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A STUDY ON EFFECT OF WASTE CERAMIC TILES IN FLEXIBLE PAVEMENT

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Abstract— now a days disposal of different wastes produced from different Industries is a great problem. These materials pose environmental pollution in the nearby locality because many of them are non-biodegradable. In recent years, applications of industrial wastes have been considered in road construction with great interest in many industrialized and developing countries. The use of these materials in road making is based on technical, economic, and ecological criteria. India has a large network of industries located in different parts of the country and many more are planned for the near future. Several million metric tons industrial wastes are produced in these establishments. If these materials can be suitably utilized in highway construction, the pollution and disposal problems may be partly reduced. The possible use of these materials should be developed for construction of low-volume roads in different parts of our country. A review of Industrial ceramic tiles waste for use in the construction of highway has been discussed in this paper.

Keywords- **ceramic waste, coarse aggregate, laboratory test.**

I. INTRODUCTION

As the world population grows, so do the amount and type of waste being generated. Many of the wastes produced today will remain in the environment for hundreds, perhaps thousands, of years. The creation of non-decaying waste materials, combined with a growing consumer population, has resulted in a waste disposal crisis. One solution to this crisis lies in recycling waste into useful products. Research into new and innovative uses of waste materials is continually advancing. Many highway agencies, private organizations, and individuals have completed or are in the process of completing a wide variety of studies and research projects concerning the feasibility, environmental suitability, and performance of using recycled products in highway construction. These studies try to match society's need for safe and economic disposal of waste materials with the highway industry's need for better and more cost-effective construction materials. The ever increasing economic cost and lack of availability of natural material have opened the opportunity to explore locally available waste material. If industrial waste materials can be suitably used in road construction, the pollution and disposal problems may be partially reduced. In this study ceramic waste is used in pavement. Ceramic waste is produced from ceramic bricks, roof and floor tiles and stoneware industries. Indian ceramic production is 100 Million ton per year.

In the ceramic industry, about 15%-30% waste material generated from the total production. In roadway transportation system, highway can be differentiated functionally and structurally. According to functional classification it may be – National Highways, State Highways, Major District Road, Village Road etc and according to structural classification it is – rigid and flexible. It should be noted that major portion of highway in our country is flexible. Generally flexible pavement is preferred in many cases over rigid pavement because in flexible pavement, material and construction cost are low and these material is locally available. At the same time it can be easily constructed and maintained and upgraded. The study of ceramic waste can determine whether it is suitable to be used in road construction. Moreover, it may reduce the cost of road construction, other than this study will increase the awareness about environment problem which cause by disposal industrial waste.

Figure 1.1 Waste Ceramic Tiles

II. BACKGROUND LITERATURE

Practices have been already done with various types of waste material such as Fly ash, Lime, Fibers, Silica fumes, plastic etc. Several studies are made, through which we can conclude:

- Fly ashes along with conventionally used stone dust are used as filler in bituminous concrete and comparison is made between them. The results show that all fly ashes are good as filler and can be used in bituminous construction up to 7% and also fly ash group rich in calcium oxide gave better results.

  (Vishal Sharma and Satish Chandra, June, 2011)
- Reduction of optimum bitumen content in bituminous mixes using plastic coated aggregates which results in economic in construction of bituminous concrete and also solve disposal problem of plastic waste.
  (Rema devi M, Leni Stephen, 3,March,2013)
- Use of ceramic waste as filler in SDBC and compare with lime as filler in SDBC and results show that ceramic waste containing bituminous concrete perform better than lime containing bituminous concrete.
  (Electric wala Fatima et al. July, 2014)
- Compare the compressive strength and durability properties of concrete by replacing 20% cement with ceramic waste.
  Results show that concrete with ceramic waste powder has minor strength loss also show that despite of this strength loss these concretes possess increase durability performance.
  (Fernando Pacheco-Torgal, 22, july, 2009)
- Study the (OPC) cement has been replaced by ceramic waste in the range of 0%, 10%, 20%, 30% 40%, & 50% by weight for M-30 grade concrete and concrete samples tested and compared in terms of compressive strength to the conventional concrete.
  (Amit kumar D. Raval et al. June, 2013)
- Experimental Investigation on ceramic dust use as a construction material in rigid pavement an d concrete specimens were tested at different age for different mechanical properties (For M35 grade concrete) and the results show that with water – cement ratio (0.46), core compressive strength increase by 3.9% to 5.6% by replacing 20% cement content with ceramic dust.
  (Electric wala Fatima et al, 2, august, 2013)
- Use of ceramic wastes in concrete production with the aim of reducing cement and fine aggregate content. **(O. Zimbili et al. 2014)**
- Study is to investigate the effects of using crushed ceramic in the production of interlocking paving units. **(Dina M. S adek et al. 14, March, 2013)**

III. MATERIALS

Aggregate (Natural + ceramic): Crushed quartzite natural and ceramic aggregate was used as coarse aggregate and also ceramic waste was used as filler in this experimental investigation. The sizes of aggregate and stone dust were used as per specification (MORTH 2013). Natural and ceramic aggregate material tests were carried out based on Indian standards, in order to ascertain the physical and mechanical properties of the material to be used in the natural aggregates. The physical properties of the natural aggregates are shown in the Table 1 & Physical properties of ceramic waste are shown in table 2.

Table-1: Physical Properties of Aggregates

Sr. No.	Description of Test	Test Method	Test Result Observed	Specification as per MORTH Table 500-18
1	Aggregate Crushing Value (%)	IS:2386-IV	20.16%	Max 10-25%
2	Aggregate Impact Value (%)	IS:2386 P-IV	17.3%	Max 24 %
3	Los Angle Abrasion Value (%)	IS-2386 (P-IV)	18.9%	Max 30%
4	Flakiness and Elongation Index (%)	IS:2386 (P-I)	23.53%	Max 30 %
5	Water Absorption (%)	IS:2386(P-III)	0.91%	Max 2%

Table-2: Physical Property of Ceramic Aggregate

Sr. No.	Description of Test	Test Method	Test Result Observed	Specification as per MORTH Table 500-18
1	Aggregate Crushing Value (%)	IS:2386-IV	20.4%	Max 10-25%
2	Aggregate Impact Value (%)	IS:2386 P-IV	16.62%	Max 24 %
3	Los Angle Abrasion Value (%)	IS-2386 (P-IV)	20.5%	Max 30%
4	Flakiness and Elongation Index (%)	IS:2386 (P-I)	24.5%	Max 30 %
5	Water Absorption (%)	IS:2386(P-III)	0.89%	Max 2%

Ceramic waste: In present study ceramic waste has been collected from morbi, Gujarat. The chemical properties of ceramic waste are shown in table 3.

Table-3: Ceramic Chemical Compositions

Constituent	Composition (%)
Aluminium Oxide, Al2O3	30.14
Calcium Oxide, CaO	2.17
Ferric oxide, Fe2O3	1.18
Magnesium Oxide, MgO	0.24
Potassium Oxide, K2O	0.01
Silicon Oxide, SiO2	61.23
Sodium Oxide, Na2O	0.09

IV. METHODOLOGY

In order to meet the objectives, the following research methodology was adopted:

1. **Selection of Material**
   i. Natural Aggregate
   ii. Ceramic waste
2. **Experimental Investigation**

- **Test on Aggregates (Natural + Ceramic waste)**
  i. Elongation Index and Flakiness Index
  ii. Impact
  iii. Los Angeles Abrasion
  iv. Water absorption
  v. Specific gravity

3. **Result analysis.**

- Comparative analysis
- Statistical analysis

V. CONCLUSION

Literature review shows that ceramic waste was utilized as filler material in SDBC and ceramic waste partially replace the cement content in cement concrete work while in present study ceramic waste will partially replace as filler as well as aggregate in flexible pavement. Laboratory tests were performed for defining the physical properties of ceramic aggregate and found to be within acceptable limits as per the Indian standards which show that ceramic waste is feasible to utilize as aggregate material in flexible pavement.

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