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COMPARATIVE STUDY OF PARTIAL REPLACEMENT OF CEMENT WITH CERAMIC POWDER FOR M30CONCRETE

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ABSTRACT

The cost of construction material is rising mainly due to high demand of concrete and scarcity of raw material affecting the economy of the structure. With increasing demand and consumption of cement, researchers and civil engineers are in search of developing alternate binders that are eco-friendly and contribute towards waste management. In such case, the use of industrial and agricultural waste produced by industrial processes has been the focus of waste reduction research for economic and environmental.

In ceramic industry, about 15%-30% production goes as waste. These wastes create a problem in present-day society, requiring a suitable form of management in order to achieve sustainable development.

The use of the waste materials in cement, concrete and other construction materials has numerous indirect benefits such as reducing the cost of concrete manufacturing, protecting environment from possible pollution effect. It may also result in foreign exchange earnings.

In this study, the properties of concrete enhanced with partially replacement of Ceramic powder in the ratio of 0%, 5%, 10% and 15% by weight of cement in concrete were studied for M 30 grade. The properties for fresh concrete are tested like slump cone test and for hardened concrete compressive strength and split-tensile strength at the age of 7, 28 and 56 days curing period and durability properties are also considered. The aim behind the use of Ceramic Powder as partial replacement in the concrete is to reduce the cost of material and as an eco-friendly structure.

KEYWORDS : Ceramic powder, coarse aggregate, Fine aggregate and cement

1. INTRODUCTION

Ceramics are special materials with many applications in almost all the engineering disciplines. But their importance has often been underestimated due to the fact that many people believe that ceramics are all about pottery and tiles. Today's ceramics industry is one of most rapidly advancing concerns in many parts of the world. Ceramic industry began to expand as a modern industry with the attribution of new techniques and knowledge gained in the 1970s. Since then it has also been one of most competitive industries in the market.

2. PROBLEM STATEMENT

Now a days, Agricultural and industrial by-products are used in concrete production as cement replacement materials or as admixtures to enhance both fresh and hardened properties of concrete as well as to save the environment from the negative effects caused by their disposal. Industrial wastes, such as blast furnace slag, fly ash and silica fume are being used as supplementary cement replacement materials. Currently ceramic powder is one of the most active research areas that encompass a number of disciplines including civil engineering and construction materials. The tile industry inevitably produces wastes, irrespective of the improvements introduced in manufacturing process. In the tile industry, about 15%-30% production goes as wastes. These wastes creates a problem in present-day society, requiring a suitable form of management in order to achieve sustainable development. Therefore, it is possible to use ceramic powder as cement replacement material to improve quality and reduce the cost of construction materials such as mortar, concrete pavers, concrete roof tiles and soil cement interlocking block.

3. AIM AND OBJECTIVE

1. To understand the utilization of Ceramic powder and its effect in concrete.
2. To ascertain its suitability as an alternative to conventional cement concrete.
3. Comparison of strength for conventional concrete and replaced concrete and also durability.

4. SCOPE OF THE STUDY

The scope of the study will be focused on the performance of concrete using ceramic powder as a partial replacement of cement. In this study the ceramic powder is collected from RAK ceramics (Gujarat), Kurnool district, Andhra Pradesh, India.

5. MIX DESIGN

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative propositions with the object of producing concrete of certain minimum strength and durability as economically as possible. The mix design is based on as IS: 10262-2009.

Water	Cement	Fine aggregate	Coarse aggregate
177.44	412.65	665	1085
0.43	1	1.61	2.62

6. TEST ON MATERIALS

6.1 Cement

OPC 53 Grade of Cement Maha cement was used in this study. The following physical test should be conduct in the laboratory as per IS codes

SL. NO.	PHYSICAL TESTS	OBTAINED RESULTS	REQUIREMENTS AS PER IS CODES
1	Fineness	3%	Not >10% as per IS 4031 part 1
2	Standard Consistency	32%	IS 4031 part 4
3	Initial Setting time	42min	Not less than 30 minutes as per IS 4031 part 5
4	Final setting time	265 min	Not more than 600 minutes as per IS 4031 part 5
5	Soundness	2 mm	Not>10mm as per IS 4031 part 3
6	Specific gravity	3.10	IS 2720 part 3

Table – 2: Physical Test results of cement

6.2 Aggregates

The aggregate used in this study was clean river sand and crushed

stone aggregate collected from near Kurnool.

Sl. No	Physical Tests	Obtained results	Requirements as per IS 383
1	Impact Test	19.74%	Not more than 45%
2	Los Angeles Abrasion Test	9.89%	Not more than 50%
3	Specific gravity		
	a) Coarse Aggregate	2.5	2.6-2.9
	b) Fine Aggregate	2.5	2.6-2.8
4	Water absorption		Not>2%as per IS:2386-Part 3
	a) Coarse Aggregate	0.6%	
	b) Fine Aggregate	0.3%	

Table – 3: Physical Test of aggregates

7. Tests on concrete

7.1 Slump test

SL.NO.	CERAMIC POWDER CONCRETE MIX	SLUMP CONE (MM)
1	0%	50
2	5%	50
3	10%	50
4	15%	40

Table – 4: Shows the slump values of ceramic powder concrete mix.

7.2.1. Compressive strength of M30 ceramic powder concrete with 5% replacement

Sample	Peak Load (KN)	Peak Stress (MPa)
7 days sample	746.02	33.15
28 days sample	950.62	42.25
56 days sample	1199.25	53.3

7.2.2. Compressive strength of M30 ceramic powder concrete with 10% replacement

Sample	Peak Load (KN)	Peak Stress (MPa)
7 days sample	711.22	31.61
28 days sample	1073.25	47.70
56 days sample	1152.07	51.2

7.2.3. Compressive strength of M30 ceramic powder concrete With 15% replacement

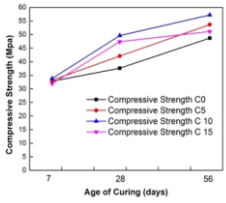
Sample	Peak Load (KN)	Peak Stress (MPa)
7 days sample	711.22	31.61
28 days sample	1073.25	47.70
56 days sample	1152.07	51.2

8.RESULTS AND DISUSSIONS

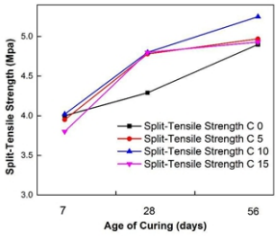
All specimens will be moist cured for one day and after moist curing the specimens will be water cured for required days. Traditional curing the cubes moulded with the cement concrete is subjected to curing in the water Tank and then checks the strengths at the age of 7 days, 28 days and 56days.

Percentage of ceramic powder in the concrete	Compressive strength in Mpa			Split tensile Strength in Mpa		
	Age in days			Age in days		
	7	28	56	7	28	56
5%	33.15	42.25	53.30	3.95	4.78	4.97
10%	34.13	48.90	57.30	4.02	4.80	5.25
15%	31.61	47.70	51.20	3.80	4.80	4.93

Graph 8.1: Representing compressive strength of different percentages of replacement



Graph 8.2: Representing split tensile strength of different percentages of replacement



9. CONCLUSIONS:

1. The compression, split tensile strength of M30 grade concrete is maximum when the cement is replaced with ceramic powder by 10% and further replacement of cement with ceramic powder decreases the strength gradually.

2. In this study, the maximum percentage of ceramic powder used to replacement is 15%.

3. Decrease in the compressive strength and split-tensile strength of concrete is observed with further increase in the content of ceramic powder in concrete.

4. This process of replacement with ceramic powder is economical compared to that of conventional concrete without any replacement.

Thus, economical concrete can be made with industrial by product for an equivalent strength.

5. Utilization of ceramic powder in concrete solves the problem of its disposal thus keeping the environment free from the pollution.

6. Ceramic powder concrete has increased durability performance.

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