An Experimental Study on Strength of Concrete by Replacement of Ceramic Waste with Cement

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***Abstract*- Production of residues from industries and construction sectors has increased during last few years. Much of this waste has been thrown to landfill without recycling. The aim of our project is to study about the physical properties of different laboratory-mixed concretes by using various industrial waste. The substitution of cement with ceramic waste produces a significant results in compressive strength. In this project the (OPC) cement of 53 grade will be replaced by ceramic waste in the range of 5%,10%, 15%,20%, 25% by the weight for M-25 grade concrete . Concrete samples will be tested and compared in terms of compressive strength, split tensile strength to conventional concrete.**

***Index Terms*- Ceramic waste, OPC, Compressive strength, Flexural strength, Workability, Slump test, Compaction factor test get enhanced.**

I. INTRODUCTION

Concrete is the most widely used man-made construction material in the world, and is second only to water as the most utilized substance on the planet. It is obtained by mixing cementing materials, water and aggregates, and sometimes admixtures, in required proportions. The mixture when placed in forms and allowed to cure hardens into a rock-like mass known as concrete. The hardening is caused by chemical reaction between water and cement and it continues for a long time, and consequently the concrete grows stronger with age.

The hardened concrete may also be considered as an artificial stone in which the voids of large particles (coarse aggregates) are filled by smaller particles (fine aggregates) and the voids of fine aggregates are filled with cement.

In a concrete mix, the cementing material and water form a paste called cement-water paste which in addition to filling the voids of fine aggregates, coats the surface of fine and coarse aggregates and binds them together as it cures, thereby cementing the particles of the aggregates together in a compact mass.

It has several desirable properties like high compressive strength, stiffness and durability under usual environmental factors. At the same time concrete is brittle and weak in tension.It is usual to specify a particular concrete by the proportions(by weight) of the above constituents and their characteristics

For example, consider a 1:2:4 concrete refers to a particular concrete manufactured by mixing cement, sand and broken stone in a 1:2:4 ratio (with a specified type of cement, water content ratio, maximum size of aggregate, etc.).

Over the decades there has been significant increase of adding the fibers to the concrete, which increases the mechanical properties like toughness, flexural strength, compressivestrength, fatigue, stiffness &fire resistance.

Experimental evidence shows the extensive use of fiber reinforced concrete in earthquake prone regions and blast resistance structures. In concrete the following types of fibers can be used to enhance the properties. They are acrylic, asbestos, cotton, glass, nylon, polyester, polyethylene rayon, Rockwool &steel. In the above fibers, Glass fiber has a special advantage of mounding into any shape & color, resistance of fire &weather. The present study involves the determination of optimum % of glass fiber reinforcement (wt/wt ratio) such that its compressive strength, flexural strength, workability, slump test, compaction factor test get enhanced

Ceramics property makes them particularly appropriate products. Products made out of ceramic

materials consist of construction materials, grinding materials, electrical equipment, dinnerware, glass products, and heat-resistant materials.Ceramic materials that contain alumina and silicon carbide are extremely rigid and are used to sand various surfaces, cut metals, polish, and grind. Ceramics that consist of silica, zirconium oxide, magnesium oxide, silicon carbide & alumina are used in making refractories. Engineers continually research developing the various uses of ceramics.

II.SCOPE OF THE STUDY

The consumption of cement for construction goes on increasing with the increase of population because shelter is the main for the human being. The present study deals with the utilization of ceramic waste powder by adding to cement and to achieve strength.

ADVANTAGES OF CERAMIC WASTE POWDER:

Ceramics are used in an array of applications:

Compressive strength makes ceramics good structural materials (e.g., bricks in houses, stone blocks in the pyramids)

High voltage insulators and spark plugs are made from ceramics due to its electrical conductivity properties Good thermal insulation has ceramic tiles used in ovens and as exterior tiles on the Shuttle orbiter Some ceramics are transparent to radar and other electromagnetic waves and are used in radomes and transmitters

Hardness,abrasion resistance, imperviousness to high temperatures and extremely caustic conditions allow ceramics to be used in special applications where no other material can be used

Chemical inertness makes ceramics ideal for biomedical applications like orthopedic prostheses and dental implantsGlass-ceramics, due to their high temperature capabilities, leads to uses in optical equipment and fiber insulation

Metals, plastics & ceramics are the significant engineering material. Among the three ceramic are largely synthetic. Ceramics comprise of Routine materials like cement, glass, porcelain, and brick & strange material like spacecraft & electronics. Due to the excellent power of resistance to heat & chemicals, ceramics finds wide use in industries.Common ceramics are made from minerals such as feldspar, talc. clay, and silica, These minerals known as silicates form the majority of the earth's crust. In the laboratory Chemists formulate advanced ceramics like alumina, silicon carbide, and barium titanate from mix excluding silicates.

Ceramic products resist to high temperatures, gases, water, salts & acids based on their mineral component, Properties of all ceramic products are not identical they vary from each other. Ceramics are normally bad conductor of electricity; in certain cases when cooled, they turn into super conductor. Few of the ceramics are magnetic engineers have power over these properties by scheming the ratio and nature of material being used.Ceramics property makes them particularly appropriate products. Products made out of ceramic materials consist of construction materials, grinding materials, electrical equipment, dinnerware, glass products, and heat-resistant materials. Ceramic materials that contain alumina and silicon carbide are extremely rigid and are used to sand various surfaces, cut metals, polish, and grind. Ceramics that consist of silica, zirconium oxide, magnesium oxide, silicon carbide & alumina are used in making refractory's. Engineers continually research developing the various uses of ceramics

III.MATERIALS

FINE AGGREGATE

Those particles passing through 9.5 mm sieve, almost entirely passing through 4.75 mm sieve, and predominantly retained on the 75 µm sieve are called fine aggregate. The river sand confirming to zone as per IS 383-1987 was used. The specific gravity and fineness modulus of sand were 2.62 and respectively.

COARSE AGGREGATES

Coarse aggregates are particles greater than 4.75mm. Crushed angular coarse aggregates confirming to IS 383-1987 was used. Coarse aggregates passing from 60mm and retained on 40mm

Figure 3.3 Coarse aggregate

WATER

Water is an important ingredient of concrete as it actively participated in chemical reaction with cement. Water to be used in the concrete work should have following properties. It should be free from injurious amount of oil, acids, alkalis or other organic or inorganic impurities. It should be free from iron, vegetable matter or other any type of substances, which likely to have adverse affect on concrete or reinforcement.

CERAMIC WASTE

A ceramic is an inorganic, nonmetallicsolid material comprising metal, nonmetal or metalloid atoms primarily held in ionic and covalent bonds. The crystallinity of ceramic materials ranges from highly oriented to semi-crystalline, and often completely amorphous (e.g., glasses). Varying crystallinity and electron consumption in the ionic and covalent bonds cause most ceramic materials to be good thermal and electrical insulators and extensively researched in ceramic engineering. The breadth of the subject is vast, and identifiable attributes (e.g. hardness, toughness, electrical conductivity, etc.) are hard to specify for the group as a whole

IV.EXPERIMENTAL RESULTS

Compressive Strength Results for Cubes by replacement of ceramic waste to Concrete

Table 1. Compressive strength of cubes

COMPRESSIVE STRENGTH (N/mm^2)			
	7 DAYS	14 DAYS	28 DAYS
CONVENTIOAL	25.04	28.74	33.44
5 % REPLACEMENT	25.83	28.96	33.84
10 % REPLACEMENT	25.66	27.92	32.69
15 % REPLACEMENT	23.48	24.91	29.65
20 % REPLACEMENT	21.74	23.78	28.11
25 % REPLACEMNT	19.57	22.41	26.52

Graph1. Compressive Strength Results for Cubes by replacement of ceramic Waste

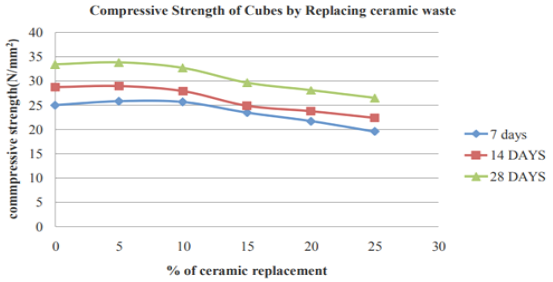
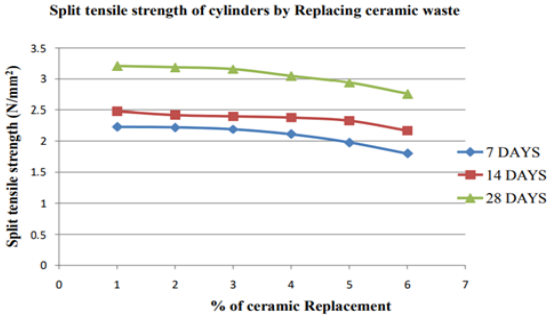


Table.2 Split Tensile Strength of Cylinders:

SPLIT TENSILE STRENGTH (N/mm^2)			
	7 DAYS	14 DAYS	28 DAYS
CONVENTIONAL	2.229	2.48	3.21
5 % REPLACEMENT	2.222	2.42	3.19
10% REPLACEMENT	2.19	2.4	3.16
15 % REPLACEMENT	2.11	2.38	3.05
20 % REPLACEMENT	1.98	2.33	2.94
25 % REPLACMENT	1.8	2.17	2.76

Graph.2 Split tensile strength of cylinders by Replacing ceramic waste



V.CONCLUSIONS

Based on experimental investigations concerning the compressive strength of concrete, the following observations are made

- The compressive strength of M 25 grade concrete increases when the replacement of cement with ceramic powder up to 10% replaces by weight of cement and further replacement of cement with ceramic powder decreases the compressive strength
- Concrete on 10% replacement of cement with ceramic powder compressive strength obtained is 32.69 N/mm2which satisfies the target mean strength (target mean strength is
- 31.6 N/mm2 and it becomes more economical without compromising concrete strength than the standard concrete.
- Utilization of ceramic waste and its applications are used for the development of construction industry, material sciences.
- It is possible alternative solution of safe disposal of ceramic waste

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