Comparative Study of Partial Replacement of Cement with Ceramic Waste Along with Addition of Polypropylene Fiber

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***Abstract*—Concrete which is broadly used material in the field of construction and its main constituent is cement which is being costly and produces a lot of gases at the time of production. On the other hand, ceramic waste also causes environmental pollution by dumping it in the environment and exposed in fields which its dump causes pollution. This dissertation is for the cement which is partially replaced with the ceramic waste by a range of 5%, 10%, 15% by weight of M25 grade of concrete. Also the polypropylene fiber is added to the concrete at 1%, 1.5%, and 2% of M25 grade and similarly the polyester fiber is added at a range of .2%, .25% and .3% respectively. The different concrete mix specimens were casted and tested and compared in the term of compressive strength and split tensile strength as per conventional concrete. To evaluate the properties of concrete these tests for 7 days, 14 days, 28 days were done. With that the durability tests and the Chemical tests i.e. edax and rcmt were also done. This study is concerned with experimental research on the concrete strength and the optimum percentage by partially replacing cement with ceramic waste and with the addition of fibers.**

Keywords—Ordinary Portland Cement, Ceramic Waste, Polypropylene Fiber.

I. INTRODUCTION

Nowadays concrete mainly utilized for wide assortments of direction to form it appropriate in various conditions. Those were normal concrete which might be neglect to display the required strength, quality or sturdiness. Exhaustion of characteristic assets is a typical wonder in most of developing countries because of quick urbanization and industrialization, including development of foundations and different luxuries. Earthenware creation is in Million ton for each year. The ceramic business has about 15 to 25 percent waste material created from the whole generation. This waste isn't reused in any frame at present. The squander is sturdy, hard and profoundly impervious to natural substances. The Ceramic enterprises are dumping in any adjacent pit or empty spaces, close to their land despite the fact that informed regions have been set apart to dump. This prompts genuine ecological and dust contamination and control of a huge zone of land, ceramic waste rapidly and use in the development business. Polypropylene filaments are manufactured strands acquired as a side product from material industry. These are accessible in various viewpoint proportions and are less in expense. The utilization of the substitution materials provide downfall in cost, vitality investment funds and less hazardous in the earth.

II. MATERIALS

A. Ceramic Waste

The standard waste thrown mixed into industry is earthenware powder, explicitly in powder shapes. The wastes are produced as a loss on process the way toward dressing and cleaning. The transfers of ceramic waste materials procure substantial land regions and stay dissipated all around, ruining the stylish land of the whole locale. It is exceptionally hard to discover an utilization of earthenware squander created. Earthenware waste can utilized in cement to enhance its quality and other toughness factors.

B. Polypropylene Fiber

The Polypropylene filaments are close by a monofilament form type and fit in thermoplastic polypropylene gathering. The Polypropylene filaments are warmth soft or more common administration temperature their properties might be misshaped. Polypropylene strands are genuinely hydrophobic. Polypropylene filaments have been utilized at minimal inside to oversee plastic shrinkage splitting of concrete.

C. Cement

The ordinary Portland cement was used in this work.

D. Fine Aggregate

The portions from 4.75mm to 150 microns are named as fine aggregate. The waterway sand is utilized in blend as fine aggregate adjusting to the prerequisites. The stream sand is washed to kill malicious materials and particles.

E. Coarse Aggregate

These aggregates are obtained because of regular assignment of rocks and manually smashing of the stone.

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III. LITERATURE REVIEW

A. *A. Kumar et al. (2013)* the production of ceramic has about 15 to 25 percent which goes as waste material created from whole generation. Those waste isn't reused in any frame at present. Notwithstanding, the fired waste is strong, hard and exceedingly impervious to organic, compound, and physical corruption powers. The Ceramic businesses are thrown the waste in any close-by pit or empty spaces, close to their unit in spite of the fact that advised territories have been set apart to dump. This prompts genuine ecological and dust contamination and control of a tremendous territory of land, particularly after the wastes exposes so it is important to arrange ceramic waste rapidly and use in the development business. As the fired waste is heaping up each day, there is a weight on artistic enterprises to discover an answer for its wastes.Maintaining the Integrity of the Specifications.

B. *D. S. Dharan et al. (2016)* The fiber scattering in the concrete tend to be the method to enhance the structural properties. It gives support and ensures no harm to structure. The strands are fabricated either by pulling of a wire strategy with roundabout cross segment or by expelling the presence of plastic film by a rectangular cross-segment. They seem either as groups or in mono fiber. Fibrillated polypropylene filaments are shaped by extension of plastic film by isolated into strips and afterward cut into pieces. The fiber packs are cut down into indicated lengths. Distinctive rate of fibers included in concrete. The tests on functionality, quality, Compressive Strength, split tensile strength and a modulus of elasticity were led on samples.

C. *S. Alsadey et al. (2016)* the One main offensive qualities of concrete as fragile material is the low rigidity, and strain limit. In this manner it requires fortification so as to be utilized the most generally development material. Customarily, this fortification is as persistent steel bars provided in concrete structure based on proper positions which is to withstand a forced elastic and a shear stresses. Strands, then again, are commonly short, broken, and arbitrarily conveyed all through concrete part to deliver a composite development material known to be reinforced fiber concrete. By exploratory work done it was discovered that with increment of polypropylene fiber there was an enormous increment in the compressive strength as well as quality.

D. *R. Yadav et al. (2017)* activities been researched on a worldwide and national dimension to control & direct waste administration. For the most part, in structure of solid blend, bond, fine totals and coarse totals are utilized from long time, which assumes an essential job in planning of a specific concrete grade. There is need to decrease the surprising expense of Cement requires escalated investigation into the utilization of locally accessible materials which could be utilized as incomplete trade for Cement and in addition the aggregate used in development work. The ceramic waste is used at different percentage for M20 grade by weight.

IV. RESULTS AND DISSCUSSION

A. Coarse Aggregate

1) Fineness Modulus = 6.436
2) Specific Gravity = 2.7
3) Water Absorption = 1%
4) Maximum Aggregate Size = 20mm

B. Fine Aggregate

1) Fineness Modulud = 2.71
2) Specific Gravity = 2.64
3) Water Absorption Percent = 1.5%
4) Free Surface Moisture = 2%

C. Cement

1) Initial Setting Time = 29 min
2) Final Setting Time = 595 min
3) Soundness = 7.64 mm
4) Fineness = 228.5 m^2/kg

D. Compressive strength of concrete by partial replacement of cement by ceramic waste-7 days.

Table 1- Compressive Strength Test Result after 7 days by partially replacing of cement with ceramic waste.

Replacement of Cement in percent by Ceramic waste	Failure Load (KN)	Failure Load (KN)	Failure Load (KN)	Average Load	Compressive Strength (Mpa)
0	550.63	545.07	572.88	556.2	24.72
5	529.92	524.56	551.33	535.27	23.79
10	476.46	471.64	495.71	481.27	21.39
15	435.03	430.63	452.60	439.42	19.53

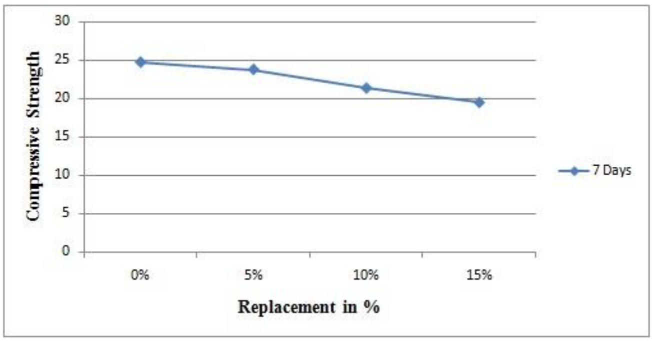

Fig 1- Compressive Strength Graph for Replacement of cement by ceramic waste.

E. Compressive Strength of cube by replacing cement by ceramic waste along with addition of PPF- 7 days.

Table 2- Compressive Strength Test Result after 7 days by partially replacing of cement with ceramic waste along with addition of PPF.

Replacement of Cement in percent by Ceramic waste	Addition of Polypropylene Fiber in Cement by Percent	Failure Load (KN)	Failure Load (KN)	Failure Load (KN)	Average Load	Compressive Strength (Mpa)
5	1.5	538.38	532.94	560.13	543.82	24.17
10	1.5	495.94	476.68	471.87	481.5	21.40
15	1.5	400.2	404.29	420.62	408.37	18.15

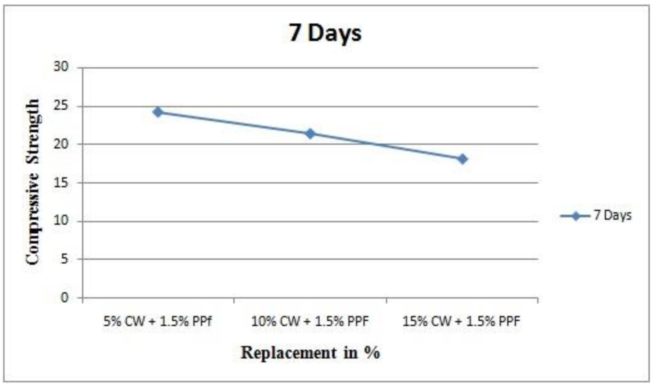

Fig 2- Compressive Strength Graph for Replacement of cement by ceramic waste along with addition of PPF.

F. Compressive strength of concrete by partial replacement of cement by ceramic waste-28 days.

Table 3- Compressive Strength Test Result after 28 days by partially replacing of cement with ceramic waste.

Replacement of Cement in percent by Ceramic waste	Failure Load (KN)	Failure Load (KN)	Failure Load (KN)	Average Load	Compressive Strength (Mpa)
0	814.36	774.83	782.74	790.65	35.14
5	729.72	759.21	722.35	737.1	32.76
10	650.2	643.63	676.47	656.77	29.19
15	593.04	570.01	564.25	575.77	25.59

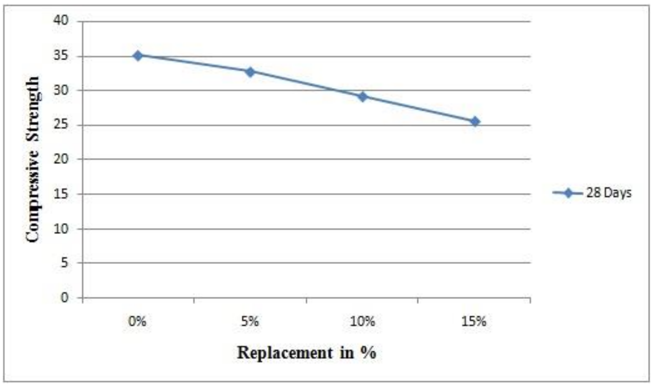

Fig 3- Compressive Strength Graph for Replacement of cement by ceramic waste.

G. Compressive Strength of cube by replacing cement by ceramic waste along with addition of PPF- 7 days.

Table 4- Compressive Strength Test Result after 28 days by partially replacing of cement with ceramic waste along with addition of PPF.

Replacement of Cement in percent by Ceramic waste	Addition of Polypropylene Fiber in Cement by Percent	Failure Load (KN)	Failure Load (KN)	Failure Load (KN)	Average Load	Compressive Strength (Mpa)
5	1.5	870.22	827.97	836.42	844.87	37.55
10	1.5	764.47	803.47	772.27	780.07	34.67
15	1.5	710.52	703.17	739.05	717.52	31.89

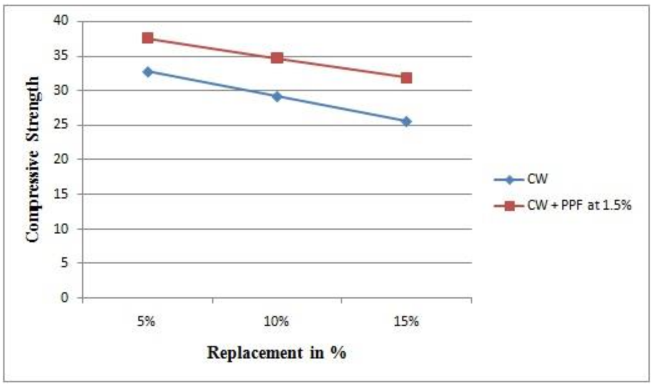

Fig 4- Compressive Strength Graph for Replacement of cement by ceramic waste along with addition of PPF.

H. Split tensile strength of concrete by partial replacement of cement by ceramic waste-7 days.

Table 5- Split Tensile Strength Test Result after 7 days by partially replacing of cement with ceramic waste.

Replacement of CW (%)	Tensile Load (KN)	Tensile Load (KN)	Tensile Load (KN)	Average Tensile Strength (Mpa)
0	2.60	2.57	2.7	2.63
5	2.39	2.51	2.41	2.44
10	2.24	2.34	2.22	2.27
15	2.20	2.11	2.09	2.14

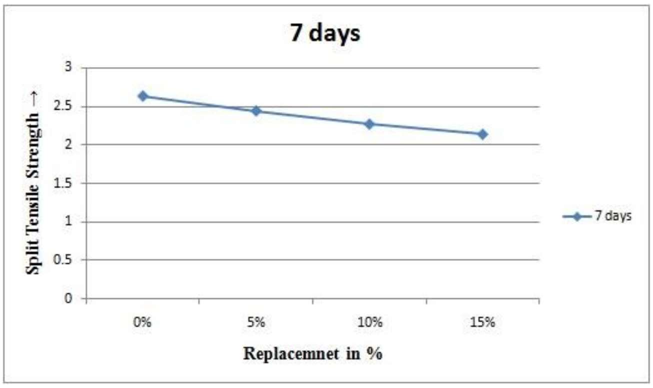

Fig 5- Split Tensile Strength Graph for Replacement of cement by ceramic waste.

I. Split Tensile Strength of cylinder by replacing cement by ceramic waste along with addition of PPF- 7 days.

Table 6- Split Tensile Strength Test Result after 7 days by partially replacing of cement with ceramic waste along with addition of PPF.

Replacement of Cement in percent by Ceramic waste	Addition of Polypropylene Fiber in Cement by Percent	Tensile Load (KN)	Tensile Load (KN)	Tensile Load (KN)	Average Tensile Strength (Mpa)
5	1.5	3.21	3.18	3.34	3.25
10	1.5	3.01	3.03	3.16	3.07
15	1.5	2.84	2.73	2.71	2.76

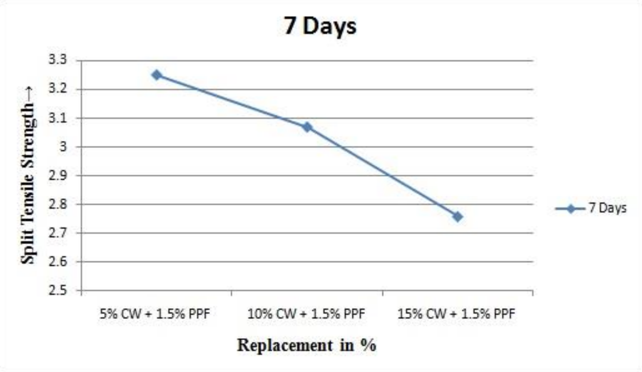

Fig 6- Split Tensile Strength Graph for Replacement of cement by ceramic waste along with addition of PPF.

J. *Split Tensile Strength of cylinder by replacing cement by ceramic waste along with addition of PPF- 28 days.*

Table 7- Split Tensile Strength Test Result after 28 days by partially replacing of cement with ceramic waste along with addition of PPF.

Replacement of Cement in percent by Ceramic waste	Addition of Polypropylene Fiber in Cement by Percent	Tensile Load (KN)	Tensile Load (KN)	Tensile Load (KN)	Average Load
5	1.5	4.71	4.76	4.95	4.81
10	1.5	4.67	4.44	4.49	4.54
15	1.5	4.15	4.32	4.16	4.2

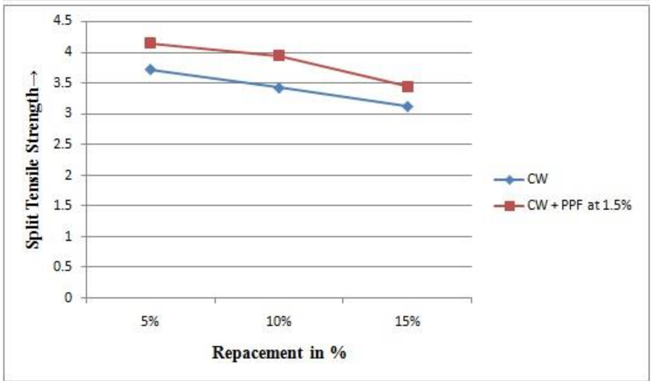

Fig 7- Split Tensile Strength Graph for Replacement of cement by ceramic waste along with addition of PPF.

V. CONCLUSION

- Cement replaced with Ceramic waste up to 10% from which the outcome is one step ahead for compressive strength and tensile strength.
- If the cement replaced with ceramic waste from more than 10% there is a downgrade in the concrete's strength.
- In permeability test, as the proportion of ceramic waste increases there is a fall in the concrete's permeability.
- It is seen that, the cement replaced by ceramic waste at 10% with the addition of polypropylene fiber at 1.5% provides the optimum value for both castings, furthermore if the replacement percent increases there is a downfall in the both compressive and tensile strength.
- The strength tend to decrease after the replacement of 10% of ceramic waste with keeping the polypropylene constant, on the other hand the durability tend to increase.
- The green concrete is formed by the use of ceramic waste with polypropylene fiber.
- By the use of ceramic waste helps to use the thrown ceramic waste which helps the environment.

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