

A CASE STUDY ON CONCRETE PAVEMENT AND EFFECTS OF WASTE CERAMICS

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Abstract - Concrete is widely used in the construction of important projects in India. This leads to faster depletion of natural resources and increases the cost of construction of structures. It becomes necessary to search for suitable alternative waste materials which could be used either as an additive or as a partial replacement for the conventional ingredients of concrete. These waste materials contribute to environmental problems by causing disposal crises. So, the use of waste in concrete has been done for the safe and economic disposal of waste materials. The use of waste materials not only saves natural resources and dumping spaces but also maintains a clean environment. Partial replacement of waste material in concrete is done to achieve the desired properties of concrete such as compressive strength, splitting tensile strength, durability, and workability. In this research, waste ceramic is used as a substitute ingredient in concrete with a view to finding the combined effects of these wastes in pavement concrete. Along with having these properties, several cubes and cylinders were cast with various percentages of both these wastes to determine the compressive strength and splitting tensile strength of Waste Ceramic Concrete (WCC).

Key Words: Compressive strength, Splitting tensile strength, Durability, Workability

1. INTRODUCTION

Pavement is one type of hard surface made from durable surface material laid down on an area that is intended to carry vehicular or foot traffic. Its main function is to distribute the applied vehicle loads to the sub-grade through different layers. The road Pavement should provide sufficient skid resistance, proper riding quality, favorable light reflecting characteristics, and low noise pollution. Its goal is to reduce the vehicle transmitted load so that it will not exceed the bearing capacity of the sub-grade. The Road Pavements are playing a crucial role in the development of any construction. There are mainly two types of road pavement used namely flexible and rigid pavements road.

2. MATERIALS AND METHODS

The comprehensive research work had been done to find out the suitable Waste Ceramic for its partial replacement and to characterize its suitability in pavement concrete. Both of these wastes were tested for its physical as well as its chemical properties before it was being used in the concrete. In this Investigation we had taken waste ceramic and its effects. Experimental tests in laboratory conditions had been done on fresh and hardened concrete to find out its acceptance and its comparison with normal concrete.



Fig -1: Ceramic Tiles Manufacturing in Industry

2.1 Characterization of Waste Materials

Waste samples collected from various ceramic industries of Morbi-Wankaner cluster were tested for chemical composition in the private laboratory of Andhra Pradesh. Physical properties of waste ceramic were tested in VNR College Laboratory, Andhra Pradesh. Here experimental methods for the tests of Specific gravity, Water absorption, Impact value test, Abrasion value test and Crushing value test are discussed below.

Sr.No	Test Results				Standards as per IS 383-2015
	Tests	Sample 1	Sample 2	Sample 3	Maximum
1	Specific Gravity	1.67	1.68	1.65	---
2	Water Absorption	0.30%	0.37%	0.30%	---
3	Impact Value	14.19%	17.12%	12.98%	30.00%
4	Abrasion Value	23.27%	26.48%	22.35%	30.00%
5	Crushing Value	29.48%	29.78%	27.37%	30.00%

Table -1: Physical Properties of Ceramic Tiles

Comparison of Test Results						
Sr	Tests	Ceramic Tiles Waste		Ceramic Insulator		Standards as per IS 383-2015
		Min.	Max.	Min.	Max.	Maximum
1	Specific Gravity	1.65	1.68	1.49	1.55	---
2	Water Absorption	0.30%	0.37%	3.20%	4.10%	---
3	Impact Value	12.98%	17.12%	20.36%	22.46%	30.00%

Table -2: Comparison of ceramic tiles and ceramic insulator

2.2 Materials used

Mix design is a process of selecting suitable ingredients for concrete and determining their proportions which would produce the minimum required strength and workability.

Sr. No.	Properties of Cement	Results	As per IS 269-2015
1	Specific Surface area m ² /kg. Blain Air Method	302	225 Minimum
2	Initial setting time (Minutes)	104	Not less than 30 Minutes
3	Final Setting time (Minutes)	222	Not less than 600 Minutes
4	Soundness (mm) Le-chatelier	1	Not more than 10 mm
5	Standard Consistency (%)	30.5	-
6	Compressive Strength Test		Not less than
	3 Days (N/mm ²)	30.1	27
	7 Days (N/mm ²)	39.4	37
	28 Days (N/mm ²)	55.2	53

Table -3: Physical properties of OPC

3. RESULTS AND DISCUSSION

3.1 Compressive Strength

To find out the optimistic compressive strength of (Waste Ceramic Concrete) WCC a wide range of 20% to 50% replacement of waste ceramic and 0.30% to 0.50% of Waste ceramic concrete was prepared. So, 11 cube sets of WCMC and 3 cube sets of normal concrete as a part of the pilot testing was casted and tested after 28 days on CTM of VNR college laboratory Ponnur, Guntur, Andhra Pradesh.

Trai's	Nodes Number	Deflection in (mm) for WCMC	Deflection in (mm) for Normal Concrete	Stress in X	Stress in X	Stress in Y	Stress in Y
							Direction N/m ² for Normal Concrete
Trai 11	1	0.53	1.05	0	0.06	0	0.06
Trai 12	2	0.52	0.88	0	0	0.31	-0.19
Trai 13	5	0.2	0.37	0	0	1.12	0.85
Trai 14	6	0.02	0.23	-0.05	0	-0.06	0
Trai 15	7	0.47	0.88	0.81	-0.19	0	0
Trai 16	12	0.12	0.24	0.78	0.42	0	0
Trai 17	25	0.17	0.37	1.38	0.85	0	0
Trai 18	30	0.07	0.16	0.79	0.25	0	0
Trai 19	31	0.03	0.23	0	0	0	0
Trai 110	32	0.11	0.24	0	0	1	0.42

Table -4: Deflection and Stress for WCMC and Normal Concrete

4. CONCLUSION

- ❖ The compressive strength of concrete mix increased due to partial replacement of waste ceramic and Waste ceramic. So, compressive strength observed for M25 grade was appropriate for pavement concrete.

- ❖ Based on the studies conducted on strength characteristic of WCMC using both waste materials it was found that concrete made with partial replacement of aggregate shows good compressive strength.
- ❖ The 7- and 28-days compressive strength of cubes prepared with 25% to 35% of Ceramic Tiles Waste as partial replacement of aggregate gives average 12% lesser compressive strength for 7 days and average 6% higher compressive strength for 28 days then the target mean strength of normal concrete for M25 grade.

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