rd, 7th, 14th and 28th day of casting.

The compressive Strength using 20% ceramic is approximately same as of Plain concrete. So use of 20% ceramic is not worthy.

Hence the addition of ceramic should not be exceeded by 15% and for best results addition of 10% ceramic is mandatory. It increases strength to greater extend.

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