The Study of Ceramic Waste Materials as Partial Replacement of Cement: Review

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Abstract— ceramic waste is one of the most active research area in the field of construction. ceramic waste powder is waste from ceramic wall floor tiles industries. ceramic products made up of different raw materials like china clay, potash, ball clay, dolomite, feldspar, talc and different chemicals for maintaining viscosity of raw material, glazing and finishing of finished goods. manufacturing of ceramic wall tiles is manufactured under very high temperature up to 2000oc. Therefore pozzolanic reactivity would be possible, which is responsible strength and durability in cement concrete. When product is in finishing touch (sizing) there is a waste in powder form like cement. Ceramic waste powder is settled by sedimentation and then dumped away, which results in environmental pollution and land exploitation. In this paper a literature analysis is done of different authors of past research.

Key words: Ceramic Waste Powder, Pozzolanic Material, Industrial Waste, Cost Effective, Green Concrete

I. INTRODUCTION

Environmental issues associated with ceramic tile and sanitary ware manufacturing primarily includes the following:

- Air Emissions, Greenhouse Gases, and Energy Efficiency
- Wastewater
- Solid waste

Each year thousands of tonnes of wastes are disposed of in landfills which effects occupation and degradation of valuable land. Depletion of natural resources is a common phenomenon in developing countries like India due to rapid urbanization & industrialization, involving construction of infrastructures and other amenities.

Indian ceramic production is 100 Million ton per year. In the ceramic industry, about 15%-30% waste material generated from the total production. This waste is not recycled in any form at present. However, the ceramic waste is durable, hard and highly resistant to biological, chemical, and physical degradation forces. The Ceramic industries are dumping the powder in any nearby pit or vacant spaces, near their unit although notified areas have been marked for dumping. This leads to serious environmental and dust pollution and occupation of a vast area of land, especially after the powder dries up so it is necessary to dispose the Ceramic waste quickly and use in the construction industry. As the ceramic waste is piling up every day, there is a pressure on ceramic industries to find a solution for its disposal. The advancement of concrete technology can reduce the consumption of natural resources. They have forced to focus on recovery, reuse of natural resources and find other alternatives. The use of the replacement materials offer cost reduction, energy savings, arguably superior products, and fewer hazards in the environment.

A. Survey of Local Area:

There are hundreds of small, medium and big ceramic companies around Morbi district of Saurashtra. So the city Morbi is known as "Ceramic City" In ceramic industry about 5% production goes as waste, which is not recycled in any form at present.

Concrete plays very vital role in building construction, which primarily composed of different aggregates like coarse aggregate and fine aggregate, cement with different proportions with respect to mix design like M15, M20, M25, and M30 and so on.

There is a rapid growth in industrialization. Every year thousands of tonnes of waste from ceramic industries are disposed in landfills. Which will be harmful for habitants and agricultural lands which inform loose the fertility of soil and farmer has to bear the problem as "BANE".

Due to faster urbanization in the developing country like "India" There is much demand for the tiles production, which will make problem by its waste dumped in any manner to the valuable lands. The application of such concrete with ceramic waste is increased now a days as it is environment friendly cost reduction and energy conserving implication.

II. DESCRIPTION OF MATERIALS

A. Cement:

The Ordinary Portland Cement of 53 grade conforming to IS: 8112 is be use. Physical property of cement is as per table 1.

Initial setting time		180min
Final setting time		240 min
Compressive strength	3 days	37 N/mm^2
	7 days	48 N/mm^2
	28 days	59 N/mm^2

Table 1: Test Result for Cement

B. Ceramic Waste:

Ceramic material is hard, rigid. It is estimated that 15 to 30% waste are produced of total raw material used, and although a portion of this waste may be utilized on-site, such as for excavation pit refill. Chemical properties of ceramic waste are as per table 2.

CONTENTS	w/w %
SiO_2	55.24
CaO	28.70
Al_2O_3	13.25

Table 2:
(Source: MET-CHEM LABORATORIES, VADODARA)

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 is being use. The Flakiness and Elongation Index were maintained well below 15%.

Property	Natural Coarse Aggregate
SPECIFIC GRAVITY	2.77
WATER ABSORPTION	1.45%
MOISTURE CONTENT	NIL

Table 3:

C. Fine Aggregate:

Those fractions from 4.75 mm to 150 microns are termed as fine aggregate. The river sand is used in combination as fine aggregate conforming to the requirements of IS: 383.

Property	Natural Fine Aggregate
Specific Gravity	2.77
Water Absorption	1.0%
Moisture Content	Nil

Table 4:

III. RESEARCH FINDING

1) In this research on effect of ceramic powder on resistance to carbonation and sulphate corrosion with different percentage in place of cement in concrete(a). The carbonation resistance of concrete mixed with ceramic polishing powder is lower than of the control concrete and with increasing the rate ceramic waste powder in concrete carbonation resistance shows a declined trend.the sulphate corrosion resistance of concrete mixed with ceramic polishing powder is better than that of the control concrete,and with the increase in cement substitution rate,the sulphate corrosion resistance of concrete shows a rising trend.
2) The use of ceramic powder as a partial replacement of cement in concrete (b).in this research study cement has been replaced by ceramic powder accordingly in the range of 0%,10%,20%,30%,40% and 50% by weight for M-25 grade of concrete.reuse of this kind of waste has advantages,economic and environmental reduction in the number of this kind of natural spaces employed as refuse dumps.from experiment result and discussion the compressive strength of M 25 grade concrete increase when the replacement of cement with ceramic powder up to 30 replaces by weight of cement and cost of the cement is reduced up to 13.27% in M 25 grade.
3) The experimental study on compressive strength and durability properties of ceramic wastes based concrete by several concrete mixes by replacing 20% cement by ceramic waste(c).the cost of cement represents more more than 45% of the concrete cost,so its helps to reduce the cost of concrete.by replacing cement with ceramic waste will give many environmental benefits.the result showed that concrete mixures with ceramic waste perform better than the control concrete mixures concerning compressive strength,capillary water absorption etc.
4) In this paper study on the setting characteristics of sodium silicate activated slag paste(d).PH value of activator,alkali modulus and alkali activator dosage were evaluated when liquid/slag ratio kept constant.when there is increase in amount of sio2,PH value decreases and increasing amount of Na2o increases the PH value of the activator phosphoric acid used as a retarder was found to be a strong retarder.
5) In this study activation with sodium silicate has been widely reported to give rise to rapid hardening and high compressive strength (e).problem however can be experienced with very short set time and subsequent shrinkage. High strength were developed rapidly on activation with 1.5 M(Na2o) (Sio2)2 solution. set time and on set of strength for alkali activation with this solution varied considerably between batches, and also from mix to mix using one batch of the slag.

IV. CONCLUSION

From the above research papers following points are observed.

- The compressive strength of M 25 grade concrete increase up to 30% replace of ceramic waste by weight of cement.
- Concrete on 30% replace of ceramic powder the cost of concrete is reduced up to 13.27% in M 25 grade.
- Increasing the Na2o concentration increased the activator PH value, while increasing the Sio2 concentration reduced PH value.
- Using a constant liquid/slag ratio the alkali activator dosage influenced the setting times. increasing the alkali activator reduced the setting time both initial and final.

REFERENCES

[1] Cheng yunhong, Huang Fei, Xu Longshuo and Hou Jianlong, "test research on effects of ceramic polishing powder on carbonation and sulphate corrosion resistance of concrete," construction and builbing materials, 2014,(pg.440-446).
[2] Amitkumar D. Raval, Indrajit N.patel and jayesh kumar pitroda, "Eco-efficient concretes: Use of ceramic powder as a partial replacement of cement, "international journal of innovative technology and exploring engineering, vol.3,issue-2,july 2013.
[3] F.Pacheco-torgal and S.Jalali, "reusing ceramic waste in concrete,"construction and building materials, 2010,(pg.832-838).
[4] J.J.chang, "A study on the setting characteristics of sodium silicate activated slag pastes"cement and concrete research of science direct, 2003(pg.1005-1011).
[5] A.R.Brough and A.Atkinson, "sodium silicate based, alkali activated slag mortars part 1.strength, hydration and microstructure" cement and concrete research of science direct, December 2001,(pg.865-879).

[6] Jay patel,B.K.Shah and Prof.P.J.Patel, "the potential activity of different ceramic waste powder as cement mortar component"international journal of engineering trends and technology,vol.9,issue 6,march-2014.
[7] Luiz A.Pereira-De-Oliveira,Joao P.Castro –Gomes and Pedro M.S.Santos, "construction and building materials of ELSEVIER,2012,(pg 197-203)

