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AN EXPERIMENTAL STUDY OF MECHANICAL PROPERTIES OF CONCRETE ON SIMULTANEOUS REPLACEMENT OF CEMENT BY RICE HUSK ASH POWDER AND WASTE CERAMIC POWDER

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Abstract - *Concrete is most useful material of construction and widely used all over the world only second to water. In the world, concrete is the first choice for the construction of a different variety and number of structures. In the concrete, try to various add waste material to additive concrete one of such being rice husk ash powder and ceramic powder.*

In this paper, mix design of M30, M40 and M50 grade of concrete with different w/c ratio and then cement would be a simultaneously replacement by waste rice husk ash and waste ceramic powder in 5%, 10% and 5%, 10%, 15% respectively proportion and compare compressive strength and split tensile strength as well as slump test, durability test and sorptivity test of concrete thus obtained with conventional concrete. The details of improvement in properties have been illustrated and evaluated in this paper.

***Key Words*: Concrete, Waste Ceramic Powder, Waste Rice Husk Ash Powder, Simultaneous Replacement, Cement, Compressive Strength, Split Tensile Strength, Durability, Workability, Sorptivity Test**.

1. INTRODUCTION

Concrete is a very strong and very important construction materials. In the concrete is a mixture of some materials like cement, fine aggregate, coarse aggregate and water. Many countries are observing a rapid development in the construction industry, which involves the use of natural resources for the development of the infrastructure. Thus, we can replace the costly and limited natural resources with inventive and eco-friendly alternate building materials. The use of waste material in concrete will not only make it economical but also help in reducing the dumping problems as well as pollution. There is no chemical effects on Ceramic Powder and Rice Husk Ash. Due to these properties ceramic powder and rice husk ash powder can be used in the simultaneously replacement of cement.

1.1 Cement

OPC of grade 53 confirming to IS 8112:1989 for material is being used.

1.2 Fine Aggregate

The aggregate passing through 4.75 mm IS Sieve and retaining on 150 micron IS Sieve is known as fine aggregate.

1.3 Coarse Aggregate

Size of aggregate between 12.75 mm and 4.75 mm are being used in coarse aggregate. The maximum nominal size of aggregate is 12.75 mm.

1.4 Ceramic Waste Powder

Waste ceramic powder can exhibit wide range of properties including high strength, low friction, low shrinkage, low density and high hardness and excellent wearing resistance.

1.5 Rice Husk Ash Powder

Rice Husk Ash powder is also called rice hull. Rice husk ash powder is a very good source for the minerals such as silica. Rice husk ash powder is a waste material and an environmental hazardous material.

1.6 Super-plasticizer

The super-plasticizer used was CONFLOW-MPC is MID range Polycarboxylic Ether based super-plasticizer of a new generation conforming to IS: 9103-1999, which is dark brown in color. It can give up to 20 percent water reduction without loss of workability to high strength concrete.

2. MIX PROPORTION

Table 1 showed below contains the mix proportion of varied ingredients.

TABLE 1: MIX PROPORTION

Mix Designation	Rice Husk Ash (%)	Ceramic Powder (%)
M0	0	0
M1	5	5
M2	5	10
M3	5	15
M4	10	5
M5	10	10
M6	10	15

3. EXPERIMENTAL INVESTIGATION

The fresh concrete tests are done to check the workability of concrete and hardened concrete tests are done to check the strength parameter of concrete.

1. SLUMP TEST

Slump test is conducted for evaluating the workability of concrete.

TABLE 2: SLUMP TEST RESULT

MIX	M30 (mm)	M40 (mm)	M50 (mm)
M0	55	56	59
M1	59	61	62
M2	61	64	65
M3	61	65	66
M4	58	59	60
M5	60	63	64
M6	63	65	66

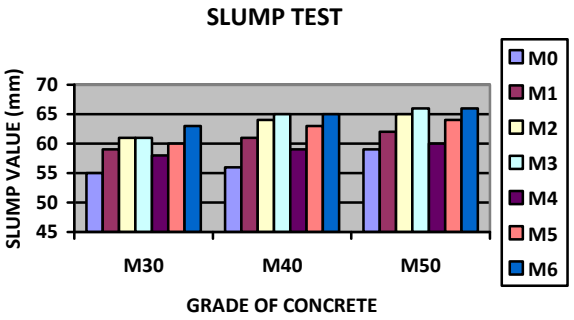

FIGURE 1 SLUMP TEST

2. COMPACTION FACTOR TEST

Compacting factor test is designed for both use in the laboratory and in the field. It gives more accurate result compare to slump test and is mostly used when concrete is to be compacted by vibration.

TABLE 3: COMPACTION FACTOR RESULT

MIX	M30	M40	M50
M0	0.82	0.82	0.84
M1	0.84	0.86	0.87
M2	0.86	0.87	0.88
M3	0.84	0.86	0.87
M4	0.83	0.84	0.85
M5	0.83	0.85	0.86
M6	0.87	0.88	0.89

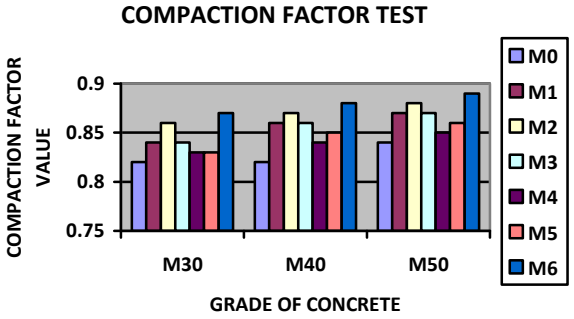

FIGURE 2 COMPACTION FACTOR TEST

3. COMPRESSIVE STRENGTH

Compressive strength test is shown on the compression testing machine. Size of cube is 150 mm * 150 mm * 150 mm. Compressive Strength was determined after 28 days and 56 days of curing respectively.

3.1 COMPRESSIVE STRENGTH AFTER 28 DAYS.

The table 4 illustrated below includes control mix M0, M1, M2, M3, M4, M5 and M6 corresponding to compressive average load of each and every proportion of each grade of concrete after 28 days of curing.

TABLE 4: COMPRESSIVE STRENGTH AT 28 DAYS

MIX	M30 (N/mm²)	M40 (N/mm²)	M50 (N/mm²)
M0	33.92	43.25	53.18
M1	35.55	45.33	55.70
M2	33.17	42.81	52.88
M3	31.85	41.48	51.55
M4	30.37	40.00	50.07
M5	28.15	37.78	47.85
M6	25.48	35.12	44.89

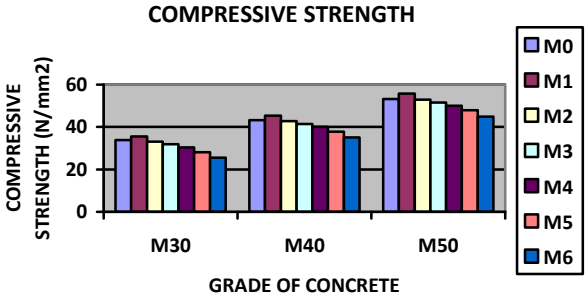

FIGURE 3 COMPRESSIVE STRENGTH AT 28 DAYS

3.2 COMPRESSIVE STRENGTH AFTER 56 DAYS.

The table 5 illustrated below includes control mix M0, M1, M2, M3, M4, M5 and M6 corresponding to compressive average load of each and every proportion of each grade of concrete after 56 days of curing.

TABLE 5: COMPRESSIVE STRENGTH AT 56 DAYS

MIX	M30 (N/mm²)	M40 (N/mm²)	M50 (N/mm²)
M0	34.51	44.59	54.81
M1	36.88	46.51	57.62
M2	34.22	44.14	54.22
M3	33.15	42.67	53.03
M4	31.41	41.49	51.55
M5	29.18	38.97	49.04
M6	26.67	36.44	46.22

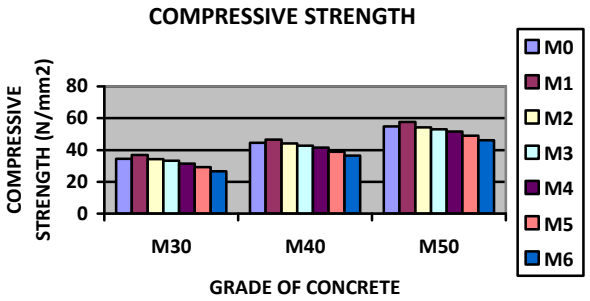

FIGURE 4 COMPRESSIVE STRENGTH AT 56 DAYS

4. SPLIT TENSILE STRENGTH

Split tensile strength test is conducted on split tensile testing machine. Size of cylinder is 150 mm diameter and300 mm height. Split tensile Strength was determined after 28 days and 56 days of curing respectively.

4.1 Split Tensile Strength After 28 Days

The table 6 illustrated below includes control mix M0, M1, M2, M3, M4, M5 and M6 corresponding to average load of each and every proportion of each grade of concrete after 28 days of curing.

TABLE 6: SPLIT TENSILE STRENGTH AT 28 DAYS

MIX	M30 (N/mm²)	M40 (N/mm²)	M50 (N/mm²)
M0	3.44	4.1	4.25
M1	3.67	4.35	4.48
M2	3.35	4.01	4.15
M3	3.3	3.7	3.86
M4	3.06	3.11	3.62
M5	2.78	2.98	3.11
M6	2.55	2.69	2.78

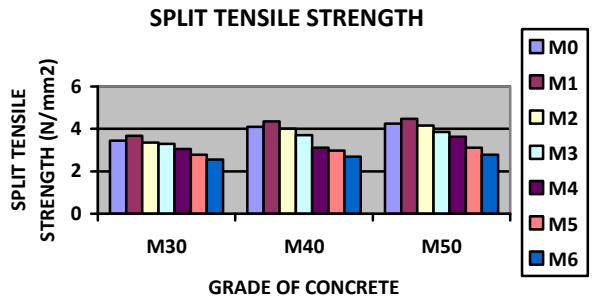

FIGURE 5 SPLIT TENSILE STRENGTH AT 28 DAYS

4.2 Split Tensile Strength After 56 Days

The table 7 illustrated below includes control mix M0, M1, M2, M3, M4, M5 and M6 corresponding to average load of each and every proportion of each grade of concrete after 56 days of curing.

TABLE 7: SPLIT TENSILE STRENGTH AT 56 DAYS

MIX	M30 (N/mm²)	M40 (N/mm²)	M50 (N/mm²)
M0	3.63	4.43	4.57
M1	3.9	4.53	4.62
M2	3.59	4.35	4.39
M3	3.34	4.01	4.10
M4	3.11	3.5	3.87
M5	2.88	3.20	3.54
M6	2.78	2.93	3.16

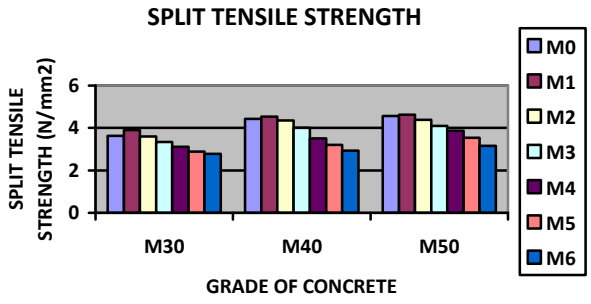

FIGURE 6 SPLIT TENSILE STRENGTH AT 56 DAYS

5. DURABILITY TEST

After 28 days curing of cubes are taken from the water and clean the surface of cubes and weight of cubes. After weight cubes are immersed in HCL for next 28 days then check the strength of cubes.

5.1 Durability Test For M30 Grade Concrete

Check the strength of three cubes of every proportion after cubes remove from the HCL for 28 days.

TABLE 8: DURABILITY TEST CHANGE IN STRENGTH IS SOAKED IN HCL FOR M30

Mix	Normal Strength (N/mm²)	Strength Due to HCL (N/mm²)
M0	33.92	31.6
M1	35.55	33.98
M2	33.17	31.95
M3	31.85	30.04
M4	30.37	28.13
M5	28.15	26.03
M6	25.48	22.96

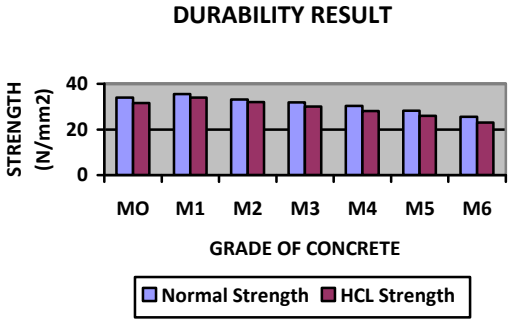

FIGURE 7 DURABILITY TEST FOR M30 GRADE CONCRETE

5.2 Durability Test For M40 Grade Concrete

Check the strength of three cubes of every proportion after cubes remove from the HCL for 28 days.

TABLE 9: DURABILITY TEST CHANGE IN STRENGTH IS SOAKED IN HCL FOR M40

Mix	Normal Strength (N/mm²)	Strength Due to HCL (N/mm²)
M0	43.25	42.2
M1	45.33	43.26
M2	42.81	41.89
M3	41.48	40.03
M4	40	38.68

M5	37.78	35.23
M6	35.12	32.78

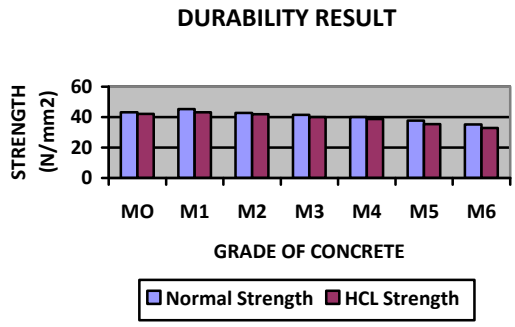

FIGURE 8 DURABILITY TEST FOR M40 GRADE CONCRETE

5.3 Durability Test For M50 Grade Concrete

Check the strength of three cubes of every proportion after cubes remove from the HCL for 28 days.

TABLE 10: DURABILITY TEST CHANGE IN STRENGTH IS SOAKED IN HCL FOR M50

Mix	Normal Strength (N/mm^2)	Strength Due to HCL (N/mm^2)
M0	53.18	51.58
M1	55.7	52.96
M2	52.88	51.64
M3	51.55	49.75
M4	50.07	47.37
M5	47.85	44.29
M6	44.89	41.8

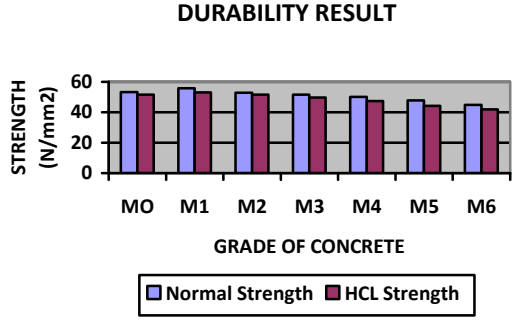

FIGURE 9 DURABILITY TEST FOR M50 GRADE CONCRETE

6. SORPTIVITY TEST

Sorptivity test is a simple and fast test to determine the specimen of concrete to absorb the water after 28 days of curing by capillary action. Every 1, 2, 5, 10, 20, 30 and 60 minutes the specimen was immersed in the epoxy chemical and determine the water absorption by specimen.

7. CONCLUSIONS

- The workability of concrete had been found decreases the increases the percentage of ceramic waste powder and rice husk ash powder simultaneously replacement of cement.
- The use of a super plasticizer can achieve the desired workability.
- The compressive strength of concrete is increases up to 10% simultaneously replacement of cement by ceramic waste powder and rice husk ash powder and further increasing the percentage of ceramic waste powder and rice husk ash powder the compressive strength of concrete decreases.
- The split tensile strength of concrete is increases up to 10% simultaneously replacement of cement by ceramic waste powder and rice husk ash powder and further increasing the percentage of ceramic waste powder and rice husk ash powder the split tensile strength of concrete decreases.
- Sorptivity test is carried out on the each experiment. It shows that the depth of water penetration is depending upon the grade of concrete. The grade of concrete is high then the amount of water absorption is high.
- Durability of concrete will be decreases with increases the percentage of ceramic waste powder and rice husk ash powder simultaneously replacement with cement.
- The weight of a specimen is heavy.
- Use of a ceramic waste powder and rice husk ash powder and its application are utilized for the improvement of construction.
- Using ceramic waste powder and rice husk ash powder in concrete can solve several environmental problems.
- On 10% simultaneously replacement of cement with ceramic waste powder and rice husk ash powder, the compressive strength and split tensile strength of concrete is more than those of normal concrete and hence it is more economical without compromising concrete strength.

REFERENCES

Research Paper:

[1] Atul Unival, Karan Singh, "Partial replacement of cement in concrete using ceramic waste", International Journal of Engineering Research & Technology (IJERT) 2019.

[2] V. Praveen Kumar, Dr. K. Chandrasekhar Reddy, "Durability Aspect of concrete by partial replacement of cement by ceramic waste", International Journal of Civil Engineering and Technology (IJCIET), Volume 8, April 2017.

[3] Amr S. EI-Dieb, Dima Kanaan, Mahmoud Reda Taha, Sama T. Aly, "Ceramic Waste powder: from landfill to sustainable concretes", Construction Materials (ICE Publication).

[4] Alefiya Kachwala, Arti pamnani, Amit Raval, "Effect of Rice Husk Ash as a partial replacement of ordinary Portland cement in concrete", International Research Journal of Engineering and Technology (IRJET), Volume 2, Issue 5, August 2015.

[5] Rafat Siddique, Karamnir Singh, Kunal, Malkit Singh, Valeria Corinaldesi and Anita Rajor, "Properties of bacterial rice husk ash concrete", ELSEVIER (Construction and Building Materials 121 – 2016, Page number 112 – 119).

[6] Ayesha Siddika, Md. Abdullah Al Mamun, Md. Hedayet Ali, "Study on concrete with rice husk ash", Innovative Infrastructure Solution (2018), jan 18, (Springer international publishing AG).

Book:

[7] Shetty M. S, "Concrete Technology – Theory and Practise".

IS Code:

[8] IS 456 – 2000, "Plain and Reinforcement Concrete"

[9] IS 2386 (Part 1) – 1963, "Method of Test for Aggregate for Concrete"

[10] IS 10262 – 2019, "Concrete Mix Proportioning – Guidelines".

[11] ASTM C 1585, "Standard Test Method for Measurement of Rate of absorption of water by hydraulic cement concrete".